Anticipating desire and food choice

Mental simulation as a strategy towards healthier choices

Naomí Cecilia Muñoz Vilches

Propositions

1. Desire is created by a state of mind that can be controlled with mental simulation (this thesis).
2. Mental simulation is a powerful tool for emotional and behavioural regulation (this thesis).
3. Doubt is the basis of scientific progress.
4. Doing experimental research is like governments trying to control the coronavirus pandemic.
5. People should be respected but not necessarily their ideas.
6. Having a child is the best motivation to not procrastinate during work hours.

Propositions belonging to the thesis, entitled

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Thesis

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CHAPTER 1

General Introduction

Carpe Diem*?*

"Be happy, happy, happy,
And seize the day of pleasure."

Live less in the present
Than in the future always,
And less in both together
Than in the past. The present
Is too much for the senses,
Too crowding, too confusing-
Too present to imagine.
Robert Frost

Remember that what you remember from the past
is needed to construct the future,
so make sure that your memories
are the right ones.

Live in the happy memories
Naomí

Introduction

Why do consumers struggle with either choosing chocolate or an apple? One of the reasons is that consumers have an innate predisposition to seek pleasure: the brain is designed to seek reward (Berridge, 2003, 2004). This predisposition is reflected on that consumers have an intrinsic bias towards instant pleasure. Indeed, instant pleasure is one of the strongest drivers of consumer behaviour (Kavanagh, Andrade, & May, 2005). Additionally, consumers perceive gain and losses asymmetrically (Weber et al., 2007). That is, consumers' perceived value of a desired object in the present is higher than the one in the future. Construal Level Theory (CLT) can help to understand why consumers balance instant gratification higher than delayed ones. This theory posits that close vs distant experiences is represented differently in the mind. The closer the psychological distance that a consumer has with the experience the more concrete are the representations in the mind (low-level construal), compared to distant experiences, which are characterised by abstract features (high-level construal) (Trope & Liberman, 2003).

Therefore, this innate bias toward instant gratification has contributed to an outstanding societal problem: unhealthy behaviour. Obesity rates are higher than ever. Just to give an example, the prevalence of obesity worldwide has tripled since 1975, 39% and 13% of adults aged over 18 were overweight or obese in 2016, respectively (WHO, 2021). Understanding consumer choices is primordial to tackle the unhealthy behaviour problem. In this light, desires and food choices are in the core of (un)healthy eating. In the realm of making consumers to make healthier choices, this thesis investigates two core concepts: desire and conflicting choices (health vs indulgent).

The reasons why consumers tend to focus on immediate gratification are difficult to tackle. Thus, *how can consumers overcome the innate bias towards instant gratification?* The prefrontal cortex allows consumers to delay pleasure to attain a goal. In other words, it permits consumers to react according to higher-level goals, which are normally further in the future, by weighting the

consequence or benefit of future or possible actions into the present. Indeed, neuroimaging research has shown that delaying pleasure (or reward) is possible by anticipating the future (Dassen, Jansen, Nederkoorn, & Houben, 2016).

Imagine an ice-cream that is being covered with melted chocolate, and a few touches of almonds falling like snow. Then, a very pretty mouth biting the ice-cream chocolate cover making a crunchy sound (a sound that is almost impossible not to hear). Although imagining this may be a pleasant experience, some consumers may experience a kind of conflict. That is because it involves a product that is rich in instant gratification but detrimental to longer-term goals. For instance, eating that ice-cream provides a short-term effect: instant pleasure, but it may obstruct a long-term goal: being healthy. Thus, often, experiencing pleasure comes with the long-term cost, and for some, this cost is difficult to balance in the present, when the instant gratification of consuming a product is more salient.

Evolution permitted individuals to develop areas in the brain, which allow to mentally simulate different scenarios, with the primary function of generating predictions based upon past experiences (Moulton & Kosslyn, 2009), and not only that, they can also be a sort of time travel with our minds (Schacter, Addis, & Buckner, 2007; Schacter et al., 2013). Cognitive and neuroimaging studies have suggested that remembering the past or envisioning the future share common cognitive and neural underpinnings (Schacter et al., 2007, 2013). Indeed, past and future thinking build on similar information stored in episodic memory (Eustache, Viard, & Desgranges, 2016). Since recalling and envisioning the future are daily life practices, using the memories to recreate experiences may be a simple strategy to bring the future to the present.

In this thesis we investigate mental simulation – the capacity to re-enact an event without sensory input – and its mechanisms underlying desire and choice behaviour. Moreover, this understanding would help to create individual strategies to balance short vs long-term gratifications. In other

words, a strategy that helps consumers to delay gratification to attain a goal. To do so, two mental simulation types commonly used in marketing are differentiated: process and outcome simulation (Escalas & Luce, 2003). Previous research on mental simulation has been limited to instructing people to imagine the consumption itself (referred to as process simulation). Hence, we contribute by adding evidence of outcome simulation in the context of eating environment, which focuses on the benefits or consequences of eating (referred to as outcome simulation) rather than only focusing on the consumption itself (referred to as process simulation).

Moreover, research has focused on using vice foods as stimuli for the mental simulations (e.g., Haasova, Elekes, Missbach, & Florack, 2016; Keesman, Aarts, Vermeent, Häfner, & Papies, 2016; Papies, 2013). However, the effect of virtue foods as part of the content of the simulation has been overlooked. Therefore, we examine how the different types of food products (indulgent vs healthy) interrelate with the mental simulation to impact desire and choice behaviour.

Furthermore, most of the research investigates mental simulation as a mechanism itself. That is, how a visual stimulus (e.g., picture) affects consumer response through evoking spontaneous mental simulations, specifically motor simulations (Elder & Krishna, 2012). Yet, although this thesis acknowledges that mental simulations are a primary source of prediction and anticipation, we aim to further broaden current knowledge of the how mental simulation impacts desire and choice behaviour, and move forward by investigating the mechanisms underlying the impact of process and outcome simulation on these two outcomes.

Background

Mental simulation

This thesis build upon the grounded cognition theory to conceptualise mental simulations. Grounded cognition challenges traditional approaches of cognition theory by stating that cognition is grounded on modal simulation

(based on the senses modalities), bodily states, and situated action (Barsalou, 2008). Under this view, mental simulation is defined as "re-enactment of perceptual, motor, and introspective states acquired during experience with the world, body, and mind" (Barsalou, 2008).

Mental simulations based on perceptual representations, which make explicit and accessible the same type of information that is registered by the senses during perception (Moulton & Kosslyn, 2009). Therefore, the brain reproduces and re-enacts based upon past episodic events (Barsalou, 2005, 2008) with the primary function of predicting and anticipating (Bar, 2011; Barsalou, 2008; Mullally & Maguire, 2013). Although mental simulations contain biases and errors, they are powerful enough to affect motivation and behaviour.

Mental simulations are diverse, and they have been used in different domains for different purposes and led to different outcomes. Mentally simulating the consumption of a tempting food led to choosing smaller portions, which was explained by an increase of product enjoyment (Cornil & Chandon, 2016; Petit, Spence, Velasco, Woods, & Cheok, 2017). Moreover, a series of experiments have been performed evidencing that repeatedly simulating the eating consumption provokes habituation, which has the potential to decrease food intake (Larson, Redden, & Elder, 2014; Morewedge, Huh, & Vosgerau, 2010a). However, others have failed to demonstrate that mental simulation leads to food-specific habituation effects (sensory-specific satiety), and conversely resulted in an unexpected increase in food consumption (Haasova et al., 2016). In other cases, the technique was only effective when self-regulatory resources were available (Missbach, Florack, Weissmann, & König, 2014). Accordingly, it seems that the mechanism by which mental simulation induces habituation and satiation is still vague, and indeed, has not been demonstrated directly (Kappes & Morewedge, 2016). Finally, food craving is induced when a pleasurable experience is vivid and easy to imagine (Harvey, Kemps, & Tiggemann, 2005; Kemps & Tiggemann, 2013; Tiggemann & Kemps, 2005). However, it has been shown that mental

simulation can also be used to reduce cravings (Hamilton, Fawson, May, Andrade, & Kavanagh, 2013; Kemps, Tiggemann, 2007; Kemps & Tiggemann, 2015; Knäuper, Pillay, Lacaille, McCollam, & Kelso, 2011). Hence, a better understanding of how and why mental simulation affects motivation and behaviour is needed to advance on strategies for heathier eating.

Mental simulation a multisensory experience

Mental simulations can reproduce motor skills, images, sounds, and even sensations and emotional states (Barsalou, 2005, 2009). They can be easily triggered, e.g. just by a word (Papies, 2013). The simulation can be dominated by the sense of sight. That is literally seeing a picture or a movie of an object or event in the mind. This is a common exercise of daily life experiences. Consumers "daydream" about their desired products/experiences, and this daydream is pleasurable by itself. Yet, not only sight is represented in a mental simulation, all the senses can be captured in the mind. For instance, the smell. Previous research has shown that vividly imagining the smell of a food increased salivation, provoked a stronger desire to eat the food, and a greater subsequent actual consumption of the food they imagine smelling (Krishna, Morrin, & Sayin, 2014).

Moreover, not only the senses can be used to simulate (e.g., visualise the product, imagine the smell), but also motor actions can be reproduced such as the act of taking the fork or putting the food in our mouth. An experiment showed that when the fork was in the left side of a plate (for right-handed individuals), and the motor activity was impeded (by holding a clap in the right hand), intentions to purchase the product decreased (Elder & Krishna, 2012). At this point, worth to remark that some of the simulations are conscious and other stay far from conscious awareness. Using the examples above, motor simulations can happen spontaneously and unconsciously (e.g., Eelen, Dewitte, & Warlop, 2013; Elder & Krishna, 2012), as most of consumer simulations. Indeed, unconscious simulations are likely to dominate cognition (Papies, Best, Gelibter, & Barsalou, 2017). Nevertheless, simulating an

experience with the senses is likely to become conscious, since it is unlikely that one deliberately sees with the "mind eye" without realising.

Process and outcome simulation

In this thesis, the eating (post) consumption context is used since pleasure for food is similar to other rewards (Kringelbach, 2015), so it is generalisable. Moreover, there is a good understanding on how the different stages of the consummatory phase affect pleasure. Pleasure has its peak during the consummatory phase, close to the satiety phase (Kringelbach, 2015). Hence, this thesis focuses in two type of mental simulation that are commonly used in marketing, these are process and outcome simulation. Process simulation refers to the consummatory phase, individuals simulate the step-by-step of consuming the food. On the other hand, outcome simulation refers to the after consumption phase. Individuals imagine the effects of having consumed the food. Process and outcome simulation contain both cognitive and affective experiences/memories. In this thesis we do not focus on the differences between these two, but rather embrace the fact that cognitive and affective states are present in process and outcome simulations.

Process simulation is also referred to as multisensory imagery, eating simulation, and consumption simulation (Lacey & Lawson, 2013; Larson et al., 2014; Papies, 2013; Papies, Johannes, Daneva, Semyte, & Kauhanen, 2020). This different terminology may hinder the progress of the mental simulation research. Moreover, the use of more general terminology (e.g., process simulation instead of all mentioned above) within the food domain is needed to be able to unify the understandings across domains. In the case of outcome simulation, it has received little attention. In the food domain it has not been addressed before, which is surprising since individuals use it in the daily life with phrases such as *"sin is never worth the trouble"*. This refer to the prediction that the instant pleasure benefit is lower than its [longer-term] cost. If individuals would more frequently imagine the effects, goals could be easier accomplished.

The mechanisms by which mental simulation affects choice behaviour

In the next section, a brief introduction of plausible mechanisms is presented. The details about how these mechanisms are further related to this topic are revealed in each empirical chapter.

Previous research has found that *perceptual fluency* - the ease by which an object is perceived - is not a mechanism by which mental simulation affects consumes' responses. Perceptual fluency always have a positive effect, independently from the valence of the stimulus. That is, if the object being evaluated has a negative valence, perceptual fluency would still be positive. However, when mental simulation is performed with a negative stimulus, the effect on the negative stimulus amplifies, i.e., it becomes more negative (Elder & Krishna, 2012). The same counts for positive stimulus, mental simulation would amplify the positive response.

Elder & Krishna (2012) have found that the simulated experience with a visual depiction as a stimulus leads to increased purchase intention when the visual stimuli facilitates more (vs. less) spontaneous mental simulation. For instance, when the spoon orientation in a yogurt matched the participant's dominant hand, purchase intentions were higher for those whose matched the dominant hand than for those whose did not match with the participant's dominant hand. Therefore, the positive effect on purchase intentions is attributed to the capacity to simulate rather than to perceptual fluency.

Desire states are represented by goals, which content is motivational (Kruglanski et al., 2002). Moreover, desire has an affective nature (Kavanagh et al., 2005), and affective responses may provoke attentional bias towards the desired object. Therefore, this thesis investigates four mechanisms by which process and outcome simulation may impact desire and choice behaviour: motivation, goal activation, attentional bias, and emotional response.

Imagine the smell of freshly baked bread. This external cue may trigger images of yourself eating a piece of bread with your favourite combination,

or remind you the time when your grandmother baked bread for breakfast. The smell or other cues may be sufficient to start fantasying about the food or experience. The Elaborated Intrusion theory of desires (EI theory) (Kavanagh, Andrade, & May, 2005a; May, Andrade, Kavanagh, & Hetherington, 2012), acknowledge a bottom-up and a top-down process. The bottom-up is that an *external cue* -the smell of the freshly baked bread- evokes a cascade of associations and fantasies about the desired object. The top-down refers to an arise of desire by means of an *internal cue* -suddenly having intrusive thoughts about a desired food (e.g., phenomenology of craving). Although the EI theory set a precedent on the effect that process simulations may interfere desire for the imagined food, the difference between process and outcome simulation in terms of motivation is not settled. In this thesis the bottom-up approach is used, and we contribute by enlightening the impact of mental simulations on choice behaviour and the role of motivation (approach-avoidance tendencies and subjective desire) in this process. The relevance of approach-avoidance tendencies is anchored in the link between specific motor actions (i.e., arm extension and flexion) and motivational states.

Consumers' behaviour is goal dependent (Bagozzi & Dholakia, 1999). Due to the motivational nature of goals, they are involved in attentional processes. Indeed, visual attention drives choice behaviour (Armel, Beaumel, & Rangel, 2008; Hare, Malmaud, & Rangel, 2011). In an eye-tracking experiment, a health prime led to longer total dwell times on healthier foods, and higher likelihood of choosing these foods, compared to control prime (van der Laan, Papies, Hooge, & Smeets, 2017). This is an indication that a stimulus that was unconsciously processed (health prime) affected visual attention towards food that matched the prime. Moreover, attentional biases towards high-calorie foods contribute to subsequent food intake (Werthmann, Jansen, & Roefs, 2014a), and could explain in a great extent, temptations and eating-disorders.

Other examples come from the mindset literature (Hare et al., 2011; Hege et al., 2018; Werthmann, Jansen, & Roefs, 2016). In a study, inducing a health

or indulgent mindset creates an attentional bias, i.e., a healthy mindset attenuates attention for high-calorie food (Werthmann et al., 2016). Neural mechanisms that relate to cognitive control or reward can be activated by exogenous attention cues (e.g., mindset induction). In the presence of health cues, cognitive control areas (e.g., ventromedial prefrontal cortex) are more responsive to healthiness of foods (Hare et al., 2011). In a functional magnetic resonance imaging (fMRI) study, merely asking people to consider either health or indulgent aspects was sufficient to activate its neural correlates. This study showed that when a health mindset was induced, the cognitive control region (left prefrontal cortex) in the brain was activated, whereas with a pleasure mindset, the area representing the subjective pleasure (left orbitofrontal cortex) was activated (Hege et al., 2018). Hence, it is expected that simulating the process versus the outcome of eating would activate neural correlates related to pleasure versus health, respectively. Attention would be driven by inducing a mindset (mental simulation) and activating certain brain regions. In this light, it is expected that mentally simulating the process or the outcome of eating food would create an attentional bias towards information that matches the mental simulation.

Furthermore, the EI theory acknowledge that the *imagery* behind desire can create conflict (Kavanagh et al., 2005). The authors refer to "imaginary relish and exquisite torture" to convey that the content of the simulation may be pleasurable by itself, may increase desire for what is being imagined, and finally, if there are limitations to accomplish the desired experience (either cognitive or external), may be a torture since intensifies the sense of deprivation (Devos, Pandelaere, & Kerckhove, 2021). Although they do not explicitly elaborate on the conflict between instant pleasures versus cognitive processes derived from higher-goals (e.g., following a healthy diet), this thesis includes it as a central point. The conflict between having instant pleasure and delaying pleasure for a greater goal shapes great part of this thesis.

Mental simulations may create or enhance the feeling of conflict, just as a real experience. For instance, acting inconsistently with a goal elicits regret,

which leads to compensatory behaviours (Sorys & Byrka, 2021). Since mental simulations are used to predict (Moulton & Kosslyn, 2009), and they substitute experience (Kappes & Morewedge, 2016), it is expected that consumers are able to predict the inconsistency and act upon (e.g., compensatory behaviour). Hence, if one has a health goal in mind, fantasising about a fatty indulgent hamburger can create a conflict between the desire one has for the hamburger and the anticipation of guilt/regret if eating it.

In the realm to help consumers to solve their conflict, the appraisal theory of emotions helps to examine the role of mental simulations in the context of conflict. Particularly, the conflict represented by the object of imagination (indulgent food) and a goal in mind – on choice behaviour. The appraisal theory of emotions posits that emotions are the product of appraisals, and they are, therefore, subject to interpretation. For instance, the discrete emotion of guilt is the result of the combination between an appraisal of self-agency (referred to that one is responsible of the act for what one feels guilty), and goal incongruency (referred to the fact that one's believe mismatch the act).

It is particularly of interest to address why and how mental simulations leads to a specific choice. Mental simulation may create a *momentary condition ("state")* that is formed by what the person imagined (content), physiological states, goals induced/prioritised, how the experience is appraised, and the emotions that are elicited. Therefore, this thesis bases on the appraisal theory of emotions to investigate the extent to which mental simulation affects choices by means of an emotional reaction.

The importance of product type

Every object (product) is conceptualised in consumers' minds differently. Consumers create associations through their life based on the experience they have with the products. The product that consumers simulate in their minds is loaded with information and is situated in certain contexts. Therefore, the product influences the content of the simulation, and is relevant to

understand the impact that mental simulation has on desires and choice behaviour.

Consumers develop hedonic and utilitarian attitudes, and the extent to which products differ depends on these two attitudinal components (Batra & Ahtola, 1991). Therefore, this thesis integrates three product categories: vice, virtue and ambivalent. The vice products are conceptualised as products that are salient by their hedonic attributes. The virtue products are salient in their utilitarian attributes, and finally, ambivalent products are not particularly salient in either hedonic or utilitarian attributes, but they are evenly present.

The role of memory: Communalities between mental simulation, episode recall, future envisioning

The brain has been considered as being prospective due to the capacity to use the information from the past to generate predictions (Schacter et al., 2007) and *pre-experience* the future by simulating it in our minds (Gilbert & Wilson, 2007). Kahneman and Riis (2005) develop further on this idea arguing that the *experiencing-self,* who is the one living in reality, barely has time to exist compared to the *remembering-self,* who is the one living in the present and future. Hence, memory is the base of mental simulations and the evaluation of memories is the base of individuals' future decisions and expectations.

Recall

The role of memory has become salient to control actual and subsequent food intake. Human eating behaviour is complex and depends on hedonic principles where subsequent meal initiation is not solely dependent on hunger and satiety states, but also brainstem mechanisms (Kringelbach, Stein, & Hartevelt, 2012). Research has shown that recalling foods eaten at lunch decreases subsequent snack intake (Higgs, Williamson, & Attwood, 2008), and the distracting effects of watching television during eating have an effect on the encoding of memory of the meal and affect subsequent consumption (Higgs & Woodward, 2009). Hence, memory for the specific attributes of foods eaten in the recent past, and memory for the predicted consequences of

eating acquired over repeated experiences are important influences on food intake (Higgs et al., 2008).

Prospection

Recent research shows that episodic future thinking has been effective in reducing food intake (Vartanian, Chen, Reily, & Castel, 2016). Moreover, it influences food choices that are reduced in calories while likely facilitating greater satiety (O'Neill, Daniel, & Epstein, 2016). Finally, it has also been shown to reduce discount rate during decision-making (Dassen et al., 2016). Indeed, impulsive behaviours can be controlled by envisioning the future vividly (Dassen et al., 2016). O'Neill, Daniel, and Epstein, (2016) found that episodic future thinking may be a particularly effective tool for reducing overeating in a wide variety of eating environments by orienting cognitive focus on long-term goals rather than short-term pleasure associated with the large variety of enticing foods commonly encountered.

For what is mental simulation used?: Prediction

Memory not only serves to remember previous experiences but to generate predictions based on mental simulations. Predictions of future hedonic reactions may initially be based on the *hedonic reactions* one experiences as one imagines the event a-temporally, and this initial prediction is then corrected with information about the time at which the event will actually occur (Gilbert, Gill, & Wilson, 2002). However, this information correction in time does not always occur correctly, because these predictions of future hedonic and emotional states are anchored in the current emotional and motivational state. This is what is called *"projection bias"*. This bias occurs since consumers are seemingly projecting their current mental state onto a future one (Kahneman & Thaler, 2006). However, this projection bias could be diminished if the mental simulation is vivid, detailed, and concrete. The ability to create detailed mental simulations depends on the experience individuals have with the elements of the event they are predicting. For instance, if a consumer wants to predict how much (s)he would like a candy

(to buy it or to not buy it), the more experiences encoded in memory (s)he has with the candy or other related products, the more information has to simulate (e.g., taste, texture, after effects, affective reactions), hence the better the prediction.

Therefore, although research has progressed on how mental simulations are conceptualised, there is still not enough evidence to fully answer *what mental simulation is* and *for what mental simulation is used.* This thesis acknowledge that there are two sides of mental simulation. One is a more fundamentalist side that refer to *why mental simulation exists as a human ability*, and the other, a more practical one is *how humans can use it in their daily life.* From the fundamentalist side, mental simulations could be seen as a mechanism to anticipate and predict future actions. The brain is a prospective organ designed to use information from the past and present to generate a prediction about the future. This view places memory as a key component of the prospective brain, since is used to simulate, plan and predict the future (Schacter, Addis, & Buckner, 2008).The prospective brain generates simulations of possible future events that contribute to the formation of plans and predictions. However, current cognitive science still discusses the nature of these mental simulations. *Are these simulations embodied, that is, is cognition grounded in the body? are these conscious and unconscious simulations part of the same system? If not, how do they differ?; do simulations are modal or amodal?*. To answer these questions is out of scope of this thesis.

This thesis elaborates on theoretical and practical contributions. It approaches the topic of mental simulation as a strategy to control consumers' desires and choices, but it also shed light on its mechanisms for choice behaviour.

Thesis overview

This thesis aims to investigate the role of mental simulation on desire and (healthy) food choices and its associated mechanisms. **Figure 1** shows an overview of the variables investigated and the corresponding chapters.

The research questions are:

1. *How does process and outcome simulation differ in terms of their effect on desire, motivation, and choice?*

2. *Does process and outcome simulation lead to differences in attentional focus towards food?*

3. *Does process and outcome simulation activate a goal? If so, which?*

4. *Does process and outcome simulation differ on the emotional response (appraisals, type of emotions, and valence)?*

This thesis consists of six chapters. *Chapter 1*, the general introduction of this thesis, reviews the scientific evidence on the variety of mechanisms underlying the effect of process and outcome simulation on desire and (healthy) choice. Moreover, it underlines the importance of the different types of mental simulation and positions the concept in the food environment context.

Chapter 2 presents an initial empirical test on the impact of mental simulation on the desire for the imagined food and choice preference between a vice versus a virtue food product. This chapter aims to contrast two different types of simulations (process and outcome simulation) by using two products different in nature (a vice and a virtue food product). Moreover, it examines the effect of these two simulations on the attentional focus individuals have when they make the choice between the vice and the virtue food.

Chapter 3 extends the results of *Chapter 2*, by implicitly investigating two mechanisms for the effect of process and outcome simulation on one's desire

for the imagined food and food choice between a vice and virtue food. This study use vice and virtue foods as the object of imagination for each of the simulations. Attentional bias and approach-avoidance tendencies are implicitly measured to determine whether the effect of the simulations on food choice (explicit measure) has a deeper and more intuitive impact on people's minds. To our knowledge, this is the first research investigating the implicit effect of these two different types of mental simulations.

Chapter 4 investigates two different mechanisms by which process and outcome simulation impacts desire for the imagined food and choice between a vice and a virtue food, in subsequent independent choice task. First, the role of valence is examined as one of the mechanisms underlying the effect of mental simulation in desire for the imagined food. Secondly, it examines whether process and outcome simulation activate a temptation goal or a health goal, respectively.

Chapter 5 investigates the role of emotional reactions on (healthy) choice behaviour. The emotional reaction is characterised by the appraisals of goal congruency and relevancy, and its associated discrete emotions (guilt, regret, satisfaction, and happiness). In this process, the moderating role of mental simulation is investigated. That is, how the goal is appraised as (in)congruent based on the type of mental simulation (i.e., process and outcome).

Chapter 6, the general discussion of the thesis, provides an overview of the results and a reflection on the main findings. Besides, recommendations for future research, and limitations are discussed.

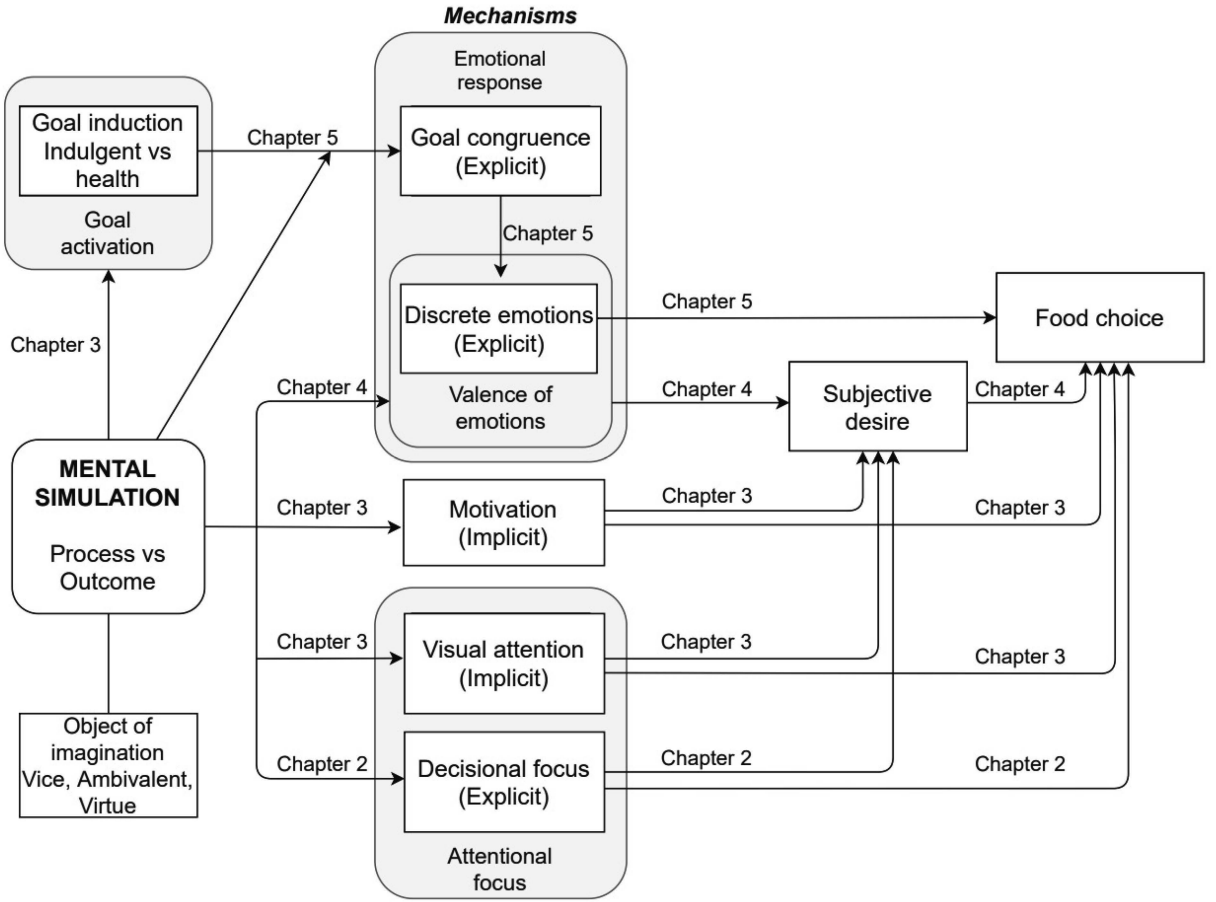

Figure 1. Thesis overview

CHAPTER 2

2

The impact of instructed mental simulation on wanting and choice between vice and virtue food products

This chapter is published as:

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Abstract

Deciding what to eat often implies a conflict between immediate goals (I need to eat, ideally something enjoyable) and long-term goals (I need to be healthy), particularly when choosing between foods superior on a hedonic dimension (referred to as vices) and foods superior on an utilitarian dimension (referred to as virtues). One sort of intervention that could potentially shift balance between short-term and long-term consequences is instructed mental simulation. Mental simulations could be characterised as images or can be embodied, as a complete experience, including body sensations, feelings and images. We examine systematic differences in two types of instructed mental simulation: imagining the moment of consumption (process) and post-consumption (outcome), and emphasise the importance of product type (vice, virtue) on its effect on wanting and choice. In a within-subject experiment, 76 participants were allocated to the two mental simulation conditions (happening in different sessions) and imagined consuming or having consumed a vice and a virtue product. After imagining each product, the participants rated their level of wanting and indicated the product they preferred: the vice or the virtue one. The results showed that imagining the consumption of the vice product or the post-consumption of the virtue product increased the rate of wanting for the correspondent product, the same pattern was found for preferences. Furthermore, results showed that health orientation moderated the effect of mental simulation on wanting and choice. Further knowledge in different simulation types may have important implications for understanding how we represent food in our mind and help with the development of effective communicational interventions that nudge people towards healthier food choices.

Introduction

The act of eating addresses a need but it also gives pleasure and joy. Consumer attitudes towards products are based on perceived benefits and these benefits can be divided according to whether they are more hedonic or more utilitarian in nature (Batra & Ahtola, 1991). Sometimes, hedonic consumption—which is motivated primarily by a desire for pleasure—conflicts with utilitarian consumption—which is driven mainly by a desire to fulfil a need or achieve a functional aspiration. To picture this conflict, just imagine having to choose between a fruit and a chocolate bar as a snack. The apple could be seen as a 'virtue' product (i.e. higher in a utilitarian dimension) as it appeals to longer-term gratification at the expense of more immediate pleasure, whereas the chocolate could be seen as a 'vice' product (i.e. higher in a hedonic dimension) for the opposite reason. This distinction is much more generic and could include, for example, drug taking as a vice, and bad-tasting medicine as a virtue. This conflict of goals could have implications for dilemmas of self-control (e.g. whether or not to eat the more tempting but less healthy food; Fishbach & Shah, 2006), as well as impacting the healthiness of our diet and modulating our food choices. On the other hand, both pleasure-oriented and instrument-oriented motivations are specific to individual consumers and relate directly to decision-making processes. Some consumers may be motivated to focus primarily on short-term gratification, whereas others may be more focused on, and motivated by, long-term consequences. Therefore, it is likely that individuals' orientation towards either short- or long-term consequences impacts consumers' evaluation of, and preference between, vice and virtue products. Within the present research, this orientation was operationalised as sensory versus healthy.

One sort of intervention that could potentially shift the balance from short-term gratification during consumption to long-term effects after consumption, is instructed mental simulation. Fantasising about our desires directs us toward long-term as well as short-term goals, and it reduces the gap in time and thereby helps us to deal with the challenges of acquiring goals (May, Kavanagh, & Andrade, 2015). We adopt this view here, and build on

findings from the mental simulation literature that have distinguished between simulations of two mental kinds: process simulation and outcome simulation. The first focuses on the step-by-step process of consuming a product, while the latter focuses on the balance of benefits and consequences in consuming it (Escalas & Luce, 2004; Taylor, Pham, Rivkin & Armor, 1998). When people are asked to construct a specific mental representation of the future experience, focused either on the experience itself (process) or on the beneficial consequences (outcome), they are likely to shift their focus toward characteristics that are more related to what they have been asked to imagine (May, Andrade, Batey, Berry, & Kavanagh, 2010).

In the present research, we are particularly interested in (1) investigating how an imposed mindset regarding short-term focus (process simulation) versus long-term focus (outcome simulation) affects consumer response, and how such effects may differ between vice and virtue products, (2) investigating how this effect differs for consumers who are chronically oriented towards short- versus long-term consequences (i.e. chronic sensory vs health orientation), and (3) demonstrating that mental simulation can influence attentional focus (decisional focus in this research).

Mental simulation

Mental simulation has been defined as "*imitative episodic mental representations of one or a series of events*" (Taylor et al., 1998). It permits us to recreate previous experiences by means of perceptual, motor, and introspective states (Barsalou, 2008), with the function of generating predictions based upon past experiences (Moulton & Kosslyn, 2009). The cognitive episodes initiated by cue-driven thoughts are of great interest across many disciplines. For cognitive psychology, for instance, the motivational impact of mental images comes from its link with goals. Often, our long-term goals conflict with our immediate goals, which are salient and desirable. Owing to our capacity to simulate different scenarios, however, we can create a mental representation of both goals to resolve that conflict. These mental representations could be characterised as images, or they can be embodied as

a complete experience, including bodily sensations, feelings and images. Based on the theory of grounded cognition (Barsalou, 2008), Xie, Minton, and Kahle (2016) proposed that, in the context of food consumption, the experiences associated with the simulation of the process, or the outcome, of food consumption include such sensory perceptions as taste and after-taste, motor states of chewing, feeling full, and introspection of enjoyment, satisfaction, and heightened energy levels.

Research results have been consistent on the effects of mental simulations: they induce salivation (Keesman, Aarts, Vermeent, Hafner, & Papies, 2016), act as a mechanism of desire, and affect food cravings (Kemps & Tiggemann, 2013; Schumacher, Kemps, & Tiggemann, 2017). It should be noted, however, that most studies have used tempting food as stimuli (Papies, 2013). These findings are supported by the Elaborated Intrusion Theory of human motivation (EI Theory) which posits that thinking about a desired food increases desire for that food (May et al., 2015). Some findings also point to mental simulation being an effective strategy to control food intake and help people make healthier choices. One approach is affecting satiety by mentally repeating the eating experience (Haasova et al., 2016; Missbach et al., 2014a; Morewedge, Huh, & Vosgerau, 2010b). For instance, Larson, Redden and Elder (2014) demonstrated that sensory simulations are important mechanisms underlying satiation, and those may be triggered by simple evaluating food pictures. Other researchers have been working on reduction of chosen portion sizes (Cornil & Chandon, 2016; Petit, Basso, et al., 2016) and on reducing the portion size effect (Petit, Spence, Velasco, Woods, & Cheok, 2017). Moreover, mental simulation has even been conceptualised as a substitute for experience (Kappes & Morewedge, 2016). These previous studies mostly refer to the simulations as eating simulation, consumption simulation, or sensory imagery, and are focused on the consummatory phase. They leave unattended the effect of outcome simulation.

The simulation of an event can happen spontaneously or can be instructed. An example of a more automatic mental simulation was studied by Elder & Krishna (2012). They found that impeding or reducing the ability

to simulate mentally a motor activity impacted the subject's purchase intentions, because there is a competition of resources between perceptual and imagined activity, e.g. holding a clamp on the right hand impeded a spontaneous simulation of using a fork placed on the right side of a plate of cake. Reducing the ease of imagining the consumption of a product (or the satisfaction after its consumption) may affect the consumer's motivation and result in behavioural consequences. Moreover, mental simulation can be instructed. In a series of studies, Cornil and Chandon (2016) investigated the effect of multisensory imagery on the choice of portion size. In the study, they asked participants to imagine vividly the taste, smell, and texture of three hedonic foods before choosing a portion size of another hedonic food. They found that sensory imagery made normal eaters choose smaller portions due to an increased expected enjoyment for a hedonic food (chocolate cake), but backfired for dieters, leading them to choose larger portions. In the case of health imagery, people saw the same three pictures but they were asked to imagine the negative impact of these foods on their health and body. No effects were found in expected eating enjoyment nor in actual enjoyment, but all participants chose smaller portions and the effect was marginally stronger among non-dieters. Hence, the mechanism underlying the choice of portion sizes with health-related imagery remains uncertain.

Therefore, this research intends to explore the effects of simulation of both process and outcome and, additionally, we use vice and virtue products to contrast the effect of each simulation with those two types of product. As stated by the EI Theory, we believe that as process simulation and sensory imagery favour immediate gratification, they would enhance the desire for vice products. On the other hand, as outcome simulation and health imagery favour more abstract thoughts, they would resonate more with the virtue product. Xie and colleagues (2016) showed that a visual stimulus can facilitate thoughts related to both the process and the outcome of consumption. Products perceived as tasty spontaneously evoked more process simulation whereas products perceived as healthy evoked more outcome simulation. Taken together, considering the systematic differences of each type of

simulation, and the importance of foods superior on a hedonic dimension (referred to as vices) versus foods superior on a utilitarian dimension (referred to as virtues), we explore the effect of the mental simulation—and its interaction with the product type—on the motivational and behavioural responses (i.e. wanting and choice). Therefore, as seen in to the previous evidence, we advocate a parallelism between the mental simulations and the type of product (see **Table 1**).

H1: when the nature of the product (vice or virtue) shares the same dimensions as the mental simulation (process or outcome) the probability of wanting and choosing the product increases; in the opposite case, it decreases.

Table 1: Summary of hypotheses

	Outcome simulation	**Process simulation**
Virtue product	Wanting increases Choice probability increases compared to the control condition (no MS)	Wanting decreases Choice probability decreases compared to the control condition (no MS)
Vice product	Wanting decreases Choice probability decreases compared to the control condition (no MS)	Wanting increases Choice probability increases compared to the control condition (no MS)

Short and long-term goal orientations

Consumers, naturally, have different orientations and ways of seeing and categorising products. This natural orientation depends on the momentary goal but also, in large part on people's personality. In the context of food, these orientations could, for example, lead them to give more importance to either hedonic or utilitarian attributes of food when making decisions. One way in which researchers have explored these orientations is by looking at motives for food choice. Therefore, we operationalise these goals through the Food Choice Questionnaire (FCQ). This questionnaire serves to investigate general determinants of food selection (Fotopoulos, Krystallis, Vassallo, & Pagiaslis, 2009). Although the FCQ contains nine dimensions (health, mood, convenience, sensory appeal, natural content, price, weight control, familiarity, and ethical concern (Steptoe, Pollard, & Wardle, 1995), we used

only two. The health motive (which has a long-term perspective) is consistent with health-related behaviour and beliefs, which leads to healthier dietary choices and more positive attitudes towards health and utilitarian benefits (Steptoe et al., 1995). On the other hand, we believe that sensory appeal (with a short-term perspective) could have a comparable effect but consistent with attitudes more favourable towards taste, and sensory and hedonic features.

Therefore, we hypothesise that:

H2: The effect of mental simulation on wanting and choice would be moderated by a goal. Individuals with a stronger goal (either health or sensory pleasure) would be less likely to change motivational and behavioural responses.

Decisional focus (attentional biases)

Attention plays a central role in food choices. Findings from an eye-tracking experiment suggest that consumer choice may originate from an increase in attention for prime-congruent items, e.g., when a health goal was primed, participants focused longer on low-energy foods (van der Laan, Papies, Hooge, & Smeets, 2017). Just as with a health-goal prime, we believe that instructed mental simulation could be effective in driving people's attention towards certain features of a product. Process simulation (imagining consuming a product) would tend to make people focus more on hedonic attributes since those are more linked to the experience of consumption itself. Conversely, outcome simulation (imagining having consumed a product) would tend to make people focus more on utilitarian attributes since those are more linked to abstractions such as health. Thus, people are asked to think actively about something that emphasises one or the other dimension, either the hedonic or the utilitarian. Since this role of mental simulation has not been studied yet, the present research explored the extent to which process simulation would draw attentional focus towards more hedonic features and outcome simulation towards more utilitarian aspects.

H3: Process simulation would make people focus more on aspects related to the experience of eating (sensory attributes, appearance and sensations evoked), whereas outcome simulation would make people focus more on functional aspects (healthiness, functionality, and practicality).

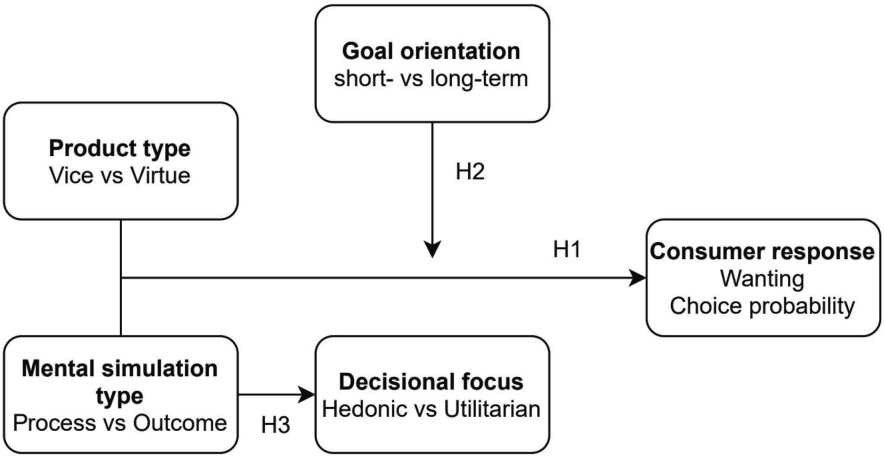

Figure 1: conceptual framework

Figure 1 shows the complete conceptual framework, as well as the contribution of each hypothesis. To our knowledge, this is the first study contributing to the mental simulation literature that reveals the importance of the nature of the product on wanting, and the preference for a vice or a virtue product. We offer an integrative approach to the effect of two types of mental simulation (process and outcome) on wanting and food choices.

Materials and methods

Pre-test

A pre-test to identify the more hedonic and utilitarian products was conducted. The hedonic or utilitarian nature was explored for twelve food

products (see **Figure 2**): frikandel[1], wine, milk chocolate bar, dairy dessert, crisps, cereal bar, raisin bread, salad, crackers, green smoothie, banana, and vitamin C supplement. Seventy-two participants were asked to evaluate how experiential (hedonic) or functional (utilitarian) the products were. Characteristic concepts of utilitarian and hedonic scales were used (Batra & Ahtola, 1991; Crowley, Spangenberg, Hughes, & Crowley, 1992; Voss, Spangenberg, & Grohmann, 2003) but were adapted to a food context. These concepts were as follows: for the hedonic dimension, sensory rich vs dull, delightful vs not delightful, fun vs not fun, yummy vs yucky, and boring vs interesting; whereas to characterise the utilitarian dimension, we used filling vs not filling, functional vs non-functional, practical vs impractical, helpful vs unhelpful, and necessary vs unnecessary. Then, in two different 100-VAS scales (0 = not at all, 100 = very much), participants were asked: *"When considering this product as a meal or snack, to what extent would you think of the experience of consuming the product?"* And then were asked: *"to what extent would you think of the functionality of consuming the product?"* We gave them the following example: *"Toothpaste may both prevent cavities (functionality) and provide pleasure from its minty sensation and cleanness (experience)"*. From these twelve products, two were selected: crisps and green smoothie. The green smoothie was significantly more utilitarian than hedonic ($M_{experiential}$ = 48.4 $M_{functional}$ = 72.23, $p < .0001$), while the crisps were significantly more hedonic than utilitarian ($M_{experiential}$ = 72.18 $M_{functional}$ = 23.79, $p < .0001$). These two dimensions are represented by the vice and the virtue products.

[1] A familiar and well known Dutch sausage-like food.

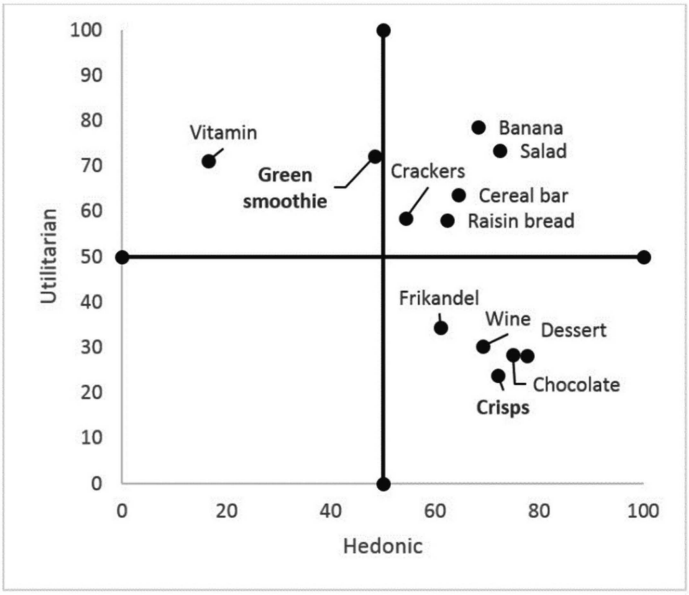

Figure 2. Classification of product categories on experiential (hedonic) and functional (utilitarian) dimensions.

Participants

The sample consisted of seventy-six participants (fifty-two females and twenty-four males) ranging from 18 to 45 years of age. A recruitment criteria was to have a healthy weight, and participants were recruited with posters located around the Campus of Wageningen University & Research, The Netherlands. Ethical approval was obtained by the Social Sciences Ethics committee of Wageningen University and Research.

Procedure

This study had a 3 x 2 within-subjects experimental design, namely: (simulation type: control, process, outcome) x (product type: vice, virtue). The vice product (crisps) and the virtue product (green smoothie) that were identified in the pre-test were presented to the participants as unbranded pictures.

During the first session, all participants engaged in the control condition (i.e., no mental simulation) to provide baseline measures for both the vice and

the virtue product. After they attended the first session, participants were randomly assigned to either the *process simulation* or the *outcome simulation* condition to start in a second session at their own convenience. Once they had finished the second session, they were contacted again and scheduled for the third and last session. All the participants completed it within one week. As seen in **Table 2**, the questions asked were the same in the three sessions. The second and third sessions were conducted with at least one day's difference, roughly at the same time for the same person to avoid confusion with process and outcome thoughts, and so as not to get influenced by the time of day.

Table 2: The three within-subject sessions.

Session 1: no simulation	**Session 2: process or outcome simulation (randomised)**	**Session 3: process or outcome simulation (randomised)**
Baseline measures for the one product (counterbalanced order) Measures of: Wanting; Basis of evaluation: 8 concepts characterised as utilitarian, hedonic. *Idem for next product Choice: none, crisps, green smoothie FCQ: Health and sensory Demographic questions.	Imagine product 1 or 2 (counterbalanced order): Write down your thoughts Measures of: Wanting; Basis of evaluation: 8 concepts characterised as utilitarian, hedonic. *Idem for next product Choice: none, crisps, green smoothie.	Imagine product 1 or 2 (counterbalanced order): Write down your thoughts Measures of: Wanting; Basis of evaluation: 8 concepts characterised as utilitarian, hedonic. *Idem for next product Choice: none, crisps, green smoothie.

Stimuli (simulations)

To manipulate the type of mental simulation, specific instructions for process and outcome simulation were created. In addition, to ensure that everyone would think of all aspects during both simulation sessions we intended to activate cognitive processing as well as affective processing. The instructions for the products were adapted from the instruction of Zhao, Hoeffler, and Zauberman (2011). These instructions were provided together with a picture of the unbranded product.

Process simulation

To create emphasis on the rational thoughts we asked participants the following: "You have a green smoothie[2] (respectively, packet of crisps) in your hand. Please take a moment to imagine rationally the step-by-step process of consuming the green smoothie (resp. packet of crisps). Focus on every detail of consuming it. Which specific features do you think about while consuming the green smoothie (resp. packet of crisps)? (Please describe your experience as specifically as possible)".

To create emphasis on the emotions, we asked participants the following: "You have a green smoothie (resp. packet of crisps) in your hand and you are about to consume it. Please take a moment to imagine the specific emotions that you may feel while consuming it. Try to focus on your feelings. Which specific emotions do you feel while consuming the green smoothie (resp. packet of crisps)? (Please describe your experience as specifically as possible)".

Outcome simulation

To create emphasis on the rational thoughts we asked them the following: "You have just consumed a green smoothie (resp. packet of crisps). Please take a moment to imagine rationally what are the effects that you may experience after having consumed it. Which specific benefits/consequences do you think about after having consumed the green smoothie (resp. packet of crisps)? (Please describe your experience as specifically as possible)".

To create emphasis on the emotions, we asked them the following: "You have just consumed green smoothie (resp. packet of crisps). Please take a moment to imagine the specific emotions that you may feel after receiving the effects of having consumed it. Try to focus on your feelings. Which specific

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[2] *Crisps* refer to an unbranded packet of crisps, and *green smoothie* refers to an unbranded bottle of a smoothie which contains: cucumber, spinach, apple, mint and kale.

emotions do you feel after having consumed the green smoothie (resp. packet of crisps)? (Please describe your experience as specifically as possible)".

Measures

Wanting was measured 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?"*.

Choice was measured through the question: "taking into consideration your current state, which product would you choose? Green smoothie, crisps, or none". The order of the choices was randomised.

Goal orientations: Only two out of the nine dimensions of the FCQ were measured: health and sensory appeal. Therefore, to determine *health orientation* people were asked (0 = not at all, 100 = very much): *"it is important to me that the food I eat on a typical day..."* (1) contains a lot of vitamins and minerals, (2) keeps me healthy, (3) is nutritious, (4) is high in protein, (5) is good for my skin, teeth, hair, nails, etc., (6) is high in fibre. To determine *sensory orientation,* we asked people, *"It is important to me that the food I eat on a typical day..."* (1) smells nice, (2) looks nice, (3) has a pleasant texture, (4) tastes good.

To measure *decisional focus* respondents were provided with a list of eight decision criteria of which three were hedonic-related (*sensory attributes*, *appearance* and *sensations evoked*), three utilitarian-related (*practicality*, *functionality* and *healthiness*) and two distractors (*social reasons and context*). Participants could choose a maximum of three out of these eight concepts. Decisional focus was operationalised by subtracting the number of attributes selected as utilitarian (maximum three attributes) from the number of attributes selected as hedonic (maximum three attributes), creating an index of decisional focus from -3 to +3, for each product and each condition. The negative values represent the utilitarian dimension whereas the positive ones the hedonic dimension.

Results

We present an example of respondents' responses provided for each simulation and product.

Process simulation of the vice product

When I open the package the smell quickly diffuses and my willingness to eat increases. When I take the crisp and ate the feeling is very good. During the time that I eat the potato my mouth start to be dry and I want some liquid. When I finish I feel full and a little intoxicated, the feeling is not good. I feel very good emotions in the start. The taste is too good for me. In a second plane, I feel like I should not be eating that. But I really want to be continue eating. (S47, M, 25-34).

Outcome simulation of vice product

Besides being full in a short period of time, eating it once in a while may have no consequences, but since I did it in regular basis, I am afraid I will have heart disease in next few years. Hopefully not. I feel a bit full but not really satisfied by the product. I know I need to eat real food for lunch that not only contain a lot of carbs but also other nutrients. I also feel guilty to my body because I eat oily food. (S2, F, 25-34).

Process simulation of the virtue product

I'm imagining a cold and smooth drink. With small vegetables and fruit parts in it. I imagine not a very nice taste, because of the spinach and mint in it. It doesn't sound like a tasty combination to me. I feel strong and proud because of drinking a very healthy smoothie. And I feel a little bit fear because I don't know what kind of taste I can expect. (S61, F 18-24).

Outcome simulation of the virtue product

I definitely feel healthy, better digestion, clear skin, feeling full, the taste mattered only for a few seconds till gulping it in and after that it had a

refreshing effect on the stomach. Refreshing, healthy, better digestion and excretion. (S71, F, 18-24).

Effect of mental simulation on motivational responses and choice

Wanting: A repeated measures ANOVA was conducted with wanting[3] as the dependent variable, and simulation type (control, process, outcome), product type (vice, virtue), and their interaction as the independent variables[4]. It was hypothesised that mental simulation and its interaction with the product would affect wanting and choice probability **(H1). Figure 3** shows the pattern of wanting ratings across the products and simulations. There was no significant main effect of mental simulation on wanting $F(2,150) = 1.66$, $p = .193$, but a significant main effect of product type $F(1, 75) = 19.46$, $p < .0001$. As expected, we found a significant two-way interaction between the mental simulation type and product type $F(2,150) = 3.07$, $p = .049$. As predicted, mean wanting was marginally increased ($M = 61.45$, $p = .069$) when outcome simulation was performed for the virtue product. Process simulation ($M = 57.46$, $p = .739$), however, did not differ from the control condition ($M = 56.42$). For the vice product, the opposite effect is shown: process simulation significantly increased wanting ($M = 45.76$, $p = .010$), while outcome simulation had no effect ($M = 40.93$, $p = .539$) and did not differ from the control condition ($M = 38.71$).

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[3] As liking tends to be more stable that motivations (wanting), this assumption was tested. 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". Indeed, in a repeated measures ANOVA, liking ratings were not affected by our manipulation (all $p > .10$). However, both products significantly differed in liking, the vice product (crisps) was significantly more liked than the virtue product (green smoothie), $F(1,73) = 8.74$, $p = .004$, as we could have expected.

[4] Gender was included as a between subject factor. No significant main effects nor interactions were found for gender, hence it will not be further discussed.

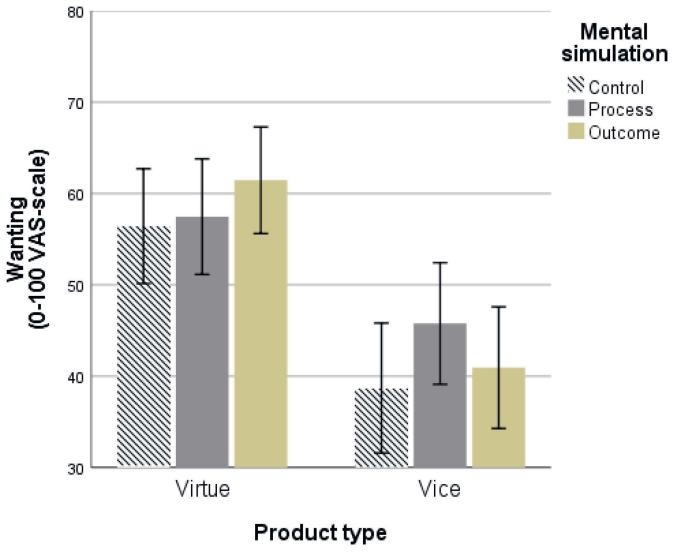

Figure 3. Effect of process and outcome simulation on wanting vice and virtue product. Wanting was measured on a VAS-scale (0 = not at all, 100 = very much).

Choice probability: Cochran's Q test and McNemar were conducted to analyse to what extent mental simulation affects people's preferences between a vice and virtue product. Product preference frequency was our dependent variable, and simulation type our independent variable (see **Figure 4**). As expected, product preference followed the same trend as wanting. The results confirm our hypothesis **H1,** as outcome simulation increased the probability of choosing the virtue product significantly ($p < .0001$) compared to no simulation and to process simulation. Although the vice product was chosen more often under process simulation, this was not significant when we compare it to no simulation. Participants did, however, choose the vice product significantly more often under the process simulation as compared to outcome simulation ($p < .0001$). Cochran's Q test determined that there was a statistically significant difference in the proportion of product preferences between the conditions, χ^2 (4) = 12.627, p = 0.013.

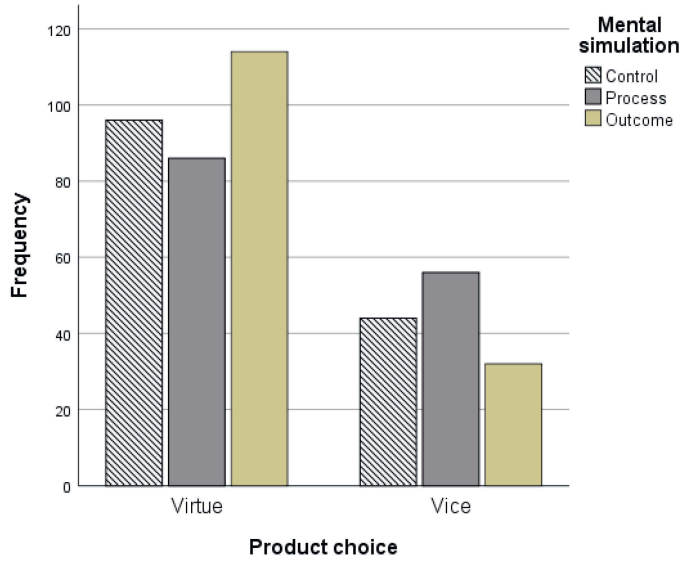

Figure 4. Frequency of choice between a virtue and a vice product across simulations. Significant levels are marked with *** at a significance level of $p \leq 0.001$; and ** at $p \leq 0.01$.

Moderating role of goal orientation on wanting and choice

We tested the boundary condition (**H2**) as follows. First, the reliability of both scales, health orientation and sensory orientation, was tested. Cronbach's Alpha was 0.859 for health orientation, and 0.730 for sensory orientation, which demonstrates a fair reliability of both scales. Therefore, we created two new variables: *health orientation* and *sensory orientation*, which were calculated as the mean of the items corresponding to each category. These two variables were tested as moderators in a repeated measures ANCOVA, with wanting as dependent variable, with simulation type (control, process, outcome) and product type (vice, virtue), and their interaction as independent variables, plus sensory and health orientation as moderators.

Wanting: We hypothesised that the effect of mental simulation on the wanting and choice of a vice product versus a virtue product would be moderated by the sensory or health orientation (**H2**). As predicted, we found a significant three-way interaction $F(2,148) = 5.50$, $p = .005$ between

simulation, product type, and health orientation on wanting, showing that the effect of process and outcome simulation on the evaluation of vice and virtue products depends on people's health orientation. Thus, we found that health orientation is a moderator of the effect of mental simulation on wanting, but sensory orientation had no significant effect, therefore it will not be further discussed.

A simple slopes analysis with the MEMORE macro (Montoya (in press); Montoya & Hayes, 2017) was conducted to explore the moderation effect of health orientation. MEMORE probes at the mean, as well as plus and minus one standard deviation from the mean of the moderator health orientation, M = 67.43, SD = 15.97. Moderation of the relationship between mental simulation (X) and wanting (Y) means that this difference between the simulation and the control condition depends on some other variable, i.e., health orientation (M). Therefore, M predicts the difference between ratings of wanting (e.g., $Y_{process} - Y_{control}$). As we are interested in estimating and conducting inferences on the effect of mental simulation at specific values of the between-participant variable health orientation, the results are separated by product type.

Vice product

Effect of goal orientation on wanting: Health orientation had a main effect on wanting the vice product (see **Figure 5**). Thus, with increasing health orientation, wanting decreased (b = -.652, p = .003). The same negative pattern was observed in process simulation (b = -.525, p = .011), but in outcome simulation there was no main effect of health orientation (b = .076, p = .719).

Moderation[5]*:* Health orientation did not moderate the effect of process simulation (b = .127, p = .454) when compared to the control. **Figure 5** shows the almost parallel line between the control condition and process simulation. But conditional effects of process simulation (compared to control) on wanting at high values of the moderator were found, b = 9.080, p = .019. On

[5] Significant conditional effects are represented in the Figures 5 and 6 by an asterisk (*).

the other hand, health orientation moderated the effect of outcome simulation on wanting, b = .728, p = .001. Conditional effects showed that at a low level, the effect of outcome simulation compared to the control marginally decreased, b = -9.405, p = .053, and in high levels, the effect of outcome simulation compared to the control significantly increased ratings of wanting, b = 13.853, p = .005. Additionally to our hypothesis, a moderation effect was found when process and outcome simulation were compared, b = .601, p = .002. Conditional effects were found in the low– health--oriented group, b = 14.433, p = .001.

Figure 5. Effect of process and outcome simulation on wanting across levels of health orientation for the vice product. Data to plot this figure were provided by MEMORE. Significant levels are marked with *** at a significance level of $p \leq 0.001$; ** at $p \leq 0.01$; and * at $p \leq 0.05$.

Virtue product

Effect of goal orientation on wanting: Results from the virtue product mirror the ones from the vice product, although they were less pronounced. A conditional effect of health orientation on wanting in the control condition was found (b = .526, p = .007), as well as for outcome simulation (b = .527, p = .003). **Figure 6** shows that as health orientation increases, wanting for the

virtue product increases (the opposite as in vice product). As in the vice product, however, the effect of health orientation disappeared when the simulation did not share the same dimensions as the product (b=.182, p=.363), in this case process simulation with the virtue product.

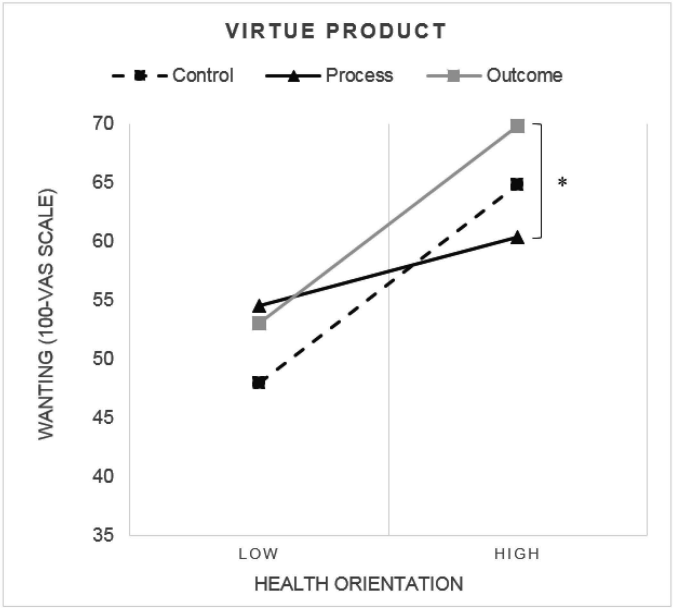

Figure 6. Effect of process and outcome simulation on wanting across levels of health orientation for the virtue product. Data to plot this figure were provided by MEMORE. Significant levels are marked with * at $p \leq 0.05$.

Moderation: **Figure 6** shows that there was no moderating effect (compared to control), either in process simulation (b = -.344, p = .079) or outcome simulation (b = .001, p = .997), also conditional effects were not found. Additionally to our hypothesis, a moderation effect was found when process and outcome simulation were compared, b = .344, p = .049. Conditional effects were found in the high health-oriented group, b = 9.489, p = .017.

In general, these results suggest that when a product does not share the same dimensions as the type of simulation (e.g., when outcome simulation is applied to a vice product) there is a moderation effect from health orientation. Moreover, when the product and simulation are aligned, wanting increases in

parallel across both levels. Although the effects for the virtue product were less pronounced, the effect was mirrored for both types of product.

Choice: In order to examine our hypothesis **H2** on choice, and the role of health orientation, a Chi-squared test was conducted[6]. Simulation type had a significant effect on choices by people who were low health-oriented, χ^2 (4) = 18.171, p =.001. More particularly, outcome simulation significantly increased the choice of virtue products, compared to the control (see **Table 3**). Although process simulation increased choice for the vice product when compared to control, the difference was not significant. When the two simulations were compared, we observed a significant difference between process and outcome in both products. As with wanting, process simulation increased preference for the vice product whereas outcome simulation increased preference for the virtue product. Moreover, it should be noted that this segment (low health-oriented) seems to be sensitive to both process and outcome simulation. The high health-oriented segment maintained their preference for the virtue product, regardless of any simulation, χ^2 (4) = 3.724, p = 0.445.

Consequently, **H2** was partially confirmed. The interaction between simulation type and product type on wanting and choice was moderated by health orientation. High versus low health-oriented people behave differently across simulations. Even though individuals with a stronger relevant goal exhibited an increased wanting for the products, they were less likely to change behavioural responses.

[6] Participants were median split into low and high (Me=69)

Table 3. Frequency of choice of total, high- and low-health oriented people. Different letters within a row indicate significantly different frequencies between the three conditions at 0.05 level. The frequencies for the option "none" are not displayed here.

	Mental Simulation/ Choice	Control	Process	Outcome
Total (n=76)	Virtue product	48 (a)	43 (a)	57 (b)
	Vice product	22 (ab)	28 (b)	16 (a)
Low (n=40)	Virtue product	21 (a)	18 (a)	29 (b)
	Vice product	14 (ab)	20 (b)	9 (a)
High (n=36)	Virtue product	27 (a)	25 (a)	28 (a)
	Vice product	8 (a)	8 (a)	7 (a)

Effect of mental simulation on decisional focus

It was hypothesised that process simulation would make people focus more on hedonic attributes, and outcome simulation more on utilitarian attributes, in the evaluation of motivational responses **(H3)**. A repeated measures ANOVA was conducted, taking the decisional focus index as our dependent variable, and simulation type (control, process, outcome) and product type (vice, virtue) as the interacting independent variables. There was a main effect of mental simulation on decisional focus, $F(2,150)=7.269$, $p = .001$. Pairwise comparisons showed that outcome simulation increased significantly ($M = -.026$, $p = .006$) the utilitarian attributes compared to control ($M = .382$), but process simulation did not influence people's focus ($M = .454$, $p = .564$). **Figure 7** shows the index of decisional focus from -3 to +3, in each condition (across the two products). The negative values represent the utilitarian dimension while the positive ones the hedonic dimension. There was also a main effect of the products $F(1,75) = 32.854$, $p < .0001$, as expected, the virtue product was considered to have more utilitarian attributes ($M = -.241$), while the vice more hedonic attributes ($M = .781$, $p < .0001$). Although no interaction effects between mental simulation and the products were observed, $F(2,150) = 1.279$, $p = .281$, pairwise comparisons showed that outcome simulation significantly increased the focus on utilitarian attributes

of the virtue product (M = -.58, p = .002) compared to the control condition (M = -.01) and process simulation (M = -.13 , p = .021), while process simulation significantly increased the hedonic attributes in the vice product (M = 1.04, p = .008) but only when compared to outcome simulation (M = .53). Therefore, we partially confirm **H3**. It is clearly seen that outcome simulation made people focus more on utilitarian aspects, regardless of the product.

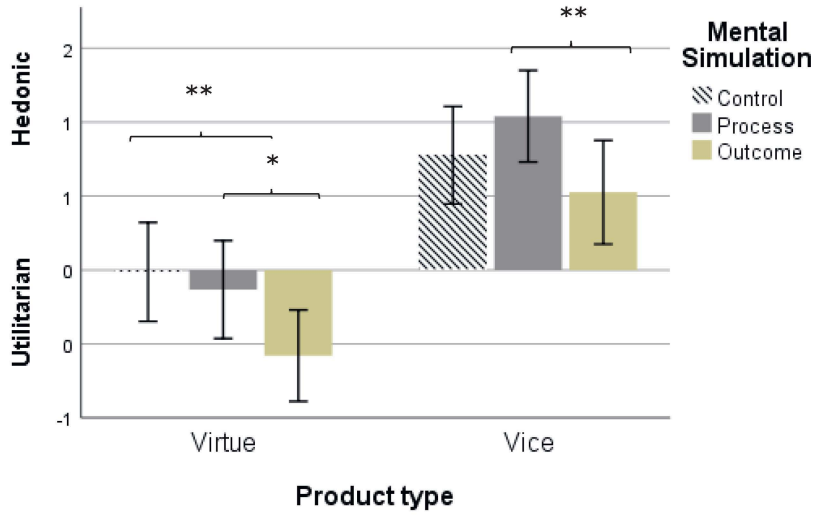

Figure 7. Decisional focus across mental simulations. Significant levels are marked with ** at $p \leq 0.01$; and * at $p \leq 0.05$.

Discussion

The primary aim of the present study was to investigate how simulating the process and outcome of consuming a food, superior on either a hedonic or utilitarian dimension, influences desire and behaviour towards those food products. In a within-participants experimental design, people's motivational and behavioural responses were measured before and after two imagination tasks. Importantly, to the best of our knowledge, this is the first study in which two products different in nature (vice and virtue) were contrasted in examining the effect of imagined (post) consumption.

Mental simulation on wanting and choice

Results of the main study were partially consistent with our expectations. As was hypothesised in H1, when the simulation and the product type shared the same dimensions, being superior on hedonic or utilitarian aspects, the ratings of wanting increased. Process simulation increased wanting for the vice product, and outcome simulation increased wanting for the virtue product. The aforementioned results were also expressed in choice behaviour, but only for outcome simulation. Preference for the virtue product increased when outcome simulation was performed. These results could be explained by means of processing fluency—the ease with which information is processed (Schwarz & Vaughn, 2002). According to fluency processing theories, perceptual fluency may be an indicator of familiarity even though it is not (Whittlesea & Williams, 2001) and thus, is affectively positive rather than neutral (Reber, Winkielman, & Schwarz, 1998). Another possible explanation is that the perceived likelihood of the consumption event increased owing to simulation heuristic, which is the ease of generating a mental script of an event (Kahneman & Tversky, 1982; Tversky & Kahneman, 1973). When people are asked to simulate the consumption experience for a vice product, the features related to the experience (as sensory attributes, enjoyment of eating) are more accessible, and thus, they would be more salient and easier to imagine. The same outcome would be expected when imagining the consequences of having consumed a virtue food, resulting in a positive motivational reaction. Additionally to our hypothesis, comparison of process versus outcome simulation was also tested. Guiding people into more process thoughts has an advantage on desire and preferences, but only for a vice product. When the product is not a vice but a virtue product, however, outcome simulation has an advantage on increasing wanting and ultimate choice for that product. Our results are in line with the results of Xie and colleagues (2016), who found that products that were congruent with the simulation type (salad with outcome simulation, and cake with process simulation) were evaluated with a more positive attitude and higher purchase intentions.

Goal orientation on wanting and choice

Furthermore, it was hypothesised that health orientation has a moderator role on the ratings of wanting and choice, and that people with a stronger relevant goal would be more resistant to change wanting and choice (H2). We partially confirmed H2, since health orientation moderated only when simulation and product type did not share the same dimensions. For instance, imposing an outcome (respectively, process) simulation mismatched with the natural thoughts of a vice (resp. virtue) product, so information appeared to be more effortful and to involve more elaborate processing (Heckler & Childers, 1992; Petrova & Cialdini, 2005), resulting in a diminished motivational response and action. This moderating effect, however, gives us different insights for both the low and the high health-oriented groups. For the low health-oriented people, a possible explanation is that they decreased their desire for the vice product because it reminded them of a health goal. In a teleological system, behaviour adjusts according to the revaluation of the goal that is triggered, either by an alteration in the state of motivation or because new knowledge is acquired (Dickinson, 1985). It is likely that outcome simulation made the health goal more salient, permitted a revaluation of goals, and led this low-health segment of people towards a behaviour more compatible with their new goal, which was having a preference for the virtue product. In other words, mental simulation could have activated and changed the initial goal of people, similar to health goal-priming. Research in goal-priming has shown that, indeed, goal primes increase attention for goal-congruent items, and increase the likelihood of choosing them (van der Laan et al., 2017). Hence, outcome simulation could have primed low health-oriented people with a healthier goal, which increased attention for the goal-congruent features (utilitarian) and led to higher preference for the virtue and healthier product.

On the other hand, we hypothesised that high health-oriented people would be less likely to change wanting and choice, regardless of the product and the simulation they performed. Although this group remained quite constant in their preferences (the virtue over the vice product) in both

simulations, however, the wanting for the vice product was not constant, and indeed, they increased their desire for that food equally in outcome and process simulations compared to the control condition. This result suggests that people with a high health orientation have high levels of self-control, since they get tempted with the vice product, but they do not choose it. Moreover, it should be considered that the relative importance they give to the virtue product is higher than for the vice product, since the virtue product, generally, had higher ratings of wanting and was highly preferred over the vice product. Research supports that the relative importance of hedonic versus utilitarian product attributes change across consumers, and that indeed, the importance of healthfulness is much higher among the health-conscious segments than other segments (Maehle, Iversen, Hem, & Otnes, 2015).

In the case of the virtue product, even though the results mirrored those of the vice product, they were not as pronounced. For this type of product, health orientation did not moderate when process and outcome simulation were compared to the control, but it did moderate when compared to each other. One possible explanation of the feebler results is that the hedonic dimension of our virtue product was still too present (pre-test). Therefore, our virtue product was closer to a "neutral" product rather than a utilitarian one. We believe that the virtue product shared, to a greater extent, thoughts related with both utilitarian and hedonic aspects. The present research intended to compare the effect of mental simulation type on extreme hedonic and utilitarian products. Further studies should, however, compare the effect of mental simulation type also on more neutral products, which appeal to both hedonic and utilitarian aspects equally.

Mental simulation effects on decisional focus

Mental simulation may have specific effects on momentarily directing people's attention towards more hedonic features (with process simulation) or utilitarian features (with outcome simulation). Cornil and Chandon found that when people mentally simulate a multisensory experience of an

indulgent product, the relative importance of hunger decreased. In other words, multisensory imagery increases the relative importance of sensory pleasure when choosing portion sizes and decreases relative importance of otherwise more salient criteria, such as hunger or dieting constraints for dieters. This result suggests that to mentally simulate a consumption experience could be effective in changing attentional focus. Our results show, however, that process simulation did not change the decisional focus (compared to the control), neither for the vice product nor for the virtue one. We believe that this is because the products were very salient in their respective dimensions. For example, the vice product was extremely hedonic, so the probability of directing attention, even more, towards hedonic characteristics is much less than that of a product that is more ambiguous. Additionally, it should be noticed that the aim of our study was not focused on increasing enjoyment or to decreasing portion sizes as Cornil and Chandon studies, but we rather show that the state of motivation can be influenced through mental simulation, that the content of people's thoughts has implications on product preferences, and that the attentional focus may play a role.

As was hypothesised, outcome simulation directed decisional focus towards more utilitarian features in both products, but only in the virtue product did the utilitarian attributes exceed the hedonic ones. It is interesting that even though automatic visual attention tends to focus on aspects of tastiness and not healthfulness or preferences (Motoki, Saito, Nouchi, Kawashima, & Sugiura, 2017), outcome simulation succeeded in changing the decisional focus towards more utilitarian aspects, and even reduced the ones linked to the hedonic aspects. Similar to experiments where decision or shopping goal are manipulated (See Bialkova & van Trijp, 2011; van der Laan, Hooge, De Ridder, Viergever, & Smeets, 2015), mental simulation could have induced participants into a momentary state of taste or health relevancy and attention could be shifted towards the current more congruent goal. Moreover, as the value depends on how much attention people give to their alternatives during the decision-making process and contributes to the

formation of memories (Armel, Beaumel, & Rangel, 2008; Krajbich, Armel, & Rangel, 2010), it is possible that outcome simulation could have enhanced attention toward its functionality, and thus, the value individuals gave to the utilitarian attributes when making a choice could have also been enhanced.

This is consistent with previous research that has shown that people make healthier food choices when their attention is directed toward healthy food and that valorising healthy food may increase self-control and decrease impulsive decision-making (Petit, Merunka, et al., 2016). Our results seem to be aligned with those of such similar strategies as mindfulness, which has been underlined for its importance in conscious attention and awareness (Brown & Ryan, 2003). Mindful attention shows a great capacity to draw attention towards different outcomes, for instance, to body sensations or to the environment, and this distinction matters. Mindful meditation that focuses on the body leads individuals to become more aware about their hunger and satiety signals, which helps consumers to compensate for prior food intake, whereas paying mindful attention to the environment does not have the same effect (van de Veer, van Herpen, & van Trijp, 2016). This evidence supports the idea that cognitive strategies could direct attention, and more precisely, "where" the attention is being focused plays a role in food evaluation, food consumption and preferences. Thus, we believe that mental simulation has a variety of outcomes, just as mindfulness does, depending on where the attention is being focused. Yet, despite the fact that we have not measured attention itself, we have left an open door to explore further the role of attention in the mental simulation domain.

In sum, the results of the present study demonstrate that instructed mental simulation can be used to enhance desire for different product categories, as well as to shift preferences from a vice product to a more virtuous one. The most striking finding to emerge from the present study was the consistent effect of the mental simulation on its corresponding product, and that this interaction has consequences on motivational and behavioural responses.

These findings have some managerial implications regarding these two simulation types. Marketers and policy makers should consider the fact that food consumption involves an intrinsic motivation of people towards more hedonic or utilitarian features. Communicational campaigns or interventions that evoke more thoughts related with one or the other intrinsic motivation, may have great impact at a decision-making level. Generally, food products are advertised alluding to the sensory pleasure and more hedonic characteristics. Yet, this practice may not be appropriate for all product categories and people's goals. According to our results, products categorised as virtues could be even more wanted when the advert persuades the consumer to evoke and visualise more utilitarian characteristics, especially for the high-health oriented segment. Moreover, outcome simulation could be used as a strategy to nudge people towards healthier products, especially amongst people with a less relevant health goal.

Further research could explore the role of mental simulation, especially outcome simulation, on the activation of a dieting goal which is a functional self-regulation mechanism. Moreover, recent research on decision-making processes suggests that the resolution of a conflict can be understood through goals activated by an external stimulus or intervention (van der Laan et al., 2017). Therefore, a potentially fruitful direction for future research is to assess the capacity of mental simulation to shift the relevant goal, and to investigate whether mental simulation affects desire and food preferences by means of changes in attentional focus. Consequently, further progress towards conflict resolution could benefit from understanding how consumers represent food in their minds and from investigating the role of mental simulation in goal activation.

It should be highlighted that this study involved imagination as well as visual stimuli. This might have hindered the results since the participants were aware that they would not be receiving the foods and that the choice was fictitious. Although the results confirmed, at least partially, our hypothesis, follow-up studies should use actual foods and consumption in a food environment to obtain more realistic responses. Although the

participants declared that their weight was healthy, this was not experimentally quantified, so it cannot be ruled out that some participants' weight was beyond the normal boundaries. Future research could take BMI as a continuous variable and explore differences between people with healthy weight and people who are overweight or obese. Moreover, we based the selection of the products on the hedonic and utilitarian dimensions only, but further research could also consider product familiarity and explore the impact of this factor on the simulated event and respective outcome.

Conclusions

This study suggests that manipulation of imagined consumption and post-consumption have profound effects on wanting, preference between a vice and a virtue product, and attentional focus. Products that did not share the same imagined dimensions resulted in a diminished desire for the imagined food and this has, as well, behavioural consequences. The biggest potential of instructed mental simulation is to aid people with a less salient health goal, to decrease their temptation and preference for unhealthier and highly hedonic products, and persuade them to make healthier choices. Moreover, the industry could benefit by evoking more outcome-related thoughts when a virtue product is in question. Mental simulation could be used to shift attentional focus, at convenience, towards more hedonic or utilitarian features. Thereby, greater understanding of the impact of mental simulation on anticipated consumption may prove fruitful in individual strategies to regulate temptation, as well as the creation of more effective communication strategies, especially for healthy food

CHAPTER 3

3

Pleasure or health? the role of mental simulation in desire and food choices

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Abstract

Many times desire possesses us impeding us to make healthier food choices. From a grounded cognition perspective, we investigate the role of two types of mental simulation (process and outcome) in desire and food choice to understand the processes that modulate them to find strategies that encourage healthier food choices. In addition to explicit measures, we use two implicit methods to measure approach/avoidance tendencies and visual attention. Our results show that imagining the process of eating a vice and virtue food increased desire for the product imagined and seems to favour the choice of a vice food. However, at an implicit level, the motivation to approach/avoid healthy and unhealthy food was neutral. Imagining the outcome of eating a vice/virtue food decreased/increased desire for the imagined food, respectively. Although imagining the outcome of eating a vice food tempted people at an implicit level, it made people more prone to choose a virtue food. When the vice food was imagined, attentional bias increased for all types of food regardless of the simulation. When the virtue food was imagined, there was no effect on choice, motivation nor attentional bias. In conclusion, simply imagining food is a potential solution for generating healthier and thoughtful choices.

Introduction

Understanding desire has become essential in a world of temptations. Desire is defined as a psychological state of motivation towards a specific stimulus or experience that is anticipated to be rewarding (Papies & Barsalou, 2015). In this research, we conceptualize desire as a fast/short-term reaction that is triggered by either an external cue (e.g., advertisement) or that arises purely due to internal cognitive processes. An example of desire triggered by an external cue could be the smell of coffee when one is passing a café. But what if you are just walking in a park and you suddenly have this desire for coffee? Many cognitive processes that could have triggered it. One of them is, for instance, spontaneously remembering drinking coffee sitting on a bench of the forest with your friends. The Grounded Theory of Desire and Motivated Behaviour (Papies, Barsalou, & Rusz, 2020) explains, by integrating psychological and neural mechanisms, why these situational experiences may trigger desire, and in turn affect behaviour.

One central construct of the Grounded Theory of Desire and Motivated Behaviour is situated conceptualization. Situated conceptualizations refer to all sensory features, contextual features, motor actions, current states, emotions, self-attributions, and much other information, which are all stored in memory, and are likely to be recreated or re-enacted when one remembers an experience (situated conceptualization; Barsalou, 2005, 2009). For example, when one smells the scent of coffee, one could suddenly create simulations that recreate a highly pleasurable (or unpleasant) scenario of drinking coffee, such a scenario could be very rich in contextual, sensory features and emotions. Having vividly simulated the experience of drinking coffee could create instant desire (or rejection) for drinking coffee.

In normal circumstances, the situated conceptualizations, that may or not trigger desire arise rather spontaneously, without any conscious effort or even awareness, however, one could voluntarily simulate a certain experience which would create desire too (this research). Also, the level of detail of those conceptualizations depends on the nature of the food. In a study (Papies, 2013),

participants were asked to list features of four tempting/vice foods (e.g. chips) and four "neutral"/virtue foods (e.g., rice, vegetables). Participants used more words to describe the experience for tempting foods than for neutral foods, and they were more likely to describe a situated eating experience when they reported that the food was very attractive and elicited a strong desire to eat. Hence, more attractive/ vice foods (or cues thereof) spontaneously activate richer situated conceptualizations than more virtue foods.

If we normally use simulations to predict desire for food (most often without our awareness), why don't we try to consciously guide simulated experiences to control desire and behaviour? One way to make these simulations conscious is to instruct people to imagine their experience with a product. By instructing people to simulate an experience with a product, a situated conceptualization is activated, which reproduces many aspects of an earlier experience, including associated internal bodily and affective states. Although mental simulations are not a veridical representation of an object/food, and indeed, they are defused and lack so many details compared to a real experience, they serve as an approximation to the reality that helps the brain to minimize errors by bidirectionally giving feedback from cortical processes (Clark, 2013), which help to predict or anticipate value, either pleasure or health.

The role of mental simulations has gained interest in the past years, and indeed, a considerable amount of literature has been published on how eating simulations affect behaviour (Chang, Mulders, Cserjesi, Cleeremans, & Klein, 2018; Cornil & Chandon, 2016; Lange et al., 2020; Muñoz-Vilches, van Trijp, & Piqueras-Fiszman, 2019, 2020b). If a person vividly imagines the smell of a vice food, they exhibit greater salivation, a stronger desire to eat the food, and greater subsequent actual consumption of the food they imagine smelling, compared to when they do not imagine the smell (Krishna et al., 2014). Similarly, imagining eating a vice food increases salivation compared to a neutral food such as bread (Keesman, Aarts, Vermeent, Häfner, et al., 2016). Some other studies have examined the effect of mental simulations on selections of portion sizes (Cornil & Chandon, 2016; Lange et al., 2020; Petit et

al., 2017). The majority of the research on mental simulation has been focusing on 1) instructing people to imagine the consumption itself (referred to as process simulation), and 2) using vice foods as stimuli for the mental simulations. Considering the increasing obesity prevalence and a constant tempting environment, it is worth to investigate how mental simulation can promote the choice of virtue foods. For this purpose, we consider of utmost importance to investigate as well the effects of simulating a post-consumption experience (called outcome simulation) and of using virtue foods, since they are known to trigger different types of reward. Recent studies comparing process and outcome simulations have established that these simulations can control desire and food choices (Muñoz-Vilches et al., 2019, 2020b); however, the mechanisms underlying these relationships have yet to be further investigated.

Attention modulates to some extent food choice (Armel et al., 2008), and additionally, is associated with obesity and food craving (Werthmann et al., 2011). Attentional bias is a form of cognitive bias and refers to a preferential involvement of attention to one particular type of information (e.g., attractive and tempting food; (Macleod & Mathews, 2012). Although this cognitively biased processing tends to be more automatically activated, it can be trained too. Several studies show the effectiveness at an interventional level (Kakoschke, Kemps, & Tiggemann, 2017). Research on attentional bias training supports the idea that attentional bias for food impacts desire for food, food choices and food intake (Werthmann, Jansen, & Roefs, 2014b), for example, participants who were trained to attend chocolate pictures (visual attention) ate more chocolate in a taste test than people who had to attend to non-food stimuli (Werthmann, Field, Roefs, Nederkoorn, & Jansen, 2014). The attentional bias modification paradigm can also encourage healthy eating by training the attentional focus toward healthier alternatives. In a study, participants who were trained to direct their attention towards pictures of healthy food had an attentional bias for such cues and ate more healthy than unhealthy snacks compared to the those trained to attend unhealthy food (Kakoschke, Kemps, & Tiggemann, 2014). We, therefore, investigate whether process and outcome

simulations can direct attention towards a particular food, and although they do not involve an explicit training as the attentional bias modification paradigm, we propose that re-enacting a food (post)consumption event by simulating it in our mind would induce a certain mindset, which would shift visual attention towards information more aligned with the current mindset (i.e., health and indulgent mindset).

In this research, people simulate voluntarily and consciously. However, we believe that motivation to eat and attentional bias towards food occur implicitly and should be observable with measures that reflect a more automatic reaction rather than a rational one. Thus, by using implicit measures we intend to investigate whether the effects caused by mental simulations in desire and choice between a vice and a virtue product (Muñoz-Vilches et al., 2019) are reflected at an implicit level.

Theoretical framework

The present research intends to confirm that mentally simulating the process of eating a vice food leads to a choice of vice foods, because of increased desire for the imagined food, whereas mentally simulating the outcome of having eaten a virtue food leads to a healthier choice because of increased desire for the imagined food. Importantly, we implicitly assess motivation to eat specifically vice or virtue foods under each simulation, and finally, we investigate whether these two simulations direct visual attention automatically towards a specific food category.

Desire/motivation and food choice

The Grounded Theory of Desire and Motivated Behaviour (Papies, 2020; Papies et al., 2017) adds to the Elaborated Intrusion Theory of desire (Kavanagh et al., 2005; May et al., 2012) that desire and its processes can be unconscious and conscious. In both theories, simulations are included as an important part of our everyday life desires. However, the EI theory (May, Kavanagh, & Andrade, 2015) conceptualizes simulations as a top-down process, emerging spontaneously and intrusively from one's mind (e.g., craving a food), and

without the one' awareness (Barsalou, 2008), these are named spontaneous mental simulations (Kosslyn, Ganis, & Thompson, 2001; Taylor, Pham, Rivkin, & Armor, 1998a). Although both theories place simulations, generally, in a nonconscious state and focus on top-down processes, we believe that we can use this brain capacity to evoke these simulations consciously and voluntarily. Indeed, studies, where consumption simulations of vice foods have been consciously evoked, have shown that appetitive reactions increased. For example, instructing people to imagine the consumption of food (process simulation) increased salivation compared to when participants simply looked at food pictures (Keesman, Aarts, Vermeent, Hafner, et al., 2016), and also increased expected enjoyment of smaller portions, which resulted in a smaller portion size selection (Cornil & Chandon, 2016).

As mentioned in the Introduction, the majority of the studies have only used or evoked consumption simulations (process simulations) but the use of post-consumption simulations (outcome simulations), especially in combination with virtue foods have been poorly studied. Understanding how these simulations operate, also with virtue foods, is relevant to promote healthier choices in a world of food temptations. For example, the strategy by which promoting a virtue food might not be the same as the strategy to promote a vice food. In fact, a recent study showed that evoking a multisensory experience of the food (e.g., taste, smell, enjoyment), a wide strategy used to promote vice foods (Krishna, Cian, & Sokolova, 2016) compared to a single-sense ad slogan (mentioning taste only), resulted in more negative thoughts when a healthy food (cherry tomatoes) was used (Roose & Mulier, 2020). Hence, the type of food used to imagine (vice versus virtue) seems to matter to be able to draw generalizable conclusions and therefore design appropriate strategies.

Previous studies have shown that evoking post-consumption simulations of foods, is a potential strategy to direct healthier choices (Muñoz-Vilches et al., 2019, 2020b). However, these effects have been only reflected in rationalized responses. We, therefore, consider relevant to study this at an implicit level, to explore the link between automatic and rationalized motivational responses.

Research in implicit approach-avoidance tendencies has established that there is a direct link between motivational states and specific motor actions (i.e., arm flexion and extension). For example, a study showed that no-hunger participants performed avoidance (vs. approach) movements significantly faster; and their approach movements towards positive (vs. negative) foods were significantly faster (using a joystick). Moreover, this study uncovered motivational tendencies for negative/disgusting food, which were not revealed on the explicit ratings of pleasantness and wanting as the positive and neutral images (Piqueras-Fiszman, Kraus, & Spence, 2014). Hence, it is relevant to know whether the effect of process and outcome simulation on the desire for the imagined food and choice between a vice and virtue food is linked to short-term/implicit reactions.

Attention

It has been suggested that a determinant of choice is the attention that is assigned to certain attributes of food (Armel et al., 2008; Krajbich, Armel, & Rangel, 2010), and that attention can be manipulated through priming (van der Laan et al., 2017) or induction of mindsets (Hare et al., 2011). A functional magnetic resonance imaging (fMRI) study showed that non-dieters made healthier choices when the attentional focus was directed to the health aspects of food, suggesting that mental simulations (comparable to the studies in mindset induction), specifically outcome simulation, may lead to healthier decisions because individual's attention is directed towards longer-term features. In the same vein, another fMRI study, in which attention was manipulated through induction of mindsets (e.g., indulgent mindset, health mindset, fullness mindset), showed that, compared to a free choice condition, the selection of portion size with the fullness mindset was bigger due to increased activity in the insula, responsible of integrative interoceptive processes as satiation. However, in the case of pleasure and health mindset, the selected portion size was smaller. Both mindsets were associated with their neural correlates. In the health mindset, there was an activation of the region of the brain which exerts cognitive control, i.e., prefrontal cortex, specifically DLPFC, which is in charge of self-control; while in the pleasure mindset an

activation of the OFC area was observed; this area is associated with the subjective pleasantness of food (Hege et al., 2018). Moreover, in another study, health versus an indulgent mindset was induced. The health mindset was induced by asking people to select a food from a menu, consisting in four low-calorie food, for their best friend who wants to lose weight, whereas the indulgent mindset was induced by asking people to select a food from a menu, consisting in four high-calorie food, for their best friend who is getting married. They found that attention (measured with a visual probe task) towards high-calorie foods was attenuated only in participants who scored high in the level of eating restrain (Werthmann et al., 2016). Similar research has shown that a heath prime resulted in longer fixation time on low energy foods, also increased low energy food choices, and decreased high energy food choices (van der Laan et al., 2017).

From this evidence that is simply asking people to consider health versus indulgent aspects of foods can actually activate their neural correlates, we expect that mentally simulating an experience (either focused on the process or the outcome of eating a food product), which is rich in situated conceptualizations, will actually have a similar effect. Therefore, we explore whether mental simulations cause a certain state of motivation and whether it causes an attentional bias towards a specific food category (vice or virtue). Outcome simulation would automatically draw visual attention toward health-related aspects (virtue food pictures) since people would enter into a more health-mindset. On the other hand, we expect that process simulation would work in the same direction and will draw visual attention automatically towards information matching with their current motivational state (e.g., indulgent mindset), that is, vice food images. Last but not least, the changes in attention and motivation would have an effect on desire and choice between a vice and virtue food; process simulation favouring vice food choices, and outcome simulation favouring virtue food choices.

Materials and Methods

Participants

Eighty students from Wageningen University and Research participated in this study. They were recruited via posters, social media, and advertisements. The inclusion criteria was not being vegan, vegetarian, lactose intolerant, or have any food allergy, and being refrained from eating at least 2 hours before participation. The study was approved by the ethical committee of the Social Sciences School of Wageningen University and Research. As compensation, participants received a 5 € gift card for various stores in the Netherlands and a snack.

Procedure

Upon arrival, all participants provided written informed consent. Before any mental simulation, participants rated their correspondent food product for desire, expected enjoyment, and hunger, to determine their baseline measurements (see Table 1). The food products selected were banana (virtue) and chocolate cookies (vice). They were then asked to follow a bogus "training" of a dot-probe task (DTP) to capture initial attentional biases. Once they have finished the "training", participants were randomly assigned to perform process simulation of either the vice or the virtue product, or outcome simulation of the same foods as in process simulation, resulting in four experimental groups. After the mental simulation phase, they rated the levels of desire for the imagined food, expected enjoyment, and hunger. Subsequently, they performed again a DTP to assesses automatic attention toward different food categories. At the end of the session, participants performed an Approach-Avoidance Procedure (AAP) to measure the approach-avoidance tendencies towards food, and participants were asked to choose between two products representing a virtue (grapes) and a vice (chocolate bar) dimension. Participants thought that they were going to consume these products during the session, but they did not. As a compensation, they could choose a snack at the very end of the study. After the

choice task participants fill in the Dutch Eating Behaviour Questionnaire (DEBQ; (van Strien, Frijters, Bergers, & Defares, 1986)) to assess the level of restrained eating, emotional eating, and external eating to control possible differences between groups.

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

Baseline measures	Desire for the virtue and vice food Expected enjoyment for the virtue and vice food Hunger
Dot probe task (DPT) (framed as "training")	Attentional bias towards vice food pictures Attentional bias towards virtue food pictures
Mental simulation	Process simulation (imagining the consumption) Outcome simulation (imagining the post-consumption)
Measures after simulation	Desire for the virtue and vice food Expected enjoyment for the virtue and vice food Hunger
Dot probe task (DTP)	Attentional bias towards vice food pictures Attentional bias towards virtue food pictures
Approach-Avoidance Procedure (AAP)	Relative approach vs. avoidance towards virtue and vice food pictures
Food choice	Virtue food vs. vice food
DEBQ	Restrained eating, emotional eating, and external eating.

Apparatus and materials

The software used for the DTP was OpenSesame (Mathôt, Schreij, & Theeuwes, 2012). For the AAP, the software used was E-Prime 2.0 (Schneider et al., 2002); Psychology Software Tools, Inc.), and it was performed after the second DPT. Participants conducted the AAP task on a separate computer.

Approach-avoidance procedure (AAP)

This method has been used to investigate the motivational approach and avoidance responses towards food that consists of a combination of direct and indirect computer-based tasks. The logic behind the task is that people

spontaneously approach positive evaluated, attractive stimuli, and avoid negatively appraised, aversive stimuli (Cacioppo, Priester, & Berntson, 1993).

Stimuli

The images were classified as being either "healthy" and "unhealthy" (See Figure 1). The healthy category contained 5 pictures of fruits and 5 of vegetables, while the unhealthy category contained 5 sweet high-caloric processed food and 5 savoury high-caloric processed food. These images were taken from two picture sets (Blechert, Meule, Busch, & Ohla, 2014; Piqueras-Fiszman et al., 2014), the images of the "healthy sweet" category were taken for this study. The direction to move (push versus pull) the joystick was indicated by a triangle appearing either above (pointing upward) or below the stimulus (pointing downward), respectively. Each picture was presented two times, once with the triangle pointing upwards and once with the triangle pointing downward. Thus, each participant did a total of 40 trials.

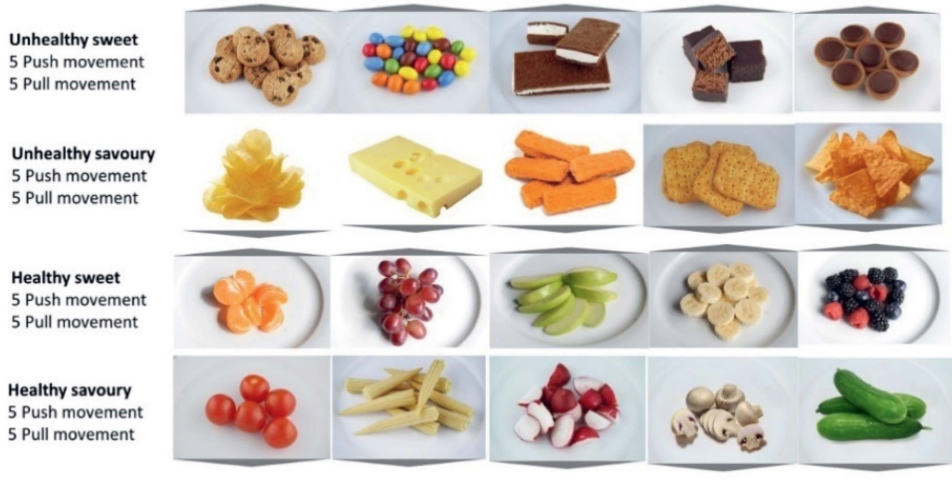

Figure 1. Outline of the AAP trials, consisting of eight practice trials and 40 test trials. Trials within blocks were fully randomized. The target images shown are real examples from the stimuli set.

Procedure

The participants were instructed to hold the joystick (Logitech, Extreme) with their dominant hand, and to position it so that they feel comfortable when moving it backward and forward. Participants received the instruction to move the joystick in one of the two directions (push or pull), according to the grey triangle they will see in the picture. They started with a practice which contained only neutral images (office tools). A trial started with the appearance of a fixation cross in the centre of the screen. After 2000 ms the cross disappeared and was replaced with the stimulus image in the center of the screen. The stimulus image disappeared when they pulled or pushed the joystick, and a new fixation cross and stimulus appeared.

Dot probe task (DTP)

The visual probe paradigm measures the allocation of attention between two competing stimuli and is suitable to evaluate attentional bias occurred by motivational states since it assesses shifts of selective attention towards relevant cues (Papies, Stroebe, & Aarts, 2008). Allocation of attention can be measured indirectly with a DTP using response latencies. The DTP consists on presenting two images (a food and a non-food picture), one on the left and other on the right side of the screen, followed by the appearance of a dot (here, an asterisk) on one of the sides, right after the picture pair disappeared (see Figure 2). The logic behind this task is that the faster the participant press the key where the dot was, the more likely they were attending to the image that was in that position.

Stimuli

The stimuli consisted of a set of target food photographs that were classified as being either "healthy" and "unhealthy". These pictures were taken from the food-pics database (Blechert et al., 2014). Of the food pictures, 10 were healthy food pictures, and 10 unhealthy food pictures, each food picture was paired with a non-food picture (neutral). All image pairs were matched as closely as possible concerning colour, complexity, brightness, and size.

Procedure

The visual DTP included 80 trials (plus 8 practice trials with unrelated stimuli). The trials consisted of 20 stimuli pairs of food and a non-food pictures (see Figure 2). Each trial started with a central fixation cross, which disappeared directly after participants fixated on it. Subsequently, the target image pair was presented for 500 ms for a more automatic attentional bias. Then, an asterisk was presented until 1000 ms or until the participant responded by pressing the appropriate key on a button box. Each picture of the pair was equally presented on the left and the right side of the screen. The pairs were presented randomly four times (all the possible combinations regarding the position of the asterisk and food image). The position of the asterisk was equally distributed per stimulus type and was also equally distributed over the left and the right side of the screen. The order of trials was randomized uniquely for each participant.

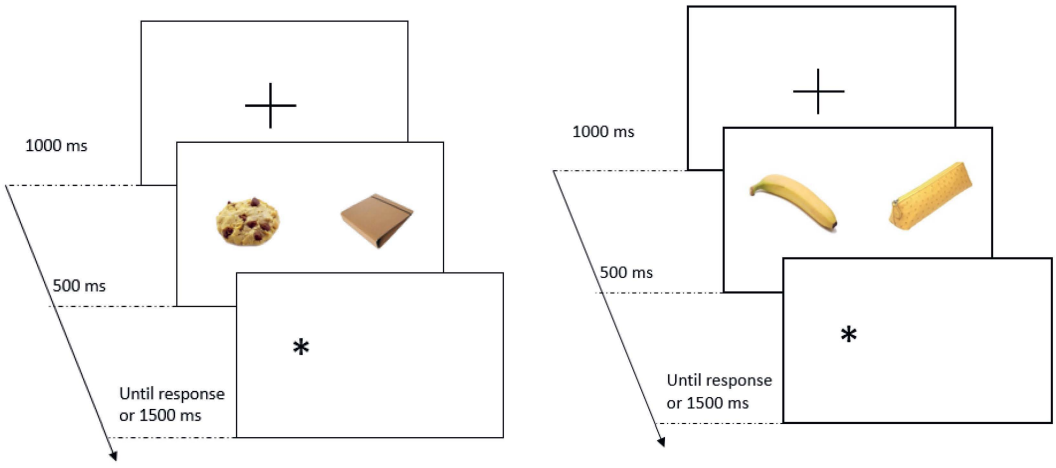

Figure 2. Two illustrations of the dot-probe task, the left with a vice product and the right with a virtue product. Finally, they were asked to press "B" if the asterisk appeared on the left side and "N" if the asterisk appeared on the right side.

Design and data analyses

The design for the explicit measures was 2 (mental simulation: process and outcome) x 2 (products imagined: banana and chocolate cookies) x 2 (time: before and after), except for the choice analysis that did not consider time. The factors "mental simulation type" and "products imagined" were between-subject factors, and "time" was a within-subjects factor. The design for the DTP task was the same as the explicit measures but with an additional within-subjects factor called "picture category" (healthy and unhealthy). The AAP design was the same as the DTP but without the factor "time".

The three tasks followed the same analysis. Thus, two independent repeated-measures ANOVAs were conducted, one to test the effect of simulating the process and the outcome of eating a vice product (chocolate cookies), and another to test the effect of simulating the process and the outcome of eating a virtue product (banana).

Approach-avoidance procedure (AAP)

The dependent variable was the approach-avoidance index (AA-index), which was calculated by subtracting the approach reaction times from the avoidance reaction times ($RT_{avoidance}$- $RT_{approach}$). The aim was to test the approach and avoidance movements relatively and to see whether these movements differed from each other among the mental simulation types (process versus outcome) when the target images of different (un-) healthy food categories appeared on the screen. All incorrect responses were excluded from the analysis.

Dot probe task (DPT)

The dependent variable was attentional bias (ms) towards food pictures. From the design, we have four measures of attentional bias per product imagined (chocolate cookies and banana). Four corresponding to the attentional bias for the healthy food images (before and after simulation) in process simulation, and four corresponding to the attentional bias for the

unhealthy food images (before and after simulation) in outcome simulation. These variables were created by subtracting the reaction time (ms) of the healthy or unhealthy images to the reaction time (ms) of its neutral pair. Therefore, a positive result would mean that participants were faster in reacting when the asterisk was in the healthy food picture (attentional bias towards food). The same applies to unhealthy food pictures. In total the data of three participants were removed, one because their accuracy was below 50%, and two others for technical problems that impeded us to record a part of the data. We also removed the incorrect trials and outliers (-3SD, +3SD over the mean of each variable).

Results

Baseline measures

Regarding baseline measures, the groups did not differ in terms of desire [$F(3,76)=0.182$, $p=0.908$], expected enjoyment [$F(3,76)=0.548$, $p=0.651$], and hunger [$F(3,76)=0.349$, $p=0.790$]. Moreover, differences in personal traits (restrained, emotional and external eaters) between the four groups were checked for. There were no significant differences between the mental simulation types, when vice and virtue product were imagined, for restrained eating [$F(3,79)=0.555$, $p=0.646$], emotional eating [$F(3,79)=1.787$, $p=0.157$], and external eating [$F(3,79)=.627$, $p=0.600$].

Effect of mental simulation on desire

Effect of mentally simulating the vice food (chocolate cookies)

Regarding the results for desire, "time" as main effect was marginally significant [$F(1,40)=3.10$, $p=0.086$]. We found no main effect of the factor "mental simulation type" $F(1,40)=1.68$, $p=0.203$, but a marginally significant interaction between "time" and "mental simulation type" $F(1,40)=3.84$, $p=0.057$. Process simulation increased the desire for the vice imagined food while outcome simulation had no effect.

Effect of mentally simulating the virtue food (banana)

Regarding the desire for the virtue food, results show that there was a main effect of "time" for the virtue product [F(1,36)=7.67, p=0.009]. We found no main effect of the "mental simulation type" or its interaction with "time", both mental simulations increased desire for the imagined virtue food.

Other measures

Since it has been suggested that multisensory imagery (equivalent to process simulation) affect portion sizes by diminishing the effect of otherwise salient feelings, such as hunger (Cornil & Chandon, 2016; Lange et al., 2020), we considered relevant to add expected enjoyment and hunger for a manipulation check. The results of expected enjoyment showed that "time" was a significant factor [F(1,76)=10.75, p=0.002]. In process and outcome simulation, expected enjoyment significantly increased but we found no significant effects on the interaction "time" and "mental simulation type" [F(1,76)=.911, p=0.440]. Regarding hunger, the results showed that "time" was a significant factor [F(1,76)=6.69, p=0.012]; after the mental simulation the levels of hunger increased, especially after process simulation ($M_{baseline}$=4.5, $M_{process}$=5.2). Although the interaction between "mental simulation type" and "time" was not significant [F(1,76)=1.02, p=0.387], pairwise comparisons showed that hunger significantly increased after having simulated the process of eating the vice food (p=0.007), there was no effect of outcome simulation on hunger.

Effect of mental simulation on choice between vice and virtue foods

Two different Chi-square tests were conducted to analyse to what extent mental simulation had an impact on people's choices between a virtue and vice product in an independent task (grapes versus a chocolate bar). We conducted one chi-square for the group who imagined the vice product (chocolate cookies), and another one for the people who imagined the virtue product (banana). Product choice frequency was our dependent variable, and simulation type our independent variable.

The results presented in **Table 2** show that process simulation and outcome simulation had a significant effect on the probability of choice for people who imagined the vice product. When mentally simulating the process of eating a vice product (chocolate cookies) led to a higher proportion of people choosing the vice product (chocolate bar) compared to imagining the outcome of such consumption (65% vs 31.8%). However, imagining having eaten the vice product (chocolate cookies) led to a higher proportion of people choosing the virtue product (grapes) compared to process simulation (68.3% vs 35%, respectively). For people who imagined the process and outcome of eating the virtue product (banana), although we found the same pattern, there were no significant differences between process and outcome simulation.

Table 2. Choice frequency (%) of participant's choices in each mental simulation, in which participants imagined a vice product (chocolate cookies) and a virtue product (banana). Different letters across columns represent significant differences between mental simulation type.

Product category of the simulation	Product choice	Process	Outcome	Chi-square
Imagining a vice product	Vice choice	65.0% a	31.8% b	$\chi2$ (1)= 4.624, p = 0.032
	Virtue choice	35.0% a	68.2% b	
Imagining a virtue product	Vice choice	60.0% a	44.4% a	$\chi2$ (1)= 0.920, p = 0.338
	Virtue choice	40.0% a	55.6% a	

Effect of mental simulation on implicit motivation (AAP)

Effect of mentally simulating the vice food (chocolate cookies)

Results in **Figure 3** show a marginal two-way interaction effect between "picture category" (healthy versus unhealthy stimuli) and mental "simulation type" [F(1,414)=2.72, p=0.100]. Unexpectantly, pairwise comparisons show that approaching unhealthy images in the outcome simulation was significantly higher than in the process simulation ($M_{process}$= -5.74, $M_{outcome}$= 19.29, p=0.004), or that mentally simulating the process of eating a vice food led to faster avoidance movements towards unhealthy foods compared to outcome simulation. We found no effect of picture category [F(1,414)=2.26, p=0.607], but a significant effect of mental simulation type [F(1,414)=5.12, p=0.024]. These

results show that imagining the outcome of having eaten a vice food led to faster approach movements towards food stimuli.

Effect of mentally simulating the virtue food (banana)

There was no significant effect on any of the factors nor interactions. As shown in **Figure 3**, for the healthy food images, both types of mental simulations led to a similar approach tendency. However, for the unhealthier food images, outcome simulation led to a neutral tendency, and that process simulation led to an approach tendency.

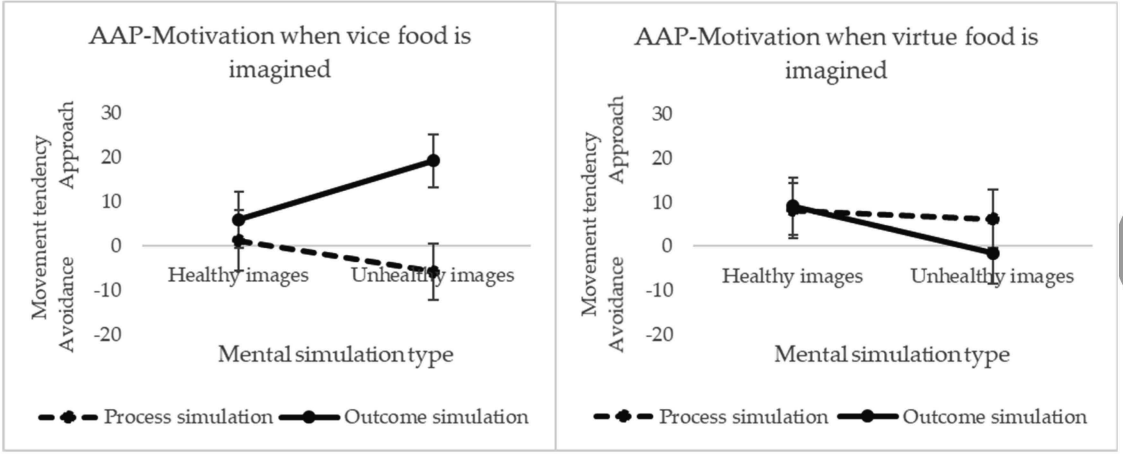

Figure 3. Approach-avoidance tendencies by type of mental simulation and product imagined.

Effect of mental simulation on attentional bias (DTP)

Effect of mentally simulating the vice food (chocolate cookies)

The three-way interaction between "time"," picture category" and "mental simulation type" was not significant [F(1,731)=0.015, p=0.903] (see **Figure 4**). We found a significant interaction between "picture category" and "mental simulation type" [F(1,731)=4.425, p=0.036]. There was also a significant main effect of "picture category" [F(1,731)=12.743 p<0.001], meaning that people had a natural attentional bias towards more healthy products, regardless of the type of mental simulation and time ($M_{healthy}$=13.59, $SD_{healthy}$=2.04, $M_{unhealthy}$=3.52, $SD_{unhealthy}$=2.07). There was a marginally significant difference in the factor

"time" [F(1,731)=2.797, p=0.095], meaning that regardless of the picture category and mental simulation type people had a positive bias towards food after simulation.

Effect of mentally simulating the virtue food (banana)

The factor "picture category" was significant [F(1,665)=6.2, p=0.013] (see **Figure 4**), meaning that people had an attentional bias towards more healthy, regardless of the mental simulation type and time ($M_{healthy}$=11.67, $SD_{healthy}$=2.30, $M_{unhealthy}$=3.35, $SD_{unhealthy}$=2.32). The results show no significant differences in time [F(1,732)=0.47, p=0.495] nor any of its interactions, meaning that having imagined any of the mental simulation types did not affect the attentional focus of participants. No significant interactions between the other factors were found, thus they will not be further discussed.

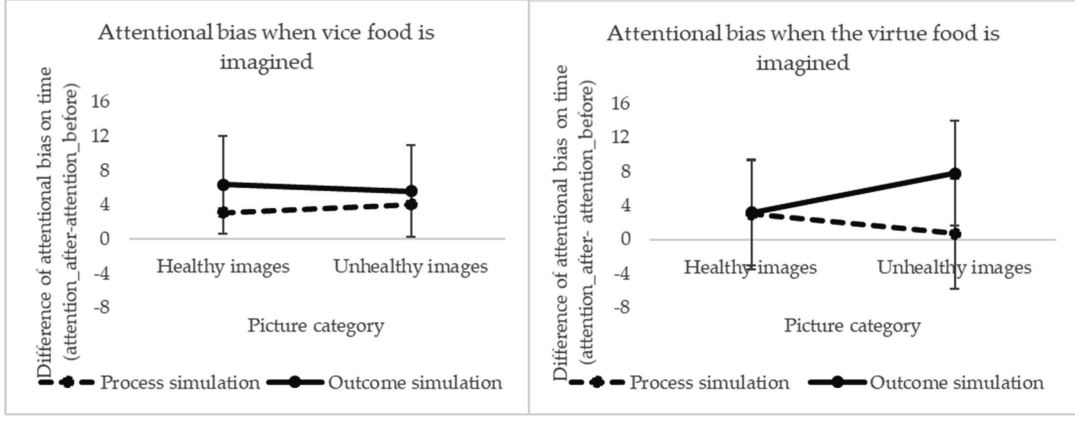

Figure 4. Difference between before and after simulation, when people imagined the vice and the virtue food product, across the picture food category

In order to give a clear overview and simplify the findings of the implicit and explicit measures, we elaborated **Table 3.**

Summary of the results

Table 3. Summary of results.

Product imagined	**Vice product (chocolate cookies)**		**Virtue product (banana)**	
Mental simulation	Process	Outcome	Process	Outcome
Desire for imagined food	Increase desire for imagined food	Decrease desire for imagined food	Increase desire for imagined food	Increase desire for imagined food
Choice between vice and virtue	Greater likelihood for vice choice	Greater likelihood for virtue choice	No significant but same trend as with imagined vice food	No significant but same trend as with imagined vice food
Implicit motivation (AAP)	Neutral motivation for healthy and unhealthy foods	Neutral motivation for healthy foods and high motivation for unhealthy food	Moderate motivation for healthy and unhealthy foods, although no significant	Moderate motivation for healthy and neutral motivation for unhealthy foods, although no significant
Attentional bias (DTP)	Greater attention towards all types of food		No effect	No effect

Discussion

This research intended to investigate how two different types of mental simulation (process versus outcome), using as imagination object a vice or a virtue food, impacts desire for the imagined food and food choice between a virtue and vice snack. Moreover, it examines the effect that these two mental simulations have on visual attention that is automatically directed towards a certain food category (healthy versus unhealthy) and implicit motivation and explores their relationship with desire and choice.

Regarding imagining the vice food, our results are in line with the theories based on grounded cognition (May et al., 2012; Papies, Barsalou, et al., 2020), and with previous studies where imagining the process of eating a vice food increased desire for the food imagined and also favoured a vice food choice, whereas imagining the outcome of having eaten a vice food decreased desire for the food imagined and made people more prone to choose a virtue food (Muñoz-Vilches et al., 2019). Extending previous research (Muñoz-Vilches et al., 2019), we found that people not only choose the food that is "matching" with the simulation (Muñoz-Vilches et al., 2020b) but in this research, we showed that this also happens for another product in the same vice/virtue category. This is in line with previous studies suggesting that food cues exposure (e.g., smell) implicitly increases appetite for foods with similar properties (Chambaron, Chisin, Chabanet, Issanchou, & Brand, 2015; Gaillet-Torrent, Sulmont-Rossé, Issanchou, Chabanet, & Chambaron, 2014; Gaillet, Sulmont-Rossé, Issanchou, Chabanet, & Chambaron, 2013; Morquecho-Campos, de Graaf, & Boesveldt, 2020). For example, people choose more fruity desserts when they are primed with a pear odour, compared to people who are not primed with any odour, who choose more frequently a brownie option (Chambaron et al., 2015). Hence, imagining a certain experience would automatically activate associated representations in memory, which would be more accessible at the moment of choice.

With this research, we contribute to the understanding of mental processes considering more neutral/healthy foods. However, our findings show that

imagining a virtue product does not have a big impact on the explicit measures of desire and food choices, and neither for the implicit measures of motivation and attentional bias. Since imagining the virtue food provoked a higher desire in the process and outcome simulation both simulations likely created positive thoughts, just as when a malleable food is imagined (contains hedonic and utilitarian characteristics; (Muñoz-Vilches et al., 2020b). The fact that mental simulation was not very effective with virtue foods could be because virtue foods evoke fewer feelings of guilt or temptation thoughts (Huyghe, Verstraeten, Geuens, & Van Kerckhove, 2017) while vice foods tend to elicit more negative thoughts about the consequences of eating, which in turn influence choice for a virtue/healthier alternative. For the majority, eating chocolate may be incredibly rewarding, but for some, thinking about the consequences could elicit shame and guilt. Thus, it may be that the content of what is being imagined generates a negative reaction (e.g., shame, guilt, disgust), and it is likely that the desire for the food imagined drops. In other words, the extent by which a simulation affects desire depends on the valence of the content and its associations, and therefore the nature of the food category used for the simulation.

Therefore, if the valence modulates the effect of the desire for the imagined food one would expect to see this reflected implicitly, since implicit methods are often used to capture affective reactions, which are normally considered to reflect relatively fast processes, and indeed precede the cognitive and deliberate reactions (Zajonc, 1980). Yet, unexpectantly, imagining the consumption of a vice food (process simulation) resulted in an avoidance tendency of vice foods. This pattern of results could be explained by an asymmetry in the association between goals and temptations ((Fishbach, Friedman, & Kruglanski, 2003a); Study 1). This means that process simulation (called temptation prime in their original study) would actually activate a health goal, showed by relatively avoiding faster than approaching unhealthy foods in this simulation type. On the other hand, imagining the post-consumption (outcome simulation) of the vice food led to an approach tendency towards vice foods, meaning that vice foods inevitably tempted

people (as first impression) but when people rationalized the consequences, they were more able to choose a food product according to their higher-order beliefs (having a healthy diet). This pattern fits with previous research that has shown that humans process taste-related information faster than health-related information (Sullivan, Hutcherson, Harris, & Rangel, 2015), and automatically detect hedonic food information such as tastiness but not healthfulness (Motoki, Saito, Nouchi, Kawashima, & Sugiura, 2017), which fits with the idea that taste corresponds to a more visceral and short-term basis; while the concept of healthfulness is a higher-level construct, which is commonly conceived to be achievable further in the future. Process simulation likely has a more intuitive and fast nature, whereas outcome simulation a more rational and reflective one. This notion is aligned with dual-process theories, which acknowledge the existence of an intuitive, fast, automatic system; and a deliberate, reflective, and rule-based system (Kahneman, 2003). Hence, results showed that people were tempted implicitly towards vice foods when imagining the post-consumption of a vice food, but they did not express it in the food choice task after having the time to think about it for longer, which could mean that the mechanism by which outcome simulation encourages healthier choices has a rational root rather than an intuitive one. However, this explanation remains rather speculative and further investigation into this result is warranted.

Last but not least, as attention is directed automatically towards those stimuli that are relevant given the current mindset (Lang, 1995), we expected that imagining consuming or having consumed a vice food would direct attention towards vice and virtue food images, respectively. With the current experimental setup, we did not observe these results. The results show that there was an attentional bias towards all types of foods indistinguishably. One could wonder whether this increased attention for all type of foods was due to a learning effect between the two sessions, similar to the principle of attentional bias modification (Kakoschke et al., 2014; Kemps, Tiggemann, & Elford, 2015; Kemps, Tiggemann, Orr, & Grear, 2014) but we think that this was not the case, since we only observed it when people imagined the vice food. When the virtue

food was imagined, there was no effect on attentional bias. At this point, it is worth noticing that this research did not use a particular population (e.g., restrained eaters), thus it might be that the majority of our participants did not feel a conflict between following a diet and indulgent eating, which could have diminished the effect of implicit motivation and attentional bias. Indeed, research has shown that the extent that a motivational state (i.e., being in indulgent mindset versus a health mindset) affects attentional bias depends on individual differences, such as the level of eating restrain (Papies, Stroebe, & Aarts, 2008; Werthmann, Jansen, & Roefs, 2016). In Werthmann and colleagues' experiment, only the group with higher restrained eating showed differences in response latency bias when they were induced in a healthy and indulgent mindset. Only high restrained eaters paid more attention to high-calorie food in the indulgent mindset and less attention to these foods in a health mindset. This may explain why visual attention was automatically directed towards all types of foods, when the vice food was imagined, in an average population, and that there was no effect when the virtue food is simulated. Hence, we could say that process and outcome simulation increased the salience of food items when the vice food was simulated. These results are in line with research showing that the rewarding effect of eating a liked food (or imagining eating in this research) can create that the cues related with food (e.g., sight, smell) gain incentive salience, provoking a potential to attract attention (for a review see Werthmann, Jansen, et al., 2014). Furthermore, other studies have shown that attention and craving are closely related (Werthmann, Roefs, Nederkoorn, & Jansen, 2013; Zhang, Cui, Sun, & Zhang, 2018). Even imagining food consumption versus a non-food scenario (having holidays) increases the intensity of craving, especially for dieters (Harvey et al., 2005), which is likely to affect attentional bias for food.

Taken together and linking these findings to those of desire and choice, we can conclude that the consequences of mental simulation in automatic motivational and attentional responses are slightly different compared to those where individuals have some time to reflect on their decisions (ratings of desire and choice in our study). A direct comparison was not intended, but rather to

explore the relationships between the two outcomes, since to the best of our knowledge, this is the first study investigating the impact that two different types of mental simulations have on implicit motivation and attentional bias in the food context.

Future research and implications

The most important implication is that imagining the process versus the consequences of having eaten a vice food impacts food choice between a vice and a virtue food (different than the imagined food). Moreover, contrary to our expectations, we found that outcome simulation tempted people at an implicit level, but this effect was not translated in a rational choice task. Therefore, future research could examine whether outcome simulation is modulated by higher-order processes and to what extent they are different from the ones that modulate the process simulation, which are more related to instant reward.

Many research findings suggest that restrained eaters differ from healthy individuals in terms of eating behaviour. This study explored the effect of imagined food (post) consumption only on a healthy population. Future research could extend this research by investigating how these findings variate among people with eating disorders.

Some practical implications are that people could simulate the consequences of a vice food to help themselves to choose healthier snacks, companies could promote healthier foods evoking more outcome-like simulations, for instance, letting people know about the satiating properties of food, the energy needed to sport or about helping them to achieve the healthy lifestyle goal.

Finally, we also encounter some methodological limitations. This study had many steps, which could have affected our results. For example, the AAP was performed after the DTP task, thus, it is possible that this contributed to diminishing the effect of the AAP task. Yet, we do not expect that this changed the pattern of our results, since the choice task, which was performed at the

very end, is very consistent across different studies (Muñoz-Vilches et al., 2019, 2020b).

Conclusion

In conclusion, mentally simulating the (post-) consumption of a vice versus a virtue food matters. Therefore, the understanding of mental simulations and their implications is key for the development of interventions and communication strategies, which could encourage consumers to adopt healthier dietary patterns. Simply imagining food is a potential solution for generating healthier and thoughtful choices.

CHAPTER 4

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

This chapter is published as:

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This chapter differs from the published version in the sections of goal activation. The goal activation sections were not added in the published version.

Abstract

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 explores 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. As potential mechanisms for the effect of mental simulation on food choice we explored liking and goal activation. 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 regarding the role of mental simulation on goal activation, 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.

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 short-term goals and long-term goals is to use people's imagination. People use their imagination, spontaneously, in everyday life, to anticipate future events that could happen, to fantasise, and to contemplate alternatives in their present decision-making (Kappes & Morewedge, 2016). 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). Moreover, 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 et al., 2014), or eating simulations (Papies, 2013), these seem to capture only one of two distinct types of mental simulation known as process simulation (Taylor et al., 1998). Process simulation evokes the act of using or consuming the product, 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. Process simulation contributes to the creation of plans (the when, where, and how) (Escalas & Luce, 2004; Escalas & Luce, 2003), which facilitates goal achievement (Pham & Taylor, 1999a). The creation of plans evoked by process simulation has been used in interventions aiming the increase of fruit consumption (Knäuper, McCollam, et al., 2011). These authors found that people who created a plan of how they would achieve to increase fruit consumption were more successful than people who merely set a "goal intention". 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 towards an activation of abstract and long-term goals. Hence, this temporal distance could be involved in people's desires and food choices.

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 the hamburger may increase the desire for food, but imagining the consequences or emotions of having eaten it, may convert it in undesirable. However, 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 goal activation. 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 predictors of food choice (Sobal, Bisogni, Devine, & Jastran, 2006).

Theoretical framework

Subjective feeling of desire (wanting)

A frequent short-term goal is to seek reward in food. Food reward is a strong driver of consumers' food choices, and it is one of the key factors that determines the motivational value of wanting (Berridge, 2009). Berridge identified various components of reward, one of them is the motivational value of wanting. Besides wanting, Berridge also includes associations and predictions (learning), pleasure (liking), and of course hunger. Our interest is to focus on wanting or subjective feeling of desire, which has two psychological components: incentive salience and cognitive salience.

Incentive salience refers to a conditioned stimulus (motivational "magnet"), cue-triggered wanting or intrinsic desire, whereas cognitive salience refers to a more goal-directed plan and to the explicit desires (see Berridge & Robinson, 2003 for a review). Often, these two psychological components of motivation conflict, generating "irrational desires", 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).

The Elaborated Intrusion Theory of desire (EI Theory; May, Kavanagh, & Andrade, 2015) places imagery (mental simulation) as a central concept to understand desire. 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 et al., 2005). Although 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 et al., 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 exploring 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).**

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 et al., 1993; Piqueras-Fiszman et al., 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 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 affect 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 products.

Food choice

Evidence suggests that the manipulation of cognition at the time of eating, as well as conditioning processes (which rely on memory), have profound effects on eating behaviour (Higgs, 2008). Mental simulation is one of these cognitive components, which allows people to predict the consequences of an event that has not yet happened by simulating them in their minds (Gilbert & Wilson, 2007). The brain recalls episodic memories spontaneously, generally without conscious awareness, and generally occurs in response to a choice conflict (Wang, Cohen, & Voss, 2015). Moreover, Robinson, Blissett, and Higgs (2011) found that remembering the positive experience of eating vegetables led to a higher predicted enjoyment and choice for vegetables. This evidence suggests that mentally simulating an event places people in a certain mindset that will trigger later 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, & 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 also aim to investigate the effect of mental simulation on subsequent food choice ruling out this potential congruity effect with the imagined product.

We hypothesise that performing process simulation with an ambivalent product will increase the likelihood of choice for the unhealthy product, and that outcome simulation will 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 goal activation and liking on a choice between a healthy and an unhealthy product.

Effect of mental simulation on food choice through goal activation

Goals direct attention towards information that is relevant to accomplish the goal (Huffman, Houston, Huffman, & Houstonw, 1993), and since consumers are motivated to choose options that serve their active goals (Markman & Brendl, 2000), an effective manner to encourage healthy eating behaviour might be to activate a health goal. Goals can be activated by an external stimulus (recipe banners). For example, van der Laan, Papies, Hooge, and Smeets, (2017) found that health goal priming favoured a healthier choice and increased its attentional focus, which in turn mediated the effect between the health goal priming and choice. Many other interventions look at conflict resolution and self-control. For instance, when people vividly imagine engaging in their favourite activity (pleasant imagery) whenever they feel

craving, craving intensity and vividness of craving-related imagery are reduced (Knäuper, Pillay, et al., 2011). More evidence of interventions to reduce impulsive behaviours is shown in a study where impulsive responses incited by mental experiences were diminished with mindful attention, which was presented as a powerful method for facilitating self-regulation (Papies, Barsalou, & Custers, 2012).

Research in goal activation has also shown that food cues could activate a dieting goal instead of a temptation goal, which may seem counterintuitive. This was demonstrated by Fishbach, Friedman, and Kruglanski (2003) who displayed food words or images. Geyskens et al. (2008, Study 1) also found that a simple association task about linking pictures of candies with the corresponding flavour of each candy (therefore tempting people) led to a diet goal activation. It is likely that in this example participants activated the goal to restrict food intake because the food presented was perceived to be unhealthy.

Although previous literature has shown overriding goal activation, if one would evaluate a food which is similarly palatable and healthy (ambivalent product), the dieting goal would not be necessarily activated, since eating that food would not conflict with that cognitive goal. According to this evidence, we believe that process and outcome simulation activate different goals in an ambivalent product. Thus, process simulation would have a role in the activation of a temptation goal, and outcome simulation on the activation of a health goal, which is a functional self-regulation mechanism.

Exploring whether mental simulation activates a goal is crucial to disentangle the mechanism by which the imagined event impacts food desire and preferences. According to the literature in goal activation, the most frequent task used to measure goal activation is the Lexical Decision Task (LDT), which is an implicit method. The principle behind this task is that words that are associated with the activated goal should be faster recognised. Therefore, we expect that process simulation would activate a temptation

goal, which makes temptation-related words more accessible **(H4a),** whereas outcome would activate a health-goal, which makes health-related words more accessible **(H4b).**

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

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 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?"*.

Results

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.

Process simulation

I 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.

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.

Desire for the imagined product

A repeated measures ANOVA was conducted with desire[7] as the 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

[7] 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 (p =0.071).

simulation on desire for the imagined food and choice between a healthy and an unhealthier product.

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

Material and methods

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.

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).

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. Subsequently, they were randomly assigned to perform a lexical decision task (LDT), either one with temptation-related words or one with health-related words.

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 of the ambivalent product	Hedonic vs. Utilitarian 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
Lexical Decision Task	Temptation-related words (H4a) Health-related words (H4b)
Measures before choosing	Liking for the unhealthy product Liking for the healthy product
Food choice	Healthy product vs. Unhealthy product (H3)

Lexical decision task

To examine the accessibility of goal-related constructs and goal-unrelated constructs, and test our H4, we designed a lexical decision task (LDT). The LDT has been previously used to implicitly measure the goal activation (Slabu & Guinote, 2010; Wilcox et al., 2009; Fishbach & Dhar, 2005; Forster et al., 2005). It has been increasingly used to measure the accessibility of goal-related constructs via response time (response latency) of goal-related word recognition to examine associative networks or constructs retrieved from memory.

After completing the mental simulation task, half of the participants were randomly assigned to a lexical decision task with temptation-related words, and the other half with health-related words. In this case, the lexical decision task did not involve a priming word as in other studies, since the intention was to see the pure effect of mental simulation on goal-activation. In this task, participants were presented with a series of letter-strings, and were asked to decide as quickly as possible whether a given letter-string was a word or not using the ''Z'' and the ''M'' keys. As conducted in other studies (e.g., Wilcox, Vallen, Block, & Fitzsimons, 2009), an equal number of words and nonwords were presented in random order and repeated two times, resulting in a total of 66 trials. Embedded within these trials were the target words *healthy*, *diet*, *fresh*, *self-control*, and *fat*. These five words represented the health goal. Response times to these words were used to assess the accessibility of health-related goals. The practice block contained stimuli of five goal-unrelated words and five non-words as targets and repeated two times. The LDT used to capture the activation of a temptation goal was identical to the previous one, only the words varied. The five words used as target words were *tasty*, *appeal*, *yummy*, *temptation,* and *fun*. Only correct responses were used in all subsequent analyses (Bargh, Chaiken, Govender, & Pratto, 1992; Fazio, 1990).

Measures

Desire was measured on a 7-point scale (1 = not at all, 7 = very much) in response to the question "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?".

Reaction times were measured with two Lexical Decision tasks. One task corresponds to temptation-related (i.e., tasty, appeal, yummy, temptation, fun) words whereas the other corresponds to health-related words (i.e., healthy, diet, fresh, self-control, fat).

Choice was measured with a masking 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).

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 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. We then analysed the effect of mental simulation and food choice between a healthy and unhealthy product and the proposed mechanisms of liking and goal activation.

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], planned contrasts showed that hunger did not differ between process (M= 4.41, p= 0.399) and outcome simulation (M=3.76, p= 0.058) when compared to control condition (M=4.20). 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.

Table 2. Results of statistical analysis for baseline measures (before simulation and for the imagined product), M (SD).

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

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 (**Figure 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

which evokes more negative imagined experiences, we could have observed this effect.

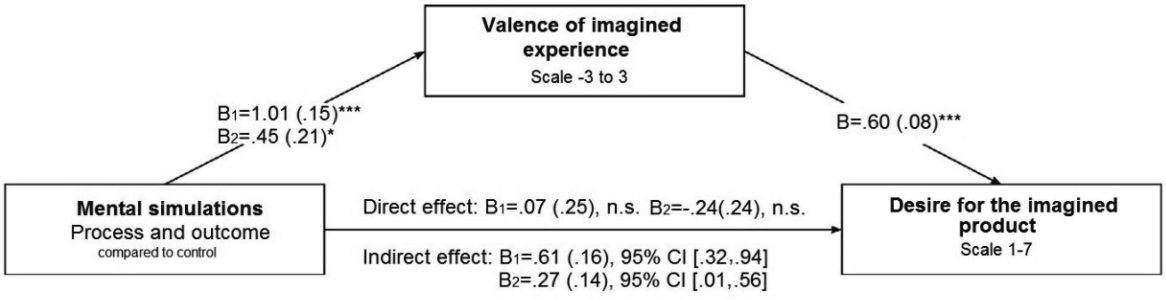

Figure 1. Mediation model of valence of the imagined experience between mental simulations and desire for the imagined product. Coding = process simulation compared to control (1), outcome simulation compared to control (2); B (SE) = path coefficient (standard error); $p < 0.05$*, $p < 0.01$**, $p <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

Other variables[8]

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.**

Expected enjoyment: There was 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 ($M_{control}$=4.08, $M_{process}$=5.07, p=0.002). Therefore, only process simulation had a significant effect on increasing expected enjoyment for the ambivalent product compared to control condition.

[8] When controlling for hunger, patterns do not change.

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)	$F(2,177)= 1.763$, $p= 0.175$

Expected healthiness: There was no significant effect of mental simulation on expected healthiness.

Expected tastiness: There was 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 ($M_{control}=4.30$, $M_{process}=5.24$, $p<0.001$). Outcome simulation also showed a marginal positive effect ($M_{outcome}=4.73$, $p=0.082$).

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.

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, $\chi 2$ (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 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.

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

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).

Since liking for the healthy and unhealthy products were the main predictors of choice, we additionally analysed the effect of mental simulation on liking for the healthy and for the unhealthy product. The results are displayed on **Table 5.**

Liking for the unhealthy product: An ANOVA with mental simulation as a between-subject factor was conducted. Results showed a main effect of mental simulation on liking. Simple contrasts showed that the liking for the unhealthy product was marginally higher in process simulation (M=5.55, p=0.078), and significantly higher in the outcome simulation (M=5.87, p=0.004) compared to control condition (M=5.03).

Table 5. Analyses of the effect of mental simulation on liking for the unhealthy and healthy product

Measures	Control (n=60)	Process (n=58)	Outcome (n=62)	Difference between conditions
Liking for the unhealthy product	5.03 (1.77)	5.55 (1.59)	5.87 (1.37)	F (2,177) = 4.32, p= 0.015
Liking for the healthy product	5.68 (1.11)	5.60 (1.24)	6.24 (.078)	F (2,177) = 6.57, p= 0.002

Liking for the healthy product: An ANOVA with mental simulation as a between-subject factor was conducted. Results showed a main effect of mental simulation on liking. Simple contrasts showed that liking for the healthy product was higher in outcome simulation (M=6.24, p=0.004) compared to control condition (M=5.68). Process simulation had no effect on liking of the healthy product (M=5.60, p=0.706), compared to control condition.

In process simulation, liking for the unhealthy product increased relatively more than liking for the healthy product when compared to the control condition ($M_{process} - M_{control}$=5.55-5.03 vs $M_{process} - M_{control}$ =5.60-5.68, respectively). In outcome simulation, although liking for the healthy product did not increase relatively more than the liking for the unhealthy product ($M_{outcome} - M_{control}$ =6.24-5.68, $M_{outcome} - M_{control}$=5.87-5.03 respectively), the liking for the healthy product was higher than the liking for the unhealthy product.

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). Since this effect is predicted by liking

for the unhealthy and the healthy product, we then analysed the effect that mental simulations had on liking both unhealthy and healthy products. We found that both simulations positively influenced the liking for the unhealthy product, but only outcome simulation influenced the liking for the healthy product. To explore in more detail other possible mechanisms we now look into the effect of mental simulation on goal activation.

Does mental simulation activates a goal?[9]

A repeated measures ANOVA was conducted with reaction times (ms) as dependent variable. Differences in reaction times between target words and normal words (factor called "word type") was tested as a within-subject factor. Mental simulations, LDT type, and interactions were tested as between-subjects factors. One participant was excluded for having an accuracy lower than 50%.

Results showed a main effect of type of words [$F(1,171)= 76.66$, $p<0.001$], target words were significantly slower than the normal words. The effect of mental simulations was marginally significant [$F(2,171)= 2.80$ $p=0.063$], simple contrasts showed that the reaction time in both process and outcome simulation was significantly higher than in the control condition ($p=0.043$ and $p=0.041$, respectively). In other words, people were generally slower in recognising the target words compared to normal words, and they were even slower in recognising the target words when they imagined the consumption or the post-consumption of an ambivalent product compared to control condition. This effect was observed regardless of the LDT performed (**Figure 3**). Since none of the interactions with the LDT type were significant, they will not be further discussed.

[9] Results do not change the pattern when reaction times are log transformed.

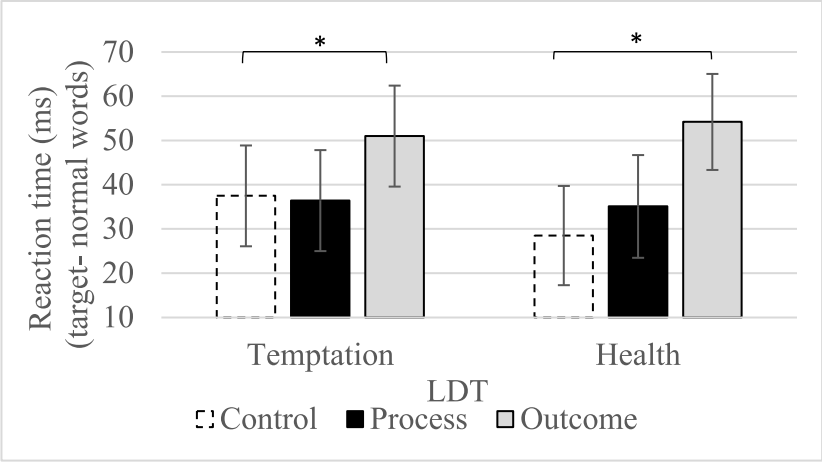

Figure 3. Differences between the reaction time (ms) of target words and normal words for Temptation-LDT and Health-LDT across conditions.

General discussion

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 heathier products.

Mental simulation and choice

Consumers are motivated to choose options that serve their active goals (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 for healthy food choice.

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, liking for the unhealthy product increased relatively more than liking for the healthy product when compared to the control. On the other hand, outcome simulation increased liking for the healthy product, which led to an absolute higher liking and frequency of choice for the healthy product than for the unhealthy product. 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 is liking.

Goal activation

The last but not less important route is that mental simulation could activate a goal that would direct people's food choices. Since imagining eating a product is a more concrete (and sensorial) thought than thinking about the consequences of having eaten it, people would tend to activate a temptation goal with process simulation, and a more abstract goal such as health when

they perform outcome simulation. This was operationalised through two lexical decision tasks: one with temptation-related words and other with health-related words. Thus, we hypothesised that process simulation would make temptation-related words more accessible, and that outcome simulation would make health-related words more accessible.

The results did not confirm our hypotheses, process and outcome simulation did not decrease the reaction times of the target words. In fact, using outcome simulation led to a slower recognition of temptation and health-related words. Nevertheless, there are some potential explanations for the results we observed. Research suggests that the association between goals and temptations is asymmetrical (Fishbach et al., 2003; Study 1), meaning that a temptation prime activates a goal (e.g., health goal), showed by a faster recognition of goal-related words, but a goal prime does not make temptation-words more accessible, in fact, inhibits temptation. The same effect can be observed in the temptation-LDT, where outcome simulation seems to inhibit temptation showed by a slower reaction time for temptation-related words. In other words, it seems that outcome simulation inhibits temptation. However, although this pattern of result is aligned with previous research, we failed in showing the asymmetrical effect. Even though we showed that outcome simulation may inhibit temptation, we could not show that process simulation activates health goal-related words nor show that it will activate a temptation goal as we expected. Also, unexpectantly, we found that outcome simulation inhibit health-related words, which may seem counterintuitive.

Another potential explanation is that outcome simulation could have caused what is called "post-fulfilment inhibition" instead (Goschke & Kuhl, 1993; Marsh, Hicks, & Bink, 1998). This phenomenon is caused after an action is finished. Since the action is finished, the accessibility of the performed action is inhibited. Liberman, Förster, and Higgins (2007) built on this notion to show, in a lexical decision task, that completion of a priming task is followed by an inhibition of task-related constructs. As those authors expected, after the task was completed, the reaction times of prime-related

(positive) words increased, similar as in our experiment, which shows an inhibition of the goal. Thus, the idea that outcome simulation could have created an activation and a termination of the goal while simulating the experience should be further explored.

Additionally, target words were overall slower than normal words. Thus, it could be that mental simulation, in both cases, increased the cognitive load. Since mental simulation retrieve past experiences from memory, it could be that the simulated experience created a kind of "noise" in participant's mind. Fishbach et al., 2003 (Study 2) found that a cognitive load would decrease all reaction times, both the relevant words and filler words (target and normal words in our study). Moreover, experiencing craving affects cognitive performance (Meule, Skirde, Freund, Vögele, & Kübler, 2012). These researchers showed that induced high-calorie food craving impairs working memory performance by exhausting cognitive resources. More interestingly, inducing chocolate craving leads to an increased distraction by chocolate (Smeets, Roefs, & Jansen, 2009), which may suggest that inducing craving leads to an attentional bias. These results could explain why process and outcome simulation slowed down the reaction times of all words.

Alternative mechanisms

These results could provide initial support for the notion that process and outcome simulation perhaps do not capture a semantic activation of goals. However, we cannot neglect the fact that there is a distinction between semantic versus goal-related accessibility (Förster et al., 2007), and that these results suggest that either mental simulation would not work through goal activation or that the lexical decision task did not capture it. Unfortunately, research in goal activation in the food domain has been limited. Moreover, the most frequent task to measure goal activation is the lexical decision task, which measures semantic constructs, but not necessarily goal-related accessibility.

An emotional response could potentially explain why process and outcome simulation were slower in recognising temptation and health-related words (target words) compared to normal words. But, why did under outcome simulation individuals have even slower recognition of target words? A plausible explanation is that process simulation encourages low levels of construal, which in turn encourages the availability heuristic. Availability heuristic relies on the ease with which relevant instances come to mind (Tversky & Kahneman, 1973). According to the Construal-Level Theory (CLT), low levels of construal increase the salience and concreteness of features and thus increase decisions relying on the availability heuristic (Braga, Ferreira, & Sherman, 2015). However, events placed in the distant future are more likely to be represented in few abstract terms, and in decontextualized representations (high-level construal) rather than concrete and incidental details of the event (low-level construal) (Trope & Liberman, 2003). This could be the case in outcome simulation, which considers more abstract representations such as health consequences rather than detailed steps of eating. Hence, it is likely that process simulation is less effortful than outcome simulation. In this light, process simulation would occupy less cognitive capacity, which could explain the better performance, compared to outcome simulation, in target words recognition.

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. It can also be used for 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.

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.

CHAPTER 5

5

Healthy incongruency: emotion elicitation and the role of mental simulation on (healthy) choices

This chapter is submitted as:

Muñoz-Vilches, N.C., van Trijp, H.C.M., Piqueras-Fiszman, B. (2022). Healthy incongruency: emotion elicitation and the role of mental simulation on (healthy) choices (*under review*).

Abstract

Mentally simulating experiences is a human capacity that we use to anticipate emotions and make decisions. Although previous efforts have attempted to understand the impact of mental simulation in (healthy) choices, little is known regarding the underlying mechanisms. This study examines the goal (in)congruency appraisal and its elicited emotions as a underlying mechanism. In a between-subjects experiment, 209 participants were allocated to four conditions corresponding to the combination of an induced goal (health vs indulgent), and a mental simulation type (process vs outcome). After mentally simulating an indulgent food, participants rated goal (in)congruency, goal relevancy, the evoked emotions, and indicate whether they would prefer to eat an indulgent or a healthy food. Results showed that mental simulation moderated the extent to which goal induction affected choices. Process simulation led to a higher incongruency compared to outcome simulation. When the goal was more incongruent with the mental simulation, higher intensity of guilt was elicited and the likelihood of healthy choice increased. However, when the goal was congruent with the simulation, happiness was evoked, and that backfired healthy choices. When the goal was relevant, this effect was more pronounced. Mental simulation can be used as a consumer strategy to choose healthier foods.

Introduction

Navigating in time with our minds is a human capacity that is often used to predict future actions. Just as consumers can vividly remember (or re-construct) past-experiences, they can also vividly simulate (construct) the future and experiences that have not even happened yet. To create these simulations, the brain relies on memories and stored knowledge to integrate them with incoming information (Barrett, Wilson-Mendenhall, & Barsalou, 2015; Gilbert & Wilson, 2007). These simulations are charged with motor, sensory, affective, and other related information stored in memory (Barsalou, 2009). The brain generates these internal simulations of body and mind states to be able to anticipate the body's needs and satisfy them before they arise (Barrett, 2017). Indeed, this mechanism is crucial to maintain the internal balance of the brain (i.e., allostasis). This internal mechanism of generating mental simulations is supported by the theory of embodied cognition (part of the theory of grounded cognition; Barsalou, 2008, 2020), and the more recent conceptual act theory (Barrett et al., 2015). These theories account for mental simulations as a primary mechanism of our brain to predict future actions.

The brain has the capacity to generate different types of mental simulation (Gilbert & Wilson, 2007; Krishna & Schwarz, 2014). Two common types used in the marketing domain are process simulation and outcome simulation (Pham & Taylor, 1999b). Process simulation is imagining the step-by-step of an event whereas outcome simulation involves the effects/consequences of an event. In the context of food, process simulation would correspond to the food consumption itself (i.e., the act of actively eating), which involves the sensory (un)pleasure of eating. On the other hand, outcome simulation would correspond to the post-consumption (i.e., benefits or consequences of eating), which involves short-term effects, such as taking away hunger, or longer-term effects such as health effects (Xie et al., 2016).

Research has shown that instructing people to simulate certain scenarios significantly affects behaviour (Muñoz-Vilches, van Trijp, & Piqueras-Fiszman, 2020a; Muñoz-Vilches et al., 2019, 2020b; Piqueras-Fiszman & Muñoz-Vilches, 2021). Although there have been some attempts to reveal processes, such as attention and goal activation, which could potentially be involved in the impact that instructed mental simulation has on desire and food choices (Muñoz-Vilches et al., 2020a; Piqueras-Fiszman & Muñoz-Vilches, 2021), the results are not yet conclusive. Previous research has shown that when imagining the food consumption, consumers increased their desire for high-caloric food and this consequently leads them to choose high-calorie food (hereafter indulgent food) over low-calorie food (hereafter healthy food) in a binary choice task. However, when post-consumption was imagined, the desire for healthier food increased and consequently led to more choices of the healthier food category. Yet, this effect has only been seen when indulgent food is used as the object of imagination (Muñoz-Vilches et al., 2020a, 2019). Although the result of process simulation fits with current theories such as the elaborated intrusion theory of desire (Kavanagh et al., 2005), more research is needed to unravel the mechanisms underlying the effect of outcome simulation, or the one unifying the effect of these two types of simulations.

Consumers constantly automatically anticipate cognitive and affective reactions. However, it is not yet known how affective anticipation impacts the decision-making process when consumers are instructed to mentally simulate an experience. For instance, how this simulated experience can help the decision of whether to choose healthier food when consumers deliberately use conscious and vivid simulations to foresee the (post) consumption experience. Hence, consumers could anticipate a (un)desired outcome by mentally simulating *"how would I feel if..."*. For example, re-enacting an experience and anticipating guilt or regret (or other associated emotions) would aid consumers to re-evaluate their decision, and if the outcome is not favourable correct for it (in a real decision).

Just as real experiences, mental simulations have the power to trigger emotions (Taylor, Pham, Rivkin, & Armor, 1998b). Instructing people to mentally simulate a scenario is a common practice in the domain of affect and emotion to elicit these emotional states (Berrios, Totterdell, & Kellett, 2015). Moreover, mental simulations can trigger physiological changes, such as salivation, when imagining eating a food (Keesman, Aarts, Vermeent, Hafner, et al., 2016), and increase subjective desire for that food (Muñoz-Vilches, van Trijp, & Piqueras-Fiszman, 2019; Muñoz-Vilches et al., 2020; Schumacher, Kemps, & Tiggemann, 2019). These appetitive signals are caused by the re-enaction of the experience, because our body activates the same brain areas that are activated during real experience (González et al., 2006). Along with body signals, affective experiences during simulation are also evoked, referred to as prefeelings or anticipated emotions. Anticipated emotions are used as predictors of the reactions that are likely to emerge in the real event (Gilbert & Wilson, 2007). For instance, one could anticipate an affective reaction of giving a presentation with a large audience by simulating the event in their minds. This imagined experience allows our body to physiologically prepare for the presentation, and it can help us cope with the anxiety that may emerge in such an event (Rivkin & Taylor, 2016). The present paper refers to anticipated emotions as the discrete emotions that are experienced during mental simulation, when a similar event is encountered.

This study aims to investigate how process versus outcome simulation moderates the emotional effects of goal (in)congruency on food choice. In this study, the discrete emotional response is characterised by the goal congruency and relevancy appraisals, and the discrete emotions satisfaction, happiness, guilt and regret. To the best of our knowledge, this is the first study examining how and to what extent the mental simulation type (process and outcome simulation) moderates the effect of goal induction (health vs. indulgent) on an emotional reaction, which in turn impacts healthy choices.

Theoretical framework

Valence (i.e., pleasantness) has been shown as an important predictor of food choice (Dalenberg et al., 2014; Gutjar et al., 2015, 2014). However, valence is only one of the dimensions of affect in the circumplex model of affect (Russel, 1980). Basing solely on the effect of valence may sacrifice specificity and explanatory power (Kranzbühler, Zerres, Kleijnen, Peeter, & Verlegh, 2020; Lerner & Keltner, 2000). Appraisal theories suggest that a multidimensional theoretical framework is needed to better predict the influence of emotions in the decision-making process (Han, Lerner, & Keltner, 2007).

Appraisal theory of emotions

The appraisal theory of emotions is a well-established theory in affective science (Mauss & Robinson, 2009; Roseman, 1991; Roseman, Antoniou, & Jose, 1996; Roseman, Spindel, & Jose, 1990). Appraisal theory is instrumental in understanding and structuring the emotional patterns (Frijda, Kuipers, & Schure, 1989; Moors, Ellsworth, Scherer, & Frijda, 2013; Smith & Lazarus, 1993) that may emerge from mental simulation. An appraisal is the interpretation or evaluation of an event, and it can have different dimensions. Researchers (Scherer, Schorr, & Johnstone, 2001) agree on seven appraisals of events that directly influence emotions: unexpectedness, situational state (motive-consistent or inconsistent), motivational state (aversive/appetitive), probability (certain/uncertain), agency (who caused the motive-relevant event), control potential (low/high), and problem type (instrumental/intrinsic).

This study proposes a theoretical framework (**Fig. 1**), in which mental simulation has an impact on how situations are appraised. Given that goal attainment is a relevant aspect of decisions, the cognitive appraisal of goal congruence (motive (in)consistency) and goal relevance would play an important role in determining the influence of mental simulation in choices.

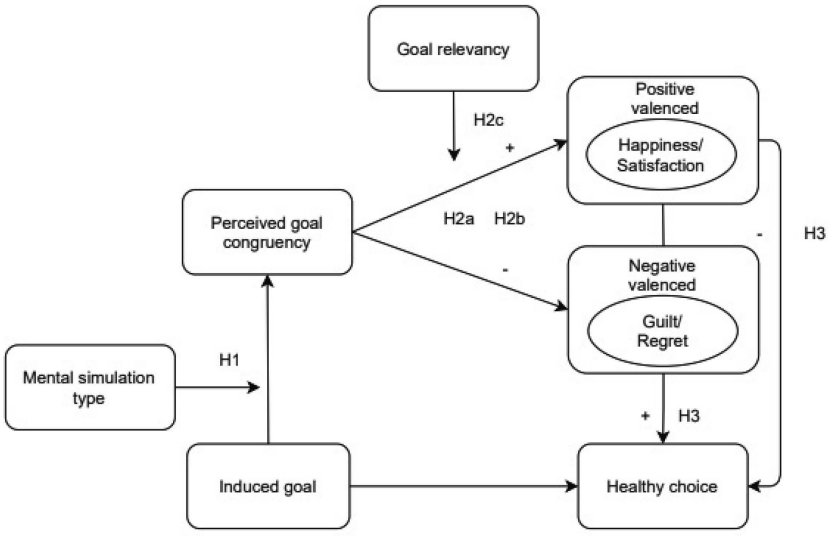

Figure 1. conceptual framework, and overview of the hypotheses.

The role of mental simulation on perceived goal congruency

Goal congruence is an important appraisal, and it is defined as "evaluating the situation in terms of (expected) goal success vs. failure, or whether it is consistent vs. inconsistent with values or ideas" (Johnson & Stewart, 2005). Emotions may occur when the events are appraised as conductive/consistent or obstructive/inconsistent, and they would differ according to their valence.

Previous research has shown that mental simulation may contribute to a shift in attention for selective attributes (Muñoz-Vilches et al., 2019). Specifically, process simulation increases the focus on hedonic attributes while outcome simulation increases the focus on utilitarian attributes. We hypothesise that an incongruency is perceived when one is confronted with a situation that hinders goal accomplishment, in this case, the emotions would be rather negative (see **Table 1**). Also that a goal congruency is perceived when the situation enables goal accomplishment, evoking positive

emotions. When having a health goal, simulating the process of eating an indulgent food would be goal incongruent, since consumers would be more focused on the hedonic attributes of the food. On the other hand, simulating the outcome of eating an indulgent food would be less incongruent than process simulation, because outcome simulation would change the focus towards more utilitarian aspects of the food, which fits better with a health goal. Therefore, mental simulation moderates the effect between the induced goal and perceived goal congruency **(H1).**

Table 1. Summary of hypothesised appraisals, emotions, and food choice per mental simulation

	Indulgent food (imagined object)			
	Process simulation		Outcome simulation	
	Health goal	Indulgent goal	Health goal	Indulgent goal
Appraisals	I failed my goal but still eating something nice	I achieved my goal	I failed my goal but ate something nice	I achieved my goal
Valence of emotions	Negative/positive	Positive affect	Negative/positive	Positive affect
Emotions	Guilt, regret. Satisfied, happy.	Happy, satisfied	Guilt, regret. Satisfied, happy	Happy, satisfied
Choice	Healthier food	Indulgent food	Healthier food	Indulgent food

The role of appraisals in evoked discrete emotions

Discrete emotions occur as a combination of appraisals. For example, pride, guilt, and regret are caused by a combination of agency (all self-caused) and motive (in)consistency (Scherer et al., 2001). Given that the agency falls in the self, and the result of incongruent goal evaluation is mostly negative, guilt and regret are likely to emerge (Roseman et al., 1990; Scherer et al., 2001; Johnson & Stewart, 2005). However, when one succeeds with achieving a goal (that only depended on the self), positive self-focused emotions are elicited, such as happiness (Roseman et al., 1990), and satisfaction (Förster et al., 2007). For example, if consumers confront an idea

of eating a mouth-watering snack while having a health goal in mind (e.g., restrained eaters) they likely feel guilty if the mouth-watering snack is preferred over a healthier alternative. This is because the locus of the cause is internal to the individual, and it is controllable (i.e., it is one's own decision affecting oneself).

Anticipating cognitive or affective responses is a common human process, that can motivate goal-directed behaviour (Baumgartner, Pieters, & Bagozzi, 2008). Anticipatory emotions are positively or negatively valenced, and are affective responses that correspond to the prospect of future events (Ortony, Clore, & Collins, 1988). For instance, a meta-analysis showed that anticipated regret is strongly associated with health behaviour (Brewer, Defrank, & Gilkey, 2016). Since regret is a negative emotion that is experienced when realizing that the outcome could have been better if we had chosen differently (Pieters & Zeelenberg, 2007), anticipating regret would help to re-evaluate the situation to be engaged in, to the point of deciding to not even experience it.

Early work on appraisals (Smith, Haynes, Lazarus, & Pope, 1993) has established that the appraisal component of guilt is motivationally relevant, motivationally incongruent, and it is self-caused (self-accountability). On the other hand, happiness represents success, and it is positive, motivationally relevant, and congruent. In this case, we hypothesise that the more (in)congruent is the goal with the imagined experience the more positive (negative) the elicited emotions (**H2a**), and one would experience happiness/satisfaction when the evaluation is goal congruent, and guilt/regret when the evaluation is goal incongruent (**H2b**). **Table 1** shows that (in)congruent goal appraisal exerts distinct influences on the food choice process.

Appraisals occur in response to a goal-relevant experience, which in turn triggers discrete emotions that are classified according to their valence (degree of pleasantness; Ruth, Brunel, & Otnes, 2002). Hence, the relevancy

or importance of the goal in mind would determine how intense the discrete emotion is experienced (moderates the effect of goal (in)congruence in the intensity of happiness/satisfaction, and guilt/regret). Hence, at high levels of goal relevancy compared to low levels, goal (in)congruency intensifies the positive (negative) evoked emotion (when incongruent guilt and regret, and when congruent satisfaction and happiness) (**H2c**).

Healthy choices as a coping strategy

The anticipated emotional experience serves the decision-maker to re-evaluate and influence a subsequent decision as a means of coping strategy (Gleicher et al., 1995). There are different ways by which consumers cope with their emotions (reappraisal). They could change their emotional response (emotion-focused) or take action to remedy the situation (problem-focused) (Johnson & Stewart, 2005). Following the Emotion system model (Roseman, 2013), the most fundamental associated coping strategies of motive-(in)consistency is "getting less" or "getting more" of what is causing the (in)consistency. This is to minimise the harm or maximise the benefits. It is then followed by control strategies suggesting that, depending on how much control one has, one could adapt or accommodate to the (in)congruent situation to change the situation. In this case, although (in)consistent imagined events are experienced, a choice task can be seen as an opportunity to remedy the incongruent situation. Moreover, for a self-caused appraisal value (e.g., I'm the one eating the indulgent food during the simulation), a self-control strategy may work best, especially if there is a high control potential to change the outcome.

The incongruency during the simulation would induce consumers to "compensate" and to choose an alternative option that does not make them feel that way (see **Table 1).** In this case, the coping strategy would be focused on solving the problem (goal incongruency), which would be reflected in the choice task. Hence, the healthy option would be chosen in order to avoid a negative outcome. Yet, if one experiences goal congruence, indulgent food

would be chosen (since it is aligned with the imagined object). Therefore, the intensity of positive emotions (happiness/satisfaction) caused by a perceived goal congruency increases the likelihood of indulgent choice, whereas the intensity of negative ones (guilt/regret) favour healthy choice (**H3).**

Taken together, the combination of the object of imagination and the activated goal leads to an (in)congruency, i.e., health goal is more incongruent than an indulgent goal when the object of imagination is an indulgent food, but it is moderated by the mental simulation type. Moreover, the combination of the agency (self-caused) and the perceived goal congruency appraisal defines the discrete emotion (Scherer et al., 2001). For example, if one has a health goal in mind, but a self-caused action violates that goal (e.g., freely choosing to eat an indulgent and unhealthy food), the emotions elicited would be a combination of the goal congruence appraisal (failed) and the agency appraisal (self-caused). Moreover, goal relevancy defines the intensity of the discrete emotion (Johnson & Stewart, 2005; Roseman et al., 1990). Finally, the elicited discrete emotions would impact behaviour (food choice). Therefore, perceived goal congruency and the intensity of discrete emotions (satisfaction, happiness, guilt, regret) are mediators of the effect of goal induction on healthy choice, and mental simulation moderates the effect of the induced goal and healthy choice **(H4).**

Materials and methods

Participants and design

Two hundred and twenty British participants were recruited by the Qualtrics company to take part in this study. The sample was a representative reflection of the age in the population from the UK: 11.38% was between 18-24 years old; 19.32% was between 25-34; 18.05% was between 35-44; 19.41% was between 45-54, and 31.84% was 55+. **Table 2** presents the characteristics of the participants. Eleven participants were removed since they failed the goal induction task (wrote something unrelated to the goal assigned; see section Goal induction), leaving 209 participants for the analysis. Hundred and four participants were randomly assigned to outcome simulation (females=49, males =55, X2 (1)=.28, p=.59), and 105 to process simulation (females=57, males= 48, X2 (1)=1.5, p=.22).

The design was a 2 (instructed mental simulation: process vs outcome) x 2 (goal induction: indulgent vs health goal) between-subjects design. The study was approved by the ethical committee of the Social Sciences School of Wageningen University and Research.

Table 2: Characteristics of participants in the four experimental conditions.

	Health goal			Indulgent goal			
	Outcome Simulation N= 49	Process Simulation N=55	*p*-value	Outcome Simulation N=55	Process Simulation N=50	*p*-value	Difference between 4 groups
Age	45.8 (2.2)	47.3 (2.0)	0.610	45 (2.0)	42.9 (2.1)	0.480	F(3, 208)=.75, *p*=.520
Hunger	3.7 (.22)	3.63 (.21)	0.700	4.0 (.21)	3.4 (.22)	0.040	F(3, 208)=.1.4, *p*=.222
Vividness[10]	4.5 (0.2)	4.8 (.18)	0.343	5.1 (.18)	5.1 (.19)	0.880	F(3, 208)=.1.9, *p*=.116
Eating restraint	2.7 (.11)	2.5 (.10)	0.317	2.7 (.10)	2.7 (.11)	0.926	F(3, 208)=.49, *p*=.685

[10] Vividness refers to how "real" participants experienced the mental simulation. This was measured with three questions (Cronbach's Alpha .884). 1) the imagined event was vivid; 2) when I was imagining the food, I felt as though I was preliving it; 3) as I was imagining the food, I could see it in my mind (1=not at all, 7=as clearly as if it was happening now).

Procedure

Participants first virtually signed the informed consent form. They were randomly assigned to one of the four conditions, which were the combination between mental simulation type: process and outcome, and goal induction: health and indulgent goal (see Goal induction section). Regarding the indulgent food to imagine during the mental simulation, participants could choose one of the four foods that were shown (see Stimuli for mental simulation, and choice section). The instructions of the two mental simulations were the same as in previous research (see the details of the instructions in Muñoz-Vilches et al., 2019). To reinforce the cognitive thoughts participants were asked to write down the specific features/effects they were thinking about while performing the simulation. To reinforce the affective thoughts participants were asked to also write down the specific emotions evoked by the imagined product while performing the simulation.

After the manipulation, the appraisal of goal congruency, and goal relevancy were measured (see Measures section for details). Then, participants selected the emotions that were evoked, and rated their intensity (Rate All That Apply method). Subsequently, participants answered questions related to the valence of emotions. Then, participants performed a choice task in which they were asked to select their preferred food product from eight food products, four classified as indulgent (high-caloric) and four as healthy foods (low-caloric). Finally, participants filled in the Dutch Eating Behaviour Questionnaire (van Strien et al., 1986).

Goal induction

Goal induction was the first instruction given to the participants. Half of the participants were induced to a health goal condition and the other half to an indulgent goal condition. Participants also were asked to write down the situation and what they would do to achieve their goal. This task was to make sure that participants remember they have a goal throughout the experiment.

Health condition

Imagine that you have decided to eat healthier. A snack choice is a good opportunity to bring this good intention into practice. Please write down a situation/step where you could decide to eat a healthier snack.

Indulgent condition

Imagine that you have decided to treat yourself. A snack choice can give you the reward you deserve. Please imagine a situation where you could decide to treat yourself with a snack.

Right after, participants were asked to mentally simulate the process or the outcome of an eating experience with their chosen indulgent food product, for which the exact instructions can be found in (Muñoz-Vilches et al., 2019).

Stimuli for mental simulation, and choice

Participants could choose one of these foods as the object of imagination (**Fig. 2**). Four indulgent food alternatives were presented to make the product more relevant to the participant. The presented products were pre-tested and analysed using a paired samples t-test. The cookies, fries, hamburger, and donuts were significantly more hedonic than utilitarian (all with p <0.0001).

Figure 2. Food stimuli presented for the mental simulation

For the choice task, four (other) indulgent and four healthy food products were used (**Fig. 3).** The indulgent products were a chocolate bar, muffin, crisps, peanuts, and cookies. The pre-test showed that they were all significantly more hedonic than utilitarian (all $p<0.001$), except for the product peanuts, which was therefore excluded. The healthy food options were tomatoes apple, banana, cucumber, and mandarin. They were all significantly more utilitarian than hedonic ($p<0.007$), except the banana ($p=0.101$), hence it was not used.

Figure 3. Food stimuli presented for the choice

Measures

Perceived goal congruency was calculated as the mean between motive consistency and conduciveness (Cronbach's alpha was .85). The questions were the following: (1) Was the imagined experience consistent or inconsistent with your goal? (1 = very much inconsistent; 7 = very much consistent) (Smith & Kirby, 2009). (2) Was the goal conductive/obstructive during the imagined experience? (1=very much obstructive; 7= very much conductive (Frijda et al., 1989).

Goal relevancy was measured with the question: Was the goal important during the imagined experience? (1 = Not at all important; 7 = Extremely important) (Smith & Kirby, 2009).

Discrete emotions were measured in two ways as a cross-validation strategy. First, participants were asked to write down their emotions (free-elicitation method). This was also part of the mental simulation manipulation

(see report of simulated experience in **Table 4**). Further, participants were asked to indicate the emotions they felt while imagining with the Rate all that apply method (RATA). The emotions included in the RATA method were guilt, sadness, anger, disgust, regret, shame, disappointment, joy, happiness, pride, satisfaction, trust, calmness, relief, others, to avoid participants feeling directed to experience a particular emotion. They were asked to select and rate the intensity of all the emotions that were felt while imagining (1= not at all intense, 7= very intense).

For *Food choice* participants answer the question: Based on how you feel now, taking into consideration the goal you had at the beginning and your imagined experience, select one food you would like to eat now if you could have it. Participants had four indulgent options and four healthy options (**see Fig 3).**

Valence of emotions was measured with the question: The emotions I had when I was imagining the event were...(1 = extremely negative, 7 = extremely positive).

Results

Goal congruency and its elicited discrete emotions on healthy choice, with mental simulation type as a moderator.

A serial moderated mediation in SPSS with PROCESS (model 84; Hayes, (2018)) was conducted to test **H1**, **H2b**, **H3**, and **H4**. The independent variable was induced goal, first mediated by perceived goal congruency, and then by the discrete emotions happiness, satisfaction, guilt and regret (all tested separately to avoid multicollinearity). The serial mediations were moderated by the mental simulation type. The binary dependent variable was healthy choice. Hunger was included as a control variable. Including this covariate did not change the direction of the results. This serial moderated mediation analysis tests the role of the induced goal on perceived goal congruency when moderated by mental simulation type (**H1**), and perceived goal congruency on guilt, happiness, regret and satisfaction (**H2b**). Moreover, the mediating

role of intensity of discrete emotions in the likelihood of choosing healthy was tested (**H3**).

Moderating role of mental simulation

As expected in **H1**, the conditional effects show that the mental simulation type moderates the effect of goal induction on perceived goal congruency (see **Fig. 5** for results). Simple effects show that in the health goal condition, process simulation affects perceived goal congruency negatively (**Fig. 4**). That means that process simulation decreases the perceived goal congruency compared to outcome simulation [B=-.058 (.26), p=.026]. Moreover, compared to the health goal, the indulgent goal increases perceived goal congruency [B=1.82(.26), p<.0001]. In sum, when having a heath goal induced, process simulation was significantly less congruent than outcome simulation. Yet, as expected, when having an indulgent goal, process and outcome where equally congruent.

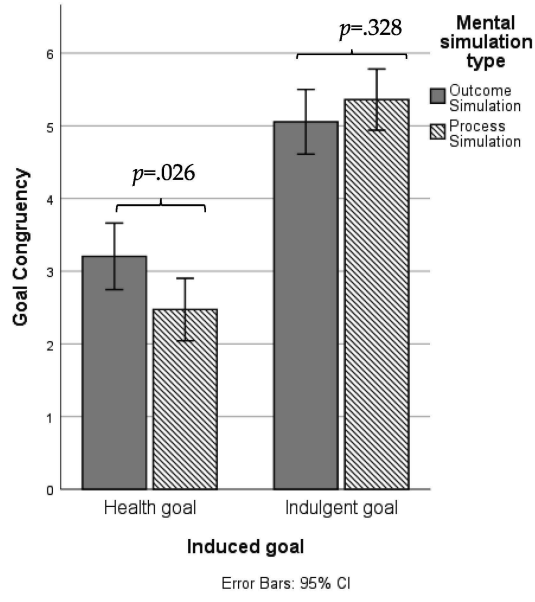

Figure 4. Interaction effect between induced goals and mental simulation type on goal congruency. Note: figure consider the marginal means of the 2 (mental simulation type: process and outcome x 2 (goal induction: indulgent and health) model.

Perceived congruency on discrete emotions

Perceived congruency affected healthy choice through happiness, guilt, and regret, but not through satisfaction. Satisfaction was affected by goal congruency [B=.308 (.11), p=.006], but did not predict healthy choice [B=-.116 (.07), p=.110]. Therefore, satisfaction is not further reported. As expected, perceived goal congruency had a positive effect on happiness and a negative effect on regret and guilt **(Fig. 5),** thus the more goal congruent the happier and the less congruent the more guilt and regret, as expected in **H2b**. Mental simulation type did not significantly affect happiness [B= -.15 (40), p= .70] nor regret [B= -.30 (28), p= .28], but it significantly affected guilt [B= -1.29 (.36), p< .001]. The induced goal did not significantly affected happiness [B= -.16 (44), p= .70] nor regret [B= -.48 (31), p= .12], but it did affect guilt [B= -.80 (.40), p= .046]. That is, outcome simulation had higher intensity of guilt compared to process simulation in both the indulgent and health goal. Moreover, the health goal condition had higher intensity of guilt compared to the indulgent goal condition. There was not significant interaction effect between mental simulation and induced goal for happiness [B=.79 (56), p= .15], regret [B= .21 (40), p= .59], and guilt [B= .80 (51), p= .12]. This is expected since goal congruence is a mediator.

Discrete emotions on healthy choice

To test the serial moderated mediation hypothesised in **H4**, the significance of the paths was tested with the confidence interval. A bootstrap confidence interval for each conditional indirect effect of mental simulation types (MS) was calculated. The mental simulation type moderated the serial mediation since in all the paths (see index of moderated mediation in **Fig.5**) the confidence interval excluded zero.

Three discrete emotions were found to mediate the effect of goal congruency on healthy choice: happiness, guilt and regret (**Fig. 5**.). Happiness decreases the likelihood of healthy choice, whereas guilt and regret increases it. Mental simulation moderated the effect of goal induction on healthy choice in all of

these three paths. In the case of guilt, process and outcome simulation had also a direct effect, being outcome simulation the condition with higher intensity of guilt, especially when a health goal was induced. Nevertheless, guilt increased the likelihood of healthy choice.

These results confirm our **H3** and **H4,** the positive emotion (happiness) elicited by the perceived goal congruency negatively affects healthy choice, while a negative emotions (guilt and regret) elicited by a perceived goal incongruency promotes healthy choice**.**

The role of relevancy of the goal in the imagined experience on intensity of emotions and healthy choice

To test whether the goal relevance moderated the effect of perceived goal congruency on the intensity of the discrete emotions (**H2c**), we conducted a moderation analysis in SPSS with PROCESS (model 1; Hayes, (2018)). The independent variable was perceived goal congruency, the independent variable were guilt, regret, satisfaction, and happiness. Goal relevancy was tested as a moderator, and hunger was added as a covariate. Results revealed that goal relevancy had a simple effect on guilt [B=.22 (.09), p=.021], and regret [B=.22 (07), p=.0027], for happiness and satisfaction the simple effect of goal relevancy was not significant. As expected, there was an interaction effect between perceived goal congruency and goal relevancy for guilt [B= -.08 (.03), p=.047], happiness [B=.12 (.04), p=.0029], and satisfaction [B=.15 (.04), p<.0001], but the interaction effect of regret was not significant [B= -.01 (.29), p=.723]. The levels of goal relevancy moderates the effect of perceived goal congruency on guilt, happiness, and satisfaction. That is, at high levels of goal relevancy compared to low levels, the intensity of the emotion increases (see **Table 3**). All overall models were significant[11].

[11] Overall model (guilt): $F(4, 204)= 7.72$, $p<.0001$, $R^2= .13$
Overall model (happiness): $F(4, 204)= 11.68$, $p<.0001$, $R^2= .18$
Overall model (regret): $F(4, 204)= 9.20$, $p<.0001$, $R^2= .15$
Overall model (satisfaction): $F(4, 204)= 8.06$, $p<.0001$, $R^2= .13$

Table 3. Results of goal relevancy at (+/- 1SD) as a moderator variable between perceived goal congruency and discrete emotions.

	Moderator level	b	t (204)	p
Guilt	Low (2.41)	-.27	-2.18	.0299
	Average (4.15)	-.41	-4.34	<.0001
	High (5.89)	-.55	-5.10	<.0001
Happiness	Low (2.41)	.29	2.15	.0322
	Average (4.15)	.51	5.03	<.0001
	High (5.89)	.74	6.36	<.0001
Satisfaction	Low (2.41)	.13	.95	.340
	Average (4.15)	.39	3.76	.0002
	High (5.89)	.65	5.51	<.0001

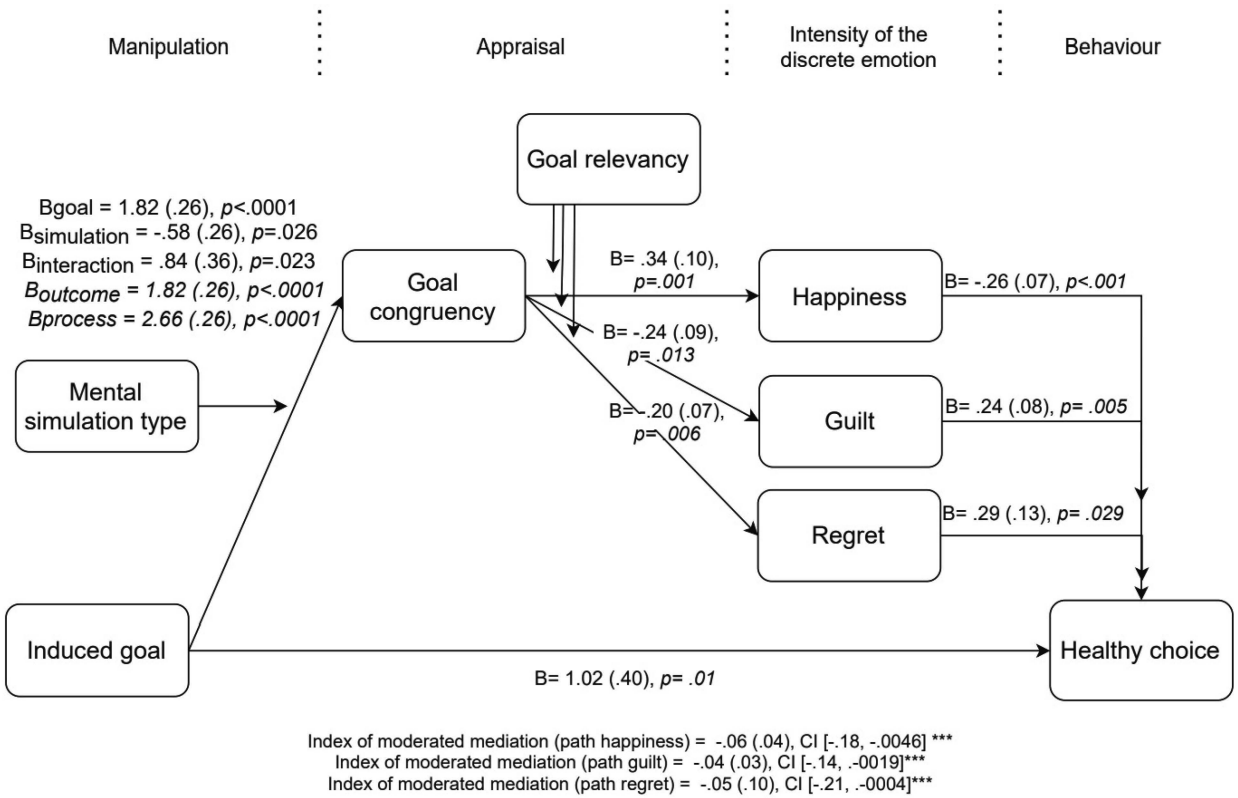

Figure 5. Serial moderated mediation of the effect of mental simulation in the likelihood of healthy choice. All the models with outcome variables goal congruence, happiness, guilt, regret, and healthy choice were significant with p<.0001. Note: Each discrete emotion, and goal relevancy were tested in a separate model. Only hypothesised paths are shown in the model.

The effect of perceived goal congruency on the valence, and frequency of the discrete emotions.

A regression with the measured valence of emotions as dependent variable, and perceived goal congruency as independent variable was conducted to test **H2a**. Moreover, to test whether happiness/satisfaction (guilt/regret) are more likely to be experienced when a congruency (incongruency) is perceived (**H2b**), the frequency of emotions was calculated by using a text-mining analysis. The analysis of the reported emotions was conducted in R, using the text-mining package "tidytext". Stop words were removed in the free-elicitation method, and no lemmatization was performed.

Perceived goal congruency predicted the valence of the emotions (B=.154, p=.026, R^2=.024). This confirms that perceived goal congruency positively impacts the valence of emotions of the imagined experience (**H2a**).

The more congruent the goal with the imagined experience, the more positive emotions are elicited, whereas the less congruent the goal with the imagined experience, the more negative emotions are elicited (**Fig. 6**), which confirms **H2a**. Both the measured valence of emotions and the valence extracted from the frequency of the selected emotions showed consistency. Moreover, the results of the main reported emotions with free-elicitation and RATA were similar (see supplementary data for more details).

In the combination of mental simulation with the indulgent goal salient, happiness, and satisfaction were the primary emotions, with 86% and 71% of participants mentioning happiness, and 82% and 75% satisfaction. Also some feelings of guilt appeared, with 14% in process simulation and 29% in outcome simulation. In the case of having a health goal salient, the primary emotions were mixed. In the process and outcome simulations, satisfaction (63% and 65%, respectively), happiness (both 51%), and guilt (57% and 35%) appeared as primary emotions. The variability of negative emotions was higher in the RATA method. Shame, disappointment, regret, disgust, and sadness did not appear in the free-elicitation method. As expected in **H2b**, guilt but not regret

was more likely to emerge as a negative emotion, and happiness and satisfaction were the positive ones.

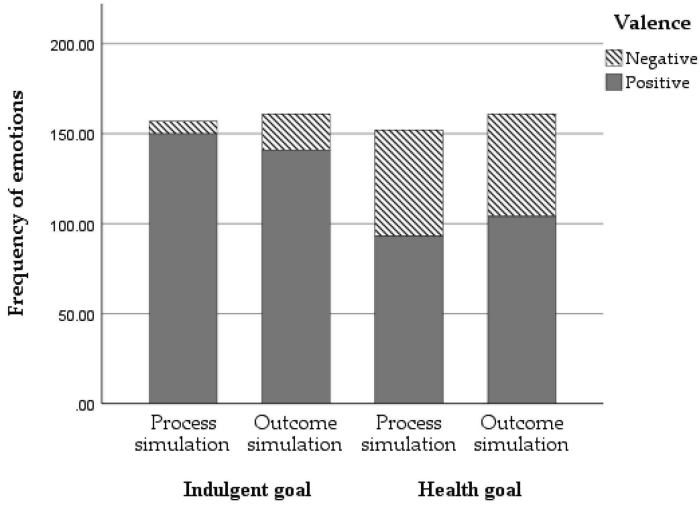

Figure 6. Frequency of negative and positive emotions under the different induced goals and mental simulation type.

Discussion

All in all, our results are in support of our contention that evoked emotions play an important role in the deeper understanding of how mental simulation affects healthy choice under different goal mindsets. Having a health goal in mind and imagining the process or the outcome of eating, creates an inconsistency which is represented by a goal incongruency. This goal incongruency leads to a higher likelihood of healthy choice. Moreover, having a goal congruent with the imagined experience increments happiness but backfires healthier choices. This happens, indeed, when consumers have an indulgent goal in mind, regardless of what they have imagined. Furthermore, feeling more guilty, and experiencing regret increased the likelihood of a healthy choice.

This approach is dissimilar to the idea that negative moods would incentivise indulgent choices (Gardner, Wansink, Kim, & Park, 2014; Wallis & Hetherington, 2009). Research has shown that consumers cope with negative

affects by indulging (Polivy & Herman, 1999), they comfort themselves by eating indulgent high-calorie food, which is also referred to as comfort food. However, it should be noted that, in this study, individuals are not necessarily induced into a negative mood, but rather they anticipate a particular emotion in a particular situation. This affective anticipation affects behaviour by correcting it if one would experience a negative emotion. These results are consistent with the theory of psychological construction (Barrett et al., 2015), which posits that mental simulations, due to their nature, create internal feelings and emotions (Barrett, 2017; Barrett et al., 2015), and they also fit with empirical research showing that emotions predict food choice (Dalenberg et al., 2014).

The present paper demonstrates the importance of appraisals in eliciting such emotions that predict food choice. Just as stated in the appraisal theory of emotions (Johnson & Stewart, 2005; Roseman, 1991), the discrete emotions were elicited by the cognitive appraisal of goal congruence, and the magnitude of the effect on food choice was affected by the appraisal of goal relevancy. The more important the goal in mind, the higher is the effect of happiness and guilt on healthy choice.

The food choice results were also aligned with our expectations. Since consumers search to correct an outcome to avoid a negative feeling (Roseman, 2013), they choose healthier options when guilt and regret were experienced more intensively as a result of a goal incongruency. This situation was observed in both process and outcome simulation when having a health goal salient, but it was more pronounced with process simulation. It should be noticed that this coping strategy seems to be purely rational. For instance, previous research has shown that outcome simulation can create an approach tendency for high-calorie food, however, this tendency is not reflected in the choice of healthy vs. unhealthy (Muñoz-Vilches et al., 2020a). Although in this study a positive implicit approach tendency was found, individuals chose healthy over unhealthy food to consume during the experiment, which corresponds to higher-order reasoning. This resembles the idea that "one both wants something and doesn't want it" (Lewis & Todd, 2007; Mesquita & Frijda,

2011). Moreover, it fits with the Choice Goals framework in preference construction, which posits that people hold the goal of minimising the experience of negative emotion during decision-making and the goal to maximise the ease of justification of a decision (Bettman, Luce, & Payne, 1998).

In this study, happiness (a higher hierarchy emotion) was the positive emotion that led the food choice. This is fine example of the problem of dimensional structure and hierarchy of emotions that Russell and Barrett (1999) describe. Here, several prototypical emotional episodes fall into superordinate categories. For example, happiness is a superordinate emotion that normally includes other middle-level categories. For example, an experience can evoke feelings or emotions that are categorised as happy, but that is in "reality" just feeling pleasant, excited, elated, contented, relaxed, etc. Indeed, happiness was also representing "satisfaction", this is because the higher hierarchy (happiness) complements rather than competes with subordinate emotions (satisfaction).

Guilt was directly caused by the imagined experience itself, by the goal, and by goal congruency. Feelings of guilt emerged with the mere thinking of having a health goal and simulating the outcome of eating an indulgent food, and when the goal was incongruent with the imagined experience. As expected, the feeling of guilt was the most reported negative emotion, in both RATA and the free-elicitation method. These results support the idea that mentally simulating an eating consumption is sufficient to anticipate negative feelings, not only as simply negatively valenced, but also eliciting concrete emotions such as guilt, and happiness.

However, there are some unexpected results. Although regret was found to be one of the mediators of healthy choice, it was not as much elicited as expected. In the discrete emotions, regret was only mentioned in the RATA method, but not in the free-elicitation method. Since regret emerges from the comparison of the actual with the counterfactual decision (Pieters & Zeelenberg, 2007), it is possible that regret did not frequently or intensively emerged because participants could not reflect on another situation that would

have been better to experience nor were asked to decide between discrepant experiences.

Based on these results, the mechanism underlying a healthy choice lays in the effect of goal (in)congruency and relevancy, and its associated elicited emotions. Therefore, the role of mental simulation depends on how (in)congruent the imagined experience is with the current goal. In this research, process simulation, compared to outcome simulation, led to a lower perceived goal congruency, which in turn increased the likelihood of healthy choice. However, in previous research, outcome simulation was found to encourage healthy choice (Muñoz-Vilches et al., 2020a, 2019, 2020b). It could be that in these studies, outcome simulation represented the more incongruent situation. This likely happened because, generally, consumers have multiple competing goals (Laran & Janiszewski, 2009; Stroebe, Mensink, Aarts, Schut, & Kruglanski, 2007). With a no salient goal in mind, mental simulation has more power to change individuals' focus. For instance, outcome simulation makes consumers focus on utilitarian features and more health attributes whereas process simulation engages them into a pleasurable imagined experience, where sensory attributes are more salient. Mental simulation creates a "state[12]", and individuals choose accordingly.

Limitations and future research

This research investigated only the appraisal of perceived goal congruency and relevancy, leaving the agency appraisal being constant (only self-focused). The goal that consumers have prioritised in mind is important to understand the effect that mental simulation exerts on consumers' choices. However, other appraisals such as perceived control potential of the situation, and problem type (instrumental/intrinsic) should be further investigated in the context of conflicting goals, and its elicited emotions. For instance, one would change

[12] By "state" we mean a momentary condition that is affected by what the person imagined (content), physiological states, goals induced/prioritised, how the experience is appraised, and the emotions that are elicited.

behaviour as a coping strategy only when a high control potential is perceived. If one perceives that the situation is out of their control, it is likely that other emotions unrelated to the self-agency are evoked. Moreover, this research showed that valence of emotions from the imagined experience is affected by the perceived goal congruency. Yet, further research should examine in more detail the role of (ambi)valence in simulated experiences, since goal (in)congruency represents goal conflict which likely produces ambivalence (mixed emotions).

Mental simulations can have the form of motor action (Elder & Krishna, 2012; Krishna & Schwarz, 2014), counterfactual thinking (Galinsky & Moskowitz, 2000; Walsh & Byrne, 2004), episodic future thinking (Atance & O'Neill, 2001; Schacter, Benoit, & Szpunar, 2017), sensory simulation (Larson et al., 2014), health simulation (Cornil & Chandon, 2016), and basically all what can be experienced in reality. This study only takes account for the process and outcome simulation, using the food consumption domain. A promising avenue for future research would be to identify more mechanisms by which these specific simulations exert an influence not only on food choice, but also other types of behaviour and contexts (e.g., sustainable choices, holidays destination, portion sizes), and in general, evaluations of products. In this study, an indulgent versus a healthy snack choice was used, but it would be interesting to evaluate whether this result is generalisable to complete meals.

Moreover, future research could investigate the mechanisms by which (un)conscious or (in)voluntary mental simulations are experienced. *Does the fact of being (un)conscious and/or having an (in)voluntary simulation make a difference? If so, how?* This paper takes account for a conscious and voluntary mental simulation, but empirical evidence has also shown unconscious and spontaneous simulation. For example, consumers prefer a product that is handle-oriented rightwards (for those who are right-handed) (Eelen et al., 2013; Elder & Krishna, 2012). This preference is explained by the ease of experience (also called processing fluency or motor fluency for the given example). The ease of experience is how fluent the incoming information is being processed. This mechanism could be one communality of conscious or unconscious

simulation. Processing fluency has proven to be involved on a remarkably range of domains from semantic priming, conceptual priming, embodied cognition, retrieval ease, imagination ease, among others (Alter & Oppenheimer, 1992), and is one of the heuristics in remembering prior experiences (Whittlesea & Leboe, 2000). For example, travel destinations that are easy to imagine are preferred over the more difficult to imagine (Petrova & Cialdini, 2005), and events that are easier to imagine seem more likely to happen (Tversky & Kahneman, 1973). Future research could evaluate the role of processing fluency between types of mental simulation regarding consciousness and volition. Most of the work in unconscious simulations is focused on motor actions simulations, but more is to be done to unravel the mechanisms that our brain uses to predict without even being aware of it.

Mentally simulating scenarios is in consumers' daily life, and the understanding of how different types of mental simulation may affect consumer behaviour is not only relevant to stakeholders and managers, to better advertise their products, but it is also relevant to consumers. Being aware of what they imagine, its consequences and its benefits may aid in better control of their decision-making process This paper shows that a perceived goal incongruency rather than congruency leads to healthy choice by means of the elicitation of specific emotions that relate to their appraisals, and that the mental simulation type moderates this process.

CHAPTER 6

6

General Discussion

In this thesis, we provided a first look into the processes that may be involved in the decision-making process when scenarios are simulated (namely a scenario focused on the process of eating vs one focused on the outcome of eating), and the behavioural consequences that accompany them. We examined the role of attentional bias, approach-avoidance tendencies, goal activation, and emotional responses in the evoked desire for the imagined food as well as choice preference between a vice vs a virtue food. The mechanisms by which a process and an outcome simulation impacts desires and choices were investigated at an implicit and explicit level.

Overview of the main findings

In Chapter 2, the desire for the vice food decreased and the likelihood of choosing the virtue food increased when simulating the outcome of eating compared to when simulating the process of eating. However, this happened only among low health-oriented individuals. For high health-oriented individuals, desire for vice foods did not differ between simulations, and desire for the virtue food increased only with outcome simulation. These results show that when the health orientation, mental simulation, and type of product are aligned, the food that shares the most characteristics with the mental simulation and imagined product is more likely to be desired and chosen (e.g., outcome simulation and virtue food).

Moreover, Chapter 2 showed that mental simulation exerts a different impact on food desire and choice between a vice and virtue food when a vice or virtue food is imagined. The intrinsic characteristics of these two products' nature play a role in the content of the simulated experience, and therefore, should be considered before drawing conclusions regarding the simulation type. The results show that outcome simulation matches better with the utilitarian features of the virtue foods, which enhances its desire and preference for this product category. On the other hand, process simulation evokes thoughts that match better with the hedonic features of the vice foods, which enhances desire and preference for vice food. Moreover, individuals focused more on hedonic attributes during process simulation, and on utilitarian attributes during outcome simulation.

The extent to which process and outcome simulation changes the decisional focus was only measured with explicit measures in Chapter 2. Chapter 3 deepens these results by investigating the role of implicitly measured attentional bias after performing process or outcome simulation. The results show that process and outcome simulation increased attentional bias towards all types of foods (vice and virtue). Moreover, unexpectedly, the results of an approach-avoidance task showed that simulating the process of eating a vice food resulted in a relatively neutral approach-avoidance tendency towards unhealthy food pictures. Simulating the outcome of eating a vice food showed a relative approach tendency towards unhealthy food pictures (compared to avoidance). These findings are contrary to what was expected based on the explicit measures, where process simulation increased the desire for the vice food and increased the likelihood of choice for these types of foods, while outcome simulation increased the desire for the virtue food and increased likelihood of the healthier choice. Hence, a question that arose from Chapter 3 is *why do individuals approach unhealthy food pictures faster after simulating the outcome of eating a vice food (compared to avoidance tendency, and process simulation)?* Since avoiding vice food was faster after process simulation than after outcome simulation, simulating the consumption of a vice food could have activated a health goal.

In Chapter 4, goal activation was investigated as another mechanism by which mental simulation impacts desire and food choice between a vice and a virtue food. Two lexical decision tasks (LDT) were conducted, one assessing the activation of temptation-related words, and the other assessing the activation of health-related words. There were two main results from the LDT. First, compared to normal words (e.g., tree, table) all target words (temptation and health-related words) were more slowly recognised in both simulations (process and outcome). Second, there was an even slower recognition trend (i.e., higher reaction time) of temptation and health-related words in outcome simulation (compared to control and process simulation). Both simulations had the same effect on target words, meaning that the mere task of simulating the process and the outcome of eating may have depleted cognitive resources. This effect was more pronounced in outcome simulation. Hence, Chapter 4 could

not confirm that goal activation is the mechanism by which outcome simulation (compared to process simulation) leads to healthier choice. Thus, another question emerged from Chapter 4: *why did mental simulation, especially outcome simulation, slow down the recognition of both temptation and health-related words, compared to normal words?* A plausible explanation is that an emotional response could have played a role. In Chapter 4, the valence of emotions was found to mediate the effect of mental simulation on food desire. Moreover, a consistent effect of both mental simulations in obstructing the accessibility to temptation- and health-related words suggests that there might be common processes between simulations that were not captured before.

Therefore, Chapter 5 investigated the role of an emotional reaction on healthy choice when a goal is induced and mental simulation is performed. This emotional reaction was constituted by the goal congruence appraisal and discrete emotions. The discrete emotions were happiness/satisfaction representing the positive valence dimension, and guilt/regret representing the negative valence dimension. These emotions are likely to be elicited when the goal congruence appraisal and self-agency are combined. Chapter 5 confirms that mental simulation is involved in the decision-making process. When the interaction between the mental simulation and the salient goal is perceived to be congruent, positive emotions such as happiness and satisfaction are elicited, whereas when this interaction is perceived as rather incongruent, negative emotions such as guilt and regret are elicited. Hence, process and outcome simulations moderated the effect that an induced goal has on healthy choices. In other words, imagining the process or the outcome of eating a vice food makes individuals appraise a situation as goal congruent or incongruent, which in turn affected the elicited discrete emotions. In this context, creating an incongruency and anticipating guilt and regret led individuals to choose healthier.

All in all, the findings of the three implicit measures were not conclusive. Mental simulation increased attentional bias towards all types of foods, suggesting that no matter what food is being imagined, the mere exposure to food pictures draws individuals' attention (Chapter 3). Moreover, implicit

motivation (approach-avoidance) pointed that simulating the outcome of eating a vice food tempted individuals (shown by a higher tendency to approach unhealthy food images), but this only happened implicitly, because individuals still chose healthier with outcome simulation. Finally, there is no evidence suggesting that process and outcome simulation exerted its effect by means of goal activation (temptation vs health)(Chapter 4). However, the results of the explicit measures were quite consistent overall. Process simulation increased the desire and likelihood of vice choices, while outcome simulation increased the desire and likelihood of virtue choices (shown consistently in Chapter 2 , 3 and 4). This effect was strong when a vice food was simulated, but when the object of imagination was a virtue food, the effects were less pronounced or non-existent. An emotional reaction seems to be a plausible mechanism by which mental simulation exerts an effect on healthy choices. This is supported by the mediation of the valence of emotions shown in Chapter 4, and by the discrete emotions elicited with (in)congruent situations shown in Chapter 5.

Table 1 summarises the results of the role of process and outcome simulation on the variables measured in each of the chapters, separated by the product imagined. It also provides the information on whether the variable was implicitly or explicitly measured.

Table 1. Summary of results

Product imagined: Vice product				
The role of mental simulation on	Process simulation	Outcome simulation		
Emotional response (Perceived goal congruency)	Process simulation, compared to outcome simulation, was less congruent when having a health goal	Process and outcome simulation were equally congruent when having an indulgent goal	**Chapter 5**	**Explicit measure**
Emotional response (discrete emotions)	Perceived goal congruency had a positive effect on happiness and a negative effect on regret and guilt. The more congruent the happier, and the less congruent the more guilt and regret.		**Chapter 5**	**Explicit measure**
Emotional response (valence of emotions of the imagined experience)	Perceived goal congruency positively impacted the valence of the emotions of the imagined experience		**Chapter 4, 5**	**Explicit measure**
Decisional focus	Process simulation increased the hedonic attributes compared to outcome simulation	No effect	**Chapter 2**	**Explicit measure**
Attentional bias	Greater attention towards all types of food	Greater attention towards all types of food	**Chapter 3**	**Implicit measure**
Implicit motivation (approach/avoidance)	Neutral motivation for healthy and unhealthy foods	Neutral motivation for healthy foods and high (positive) motivation for unhealthy food	**Chapter 3**	**Implicit measure**
Health orientation (desire)	Did not moderate the effect of process simulation on desire for the vice food	Moderated the effect of outcome simulation on desire for the imagined food. At low levels desire for the vice food decreased and at high levels desire increased.	**Chapter 2**	**Explicit measure**
Health orientation (choice)	Likelihood of vice food choice increased with process simulation compared to outcome simulation. Likelihood of virtue food choice increased with outcome simulation compared to process simulation. This effect only appeared in low health-oriented individuals. High health-oriented individuals always chose virtue food.		**Chapter 2**	**Explicit measure**

The role of mental simulation on	Product imagined: Vice product (*Continuation*)			
	Process simulation	Outcome simulation		
Desire for imagined food	Increased desire for imagined food	Decreased desire for imagined food	**Chapter 2,3,4**	**Explicit measure**
Choice between vice and virtue	Greater likelihood for vice choice	Greater likelihood for virtue choice	**Chapter 2,3,4**	**Explicit measure**
Healthy choice	Happiness decreased the likelihood of healthy choice, whereas guilt and regret increase it. The more relevant the goal the higher the intensity of the emotions elicited. Mental simulation moderated the effect of goal induction on healthy choice.		**Chapter 5**	**Explicit measure**

The role of mental simulation on	Product imagined: Virtue product			
	Process simulation	Outcome simulation		
Decisional focus	No effect	Outcome simulation increased the focus on utilitarian attributes compared to control and process simulation	**Chapter 2**	**Explicit measure**
Attentional bias	No effect	No effect	**Chapter 3**	**Implicit measure**
Implicit motivation (approach/avoidance)	Moderate motivation for healthy and unhealthy foods, although no significant	Moderate motivation for healthy and neutral motivation for unhealthy foods, although no significant	**Chapter 3**	**Implicit measure**
Health orientation (desire)	Mirrored the ones of the vice product but less pronounced	Mirrored the ones of the vice product but less pronounced	**Chapter 2**	**Explicit measure**
Desire for imagined food	Increased desire for imagined food	Increased desire for imagined food	**Chapter 2,3,4**	**Explicit measure**
Choice between vice and virtue	No significant but same trend as with imagined vice food	No significant but same trend as with imagined vice food	**Chapter 2,3,4**	**Explicit measure**

The role of mental simulation on	Product imagined: Ambivalent			
	Process simulation	Outcome simulation		
Emotional response (valence of emotions of the imagined experience)	Valence mediated the effect of process and outcome simulation on desire for the imagined food. The more positive the valence the higher the food desire		**Chapter 4, 5**	**Explicit measure**
Goal activation	Target words (health and temptation) were overall slower than normal words, especially in outcome simulation.		**Chapter 4**	**Implicit measure**
Desire for imagined food	Increased desire for imagined food	Increased desire for imagined food	**Chapter 2,3,4**	**Explicit measure**
Choice between vice and virtue	Process simulation favoured the unhealthy choice	Outcome simulation favoured the healthy choice	**Chapter 2,3,4**	**Explicit measure**

Theoretical reflections

This thesis is positioned at the interplay of fundamental and applied research and embraces the multidisciplinary focus of the topic of mental simulations. Fundamental research in mental simulation has contributed by examining neural mechanisms through neuroimaging technologies (e.g., Bar, 2011; Bubic, von Cramon, & Schubotz, 2010; Clark, 2013; Greve, 2015; Pezzulo et al., 2011; Schacter, Addis, & Buckner, 2008), and typically focuses on answering questions related to the functioning of the brain and mind, such as why do humans have the capacity of simulating and for what was designed for? (Schacter, Addis, & Buckner, 2008) or what are the neural mechanisms? (Addis, 2020; Schacter et al., 2013). More applied research in mental simulations built on this by showing direct effects of mental simulation on portion sizes (Petit, Spence, Velasco, Woods, & Cheok, 2017; Cornil, & Chandon, 2016), satiation (Larson et al., 2014; Morewedge et al., 2010b) and consumer intentions (Escalas & Luce, 2003, 2004; Wu, Park, & Ju, 2019; Xie et al., 2016), but the mechanisms underlying these effects are barely further examined. This thesis contributes theoretically at the interface by systematically exploring potential mechanisms underlying the effect of mental simulation on conflicting choices. In doing so, it also takes into consideration the unhealthy eating problem of modern societies, contributing to potential personal strategies, and marketing strategies for healthier eating behaviour.

More specifically, we contribute by showing systematic differences between the effect of process and outcome simulation on desire and choice behaviour. Although previous research has investigated the effect of process simulation in different motivation and behavioural outcomes (Haasova et al., 2016; Keesman, Aarts, Vermeent, Hafner, et al., 2016; Lange et al., 2020; Missbach, Florack, Weissmann, & König, 2014; O. Petit et al., 2017), the role of outcome simulation has been very little studied in the food domain. In chapter 2, 3 and 4, we consistently show that the outcome simulation

favoured healthy food choices and that process favoured the indulgent choice.

Previous research in mental simulation used vice foods as object of imagination (Keesman, Aarts, Vermeent, Hafner, et al., 2016; O. Petit et al., 2017; Xie et al., 2016), and assess their impact on indirect variables such as intentions or salivation but not choice behaviour. Hence, we contribute by showing that imagining the process or the outcome of different products categories (vice, virtue and ambivalent) greatly impact the desire for food and choice behaviour. Moreover, although previous literature has identified the elaboration of mental simulations as a key component of craving (Andrade, 2013; May et al., 2012; May, Andrade, Kavanagh, & Penfound, 2008; Schumacher et al., 2019), this is the first research examining the effect of two different mental simulation (process vs outcome) in desire for the imagined food and conflicting choices (vice vs virtue). In chapter 2, 3, and 4 we show that when there is a match between the simulation and the product (e.g., simulating the process of eating a vice food or simulating the outcome of a virtue food), the simulation has greater effect either in favouring desire and choice preference for vice food with process simulation or favouring desire and choice preference for the virtue food with outcome simulation, or having a less pronounced effect when an ambivalent food was simulated. This is because consumers see vice, virtue and ambivalent products through different lenses, while vice products have a strong hedonic component, which is exacerbated by process simulation (Chapter 2), virtue products have an utilitarian component, which is enhanced with outcome simulation.

Previous research has established the importance of emotions on behaviour (Brewer et al., 2016; Gutjar et al., 2014; Mauss & Robinson, 2009). However, the role of process and outcome simulation in emotion anticipation has not yet been fully explored. Hence, in Chapters 4 and 5 we contribute by confirming that mental simulations are involved in affect and emotional appraisals, and specific emotions that are evoked when perceiving the imagined situation as (in)congruent with one's goals. This thesis shows

that anticipating guilt and regret encourages healthy eating and that these emotions are the result of simulating the process or the outcome of eating a vice food when having a health goal. Moreover, it is shown that anticipating happiness decreased the likelihood of healthy choices. These results should, however, be interpreted with care. We do not intend to say that experiences should not be enjoyable or pleasant. But, when having a long-term goal, mentally simulating the eating experience or its effects helps to anticipate the negative emotions that may be experienced. Since anticipating emotions can be done before decision-making it has great potential for tackling unhealthy eating behaviour.

Nevertheless, there are some inconsistencies when it comes to the findings of the implicit and explicit variables that should be further discussed. The findings of this thesis show that motivation (approach-avoidance tendency) and attentional bias, which were measured implicitly, do not converge with the findings of their correspondent explicit measures (desire and decisional focus, respectively).

The approach-avoidance tendencies turned out to be contrary to what we expected, and they did not match with subjective desire (Chapter 3). Simulating the outcome of eating an ambivalent food tempted individuals, their approach tendency towards unhealthy foods was higher than the avoidance tendency (also when compared to process simulation). Yet, in the self-report measurement, individuals' desire for the imagined food was not affected by outcome simulation as it happened in the approach-avoidance task. Moreover, individuals under outcome simulation chose the healthier choice compared to those under process simulation, which was consistent with the self-report measure of desire but not with the approach-avoidance task. On the other side, process simulation led to relatively slower approach tendencies compared to outcome simulation (more neutral approach-avoidance index). This result could be explained by previous research on goal activation, stating that tempting situations would activate a health goal instead of a temptation goal (Fishbach, Friedman, & Kruglanski, 2003b;

Geyskens, Dewitte, Pandelaere, & Warlop, 2008). Although this possibility was tested, it was not possible to demonstrate. Rather, we find that in both process and outcome simulation participants spent more time in recognising the health- or temptation-related words (e.g., healthy, diet, tasty, and temptation) than normal words (e.g., table, tree). This could be explained by either the fact that our experiment could not capture the goal activation, or that mental simulations may have caused a cognitive load. The act of simulating food could have generated an overload in the working memory, which would have slowed down the recognition of target words, which open ups the possibility that there was an emotional reaction interfering with the performance.

The differences between implicit and explicit measures give a hint in that it is likely that the mechanisms of mental simulations involved may be in great part cognitive. Especially considering that the only mechanism we could confirm comes from the interpretations of how individuals perceive the situations (appraisals). With this and the inconsistency between implicit and explicit measures, it is likely that mental simulations effect desire and conflicting choices behaviour because of an evaluative process, where cognitive control and explicit desires are involved, although this is speculative and warrants investigation. In this light, it seems that individuals do not choose between experiences but rather between the anticipated reward of the experiences, which in turn is based on what is remembered and not necessarily on what is perceived.

This thesis also makes a methodological contribution to the field. Explicit and implicit methods were used to assess the impact of mental simulation on motivation, attentional bias, goal activation, and approach-avoidance tendencies. Combining implicit and explicit measures to examine the effects of mental simulation on conflicting choices can be considered innovative within the field of mental simulations. To our knowledge, the findings of this thesis provide the first insights on the differences between process and outcome simulation within the food domain. Moreover, since

little is known about the processes underlying the effect of mental simulations on desire and food choices, it provides a solid ground for future researchers in this area.

Practical implications

Memory for the specific attributes of foods eaten in the recent past, and memory for the predicted consequences of eating acquired over repeated experiences are important influences on eating behaviour (Higgs et al., 2008). Recalling the past, simulating experiences, and envisioning the future have memory as a common factor (Schacter et al., 2013). Interventions as mindfulness can improve cognitive abilities such as learning and memory by enhancing the encoding process (Lueke & Lueke, 2019), and reducing food intake (Higgs & Donohoe, 2011), while being distracted with our smartphones or TV while eating may hinder the encoding process, having a great impact on future eating consumptions. Hence, the extent to which (food) memories are encoded in the brain has a great impact on how individuals simulate and recall experiences.

Mental simulations have a wide spectrum of uses in daily life. They can be used to improve performance while one mentally simulates exercising (Beilock & Lyons, 2009), to find the means to reach a goal by simulating the step-by-step to reach it such as eating more fruit (Knäuper, McCollam, et al., 2011), to decrease portion sizes by increasing enjoyment of food (Cornil & Chandon, 2016; Petit et al., 2017), among others. In this thesis, we show that mental simulations help to anticipate specific emotions, and that this is powerful enough to affect food desire and choice behaviour. In this light, when individuals hold a health goal, such as having a healthy diet or losing weight, both process and outcome simulation can be used to promote healthier choices. That is because both produce a perceived goal incongruency, which in turn elicits negative anticipated emotions such as guilt and regret. These anticipated emotions serve in the process of re-evaluation and to make a choice that is more aligned with one's goal. On the other side, when there is not a specific goal prioritised in mind, process

simulation has been shown to increase desire for food, which can be counterproductive for healthy eating. However, process simulation could also be used for individuals that do not have a great appetite or want to increase weight. More research in this area is needed to give further advice in this matter.

Limitations and future research

In this thesis, individuals were instructed to mentally simulate. Instructing individuals to simulate can be widely utilised in communicational campaigns, promotion strategies, at the level of more personal advice from nutritionists and healthcare professionals, or just as a personal strategy controlled by oneself. This thesis, however, does not consider automatic or spontaneous mental simulations. Hence, a fruitful avenue for future research could investigate other types of mental simulation elicitation at a more unconscious level. Little research has been done focused on spontaneous mental simulations (Xie et al., 2016), especially when it comes to the differences between process and outcome. It is, therefore, to be confirmed whether process and outcome simulations differ in their impact on desire and choice behaviour when they are spontaneously evoked, either in a top-down process (e.g., intrusive thoughts) or in a bottom-up process. That is, future research could investigate to what extent spontaneous mental simulations can be evoked with an external cue, in a retail environment either online or in-store. For example, with short slogans, banners, packaging information or other external cues that do not necessarily instruct the individual to simulate a certain scenario, but rather spontaneously trigger simulations.

I desire because I imagine or I imagine because I desire? Some attempts have been made to answer this question. The Elaborated Intrusion theory (Kavanagh et al., 2005) build on evidence that there is a bottom-up and top-down process modulating desires, and that desires are dynamic, highly sensitive to sensory cues (e.g., the smell of coffee just prepared) and hence malleable. More efforts have to be done to understand intrusive

desires (i.e., top-down process), which occur involuntarily and without external (conscious) cues. Intrusive desires exist, and they are heavily affected by mental imagery (Tiggemann & Kemps, 2005). More interdisciplinary research is needed to understand, for example, the phenomenology of cravings and intrusive thoughts.

A limitation of studying instructed mental simulations is that, besides asking individuals how vivid or real the imagined experience was, it is not possible to prove that individuals are actually simulating or to what extent they are simulating. Although in each study we asked individuals to write down their experience, which permitted us to assess the level of detail, more research is needed to validate instructed mental simulation (process and outcome). Combining this task of instructing individuals to simulate the process or the outcome of eating with a neuroimaging technology could be a fruitful area of research. This would permit to validate and correlate activated areas in the brain with the specific simulation (process or outcome) and the imagined product. Based on the results of this thesis, it should be expected that process simulation is able to activate pleasure-related areas in the brain (e.g., nucleus accumbens), whereas outcome simulation would variate depending on the nature of the product simulated. If a vice product is simulated it is likely that cognitive control areas are activated, especially if a health goal is salient.

Efforts have been made to understand the role of mental simulation in motivation and behaviour (Keesman, Aarts, Vermeent, Häfner, et al., 2016; Papies, 2013; Petit et al., 2017). However, promoting healthier behaviour has mainly been approached from reducing unhealthy eating rather than promoting healthy eating. Promoting healthy and more sustainable eating (e.g., plant-based foods) with mental simulations is an emerging topic, and has great potential for the adoption of these relatively new products by increasing their attractiveness (Papies, Johannes, et al., 2020).

In this thesis, we could not fully elucidate why mental simulations do not impact behaviour when a virtue food is simulated. Hence, a promising

field of research is to investigate the why of the differences in performance between the virtue and the vice foods in evoking strong motivation and behavioural change. Future research could examine the possibility that virtue foods are less appealing than vice foods because memories are encoded to a lesser extent than with vice foods. Creating happy memories with virtue foods may change the panorama for healthier and sustainable eating.

Finally, future research could open avenues for understanding how balancing the thoughts between the past, present and future affects the decision-making process. Some individuals are constantly worried or dreaming about the future, they plan every step as the unique option in life, they are focused on episodic future thinking. Other individuals live from their remembered experiences (i.e., episodic memories) and look back with nostalgia and joy or often ask themselves "what if I would have done it differently" (episodic counterfactual thinking). Finally, other individuals live their lives with a 'Carpediem' mindset. They are focused on the pleasures of the present. Although these time perspectives have been studied, mostly isolated from each other (e.g., Abraham, Schubotz, & von Cramon, 2008; Addis, 2020; Brunstrom et al., 2012; D'Argembeau & Mathy, 2011; Özbek, Bohn, & Berntsen, 2017; Todd & Hills, 2020; Vartanian, Chen, Reily, & Castel, 2016), there are still questions to be answered with regards to how can we use them in daily life to our own benefit, and whether individuals have a tendency to stick to one of these time perspectives as a sort of personality trait. The future consideration scale (Strathman, Gleicher, Boninger, & Edwards, 1994) gives a basis on the extent that individuals sacrifice immediate gratification for potential future outcomes, and helps, to some extent, solving the disjunctive between choosing immediate vs delayed gratification. However, the three time perspectives (past, present, and future) have not been weighted together. Hence, future research could answer questions such as: *from where do these tendencies to think about the past, present or future come from? To what extent does this "personality trait" impacts the capacity to balance instant vs delayed gratification while maximising happiness?*

How can mental simulations help to balance these three time perspectives on individual decisions? If these time perspectives could be captured on a scale, would there be systematic differences between individuals who tend to think in the past, in the present, or in the future when they make decisions? In other words, do individuals have different strategies to think about the past, present, and future to plan action?

Conclusion

This thesis shows that both the individuals' goals and the nature of the imagined product influence the extent to which process and outcome simulation affects consumer response (desire and food choice) and its associated mechanisms. Simulating the process or the outcome of eating vice food has a great impact on desire and conflicting choices, as opposed to simulating virtue foods, which has little impact. Mental simulation promotes healthier choices, but only when certain conditions are met.

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Summaries

Summary
Resumen

Summary

Why do consumers struggle with either choosing chocolate or an apple? Because consumers have an intrinsic bias towards instant pleasure. This innate bias toward instant gratification has contributed to an outstanding societal problem: unhealthy behaviour. Obesity rates are higher than ever. Just to give an example, the prevalence of obesity worldwide has tripled since 1975, 39% and 13% of adults aged over 18 were overweight or obese in 2016, respectively (WHO, 2021). Understanding consumer choices is primordial to tackle the unhealthy behaviour problem. In this light, desires and food choices are in the core of (un)healthy eating. In the realm of making consumers to make healthier choices, this thesis investigates two core concepts: desire and conflicting choices (health vs indulgent).

Moreover, we provided a first look into the processes that may be involved in the decision-making process when scenarios are simulated (namely a scenario focused on the process of eating vs one focused on the outcome of eating), and the behavioural consequences that accompany them. We examined the role of attentional bias, approach-avoidance tendencies, goal activation, and emotional responses in the evoked desire for the imagined food as well as a choice preference between a vice vs a virtue food. The mechanisms by which a process and an outcome simulation impact desires and choices were investigated at an implicit and explicit level.

The results of the explicit measures were quite consistent overall. We contributed by showing systematic differences between the effect of process and outcome simulation on desire and choice behaviour.

Process simulation increased the desire and likelihood of vice choices, while outcome simulation increased the desire and likelihood of virtue choices (shown consistently in Chapters 2, 3, and 4). Moreover, we contributed by showing that imagining different products categories (vice,

virtue, and ambivalent) greatly impact the performance of process and outcome simulation. The effect of mental simulation on desire and choice behaviour was strong when a vice food was simulated, but when the object of imagination was a virtue food, the effects were less pronounced or non-existent.

Considering two different types of simulations and three product categories as objects of imagination throughout Chapter 2, 3 and 4, permitted us to show that when there is a match between the simulation and the product (e.g., simulating the process of eating a vice food or simulating the outcome of a virtue food), the simulation has greater effect either in favouring desire. It also showed that imagining either the process or the outcome of virtue or ambivalent food has a less pronounced effect on choice behaviour. This is likely because consumers see vice, virtue, and ambivalent products through different lenses, while vice products have a strong hedonic component, which is exacerbated by process simulation (Chapter 2), virtue products have a utilitarian component, which is enhanced with outcome simulation.

In Chapter 5, we show the role of an emotional reaction on healthy choice when a goal is induced and a mental simulation is performed. We showed that when the interaction between the mental simulation and the salient goal is perceived to be congruent, positive emotions such as happiness and satisfaction are elicited, whereas when this interaction is perceived as rather incongruent, negative emotions such as guilt and regret are elicited. Hence, process and outcome simulations moderated the effect that an induced goal has on healthy choices. Moreover, in Chapter 4 we found that process and outcome simulation impacted desire through a mediation effect of valence (positive or negative affect). Therefore, an emotional reaction seems to be a plausible mechanism by which mental simulation exerts an effect on (healthy) choices.

The results of the implicit measures showed that (1) when the process or the outcome of eating a vice food is simulated, there is a trend to increase

attentional bias towards all types of food; (2) Process and especially outcome simulation slowed down the recognition of target words (e.g., healthy, diet, yummy, temptation), compared to normal words, which does not support that mental simulation activates a health or a temptation goal; and (3) Outcome simulation but not process simulation enhanced the approach tendency of unhealthy foods compared to avoidance. However, this result did not translate into the choice preference between a vice and a virtue food, where outcome simulation favoured healthy choice.

All in all, the mechanisms underlying the effect of mental simulation in healthy choice seem to be due to a conscious evaluative process, in which cognitive control and explicit desires are involved. In this light, when individuals hold a health goal, such as having a healthy diet or losing weight, both process and outcome simulation can be used to promote healthier choices. That is because both produce a perceived goal incongruency, which in turn elicits negative anticipated emotions such as guilt and regret. These anticipated emotions serve in the process of re-evaluation and making a choice that is more aligned with one's goal.

Resumen

¿Por qué los consumidores tienen dificultades para elegir un chocolate o una manzana? Porque los consumidores tienen un sesgo intrínseco hacia el placer instantáneo. Este sesgo innato hacia la gratificación instantánea ha contribuido a un problema social sobresaliente: el comportamiento poco saludable. Las tasas de obesidad son más altas que nunca. Solo para dar un ejemplo, la prevalencia de la obesidad en todo el mundo se ha triplicado desde 1975, el 39% y el 13% de los adultos mayores de 18 años tenían sobrepeso u obesidad en 2016, respectivamente (OMS, 2021). Comprender las opciones de los consumidores es primordial para abordar el problema del comportamiento poco saludable. En este sentido, los deseos y la elección de alimentos están en el centro de una alimentación (no) saludable. Con la motivación de hacer que los consumidores tomen decisiones más saludables, esta tesis investiga dos conceptos centrales: el deseo y las elecciones conflictivas (producto saludable versus hedónico).

Además, proporcionamos un primer vistazo a los mecanismos que pueden estar involucrados en el proceso de toma de decisiones cuando se simulan escenarios (es decir, un escenario enfocado en el proceso de comer versus uno enfocado en el resultado de comer), y las consecuencias conductuales que acompañan a éstos mecanismos. Examinamos el papel del sesgo de atención, las tendencias implícitas de aproximar o alejar alimentos tanto saludables como no saludables, la activación de un objetivo de salud versus uno hedónico y las respuestas emocionales en el deseo evocado por el alimento imaginado, así como la preferencia de elección entre un alimento saludable o uno hedónico. Los mecanismos por los cuales imaginar el consumo versus las consecuencias del consumo impactan los deseos y elecciones se investigaron tanto a un nivel implícito como explícito.

Los resultados de las medidas explícitas fueron bastante consistentes en general. Contribuimos mostrando diferencias sistemáticas entre imaginar el

consumo versus el resultado del consumo en el deseo y el comportamiento de elección.

Simular el proceso de comer aumentó el deseo y la probabilidad de elecciones de alimentos hedónicos, mientras que simular el resultado de comer aumentó el deseo y la probabilidad de elecciones saludables (mostrado de manera consistente en los Capítulos 2, 3 y 4). Además, contribuimos mostrando que imaginar diferentes categorías de productos (hedónico, saludable y ambivalente) impacta en gran medida el rendimiento de la simulación mental. Imaginar el proceso de consumo de un alimento hedónico impactó el deseo y la elección de alimentos en una mayor medida que cuando se imaginó el de uno saludable.

La consideración de dos tipos diferentes de simulaciones y de tres categorías de productos como objetos de la imaginación a lo largo de los capítulos 2, 3 y 4, permitió demostrar que cuando existe una congruencia entre la simulación y el producto (por ejemplo, simular el proceso de comer un alimento hedónico o simular el resultado de consumir un alimento saludable), la simulación tiene un mayor efecto sobre el deseo del alimento imaginado. También se demostró que imaginar el proceso o el resultado de consumir un alimento saludable o ambivalente tiene un efecto menos pronunciado en el comportamiento de elección. Es probable que esto se deba a que los consumidores ven los productos hedónicos, saludables y ambivalentes con diferentes perspectivas. Mientras que los productos hedónicos tienen un fuerte componente de placer, que se ve exacerbado al imaginar el consumo de un alimento (capítulo 2), los productos saludables tienen un componente utilitario, que se ve potenciado con imaginar el resultado del consumo.

En el capítulo 5, mostramos el rol de una reacción emocional en la elección saludable cuando se induce un objetivo y se realiza una simulación mental. Mostramos que cuando la interacción entre la simulación mental y el objetivo en mente se percibe como congruente, se evocan emociones positivas como la felicidad y la satisfacción, mientras que cuando esta interacción se percibe

como más bien incongruente, se evocan emociones negativas como la culpa y el arrepentimiento. Por lo tanto, la simulación del proceso o del resultado de consumo moderan el efecto que un objetivo inducido tiene sobre las elecciones saludables. Además, en el capítulo 4 descubrimos que la simulación del proceso y del resultado del consumo afectaba al deseo a través de un efecto de mediación de la valencia (afecto positivo o negativo). Por lo tanto, una reacción emocional parece ser un mecanismo plausible por el que la simulación mental ejerce un efecto sobre las elecciones (saludables).

Los resultados de las medidas implícitas mostraron que (1) cuando se simula el proceso o el resultado de consumir un alimento hedónico, hay una tendencia a aumentar el sesgo atencional hacia todos los tipos de alimentos; (2) imaginar el proceso y especialmente el resultado de consumo de un alimento ralentizó el reconocimiento de las palabras objetivo (por ejemplo, saludable, dieta, delicioso, tentación), en comparación con las palabras normales (por ejemplo, mesa, y árbol), lo que no afirma que la simulación mental active un objetivo de salud o hedónico como se esperaba; y (3) imaginar el resultado del consumo de un alimento, comparado con imaginar el proceso, aumentó la tendencia de acercamiento a los alimentos poco saludables relativamente a la evitación de ellos. Sin embargo, este resultado no se tradujo en la preferencia de elección entre un alimento hedónico y uno saludable, ya que simular los resultados del consumo favoreció la elección saludable por sobre simular el proceso de consumo.

En definitiva, los mecanismos que subyacen al efecto de la simulación mental en la elección saludable parecen deberse a un proceso evaluativo consciente, en el que intervienen el control cognitivo y los deseos explícitos. En este sentido, cuando los individuos tienen un objetivo de salud, como tener una dieta saludable o perder peso, tanto la simulación de proceso como la de resultado pueden utilizarse para promover elecciones más saludables, dependiendo de los otros factores que lo acompañen.

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It's difficult to believe that I'm writing this part of my thesis. After 5 years, one child, one pandemic with several lockdowns and restrictions. At this point I can just thank everyone who accompany me in this PhD journey.

I will start with my best supervisors ever! I would like to convey my RESPECTS to Hans van Trijp and Betina Piqueras-Fiszman.

Hans, you are an incredible person. Besides all your responsibilities, I never felt alone, you taught me the most unexpected things. I will never forget what you told me during my first year, you said something like "research needs creative brains, if you overwork, that will not come easily. Go home!". That message meant everything to me, because I came from a culture where you are asked to do as many hours as you can before you explode. It was surprising that that message came from my boss. That's speaks enough for me to show how emphatic you were with myself so could see how stressed I was, and that you could say just the right words to solve it. I think there are not so many persons that have that balance between letting others think without leaving them alone. You were ALWAYS there. I admire how you read every single word of all my drafts, how you involved in my ideas, how you carefully made comments where I knew there was "something not good enough", you catch me always! (haha). Sometimes we would not agree (actually, very frequently!), but with rough honesty we could solve our "issues". I will miss that level of honesty, truly.

Betina, you are the most active, QUICK, nice, young / competent person that I know. You could not complement Hans better. You gave me the daily motivation to trust myself and my ideas, always very responsive and quick! I have already told you that I think that you are the QUICK person to me. You can do everything fast, and that also honors you being active at work and as a person. You transmit good energy and calm down the waters when there was a storm. You were literally my translator to Hans (tienes el don de

la palabra!). Por otra parte, veo nuestro "mal entendido" como algo positivo. Estoy muy sorprendida de cómo reaccionaste y de cómo lo manejaste. Estoy muy contenta de que nuestra relación no se dañó, sino que me dio más razones para confiar en ti, en que quieres hacer las cosas bien, y que existe un respeto mutuo. No me voy con un sabor amargo, sino todo lo contrario. Eres una persona admirable y me siento muy afortunada de haberte tenido como supervisora.

Por supuesto, también tengo que agradecer a mi familia, que, aunque no entendían lo que estaba haciendo, siempre me apoyaron incondicionalmente. Mamá, tú eres la de las palabras sabias, y tus frases enlistan las proposiciones de mi vida. TU ERES MÁS IMPORTANTE. Esa frase me acompañó siempre. Cada vez que las cosas se ponían un poco pesadas en mi camino, esa frase me daba la fuerza para ponerme como prioridad, que ninguna tesis ni presentación era más importante que mi autocuidado, mi salud, mi bienestar. Esa frase me ayudó a mantener el equilibrio entre mi vida personal y mi tesis. Aparte de tus frases épicas, quiero agradecerte por acompañarme en cada momento de mi vida, por estar presente y por mostrarme lo que es ser mamá. A mi papi, quiero agradecerle por darlo todo por nuestros sueños y desarrollo personal. Por enseñarme que no existen los límites, y que solo hay que trabajar, tener la paciencia y perseverancia suficiente para hacer realidad todo lo que pueda imaginar. A ambos, gracias por apoyarnos en nuestros sueños personales, por cuidar y gestionar nuestra casita que es parte de nuestro sueño de vida. Gracias por por mantener mi cabeza en paz para enfocarme en este camino de PhD. Gracias por enseñarme lo que es tener garra, trabajar sin cansancio por crecer, por ser más de lo que uno imaginó para uno mismo. Gracias por quererme, aceptarme y ¡aguantarme! Por entender mis ideas y por ayudarme a concretarlas. Gracias por enseñarme a ser yo, por guiarme en los caminos que inventé y que me llevaron hasta donde estoy hoy. También quiero agradecer a mi hermano Hamlet por nuestras conversaciones eternas y

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A mi comunidad chilena en Wageningen, ¡gracias por vuestros consejos! Marcia, mi mesa de ayuda, gracias por saber tanto y tener la disposición de compartirlo todo. Eres la más seca y mejor consejera. Fran, gracias por tantos paseos y conversaciones. Gracias por ser tan amable y hacerme sentir que ahí estás. Qué especial que Marcia, Fran, Lucía, Maca, Yannina, y Ale hayamos sido madres casi al mismo tiempo. Qué único haber podido tener mi comunidad de mamis en Wageningen durante esta pandemia que nos tocó a todas. Por saber que siempre había alguien que me entendería. Gracias también al resto de la comunidad chilena en Wageningen. Qué buenas juntas tuvimos, gracias por traer Chile a Wageningen, por la música de Saonda, por los bailes axé y no axé, por los 18 de septiembre y por las conversaciones casuales.

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Ignacio, mi gran amigo. ¿Quién lo diría ah? Llegaste a Holanda inesperadamente, en el momento justo. Gracias por nuestras conversaciones de muchas horas que iban de tópicos de investigación hasta inmensidades del universo, por darme ese espacio para hablar sin límite moral o temporal. ¡Gracias por tanto! Gracias por ser mi amigo, mi colega, mi compañero de conferencias, mi co-author, y mi inyección de energía. Y esto lo escribo y se lee con acento español (jajaja!)

Gracias a Francisca Silva y Coca por motivarme en primera instancia a hacer este doctorado. Sin ustedes no estaría escribiendo esto. Ustedes me confirmaron que un doctorado era un buen camino para mis ambiciones, y además me siguieron apoyando en el camino. ¡Muchísimas gracias por todo ese apoyo!

Finalmente, tengo que agradecer a mi familia holandesa. Primero, a mi amado esposo, Antoine. Cuánto que agradecer, que decir y que las palabras no serán suficientes. Quiero darte las gracias por hacer mi vida más fácil, más divertida, más interesante. Por acompañarme en los sueños, en las aventuras, por escucharme, por amarme y por haberme apoyado en este camino de doctorado. Aún cuando teníamos una vida planeada en Chile antes de empezar el doctorado, de un día para otro decidiste seguirme a lo incierto. Gracias por todos tus sacrificios. Gracias por ser el mejor papá de Luuk, por compartir y complementar la paternidad. Gracias a mi Luuk, aunque aún no puedas leer esto, algún día podrás saber que fuiste un aprendizaje que se expandió en todos los aspectos de mi vida, incluso el doctorado. Gracias a ti llegué al balance perfecto entre trabajo y vida. Tú me ayudaste a mantenerme constante, a trabajar ciertas horas y luego disfrutarte. Ser tu mamá me enseñó más que cualquier otra cosa, porque no había opción de no aplicarlo, porque ahí estabas tú necesitándome, y así necesitándonos. Gracias Antoine y Luuk por ser mi familia y enseñarme cada día lo que el amor puede hacer.

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were so nice to explain me all what I asked. I hope our paths will continue close.

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Thanks to all the other PhDs, postdocs, and staff members that made this path so special, and for helping me becoming the researcher I am.

Naomí

About the author

Naomí Cecilia Muñoz Vilches was born in Santiago de Chile on the 23rd of May of 1989. She received her title of Agricultural Engineering with a major in agribusiness from the Pontificia Universidad Católica de Chile in 2013. She was awarded the Erasmus Mundus Scholarship in 2013. She graduated with a double degree in MSc. Food Technology and Health (University of Montpellier, France) and MSc. Sustainable Management of Food Quality (IAMZ, Spain). She also spent 3 months at the Università degli Studi della Basilicata, in Italy (Potenza), and another 3 months at Universidade Católica Portuguesa in Porto.

In 2016 she started her PhD in the Marketing and consumer behaviour group. Her research focuses on finding strategies that help people eat healthier. In particular, the role of mental simulation in food choices, and its associated psychological mechanisms. She has published most of her chapters, and a book chapter. She presented in several international conferences and she even received the European Sensory Society award during Eurosense 2020. Her thesis topic stems from a personal interest in human behaviour.

Naomí got married in 2018 to a Dutchman (Antoine) she met in Portugal, and they have a 2-years old son named Luuk.

Naomí is ready to start her new job at DVJ Insights as a research expert.

List of publications

Piqueras-Fiszman, B.; and **Muñoz-Vilches N.C.**, (2021) "The Psychology of Food Choice: Anticipation and Mental Simulation," in Handbook of Eating and Drinking. *Springer International Publishing*, 2021, pp. 1–15.

Muñoz-Vilches, N.C., van Trijp, H.C.M., and Piqueras-Fiszman, B., (2020) **"**Pleasure or Health? The Role of Mental Simulation in Desire and Food Choices". *Foods,* 9, 1099. https://doi.org/10.3390/foods9081099

Muñoz-Vilches N.C., van Trijp, H. C. M., and Piqueras-Fiszman B., (2020). "Tell me what you imagine and I will tell you what you want: The effects of mental simulation on desire and food choice". *Food Quality and Preference*, vol. 83, p. 103892.

Muñoz-Vilches N.C., van Trijp H. C. M., and Piqueras-Fiszman B., (2019). "The impact of instructed mental simulation on wanting and choice between vice and virtue food products". *Food Quality and Preference*, vol. 73, pp. 182–191.

De Magistris T., Xhakollari V., and **Muñoz N**., (2015). "The effect of sensory properties on non-celiac consumers' willingness to pay for a gluten-free snack". *Econ. Agro-Alimentare*, vol. 17, no. 1.

Completed Training and Supervision Plan

Naomí Cecilia Muñoz Vilches

Wageningen School of Social Sciences (WASS)

Completed Training and Supervision Plan

Wageningen School of Social Sciences

Name of the learning activity	Department/Institute	Year	ECTS*
A) Project related competences (managing your own research project)			
Writing Research Proposal	WASS	2017	6
Psychobiology of food choice and eating behaviour, HNE-30306	WUR	2017	6
The impact of mental simulation on desire and choice	WASS PhD day	2018	1
MCB PhD colloquia series	WUR	2017-2021	2.5
B) General research related competences (becoming a broad academic)			
WASS introduction course	WASS	2017	1
Understanding consumers. Preference, emotions, expectations, contexts and sensory characterisation	SISS, Florence Italy	2017	1
The essentials of Scientific Writing and Presenting	WGS	2017	1.2
Advanced statistics course: Design of Experiments	WIAS/PE&RC	2017	0.8
PhD Carousel	WGS	2017	0.3
'The impact of mental simulation on desire and choice between hedonic and utilitarian food products'	Eurosense conference Verona	2018	1
EDEN doctoral seminar on consumer research	EIASM	2018	4

Scientific writing	Wageningen in'to Languages	2018	1.8
'The effects of mental simulation on desire and food choice'	Eurosense conference Rotterdam	2020	1
Systematic approaches to reviewing literature	WASS	2020	4
C) Career related competences (personal development and your own future)			
PhD competence assessment	WGS	2019	0.3
Scientific paper reviews	Journal of Consumer Behaviour, and Appetite	2019-2021	1.2
Student thesis supervision	MCB Group	2017-2020	1.5
Scientific Publishing	WGS	2020	0.3
Supervising BSc & MSc thesis students	Education Support WUR	2020	0.65
Research Data Management	WUR Library	2020	0.45
Career perspective	WGS	2020	1.6
Writing grant proposals	Wageningen in'to languages	2020	2
Total			**39.6**

*One credit according to ECTS is on average equivalent to 28 hours of study load

Abbreviations
WUR: Wageningen University & Research
WASS: Wageningen School of Social Sciences
MCB: marketing and Consumer Behaviour
HNH: Human Nutrition and Health
PE&RC: Production Ecology & Resource Conservation Graduate School
WIAS: Wageningen Institute of Animal Sciences
WGS: Wageningen Graduate School
EIASM: European Institute for Advanced Studies in Management
ESC: Educational Support Centre

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