Seeing is for Doing

An Embodied Cognition Approach to Nudging

Seeing is for Doing – An Embodied Cognition Approach to Nudging

Nudging vanuit een belichaamd cognitie perspectief

(met een samenvatting in het Nederlands)

Proefschrift
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Content

Chapter 1

Introduction

Consumers live in an environment that is conducive to behaviors with negative consequences for health and wellbeing. The abundance of easily accessible food in combination with limited need for physical activity has contributed to the rise of overweight, obesity, and related illnesses including cardiovascular diseases, diabetes, and cancers (Swinburn, Sacks, Hall et al., 2011).

Overconsumption and choices for unhealthy, highly caloric food have become a major challenge of the 21st century (WHO, 2014) affecting both the societal (Wang, McPherson, March, Gortmaker, & Brown, 2011) and the individual level (Berrington de Gonzales, Hartge, Cerhan et al., 2010) through straining health care systems as well as personal health management. People want to live long and healthy lives (Roininen, Lähteenmäki, & Tuorila, 1999). The achievement of this goal is strongly influenced by healthy eating behavior and the maintenance of a healthy body weight (Ramage, Farmer, Eccles, & McCargar, 2013). On a general level, consumers know what a healthy diet and lifestyle entail (Dickson-Spillmann & Siegrist, 2010). Nevertheless, despite having both the knowledge and the motivation many consumers struggle adhering to the long-term goal of eating healthily and maintaining a healthy body weight.

The obesogenic environment

Peoples' bodies have evolutionarily developed a preference for high-energy food, indicated by high sugar and fat content (Breslin, 2013). This preference was conducive to survival and reproduction in the environment of evolutionary adaptedness in which food was a scarce resource. However, it has become problematic in today's obesogenic environment (Wansink, 2004). Consumers are constantly exposed to unhealthy food that appeals to their innate taste for sugar and fat. In these cases consumers face a self-control dilemma: Adhering to their long-term goal requires the exertion of self-control to resist the food temptation. In light of these temptations the short-term goal of consuming tasty food often outweighs the long-term goal leading to self-control failure (Baumeister, 2002).

The mere availability and accessibility of hedonic, but unhealthy food in the environment is considered one of the main contributors for overconsumption and unhealthy choices (Hill & Peters, 1998). Consumers appear to be particularly vulnerable to overconsumption and unhealthy choices when exposed to them in their immediate environment (Maas, De Ridder, De Vet, & de Wit, 2012). Access to fast food restaurants (Swinburn, Egger, & Raza, 1999), candy dishes at the office (Wansink, Painter, & Lee, 2006), and stockpiling food in the home (Chandon & Wansink, 2002) have all been associated with unhealthy eating behavior. However, the precise mechanisms via which the environment exerts its influence on

consumers' food intake remain unrevealed. As mentioned previously, most consumers are motivated and sufficiently knowledgeable to eat relatively healthily, however fail to act in line with this goal when exposed to food temptations. The reasons for this self-control failure may lie in the environmental influences on consumers. In most instances exposure to food initially occurs on a visual level. Yet, it is unclear how visual exposure to food influences consumers' reactions on a cognitive, motoric, and behavioral level.

The studies reported in the first part of this dissertation aim at uncovering the mechanisms by which the environment influences consumers' eating behavior. Specifically, it focuses on the effects the environment exerts on people's visual, cognitive, motoric, and behavioral responses to food in the environment. The second part of the dissertation examines whether these mechanisms can be employed to improve consumers' eating behavior. It investigates both the question of whether the environmental influence on eating behavior can be employed as a strategy to reduce unhealthy, but increase healthy eating behavior. Moreover, it examines the conditions under which consumers approve of the implementation of such environmental designs for the promotion of healthy eating in their immediate environment.

Theoretical framework

Humans have a highly developed visual system on which they rely to learn about and interact with their environment. Like other objects, food in the environment is first encountered with the eyes and this visual encounter prepares the body for consumption via the activation of physiological, emotional, and cognitive mechanisms (Van der Laan, De Ridder, Viergever, & Smeets, 2011; Engelmann, 2006; Mattes, 1997; Kroese, Adriaanse, Evers, & De Ridder, 2011; Simons, Martin, & Barsalou, 2005). The visual system is an integral part of guiding the body's interaction with the environment. It locates objects and directs the body towards them, guides the manipulation of objects in relation to each other, and it checks the status of a body-object interaction (Land & Hayhoe, 2001). In addition to that, the visual system is fundamental to the intimate link between the perception of objects and motoric interactions with them as posited by the theories of embodied cognition (Goslin, Dixon, Fischer, Cangelosi, & Ellis, 2012; Gibson, 1979). These theories claim that perceptual and motor systems are not merely input devices to the mind, in which centralized cognitive processes take place. Instead, cognition is understood as ultimately linked to sensorimotor processing. Cognition does not occur in a vacuum but is intertwined with its body's abilities and the environment in which it is situated (Wilson, 2002). For example, people's attentional bias towards their near environment is influenced by their arm's length because this body feature

determines this area of potential body-environment interaction (Longo & Lourenco, 2007).

The cognitive system has evolved to contribute to the body's effective functioning. As part of that, embodied cognition theorists argue, the main function of the visual system is to facilitate sensorimotor interactions between body and environment (Martin, 2007). In fact, previous research has revealed the existence of two separate neural pathways, the ventral and the dorsal visual pathway, which process visual information depending on the function of the information (Goodale & Milner, 1992). Whereas the ventral stream processes information about an object's properties (what), the dorsal stream handles information about the object's location (where) and how to interact with it (Wilson, 2002). As such, they form two separate, but interacting pathways specialized for perception and action, respectively (Cloutman, 2012; Himmelbach & Karnath, 2005; Milner & Goodale, 2008).

A large array of scientific investigations has collected support for these notions by illustrating how visual object perception prepares the body for motor interaction. The theory of affordances postulates that objects in the environment afford potential interaction (Gibson, 1979). As such, affordances are perceptions of the action system between the body and the environment in which it is situated (Warren & Whang, 1987; Chemero, 2003; Barsalou, 2008). Perceiving an object's affordance leads to the activation of the motor system, which prepares the body for interaction with the object (Goslin et al., 2012; Wilson, 2002). Chairs afford sitting, handles afford to be grasped, and stairs afford to be climbed (Warren, 1984). This notion is supported by studies revealing congruency and spatial alignment effects: Congruency effects are shown through response facilitation of movements that are compatible rather than incompatible with observed objects. Tucker and Ellis (2001; 2004) have shown that a movement is facilitated if a task-irrelevant object feature, such as its size, is compatible with the movement required by the task. For example, in one of their experiments participants had to categorize objects according to whether they were natural or manmade by executing a precision or a power grip. The presented objects either afforded to be grasped with a power grip (e.g. hammer) or a precision grip (e.g., screw). Participants were faster categorizing the objects into being a precision or power grip if the grasp type required for the categorization matched the afforded, but task-irrelevant grasp type. Thus, their results support the notion that motor actions are activated upon mere visual perception of objects. Similarly, these congruency effects have been shown for an object's left and right rotation on keyboard responses with participants' left and right hand (Tucker & Ellis, 1998), for reach to grasp movements (Ranganathan, Lee, Brown, & Newell, 2011), and have been supported by fMRI imagining showing theory-consistent brain activations in pre-motor areas (Grèzes, Tucker, Armony, Ellis, & Passingham, 2003;

Chao & Martin, 2000). Furthermore, motor activation has been shown to be dependent on the functionability of the observed objects (De Stefani, Innocenti, Bernardi, Campione, & Centilucci, 2012), and is stronger when two observed objects are functionally compatible (Borghi, Flumini, Natraj, & Wheaton, 2012). An alternate approach to investigate motor activation upon object perception relies on the spatial alignment effect. This paradigm has shown movement facilitation for tasks in which required movement and object affordances match. Movements with the right and left hand are facilitated when the observed object's handle is orientated towards the right and left side, respectively (Bub & Masson, 2010). Thus, spatial alignment effects yield additional support for the notion that task-irrelevant movements are activated upon the mere visual perception of objects.

The theories of embodied cognition and of affordances posit that objects in the environment automatically activate the motor system involved in potential interactions with the observed objects. Thus, visual perception entails both information about an object's properties and information that prepares for action. Considering that consumers struggle resisting food temptations when they are visually encountered in the environment it could be argued that, like other objects, food affords interaction. Accessible food in the environment might afford to be reached for and eaten. As explained above, this affordance perception would prepare the body for interaction with the food: for reaching and possibly for eating itself. The first part of this dissertation examines the effects of both aspects of vision on cognition and behavior. Specifically, it aims at determining whether the vision-induced preparation for motor interaction influences consumption above and beyond the mere visual property driven desire to eat. In other words, it tests whether the influence of seeing food in the immediate environment not only influences consumption via the provision of visual information about the food's properties, but also via the inherent preparation of the motor system to interact with the food. Thereby it attempts to explain the influence the observation of food in the environment has on people's food-related behaviors.

Embodied cognition informed choice architectures

The environment's influence on eating behavior and food choice currently yields mostly negative consequences for consumers' health. The environment is laden with unhealthy food that consumers cannot resist, and the constant availability in combination with ever-growing portion sizes leads to overconsumption (Wansink, 2004; British Heart Foundation, 2013). Understanding how the environment exerts its influence on consumers may inform strategies for consumer protection and wellbeing. On this basis one could make unhealthy food inaccessible, raise consumers' awareness about the influences they are subjected to in order to

facilitate resistance, and inform consumer protection laws. These strategies attempt to overcome the environment's influence on consumers. Following an alternative strategic route could entail the employment of the environment's influence on consumer behavior to promote healthy behaviors. This strategy entails piggybacking on what is currently depicted as a weakness in consumers' behavior.

Designing environments that promote behaviors beneficial for consumers is the idea underlying the concept of nudging. By definition, nudging aims at influencing consumers' behaviors in predictable ways without excluding any options from the choice array or meaningfully changing the costs involved in any option (Thaler & Sunstein, 2008). Essentially, nudging uses the design of clever choice architectures to make choices and behaviors that benefit the consumer the easier or more attractive ones. All options for choices and behaviors remain available to the consumer; however, the beneficial ones are presented in such way that they are easier, more salient, or more attractive (De Ridder, 2014). Examples of nudging in the realm of eating behavior include the presentation of healthy choices in prominent locations such as the cashier at the supermarket (Kroese, Marchiori, & De Ridder, 2015), the provision of smaller plates at all you can eat buffets to promote the consumption of smaller portions (Wansink & Van Ittersum, 2013), and the sale of readily sliced fruits to promote fruit consumption (Wansink, Just, Hanks, & Smiths, 2013). These choice architectures could promote healthy eating behavior and food choices if based on an in-depth understanding of the mechanisms in which consumers are influenced by their environments.

Criticisms of nudging consumer behavior

Despite the current prominence of these nudging strategies, policy makers and governmental 'nudge units' are experiencing resistance in their attempts to include nudging into their policy repertoire (Sunstein, 2015a, Local Government Association, 2013). Criticisms of nudging revolve around four broad issues.

Firstly, the effectiveness and boundary conditions of nudging have not conclusively been demonstrated. One remaining question, for example, concerns the degree to which the effectiveness of nudging depends on people's unawareness of the influence (Kroese et al., 2015). Moreover, the long-term effects of nudging on consumer behavior have not been addressed sufficiently, thus causing a point of concern for opponents of nudging (Marteau, Ogilvie, Roland, & Suhrcke, 2011).

Secondly, critics are opposed to the idea of employing people's cognitive shortcomings to influence their behavior. The effectiveness of nudging is based on the fact that people do not rationalize and deliberate many of their behaviors and

choices, but instead rely on mental shortcuts, so called heuristics and biases (Kahneman, 2003). While these shortcuts have a reputation for leading to suboptimal outcomes, research in fact has shown that people benefit from relying on these subconscious influences (Bechara, Damasio, Tranel, & Damasio, 1997; De Ridder, Kroese, Adriaanse, & Evers, 2014; Salmon, Fennis, De Ridder, Adriaanse, & De Vet, 2013; Wilson and Schooler, 1991). Nevertheless, critics of nudging maintain their discontent with the employment of heuristics and biases to influence consumers.

In addition, philosophers are concerned with the implications of nudging for consumer's autonomy (Sunstein, 2015a). Nudging is based on libertarian paternalism. It is paternalistic in that a particular behavior or choice is promoted by an external source, and libertarian in that no behavior or choice is enforced or excluded from the choice array (Thaler & Sunstein, 2008). The fact that an external source decides what behaviors are beneficial for consumers is suggested to pose a threat to consumers' autonomy because their behaviors are directed without the involvement of consumers' conscious processing (Sunstein, 2015b).

Finally, nudging by definition is a non-regulatory approach that may bypass the democratic procedures required for mandated regulations (Oliver, 2013). As such, nudges are more easily implemented, but also require less official approval and may receive less publicity (McCrudden & King, 2015), which makes them vulnerable to abuse, hinder the implementation of the regulatory stronger mandates, and less available to public criticism.

Despite the ongoing philosophical discussions as to the appropriateness of nudging, the strategy is targeted at consumers and aimed at increasing consumers' welfare. Therefore, consumer's attitudes towards, criticisms of, and concerns with nudging should be considered when evaluating nudging strategies and determining their appropriateness for the improvement of consumers' behavior. For that reason, the second part of this dissertation sets out to determine consumers' attitudes towards nudging as well as the boundary conditions that determine consumer approval. Overall, this understanding should contribute to consumer welfare: The main aim of the 'Consumer Competence Research Training Network' (ConCoRT), under the umbrella of which the research in this dissertation has been conducted.

Summary

The previous paragraphs have outlined the societal problem of overconsumption and unhealthy food choices as well as how these behaviors are influenced by visual exposure to accessible food in the obesogenic environment. While the influence of

accessibility of food on consumption has been shown consistently, the cognitive mechanisms underlying the effects lack scientific inquiry. Yet, understanding these mechanisms yields the opportunity to employ the environment's influence for the promotion of health behaviors, as suggested by proponents of choice architectures and nudging. While these strategies may promote health behaviors, they have been criticized for their potentially harmful consequences for consumers and society. The target group of nudging strategies however, the consumers, have remained excluded from these discussions and their attitude towards nudging remains to be investigated.

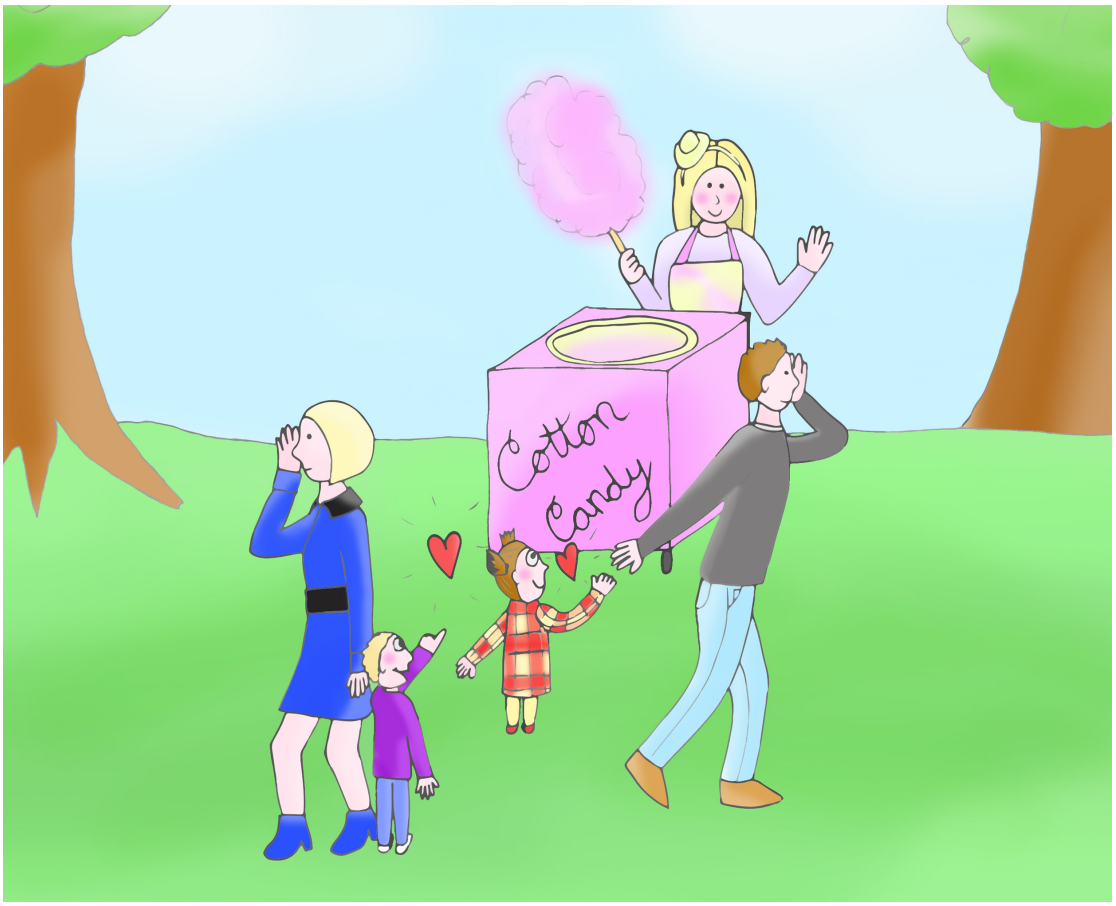
Chapter Overview

Part one of this dissertation investigates the cognitive mechanisms underlying the influence of visual exposure to food in the environment. Chapter 2 reports an eye-tracking experiment that examined the degree to which children and adults differentially exert visual attention to healthy and unhealthy food. The experiment described in Chapter 3 extends the influence of food in the environment from visual attention to actual eating behavior. By disentangling the effect of visual exposure to, and the ability to comfortably interact motorically with food, both the impact of the visual properties of presented food and the impact of potential motor interactions are studied. Thereby, the study examines the differential contributions of seeing food's visual properties and motor preparation to interact with the food on consumption. The importance of potential interactions with food on the cognitive system is further explored in Chapter 4. In two experiments both the impact of food's accessibility in terms of distance and of packaging on the activation of eating information is examined using a reaction time measure. As such, Chapter 4 describes how accessible but not inaccessible food activates cognitive systems involved in motor interaction. In extension, Chapter 5 investigates whether exposure to accessible and inaccessible food differentially influences the ability to inhibit movements towards the food in two experiments. These experiments were conducted with long-tailed macaques as they are considered a culturally and educationally unbiased sample regarding their responses to food. At the same time these monkeys share essential aspects of their cognitive and physiological markup, such as action-selection and action-inhibition mechanisms with humans (Sartori, Camperio-Ciani, Bulgheroni & Castillo, 2014). These studies reveal the influence of visual exposure to food in the environment on visual attention, consumption, and the activation of the motor system involved in interaction.

Drawing on the findings in part one, the second part of the dissertation investigates firstly whether environmental influences can be employed to promote healthy behavior. Chapter 6 reports findings based on observational data collected when a

large fast food restaurant chain reduced their French fry portion sizes and added fruit slices to their kid's menu. In extension to showing the effectiveness of this accessibility nudge Chapter 7 explored another type of nudge using the choice-blindness paradigm. The study is based on a discrepancy between consumers' self-reported preferences and their behaviorally revealed choices of food. While commonly reporting a preference for natural ingredients in their food consumers' actual food choices appear to be unaffected by the naturalness of ingredients. In an attempt to test whether nudging can overcome this discrepancy, the influence of a subtle reminder to consider the naturalness of ingredients on consumers' attention to ingredient lists is examined.

Building on the exploration of the effectiveness of nudging on consumer behavior and in light of the criticisms of nudging raised by theorists and philosophers the final part of the dissertation investigates consumers' attitudes towards nudging in the realm of health behavior. Chapter 8 describes a qualitative exploration based on semi-structures interviews with consumers. On the basis of these interviews a cross-national survey was designed. Chapter 9 reports how this study explored the degree to which a nudge's perceived intrusiveness impacts consumers' approval with the nudge and tested whether levels of approval depend on the source of the nudge as well as the degree to which this source is trusted.


Cotton
Candy

Chapter 2

UnAdulterated
Children and Adults' Visual Attention to Healthy and Unhealthy Food

Junghans, A. F., Hooge, I. T. C., Maas, J., Evers, C., & De Ridder, D. T. D. (2014). UnAdulterated – Children's and Adults' Visual Attention to Healthy and Unhealthy Food, *Eating Behaviors, 17*, 90-93.

Adults screaming at the supermarket cashier because they are not allowed any candy are rarely encountered; screaming children, however, can be observed regularly. This is hardly due to adults not liking the offers of snacks but due to the fact that they, as opposed to children, self-regulate their eating behavior. The combination of omnipresent food temptations and people's desire to be healthy often causes self-control dilemmas (Crawford, 2006; Lake & Townshend, 2006; Serdula et al., 1999). To successfully resist food temptations people employ self-regulation strategies (Baumeister & Vohs, 2005).

Previous research revealed attentional biases to food compared to neutral objects (Nijs et al., 2010), as well as to unhealthy, palatable compared to healthy food because these foods suggest rewarding experiences (Werthmann et al., 2011; DiPellegrino et al., 2011). Palatable food activates the reward system due to repeated coupling of the food cue and the rewarding consumption experience (Nijs et al., 2010; Castellanos et al., 2009). This incentive salience (Berridge, 2009) increases the attention to unhealthy food cues (Jansen et al., 2003) and the craving for the food (Field & Cox, 2008; Castellanos et al., 2009). Experimentally manipulated attention to unhealthy rather than healthy food has even shown to increase subsequent consumption (Werthmann et al., 2014) and field studies revealed increased consumption resulting from proximity and salience of food (Cohen & Farley, 2008 Maas et al., 2012; Painter et al., 2002; Wansink et al., 2006). Consequently, visual attention to unhealthy food may be harmful to successful resistance (Nijs et al., 2010; Werthman et al., 2014). In an attempt to prevent this cue-triggered urge to eat, people may self-regulate their visual attention to avoid the food, thereby resisting the temptation to eat and acting in consistence with long-term health goals (Berridge et al., 2010). However, the required self-regulatory capacity is often insufficiently available (Baumeister et al., 1994), because it weakens during previous exertion of self-control, for example when coping with stress and regulating emotions (Muraven & Baumeister, 2000).

Considering that self-regulatory skills develop throughout childhood and adolescence (Mischel et al., 1989; Rothbart et al., 2006) adults should be better at visually avoiding food than children. To test this idea this study employed a novel method of comparing self-regulatory capacity between children and adults in an eye-tracking paradigm. Specifically, it tested whether they differ in their self-regulatory tendency to avoid unhealthy food by measuring visual attention, in terms of gaze direction and gaze duration, to healthy and unhealthy food.

Visual attention is presumably driven by two processes: Bottom-up processes are driven by stimulus features leading to involuntary and unconscious attentional shifts to potentially relevant stimuli. Thus, they are particularly strong during the early stages of visual exposure. Top-down processes are voluntary and conscious mechanisms that shift attention to goal-relevant stimuli meaning they gain influence at later stages (Connor et al., 2004; Kean & Lambert, 2003). Consequently, bottom-up features, such as the attractiveness of a stimulus, should have a strong influence on early visual attention, whereas conscious goals and self-regulatory strategies should become more influential at a later stage. Thus, unregulated initial fixations

should be influenced most strongly by the attractiveness of the food, whereas overall dwell time, reflecting maintained attention, should be more influenced by self-regulatory strategies related to an attempt to avoid the unhealthy food. However, these self-regulatory strategies should have a stronger impact on adults' than on children's maintained visual attention because children are supposedly less capable of self-regulation (Mischel et al., 1989). Consequently, both children and adults should reveal an initial attentional bias toward unhealthy, attractive food. For maintained attention, adults that are motivated to avoid unhealthy food should exert self-regulatory strategies that lead them to avoid unhealthy food while children should reveal less influence of self-regulatory strategies. Their visual maintained attention should remain stronger on the unhealthy food.

This research provides a novel method of examining self-regulatory mechanisms by differentiating between uncontrolled bottom-up and goal-influenced top-down visual attention. Additionally, the method relies on naturalistic viewing instructions and procedures that limit experimental influences on viewing behavior.

Methods

Sample and participant selection. Participants were junior summer school attendants at Utrecht University and young adults recruited on the campus for monetary reward. After exclusions the final analysis included N = 80 (34 children; 46 adults). Exclusions were based on adherence to the task and data quality. Participants looking off the screen in > 75% of the cases were excluded (4 adults; 18 children). Otherwise only the respective trials were excluded (24 in adults; 28 in children). Additional exclusions were made if the root mean square noise exceeded 1 degree (39.5 pixels) on the screen (Holmqvist et al., 2011, p. 35 (5 trials in adults; 2 trials in children)). 52.9% of children were females with a mean age of 9.9 years (*SD* = 1.1). Adults included 56.5% females with a mean age of 20.4 years (*SD* = 2.7). The study was conducted in accordance with the ethical standards described by the Medical Research Involving Human Subjects Act (WMO, 2012). Children's parents provided prior consent in addition to children volunteering. For the adult sample formal informed consent was obtained.

Procedure. Children's and adults' eye-movements were calibrated using a 9-point calibration and were instructed to look at 4 experimental and 14 filler pictures. Exposure time was self-paced to ensure naturalistic viewing of the images (See Pieters & Wedel, 2007; Theeuwes et al., 1998). Consequently, exposure time depended on participants' interest in the picture and terminated upon clicking the space bar (maximum = 10 seconds; mean for adults *M* = 547; *SD* = 250 and children *M* = 445; *SD* = 191) after which the picture disappeared. A click initiated the next trial, which started with a fixation point at the center of the screen, between the two food objects, for durations ranging from .3 to .7 seconds. A remote eye tracker (Eyetech TM3) was used. Gaze was recorded at a frequency of 52 Hz. This procedure was followed by a questionnaire on the importance of eating healthily.

Materials.
Images: Photographs of one naturalistic scene of a dinner table with two opposing sets of dishes and two serving plates between the sets were presented. One serving bowl contained the unhealthy food, fried breaded meat sticks (a popular Dutch snack), and the other bowl contained the healthy food, peas. Both represent commonly consumed foods in the Netherlands. The bowls on the pictures were exhibited at slightly different combinations of distances to avoid the repetition of identical pictures. Whereas previous research has shown effects of stimulus distance (Junghans et al., 2013), differences here employed were much smaller (~10-15 cm).

Areas of Interest: In each experimental picture two almost equally sized (maximum diversion: 4%) oval areas of interest (AOI) were defined.

Figure 1. Sample picture with healthy and unhealthy food and their respective Areas of Interest.

Measures. Measures of attention attraction were based on initial fixations and measures of attention maintaining capacities were based on overall dwell time (following Holmqvist et al., 2011). Initial fixations were defined as the fixation following the first fixation during onset of the image (based on an adaptive velocity threshold method (See Smeets & Hooge, 2003; Nyström & Holmqvist, 2010). Dwell time was defined as the overall amount of time that gaze was directed to an AOI. The questionnaire examined participants' ratings of importance of eating healthily and attempt to eat healthily (1: not at all – 5: very much). All participants provided demographic data.

Results

Comparisons of importance of healthy eating and attempts to eat healthily revealed no difference between children and adults, $t(78) = 1.48$; $p = .14$; $t(78) = -0.39$; $p = .67$.

Attention attracting capacity. Results revealed participants' tendency to look toward the left side of the computer screen in the filler images: 81.6% within adults, 76.2% within children. Consequently, the proportion of looking at the unhealthy (left) rather than the healthy food (right) in the experimental images was calculated against the proportion of looking towards the left rather than the right side of the screen. A non-parametric binomial analysis revealed a stronger tendency for both adults and children to look at the unhealthy food rather than the healthy food, compared to looking at the left rather than the right side of the screen: Adults: p = .03, Children: $p < .001$. Thus, the tendency to look towards the unhealthy food was significantly larger than the general bias towards the left side of the computer screen. Consequently, the proportion of initial fixation toward the unhealthy food was 7.9% and 14.2% higher than the proportion of initial fixations to the left side of the screen for adults and children, respectively. These findings support the first hypothesis that children and adults initially fixate on the unhealthy food to a disproportionally high degree.

Attention maintaining capacity. To test hypothesis two, which predicted stronger maintained attention on healthy food in adults than in children, their overall dwell time on healthy versus unhealthy food was compared. Means of the variable 'dwell time' were computed per category (healthy, unhealthy) and were natural log transformed to normalize their distribution. Outliers (+/-2SD from the mean) were excluded. All reported means are based on untransformed data for ease of interpretation. A multivariate ANOVA with children and adults as between subjects factor, healthiness of the food as within-subjects factor, overall dwell time on the image as covariate, and dwell time as dependent variable revealed a significant difference in dwell time on healthy and unhealthy food between children and adults, $F(2, 76) = 5.8$; $p < .01$; $\eta^2_p = .13$. Overall dwell time on the pictures was a significant covariate $F(2,76)$, $p < .001$, $\eta^2_p = .24$. Post hoc tests showed that for the comparison of each individual food the dwell time on the unhealthy food differed significantly between adults and children (p = .001) whereas for healthy food no significant difference was observed (p = .48). While children paid more maintained attention to the unhealthy food (M = 953; SD = 747) than adults (M = 736; SD = 595), children paid equal amount of maintained attention to the healthy food (M = 592; SD = 423) as adults (M = 717; SD = 505). Thus adults shifted their visual attention away from the unhealthy food as time elapsed whereas children remained focused on the unhealthy food.

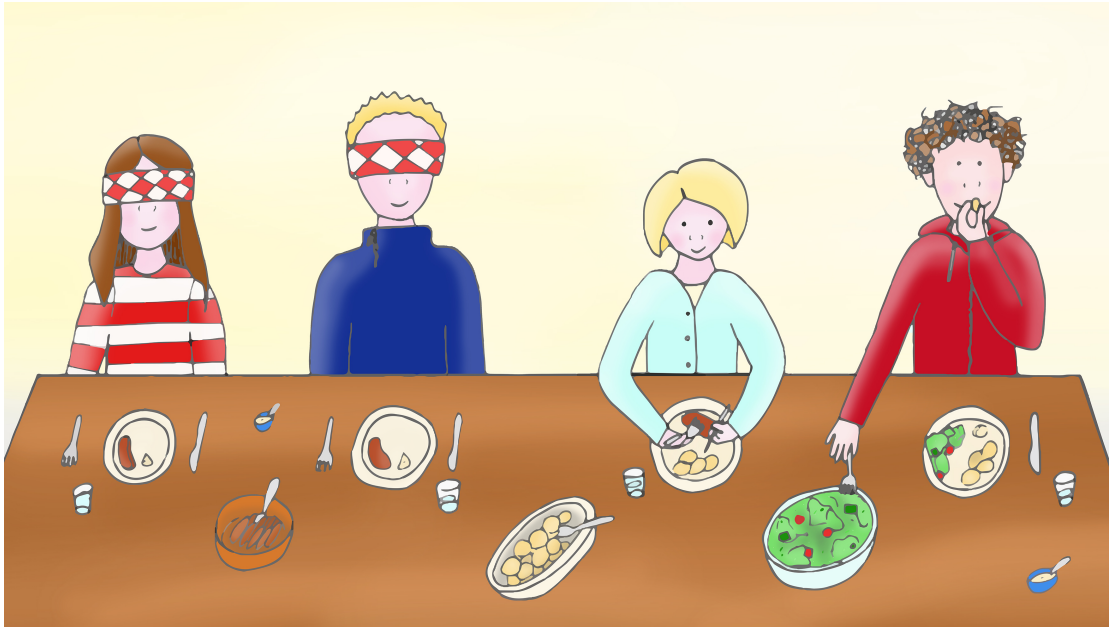
Discussion

These findings reveal differential self-regulatory avoidance tendencies in children and adults. While they report similar importance of healthy eating and attempting to eat healthily, only adults self-regulate their visual attention away from unhealthy food. The findings show that adults are strongly attracted by unhealthy food, as revealed by unhealthy food's strong initial attention attracting capacity. However, once goal-influenced top-down processes have an influence on visual attention, adults shift their attention from the unhealthy food to the healthy food or other features on the image, suggesting a self-regulation process of avoidance. Thus,

adults should be able to successfully avoid the cue-induced desire to consume the unhealthy food. Contrarily, children attend more strongly to the unhealthy food. These findings are particularly important considering the effect of endured visual attention on the increased likelihood of choosing an object (Armel et al., 2008) as well as the effect of an attentional food bias on craving and consumption (Castellanos et al., 2009; Jansen et al., 2003; Werthmann et al., 2014b). They are even more critical in light of the previously shown predictive power of attentional food biases on the development of overweight and obesity (Berridge, 2009; Nijs et al., 2010). Despite not measuring actual eating behavior, the findings suggest a need for better protection of children from food cues in the environment at young age (Nader et al., 2006).

Despite the advantages of naturalistic viewing in eye-tracking, future studies should complement this study with more controlled procedures and higher number of trials. While participants' tendency to look towards the left side of the screen could be statistically accounted for, future research should overcome this bias by mirroring images and using a counterbalancing procedure. A further limitation could be the use of self-report measures for importance of healthy eating and the impact of liking of the food on visual attention.

Overall, this study revealed adults' stronger self-regulatory avoidance of unhealthy food compared to children, thereby allowing for stronger cueing effects in children despite their goal to eating healthily. The findings call for strategies that promote children's self-regulatory skills in successfully navigating the obesogenic environment.



Chapter 3

Highlights in the Dark
How the Ability to Maneuver Influences Consumption in the Dark

Junghans, A. F., Stok, F. M., Evers, C., De Ridder, D. T. D., Renner, B. (Submitted for publication). Highlights in the Dark: How the Ability to Maneuver Influences Consumption in the Dark.

In light of the obesity epidemic and health consequences resulting from unfavorable eating behaviors, researchers have been investigating the drivers of food consumption. One branch of investigations has specifically focused on the influence of visual factors on eating, by manipulating the visibility of food through blindfolding participants or darkening rooms. These studies have found lower consumption (Linné, Barkeling, Roessner, & Rooth, 2002; Renner, Sproesser, Stok, & Schupp, Manuscript under Revision), reduced monitoring capability (Scheibehenne, Todd, & Wansink, 2010), lower willingness to buy the food (Renner et al., 2015) less decelerated eating curves (Barkeling, Linné, Melin, & Rooth, 2003), and reduced acceptance of food (Wansink, Shimizu, Cardello, & Wright, 2012) under dark compared to normal vision conditions. To this point none of these investigations has incorporated the ability to maneuver in a darkened environment or under blindfolded conditions into their analysis as a potential mediator of these effects. Despite participants reporting motoric difficulties with eating in the dark (Scheibehenne, et al., 2010), a systematic examination and experimental variation has been missing. Yet, understanding how the ability to maneuver and motorically interact with these environments influences eating behavior is essential to ensure a holistic interpretation of the effects of food visibility on consumption. For example, slowed eating under dark conditions can be attributed to an enhanced focus on internal satiety cues as suggested in previous research (Marx et al., 2003; Linné et al., 2002; Barkeling, et al., 2012), but could also be driven by a greater difficulty to locate the food in the dark. Furthermore, it is important to understand how both visual exposure to food and the ability to motorically interact with it affects consumption in everyday eating situations. Previous research has indicated that eating behavior is influenced by accessibility of food (Wansink, Painter, & Lee, 2006), visual information about the food consumed (Wansink, Painter, & North, 2005), as well as the degree to which it yields immediate interaction, such as grasping and eating (Junghans, Evers, & De Ridder, 2013).

In this study we examine the effect of food visibility and resulting difficulty to maneuver in dark conditions on food consumption. As such, we examine the potential influence of difficulty to maneuver in dark eating environments on consumption. In addition, the results of the investigation shed light on the importance of visual cues for interacting with the environment beyond the realm of eating behavior.

An Embodied Cognition Perspective on Interaction with Food

Embodied cognition theorists claim a strong link between object perception and motor interaction with objects (Wilson, 2002). Visually perceiving object properties provides information to the nervous system activating appropriate action patterns that allow body movements to be attuned to particular environment and object properties (Goslin, Dixon, Fischer, Cangelos, & Ellis, 2012). Gibson (1979) has termed the potential interactions exerted by objects and perceived by individuals as affordances. Any functional object in the environment exerts possibilities for interaction. As such, stairs afford to be climbed, handles afford to be grasped, and chairs afford to be sit on (Warren, 1984; Warren & Whang, 1987). The implication of these accounts is that visual object perception not only informs about the specific

properties of the objects. It additionally provides information about the potential motor interactions with the object. A large array of studies has shown that object perception automatically activates motor interaction with the objects (Grezes & Decerty, 2002; Tucker & Ellis, 1998; Grèzes, Tucker, Armony, Ellis, & Passingham, 2003). The evidence derives from task-irrelevant response facilitation by mere visual object perception (Tucker & Ellis, 2001). For example, participants asked to respond to object features such as color with either the left or right hand will be affected by the spatial orientation of the presented object. If the spatial orientation of the objects affords interaction with the left hand, movements with this hand will be facilitated (and vice versa) despite the task-irrelevance of this object feature (Bub & Masson, 2010).

On a neurological level these effects are based on two interacting pathways of the visual system. While the ventral pathway has been shown to encode the descriptive aspects of object perception, the dorsal pathway encodes the spatial properties of observed objects (Ellis & Tucker, 2000; Tucker & Ellis, 2001; Himmelbach & Karnath, 2005). Through this immediate perception of the spatial properties of objects in combination with the automatic activation of interaction-relevant motor patterns the interaction between individuals and their environment is facilitated and eased (Land & Hayhoe, 2001; Junghans, Evers, & De Ridder, 2013).

These lines of research support the embodied cognition notion that visual perception of objects in the environment facilitates interaction through the automatic activation of the motor system, especially the motor movements involved in interacting with the observed objects (Goslin et al., 2012). Thereby, the findings speak for the essential role of visual object perception in successfully and comfortably interacting with the environment. Without the visual perception of objects, spatial information cannot be decoded and affordances are not perceived, implying that motor patterns for interaction are not activated, thereby hindering the visual guidance of action (Warren & Whang, 1987).

Based on this rationale it can reasonably be expected that people perceive more difficulties interacting with objects in their environment when they are not visually perceiving the objects they are interacting with, as is the case when blindfolded or in fully darkened rooms. This difficulty has indeed been reported in investigations into the effect of food visibility on eating behavior. Scheibehenne and colleagues (2010) asked participants how difficult they found it to eat in the dark and found higher ratings for the dark than the vision condition. The manipulation in their experiment, as well as those in a number of other experiments in which participants were blindfolded or placed in completely dark environments, can be considered unfamiliar environments. One could also expect that wearing goggles or blindfolds, or being placed in a dark room, my add to this effect and distract participants from aspects of the situation they would attend to under normal vision conditions, and require more cognitive resources to successfully maneuver in these unfamiliar environments due to lacking facilitation of motor activations. These factors may distract people from other aspects of eating, such as the taste, they have capacity to attend to under normal seeing conditions, thereby impacting the amount they consume.

Nevertheless, these assumptions about a possible inability to maneuver and comfortably interact with the food and utensils have not been empirically investigated to this day.

The Current Study

For those reasons the current study investigated the effect of food visibility on consumption and the degree to which this relation is influenced by the ability to maneuver in dark conditions. The current study set out to fill this gap by including an additional highlighting manipulation in an experiment testing the effect of vision on consumption. Specifically, by providing utensils and bowls that glow in the dark, it was tested whether previously observed effects of food visibility on eating behavior can be attributed to a reduced ability to maneuver in dark conditions. This additional manipulation allowed examining the degree to which the amount of food consumed under dark and vision condition can be attributed to different abilities to maneuver and motorically interact with the food using utensils. It was predicted that participants in the dark condition would consume less food compared to those in the normal vision condition as shown in previous research (Hypothesis 1). However, the effect should be alleviated by highlighting utensils in such way that consumption should be higher in the dark highlighted condition than the dark not highlighted condition (Hypothesis 2). Moreover, it was predicted that participants in the dark condition would experience eating to be more difficult than those in the vision condition (Hypothesis 3). Finally, it was hypothesized that difficulty to maneuver would mediate the effect of vision and highlighting on consumption (Hypothesis 4). These findings would suggest that decreased consumption under dark conditions is driven by a difficulty maneuvering in the dark.

Methods

Design. The study was based on a 2 (vision vs. dark) x 2 (highlight vs. no highlight) between subject design. The manipulation of vision was operationalized by placing participants in normally lit rooms (vision condition) or fully dark rooms (dark condition). Furthermore, each participant received either eating equipment that was highlighted by fluorescent color which glows in the dark to ease their maneuvering while eating (highlighted condition) or no such highlighted utensils (non-highlighted condition).

Procedure. A total of 123 participants (90 females; 33 males) were recruited from a student sample for course credit or monetary rewards and invited to a taste test. They were randomly assigned to one of the four conditions (vision highlighted, vision non-highlighted, dark highlighted, dark non-highlighted). Each participant provided informed consent prior to being guided to the experimental room. In all conditions participants were asked to sit at a table in a window-less cubicle with two cups of different yoghurts placed on a table in front of them. They were further asked to eat as much as they liked but try each yoghurt at least a little to be able to evaluate it afterwards. In the vision conditions the lights remained switched on, whereas the lights were switched off in the dark condition, leaving the room completely dark with

no source of light. Participants in the dark condition were shown manually, by guiding participants' hands to the cups, where the yoghurts and spoon were situated and given the opportunity to try each. They were further instructed to inform the experimenter when they had completed the tasting. The experimenter then took the yoghurts, switched on the lights and provided participants with questionnaires assessing participants' perceived difficulty involved in eating, as well as questions evaluating the yoghurts on a number of dimensions including liking and tastiness. The experimenter weighted each yoghurt to obtain the amount that participants had consumed. A week after the taste test participants were sent a follow-up questionnaire via email assessing their demographics and information including height, current weight, and ideal weight.

The study was conducted in accordance with the ethical standards described by the Medical Research Involving Human Subjects Act (WMO, 2012). Additional ethical approval had been obtained from the Ethical Committee at Utrecht University.

Measures. Amount of yoghurt consumed was obtained by unobtrusively weighing the yoghurt cups before and after the taste test and calculating the discrepancy for both yoghurts combined. Participants' perceived difficulty of maneuvering in the conditions was assessed by asking how difficult they found it to eat the yoghurt (1 = not at all difficult to 7 = very difficult).

Results

Participants and Randomization Check. Participants' average age was 21.64 (SD = 2.75) and 73.2% were female. The follow-up questionnaire was provided by N = 110 participants who had an average BMI of 21.7 (SD = 2.68). There was no significant difference in drop outs from different conditions (p = .839). Randomization checks revealed no significant differences between conditions in terms of age, hunger, BMI, or gender (all ps > .386; all Fs < 1.021). As a significant difference in consumption between genders (males ate more than females, $t(115) = -4.27$; $p < .001$) was observed, this variable was included as a covariate in the subsequent analyses.

Consumption. To normalize the distribution +/- 2SD from the mean were excluded from the analysis, which excluded a total of six participants. A univariate ANCOVA with vision condition and highlighting condition as independent variables, consumption in grams as dependent variable, and gender as covariate was conducted to examine the first two hypotheses. The results revealed no significant main effect of highlighting, $F(1,112) = 1.15$, $p = .286$ but a significant main effect of vision, $F(1,112) = 4.576$, $p = .035$, $\eta^2_p = .039$. Participants in the vision condition consumed more grams of yoghurt (M = 71.19, SD = 33.94) than participants in the dark condition (M = 58.29, SD = 29.43). This effect was qualified by a marginally significant interaction between vision and highlighting, $F(1,112) = 3.921$, $p = .05$; $\eta^2_p = .034$. Pairwise comparisons revealed that this interaction was driven by a significant effect of highlighting on the dark condition ($p = .035$), but not the vision condition ($p = .522$). As shown in Figure 1 participants within the dark condition consumed significantly more with highlighted utensils (M = 67.29; SD = 5.5), than

those without such highlights (*M* = 50.64; *SD* = 5.47). Finally, gender was a significant covariate; $F(1,112) = 20.61$, $p < .001$, $\eta^2_p = .155$. On average, males consumed more (*M* = 84.61; *SD* = 33.58) than females (*M* = 57.65; *SD* = 28.83). Conducting the analysis on the not normalized distribution led to insignificant results.

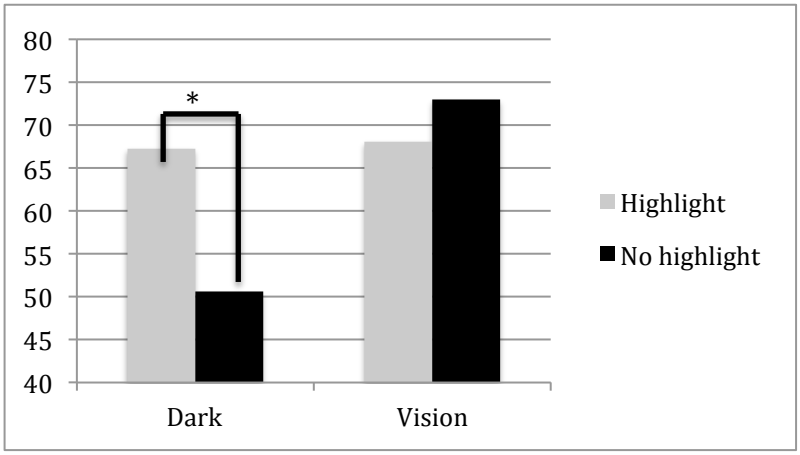


Figure 1. Mean consumption (grams) per condition.

Difficulty of maneuvering. As this initial finding suggests that highlighting the utensils in the dark condition influenced consumption, regression analyses were employed to assess whether vision and highlighting influenced the difficulty of eating in the dark and whether this difficulty mediated the effect on consumption. To this end, the variables gender, vision, highlighting, and the vision-highlighting interaction (standardized) were included. In all subsequent regression analyses gender was controlled for. Provided means are based on unstandardized data for ease of interpretation. First, the effect of vision and highlighting on consumption was tested. Second, the effect of vision and highlighting on difficulty of maneuvering was tested. And finally, it was examined whether difficulty of maneuvering has an effect on consumption when controlling for vision and highlighting. If difficulty of maneuvering is affected by vision and condition in step two, and if the effect of maneuvering on consumption while controlling for vision and highlighting is significant, we could conclude that difficulty mediates the effect of vision and highlighting on consumption.

As shown in Table 1, the results of these analyses show firstly, a significant effect of vision and significant interaction of vision and highlighting on consumption, replicating the findings of the ANCOVA reported above. Secondly, the regression analyses showed a significant effect of vision and significant interaction of vision and highlighting on difficulty of maneuvering. Participants rate difficulty to be higher in the dark (*M* = 2.54; *SD* = 1.57) than the vision condition (*M* = 1.5; *SD* = .88), but this main effect was qualified by an interaction with highlighting such that there was a much larger difference in the dark condition (highlight *M* = 2.13, *SD* = 1.25; non-highlight *M* = 2.94, *SD* = 1.75) than in the vision condition (highlight *M* = 1.65, *SD* = 1.02; non-highlight *M* = 1.35; *SD* = .71) as predicted by hypothesis 3. Finally, the regression analyses showed no significant effect of difficulty on consumption when

controlling for vision and highlighting. As such, the second step in the regression analysis showed that vision and the interaction between vision and highlighting did indeed have an effect on perceived difficulty of maneuvering, however, contrary to the prediction of hypothesis 4, this difficulty did not mediate the effect on consumption.

Model	R^2	Variable	*Beta*	*t*	*p*
1 predicting consumption	.205	Gender	.389	4.54	< .001
		Vision	-.348	-2.908	.004
		Highlight	-.076	-.642	.522
		Vision x highlight	.289	1.98	.05
2 predicting difficulty	.196	Gender	-.038	-.451	.653
		Vision	.581	4.994	< .001
		Highlight	.104	.893	.374
		Vision x highlight	-.348	-2.451	.016
3 predicting consumption controlling for difficulty	.207	Gender	.387	4.501	< .001
		Vision	-.316	-2.39	.019
		Highlight	-.071	-.592	.555
		Vision x highlight	.27	1.798	.075
		Difficulty	-.054	-.567	.572

Table 1. Results of three regression analyses investigating the relationship between vision, highlight, vision x highlight interaction, difficulty of maneuvering, and consumption.

General Discussion

The results corroborate findings from previous research by showing that participants in dark conditions consume less than those who can see (Barkeling et al., 2003; Burger et al., 2011; Linné et al., 2003; Renner et al., 2015). Additionally, the findings show that providing highlights to utensils has a positive effect on consumption in the dark as it overcomes the negative effect of dark conditions on consumption. Moreover, it is shown that participants perceive maneuvering in the dark and without highlights as more difficult than maneuvering in seeing and highlighted conditions. Nevertheless, experienced difficulty of maneuvering did not mediate the effect of condition (vision and highlight) on consumption.

The results firstly support previous research showing that people consume less food under dark conditions compared to normal vision conditions. Additionally, the study sheds light on the causes for this reduced consumption. Whereas previous research

has attributed reduced consumption under dark conditions for example to increased attention to internal satiety cues, the current findings show that reduced consumption can, at least partially, be attributed to higher difficulty to maneuver. People perceive eating in the dark to be more difficult than eating under normal conditions. While this observation has already been made in previous research (see Scheibehenne et al., 2010) it had so far not been incorporated into the interpretation of vision effects on consumption. The current study fills this void: It shows that highlighting those features of the environment that are required for eating, the utensils and bowl of food, without allowing participants to see any visual properties of the food itself, alleviates the difficulty to maneuver in dark conditions. Participants experience eating in the dark to be easier when their motor interactions with the environment are supported by highlights. However, this improved ease of maneuvering does not translate into higher consumption.

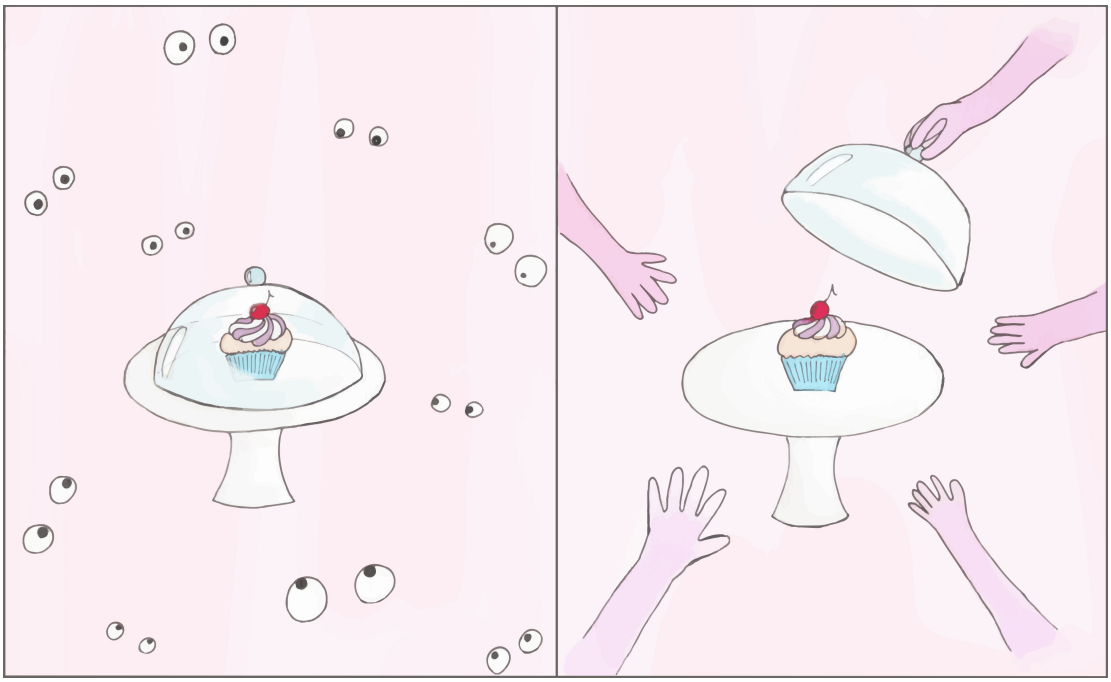
The findings can be explained in light of previous research, which has revealed strong influences of visual qualities of food on consumption. The mere visual exposure to images of food activates brain regions involved in gustatory processing, thereby inducing expectations about taste (Simmons, Martin, and Barsalou, 2005; Van der Laan, De Ridder, Viergever, & Smeets, 2011), increasing blood insulin levels that prepare the body for food consumption (Johnson & Wildman, 1983), and leading to increases in hunger and appetite thereby increasing the likelihood for consumption (Bossert-Zaudig, Laessle, Meiller, Ellgring, & Pirke, 1992; Wadhera & Capaldi-Phillips, 2014). Similarly, the observation of food is sufficient to induce salivation preparing people for eating (Spence, 2011). Via these mechanisms seeing food can increase appetite and desire to eat, leading to higher consumption when people can see the food, compared to when they cannot. Yet, in light of the current findings, these visual qualities of food are not the sole drivers of the effect of darkness on consumption. In addition, reduced consumption in the dark can be attributed to the unfamiliar dark environment, difficulties to find the food, and successfully interact with and eat it. Our findings show that highlighting the utensils both improves the ease of maneuvering and increases consumption, while at the same time revealing that the former is not on its own responsible for the latter. This could be explained in two ways: Firstly, one could argue that, while both difficulty to maneuver and consumption are affected by highlighting, a large driver of consumption, the tempting visual qualities of food, is not reinstalled by an improved ability to maneuver. While participants find it easier to consume the food, they may not do so to the extent they could because the external motivation for eating is lacking. Secondly, it could be that the question employed to assess difficulty to maneuver was not sufficiently precise and specific to accurately tap into the mechanism that does mediate the effect of vision and highlights on consumption. Future research should try to examine whether more elaborate assessments of difficulty to maneuver can provide a more detailed picture of the relationship.

The implications to be drawn from this study for the realm of eating behavior are twofold. Firstly, the findings imply that difficulty of maneuvering in a darkened environment needs to be taken into account when interpreting eating behavior under no vision conditions. Secondly, the study corroborates claims from the

embodied cognition literature about the importance of the interaction of mind, body, and environment in determining behavior (Wilson, 2002). Eating behavior appears to be driven by a combination of cognitive factors and the possibility of the body to successfully interact with the environment.

Furthermore, implications can also be drawn for general behavior and interaction between people and objects in their environments. The results provide evidence for the importance of visual information about the environment for the ease of interacting with it. Lacking visual perception implies missing information about the properties of the objects, but also that no motor systems can be activated via affordances of the objects. It could be argued that the latter is related to the increased difficult of maneuvering, whereas the former could be related to the lower consumption even under highlighted conditions. The visual properties of the food, the tempting qualities that have shown to influence peoples' consumption are lacking in the dark highlighted condition, which could explain the missing mediation effect. Future research is required to evince these speculations.

For the field of embodied cognition the findings suggest that it may not be necessary to observe all aspects of objects to facilitate motor interaction. Detail-deprived information, as in the dark highlighting condition, may be sufficient to show affordance effects and facilitate interaction, at least in situations in which people are aware of what kind of objects they are perceiving. Future research should investigate the amount of detail object perception needs to entail to facilitate motor interaction.



Chapter 4

Eat Me If You Can
Cognitive Mechanisms Underlying the Distance Effect

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The current escalation of problematic eating behaviors and obesity is commonly explained by people's tendency to overeat and choose unhealthy food. This tendency is enhanced by the constant provision of food in today's environment, which people often cannot resist. Consumption is exceptionally high when food is located within people's physical reach (Maas, de Vet, de Ridder, & de Wit, 2012). This observation provides the foundation for the current research, which aims at investigating the underlying mechanism for the increased consumption of food within people's reach. Specifically, the current research investigates whether the accessibility of food modulates the activation of eating-related information.

To answer this question a paradigm from cognitive psychology is applied to assess whether accessible food activates an eating affordance that may stimulate eating behavior. Affordances are potential interactions between an object and its perceiver. Objects afford interactions (e.g. grasping, reaching, sitting) and thereby activate the motor information involved in interacting with the object (Tucker & Ellis, 2004; Ranganathan, Lee, Brown, & Newell, 2011; De Stefani, Innocenti, Bernardi, Campione, & Gentilucci, 2012; Michaels, 1988). Past research has repeatedly shown the activation of motor information upon sight of proximal objects (e.g. Tucker & Ellis, 2001). For example, Costantini, Ambrosini, Tieri, Sinigaglia, & Committeri (2010) employed the spatial alignment paradigm to show that interaction-relevant object features evoke motor activations. Perceiving the handle of a cup to the right or left side facilitates responses with the right or left hand, respectively. However, these studies have focused on artificial rather than natural objects because of their constitutive functionality. Yet, it seems likely that motor information is equally activated upon the sight of natural objects, such as food, under the condition that those are relevant to the observer. However, hitherto this has not been examined empirically. Therefore, this study employs a reaction time measure to assess the activation of information related to potential interaction at the sight of natural and artificial objects; The activation of eating information upon sight of accessible food and the activation of playing information upon the sight of accessible toys. This information is expected to be activated due to the affordances exerted by the actionable objects. This comparison should clarify the differences and similarities between affordances posed by natural and artificial objects. Furthermore, applying the concept of affordances to understanding eating behavior will enhance health psychologists' knowledge of the mechanisms instigating mindless eating behavior and, eventually, enrich the field with novel opportunities to support people in their attempts to eat less, and more healthily.

Theoretical Background

People consume more food when it is located in their proximity than at a distance (Wansink, Painter, & Lee, 2006). This effect can be observed in distances as small as 50 cm. Placing food at 20 cm distance compared to 70 or 140 cm distance has shown to significantly increase consumption (Maas et al., 2012). While effort has often been suggested as the underlying mechanism of this distance effect (Waugh & Gotlib, 2008), the current research examines whether the difference in consumption is, at least partially, driven by the eating affordances posed by proximal food. The

difference between proximity (within arm's reach) and distance (out of arm's reach) can be more clearly defined by the concepts of peripersonal and extrapersonal space. Whereas the peripersonal space refers to the area within reach, the extrapersonal space lies outside of reach. The precise difference is constituted by a person's movement-related spatial map. Neurons in the ventral premotor cortex (area F4) are activated by visual and tactile receptors in such way that the visual receptive field is defined by the tactile receptive field and the area immediately adjacent to it (Rizzolatti, Fadiga, Fogassi, & Gallese, 1997). Moreover, these neurons respond to objects located within the peripersonal space, thereby determining whether objects activate motor information or not (Rizzolatti et al., 2011). Consequently, the terms proximity and distance, as used in the current research, are defined by the peripersonal and extrapersonal space. Objects within this proximity provide immediate potential interactions, so-called affordances that activate information required for the interaction (Gallivan, Cavina-Pratesi, & Culham, 2009; Costantini et al., 2010). The concept of affordances (Gibson, 1979) stems from the notion that observing an object facilitates the possible interactions with the object (Cardellicio et al., 2011). Behavioral studies have shown that the mere perception of (images of) objects activates the motor-acts required for the interaction with the objects. Thus, observing a glass activates the movement involved in reaching for the glass. Similarly, handles afford to be grasped, chairs afford to be sit on, and stairs afford to be climbed (Tucker & Ellis, 2001; Grèzes, Tucker, Armony, Ellis, & Passingham, 2003; Bub & Masson, 2010; Ranganathan et al., 2011; Costantini et al., 2010).

Whether objects present immediate affordances depends, on the one hand, on the spatial location of the objects. Objects generally activate motor information when they are located within reach (Ter Horst, van Lier, & Steenbergen, 2011; Ambrosini et al., 2011). On the other hand, affordances depend on the functionality of the objects. Functionality refers to the possibility to use the objects for their specific function. This implies that objects only activate motor information if they are functional. If objects are presented in such way that prevents their usage, no motor information is activated. Perceiving a bottle of water and a full glass has shown not to activate the affordance to pour as the glass is already full and therefore not functional (De Stefani et al., 2012). Both of these requirements appear to be at odds with the idea of affordances posed by images of objects as those are neither reachable nor functional: They are, as a matter of fact, not actionable (Geyskens, Dewitte, Pandelaere, & Warlop, 2008). Yet, what matters for the activation of motor information is not the realistic actionability, but the perceived actionability. Objects do not require to be realistically reachable and functional, but to lie within a spatial location that is perceived as reachable and in a manner in which the object appears functional. Therefore, images of functional objects that appear to be within reach should activate object-specific motor information despite their inactionability (Ferri et al., 2011: Costantini et al., 2010).

It has previously been argued that artifacts, such as cups, provide stronger affordances than natural objects, such as food, because they are specifically designed for a particular function and are thus mentally represented in terms of this

functionality. Natural objects, on the other hand, are supposedly represented mentally more in terms of their sensory properties such as color, shape, and size (Ferri, Riggio, Gallese, & Costantini, 2011). After all, natural objects have not deliberately been designed for a particular function; instead, existing natural objects are made use of when people can use them to fulfill a function. Food has originally not been designed for eating, and yet, people use it to satisfy their hunger. Despite the fact that today's food is often processed rather than naturally grown, it maintains the quality of possessing an inartificial, natural function as opposed to artifacts that fulfill more designated functions. Consequently, it is proposed that relevant natural objects, that are used to serve a function, should also exert affordances. Considering its evolutionary importance for survival, food represents a highly relevant natural object that functions as energy source (Pinel, Assanand, & Lehman, 2000; Van der Laan, de Ridder, Viergever, & Smeets, 2011). Therefore, food should present affordances in a similar manner as artifacts.

The above presented theorizing based on grounded cognition shows how cognitive processes are dependent on the environment in which they occur. Whether objects exert affordances depends on the potential to interact with the objects. Only functional and accessible objects exert affordances and thereby activate the information related to the specific interaction. Grounded cognition research has also provided evidence showing that language comprehension and motor activations are neurologically linked (Pulvermüller, 2005). Previous research has, for example, shown that evaluating grammatical correctness of sentences involving supposedly irrelevant directions (away and toward) facilitated responses requiring bodily movement compatible to the movement of the actions implied by the meaning of those sentences (Glenberg & Kaschak, 2002). Consequently, objects should activate the information related to potential interaction with the objects both in terms of motoric activation and verbal information. On the one hand, observing an object should activate its semantic concept, thereby causing a readiness to respond to words compatible with the object. Seeing food should lead to an activation of the food and eating concept, thereby leading to faster recognition of food and eating related words. On the other hand, observing a proximal object should activate the motoric response involved in interacting with the object, thereby causing a readiness to move the muscles involved in the afforded action. Consequently, observing proximal food should afford grasping for the food (as that is the first step involved in eating thereby activating the muscles involved in the grasping movement. This muscular readiness not only facilitates motoric responses to the actually afforded action, the grasping), but also other actions that rely on the same muscles as corroborated by Wilf, Holmes, Schwartz, and Making (2013). Due to their neurological link semantic and motoric activations cannot be disentangled using the current paradigm. Consequently, potentiated responses could be explained by the activation of either semantic or motoric activation. Nevertheless, as presented above, research has repeatedly shown the modulation of motoric, rather than semantic activation by distance and accessibility. Therefore, potentiated responses are expected to be driven by motoric activations rather than semantic activations. Nevertheless, the terms eating-, and playing-related information will be employed to refer to both semantic and motoric activations. As has been done previously

(Costantini et al., 2010; Ambrosini, Scorolli, Borghi, & Costantini, 2011), this research uses reaction times to verbal labels to measure what action-related information is activated upon exposure to objects. The activation of eating- and playing-related information is therefore a measure of whether the potential to play or eat is activated upon the sight of accessible and inaccessible toys and food, respectively.

The present research

Based on this rationale, the current research examines whether accessible, as opposed to inaccessible food (natural object) and toys (artifacts), activate the information related to eating or playing, respectively. The activation of this information is measured using reaction times to verbal labels that represent object-compatible (e.g. food and eating) or object-incompatible (e.g. toy and eating) interactions. Participants have to judge the compatibility of function and observation words with proximally and distally presented objects. Function words are related to the interaction with the objects. Compatible function pairs are therefore foods and eating words as well as toys and playing words. Observation words are compatible with both food and toys.

We hypothesize that reaction times to compatible function words are faster when they follow the sight of a proximal rather than a distant object. Only proximal food and toys are expected to activate eating- and playing-related information, respectively, because only proximal food and toys allow for immediate interaction. Consequently, seeing proximal rather than distant food should activate eating-related information: On the one hand it should lead to an activation of the semantic concept of food leading to faster recognition of eating related words. On the other hand it should potentiate the muscles involved in grasping for the food (and involved in pushing the response button), which should lead to faster reaction times to eating words following food within reach than food outside of reach. Analogously, seeing a proximal rather than distant toy should activate playing-related information, which should lead to faster reaction times to playing words following reachable toys compared to not reachable toys. Since the observation of objects is possible for both proximal and distant objects, reaction times to observation words should not depend on distance. Therefore, there should be no difference in reaction times between responses to observation words following proximal and distant objects. Furthermore, we examined whether motivational states, such as hunger influence the activation of eating-related information, as the relevance of food potentially depends on such motivational states. After all, hungry people could experience stronger activations of eating-related information when perceiving proximal food than satiated people. To our knowledge, such motivational influences on the nature of information activation and relatedly on affordances have not been investigated to this date.

Two experiments were conducted to examine these hypotheses. Experiment 1 investigated the activation of eating- and playing-related information by objects at proximity and distance in general, as well as the activation of eating- and playing-related information by toys and food independently, whereas Experiment 2

extended the range of food to include both wrapped and unwrapped food. Wrapped food cannot readily be eaten. It is not actionable. Consequently, eating-related information should not be activated upon the sight of proximal wrapped food. Unwrapped food, on the other hand, can readily be eaten, therefore is actionable, and should activate eating-related information. This additional manipulation extends the factor of accessibility to not only include the effect of distance on the activation of eating-related information but also the effect of packaging.

Investigating these three kinds of objects (toys, wrapped food, unwrapped food) will shed light on the differences and similarities of their respective activations of eating- and playing-related information. It will reveal whether natural objects activate this information in the same manner as artifacts, and whether the perceived possibility to readily interact with the object influences the nature of these activations. Furthermore, examining the activation of eating-related information will deepen health psychologists' understanding of the influences of unconscious, cognitive processes involved in the representation of food. If food is represented differently depending on context and affords eating only when it is accessible, then behaviorally observed responses to food in the environment can be better understood, explained, and eventually circumvented.

Experiment 1

The experiment entailed a 2 (object: food vs. toys) x 2 (distance: proximity vs. distance) x 2 (word: observation vs. function) factorial design. It was firstly hypothesized that participants react faster to function words following proximal compatible objects than distant compatible objects. This distance effect should not occur for observation words. More specifically, the second hypothesis predicted faster reaction times to eating words following food at proximity than following food at distance. Similarly, participants should react faster to playing words following toys at proximity compared to toys at distance. Reaction times to observation words should be similar at both distances. Finally, stronger motivation to obtain food, due to hunger, was expected to be positively associated with the distance effect for food and eating.

Method

Sample and participant selection. Participants (*N* = 52) were recruited from the campus of Utrecht University to take part in this experiment for money (4 Euro) or course credit. All participants were native Dutch speakers and had normal or corrected to normal vision, with the exception of four participants who reported to require correction but not wearing any during the experiment. Since excluding these participants from the analysis led to the same results they remained included. Participants (*N* = 5) not responding to 50% or more of the compatible observation trials were excluded for not adhering to the task. The final dataset included 47 participants (33 women, 14 men) with an average age of 20.34 (*SD* = 1.97), and an average BMI of 21.77 (*SD* = 2.3). The study was conducted in accordance with the ethical standards described by the Medial Research Involving Human Subject Act

(WMO, 2012). This Act exempts research on healthy human subjects from review for as long as it does not involve any invasion of participants' integrity. Consequently, no formal ethical approach was required according to Dutch national standards. Written consent was required from each participant prior to participation.

Procedure. Participants were seated in front of a computer screen at a distance of approximately 48 cm. Before starting the actual experiment participants completed eleven practice trials in which they received feedback on the correctness of their response to ensure that participants understood the concept of compatibility between words and images. The actual experiment consisted of 216 trials in which participants were first exposed to an image of food or toys for one second, followed by a word (eating, playing, or observation). The word was presented on the area of the screen that was on average at equal distance from the proximal and the distant object on the image. Participants had to decide whether the word was compatible with the object by clicking the space bar or whether it was incompatible with the object by refraining from any response. The word remained on the screen until the participant had responded or 2.5 seconds had passed. Each participant was exposed to each combination of image and word exactly once at random order. Thus, 33% of the trials were incompatible (toy and eating word; food and playing word). After the experimental procedure participants filled in a questionnaire assessing demographic variables and level of hunger. Finally, they were debriefed, thanked, and granted their rewards.

Materials.

Images: Images of food and toys were presented on computer screens. The images were photographs on which the target object was located on the near or far end of a table elongated into the distance. Metrically, the proximal object was at ~ 50 cm (within perceived reach) and the distant object at ~ 180 cm distance (outside perceived reach) from the viewpoint of the photographer. The perceived distances of the objects in the images were pre-tested as part of a larger study. Participants (N = 95) rated whether objects at either distance were reachable or not (1 = reachable; 2 = not reachable). A Wilcoxon signed-rank test revealed that all proximal objects (all *Mdn*s = 1) were rated as reachable significantly more often than distant objects (all *Mdn*s = 2), - all *p*s < .001 -. The final set of objects on the food pictures, all presented in glass bowls, included M&Ms, apples, muffins, carrots, cookies, and chips. These foods were chosen to include different levels of healthiness, salty and sweet choices, as well as a wide range of different colors. The images of toys included building blocks, a puzzle, and different kinds of construction sets.

Verbal labels: Words were selected on the basis of compatibility with images of food and toys. In an online pre-test native Dutch participants (N = 25) were asked to rate the degree of compatibility (0 = low compatibility - 100 = high compatibility) between six eating words, six playing words, and six observation words with nine food images and six toy images (6 of these food images were later selected for the main study based on perceptibility, variability of food, and coherence with previous studies). The three eating and playing words most compatible with images of food and toys, respectively, were chosen for the study (toys: to play (M = 85.5; SD =

20.47), to build (*M* = 85.3; *SD* = 13.66), to assemble (*M* = 82; *SD* = 17); food: to eat (*M* = 87.3; *SD* = 15.97), to consume (*M* = 83.4; *SD* = 11.86), to taste (*M* = 80.4; *SD* = 12.41)). A Wilcoxon signed-rank test revealed that each of these words was significantly more compatible with its object category than the other object category (all *p*s < .001). The three most compatible observation words were chosen on the basis of compatibility with all the objects (to see (*M* = 54.6; *SD* = 17.6), to watch (*M* = 50.9; *SD* = 16.87), to perceive (*M* = 51.9; *SD* = 17.36)). Note must be taken of a significant difference in compatibility between food and toys with observation words. Observation words were more compatible with toys (*Mdn* = 61) than with food (*Mdn* = 48) (*z* = -3.23; *p* = .001). This difference has to be taken into account in the analysis of the main studies.

Measures. Reaction time mean scores for each combination of compatible object and word category for proximity and distance were computed and natural log transformed to normalize the distribution. Furthermore, +/- 2 *SD* from the mean of the respective category were excluded from the analysis. This exclusion led to different numbers of participants being excluded from the different analysis. For the ease of interpretation means will be reported in reaction times (milliseconds). Error rates, representing the lack of responses to compatible pairs, were calculated for each category and ranged from 2,7% to 16,2%. In order to examine whether motivation influences the activation of eating-related information, level of hunger (1 = not hungry – 3 = very hungry) was assessed with one item.

Results

General Affordance Activation. To test the hypothesis that participants respond faster to compatible function words following proximal than distant objects in general a repeated measures ANOVA was conducted with object (toys vs. food), distance (proximity vs. distance) and word (compatible function vs. observation) as within-subject-factors. The results revealed a significant main effect of object, $F(1,38) = 24.105$; $p < .001$; $\eta^2_p = .388$, with participants responding faster to food (*M* = 796.16; *SD* = 91.27) than toys (*M* = 839.62: *SD* = 117.77); a significant main effect of word, $F(1,38) = 46.842$; $p < .001$; $\eta^2_p = .552$, with participants responding faster to compatible function words (*M* = 779.05; *SD* = 87.83) than observation words (*M* = 856.73; *SD* = 105.78); and a significant interaction between object and word, $F(1,38) = 35.956$; $p < .001$; $\eta^2_p = .486$. For compatible function words participants responded significantly faster to food (*M* = 736.3; *SD* = 80.67) than to toys (*M* = 821.8; *SD* = 107.83), $F(1,38) = 52,585$; $p < .001$; $\eta^2_p = .581$. However, there was no significant difference between reaction times to observation words between toys (*M* = 857.44; *SD* = 138.38) and food (*M* = 856.02; *SD* = 102.72), $F(1,38) = 0.0$; $p = .99$. There was no significant main effect of distance $F(1,38) = 2.214$; $p = .15$. Finally, a significant interaction between distance and word was found, $F(1,38) = 8,649$; $p < .01$; $\eta^2_p = .185$. Participants responded faster to function words following compatible objects at proximity (*M* = 760.52; *SD* = 82.44) than at distance (*M* = 797.57; *SD* = 102.33), $F(1,38) = 15.635$; $p < .001$; $\eta^2_p = .292$. For observation words there was no significant difference between reaction times to proximal (*M* = 863.76; *SD* = 135.72) and distant objects (*M* = 849.7; *SD* = 129.09), $F(1,38) = 1.085$; $p = .3$.

Food. To test the distance effect specific to food planned contrasts were conducted. Paired samples t-tests revealed that participants responded significantly faster to eating words following proximal food (*M* = 724.7; *SD* = 85.09) than distant food (*M* = 757.58; *SD* = 94.99), *t*(43) = -3.341; *p* (2-tailed) <.01; Cohen's *d* = .0.36. For observation words no significant distance effect was found between proximal (*M* = 868.93; *SD* = 168.85) and distant (*M* = 870.66; *SD* = 143.11) objects, *t*(43) = -0.283; *p* = .78 (See figure 1).

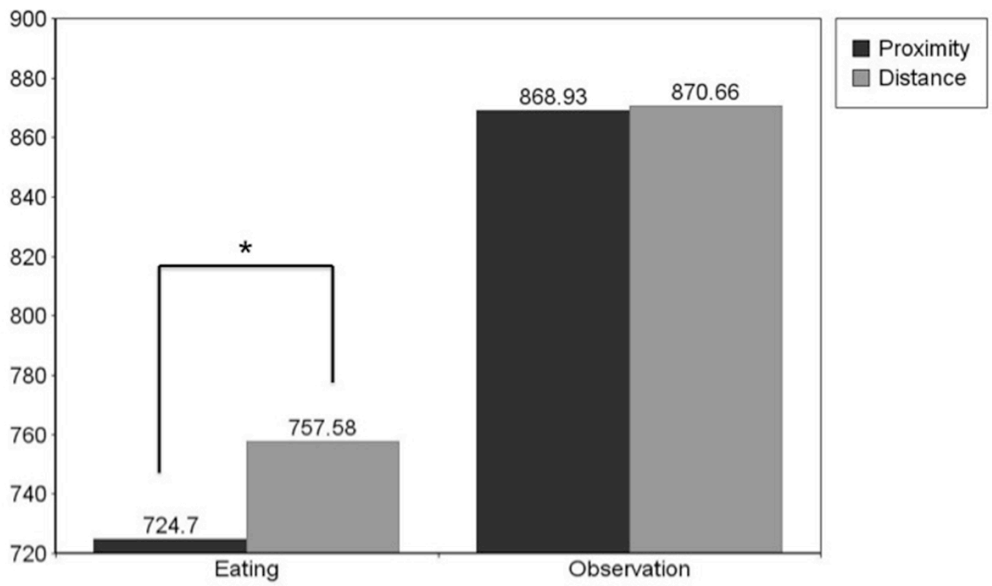


Figure 1. Experiment 1. Mean Reaction times to Food.
Mean reaction times to eating and observation words following food images at proximity and at distance: Reaction times to proximal eating words are significantly faster than reaction times to distant eating words *p*<.05.

Toys. To test the distance effect specific to toys similar planned contrasts were run. The paired samples t-tests revealed significantly faster reaction times to playing words following toys at proximity (*M* = 801.8; *SD* = 104.3) than at distance (*M* = 845.22; *SD* = 135.85), *t*(43) = -2.791; *p* (2-tailed) < .01; Cohen's *d* = .36. For observation words participants responded significantly faster following distant toys (*M* = 847.98; *SD* = 162.72) than proximal toys (*M* = 883.84; *SD* = 161.12), *t*(41) = 2.482; *p* = .02; Cohen's *d* = .22 (See figure 2).

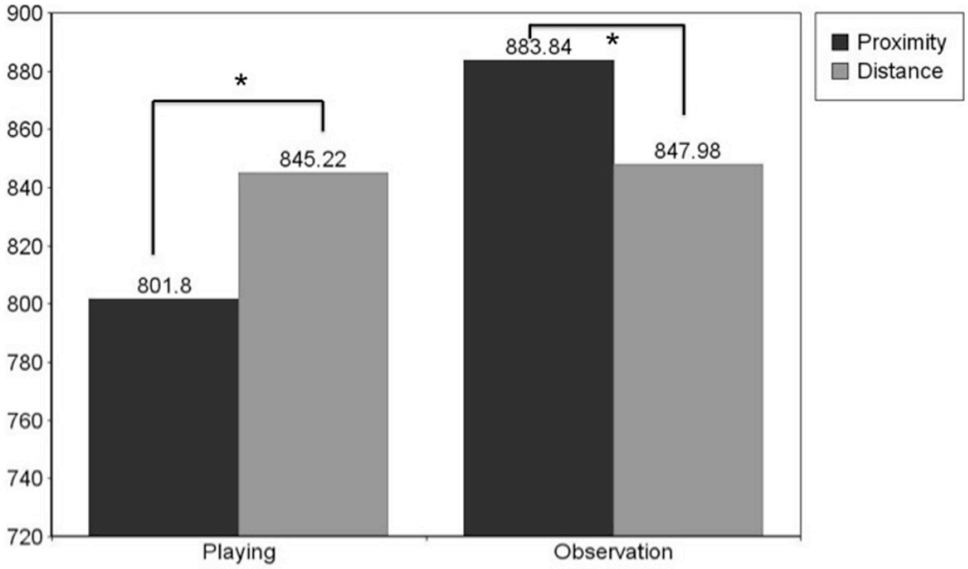


Figure 2. Experiment 1. Mean Reaction Times to Toys.
Mean reaction times to playing and observation words following toy images at proximity and at distance: Reaction times to proximal playing words are significantly faster than reaction times to playing words $p<.05$. Reaction times to distant observation words are significantly faster than reaction times to proximal observation words $p<.05$.

Hunger. Level of hunger was not significantly associated with the reaction time difference score (r = -.06; p = .689). This difference score (difference between reaction times to eating words and food at proximity vs. distance) was computed to represent the strength of the distance effect.

Discussion

In support of the first hypothesis, participants responded faster to compatible function words following proximal than distant objects. This implies that images of proximal food and toys activate eating- and playing-related information more strongly than distant objects, indicating the necessity of potential interaction in terms of terms of spatial location for the activation of this information. Additionally, the results revealed faster responses to food in general which could be explained by the strong evolutionary relevance of food objects. Participants also responded generally faster to compatible function words than to observation words regardless of distance as shown by the main effect of word. Planned contrasts revealed that eating-related information was activated upon the sight of proximal but not distant food. No distance effect was found for observation words. This finding indicates that eating-related information was activated and consequently responded to faster when interaction was possible due to the spatial location of the food. Only proximal food provides the potential to eat, leading to differential reaction times to eating

words between the two distances. At the same time both proximal and distant food provide the potential to be looked at, leading to no differential reaction times to observation words following proximal and distant objects.
For toys the planned contrasts supported the activation of playing-related information upon the sight of proximal toys compared to distant toys. Surprisingly, a reverse distance effect was found for observation words with participants responding faster to observation words following toys at distance than at proximity. This finding cannot be explained at this point but Experiment 2 aimed at replicating these findings to unveil whether this reverse distance effect is stable and represents a structural difference between the activation information related to potential interaction posed by natural and artificial objects. Level of hunger was not significantly related to the distance effect on food and eating words. Thus, the activation of eating-related information seemed unaffected by the motivational state of the perceiver. This implies that the motivational state of the perceiver does not influence the affordances exerted by objects. Experiment 2 included additional motivational measures to examine whether this lack of motivational influence is consistent across different motivational states.

Although Experiment 1 provided initial support for the activation of eating-related information exerted by proximal food Experiment 2 aimed at investigating the influence of the accessibility of food in more detail. In addition to examining the accessibility due to distance Experiment 2 included the accessibility due to packaging. More specifically, it was tested whether the packaging of food similarly modulates the activation of eating-related information. Wrapped food cannot readily be eaten and should consequently not exert the affordance to eat. Unwrapped food, on the other hand, can readily be eaten and should activate the affordance to eat. To test this, participants were presented with images of wrapped and unwrapped food. It was ensured that each food package was transparent so that the food itself remained visible.

Experiment 2

The experiment was based on a 2 (object: food vs. toys) x 2 (distance: proximity vs. distance) x 2 (word: eating vs. observation) x 2 (packaging: wrapped vs. unwrapped; only for food) within-subject design. Similarly to Experiment 1 we hypothesized that participants respond faster to function words following proximal compatible objects than distant compatible objects in general and that this distance effect does not occur for observation words. Secondly, we expected the distance effect for food to occur only upon the sight of unwrapped but not wrapped food. Consequently, participants should be faster responding to eating words following proximal unwrapped food compared to distant unwrapped food. This distance effect should occur neither for wrapped food nor for observation words. Thirdly, stronger motivation to obtain food was expected to be positively associated with the distance effect for unwrapped food and eating. Finally, faster reaction times to playing words following proximal toys than distant toys and no such effect for observation words were expected.

Method

Sample and Participant Selection. Participants (*N* = 71) were recruited from the campus of Utrecht University for course credit or money (4 Euro). All participants were native Dutch speakers and had normal or corrected to normal vision. Some participants (*N* = 3) reported to require correction but not wearing any during the experiment. Since excluding these participants from the analyses led to the same results they were retained. Additionally, participants (*N* = 8) not responding to 50% or more of the compatible observation trials were excluded from the analysis for not adhering to the task. The final dataset included 63 participants (49 women, 13 men, 1 unknown) with an average age of 21.21 (*SD* = 3.31), and an average BMI of 21.35 (*SD* = 2.55). As previously, the study was conducted in accordance with the ethical standards described by the WMO. Written consent was required from each participant prior to participation.

Procedure & Materials. The procedure and all materials were exactly the same as for Experiment 1, with an exception for (a) the food items: the images included both wrapped and unwrapped food (peeled and unpeeled oranges, wrapped and unwrapped muffins, wrapped and unwrapped raisin bread rolls) and (b) the assessment of motivation influences in the activation of eating-related information (see Measures section).

Measures. Similar to Experiment 1, means for each category were computed for each combination of compatible object, word, packaging (for food), and distance category were computed and natural log transformed to normalize the distribution. Furthermore, +/- 2 SD from the mean of the respective category were excluded. This exclusion led to different numbers of participants being excluded from the different analysis. Error rates, representing lacking responses to compatible trials, were computed for each category and ranged from 0,7% to 7,67%. In order to examine whether motivation influences the activation of eating-related information not only hunger was assessed, but also dieting behavior and people's reaction to food. It could be argued that dieting participants experience stronger activations of eating-related information at sight of proximal food because restraining food intake increases the saliency of external food cues (Fedoroff, Polivy, & Herman, 1997). Therefore, this experiment included the Restrain scale (Herman & Polivy, 1975) measuring people's dietary habits and the degree to which people attempt to restrict their food intake (10 items, α = .727) as well as the Power of Food scale (Lowe, Butryn, Didie, Annunziato, Thomas, Crerand, Ochner, Coletta, Bellace, Wallaert, & Halford, 2009) measuring the degree to which people are influenced by food (15 items, α = .866).

Results

General Affordance Activation. To test the hypothesis that participants respond faster to compatible function words following objects at proximity than at distance in general a repeated measures ANOVA was conducted with object (toys vs. food), distance (proximity vs. distance) and word (compatible function vs. observation) as

within-subject-factors. The results revealed a significant main effect of object $F(1,53) = 29.591$; $p < .001$; $\eta^2_p = .358$, a significant main effect of distance $F(1,53) = 5.192$; $p < .05$; $\eta^2_p = .089$, and a significant main effect of word $F(1,53) = 36.377$; $p < .001$; $\eta^2_p = .407$. Participants responded faster to food (*M* = 820.98; *SD* = 86.05) than to toys (*M* = 859.74; *SD* = 86.54); faster to proximal (*M* = 833.64; *SD* = 85.27) than to distant objects (*M* = 847.09; *SD* = 83.58), and faster to compatible function words (*M* = 808.86; *SD* = 77.66) than to observation words (*M* = 871.87; *SD* = 102.18). Moreover, a significant interaction between object and word, $F(1,53) = 80.262$; $p < .001$; $\eta^2_p = .602$ was found. For compatible function words participants responded significantly faster to food (*M* = 768.1; *SD* = 81.29) than to toys (*M* = 849.62; *SD* = 86.81), $F(1,53) = 88.146$; $p < .001$; $\eta^2_p = .625$. For observation words no such difference was observed between food (*M* = 873.86; *SD* = 111.8) and toys (*M* = 869.87; *SD* = 109.44) $F(1,53) = 0.138$; $p = .71$. Furthermore, the results showed a significant interaction between distance and word, $F(1,53) = 4.365$; $p < .05$; $\eta^2_p = .076$. Participants responded significantly faster to compatible function words at proximity (*M* = 794.53; *SD* = 87.26) than at distance (*M* = 823.19; *SD* = 79.77), $F(1,53) = 10.409$; $p < .01$; $\eta^2_p = .164$. No such distance effect was found between proximity (*M* = 872.74; *SD* = 111.34) and distance (*M* = 870.98; *SD* = 111.29) for observation words, $F(1,53) = 0.008$; $p = .93$.

Food. To examine the second hypothesis that participants respond faster to eating words following proximal unwrapped food than distant unwrapped food and no distance effect for wrapped food and eating words planned contrasts were performed. The paired-samples t-tests revealed a significant distance effect for eating words and unwrapped food $t(56) = -1.985$; p (2-tailed) = .05; Cohen's $d = .24$. Participants responded faster to eating words following proximal unwrapped food (*M* = 741.5; *SD* = 99.1) than distant unwrapped food (*M* = 765.68; *SD* = 98.56). This effect was not observed for eating words and wrapped food $t(56) = -0.706$; p (2-tailed) = .48, (proximity: *M* = 774.76; *SD* = 117.99; distance: *M* = 782.59; *SD* = 110.66); for observation words with unwrapped food $t(56) = -0.152$; p (2-tailed) = .88, (proximity: *M* = 856.34; *SD* = 145.26; distance: *M* = 857.79; *SD* = 137.02); or observation words and wrapped food $t(56) = -0.709$; p (2-tailed) = .48, (proximity: *M* = 890.18; *SD* = 176.46; distance: *M* = 868.16; *SD* = 113.02) (See figure 3.).

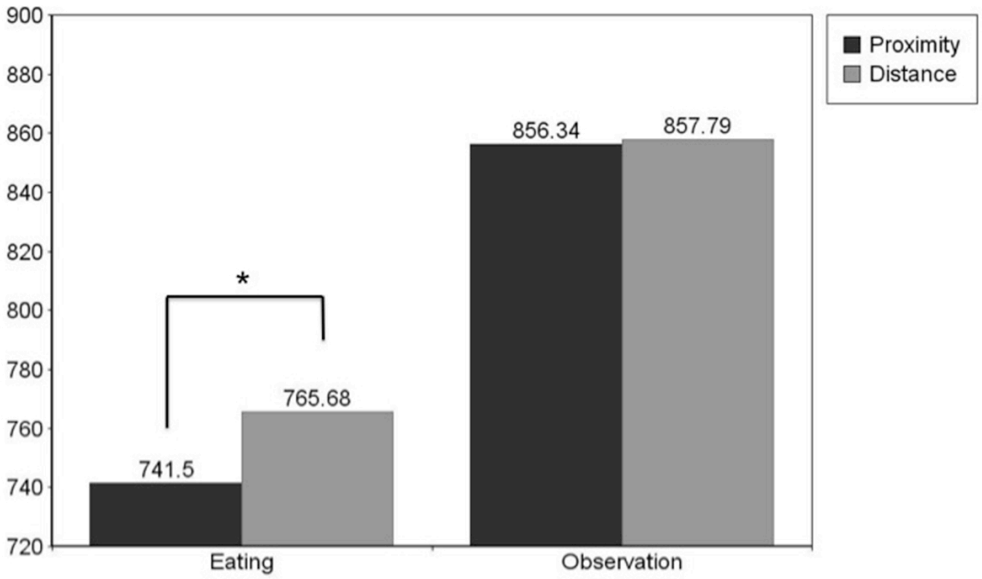


Figure 3. Experiment 2. Mean Reaction Times to Unwrapped Food.
Mean reaction times to eating and observation words following unwrapped food images at proximity and at distance: Reaction times to proximal eating words are significantly faster than reaction times to distant eating words $p<.05$.

Hunger and dieting. Correlation analyses were computed between the mean scores of the Restraint scale (RS), Power of Food scale (PoF), and level of hunger and the difference score (difference between reaction times to eating words and unwrapped and wrapped food at proximity vs. distance). None of the scores was significantly related to the difference score between eating words at distance and proximity for unwrapped food.

Toys. Testing the final hypothesis, the planned contrasts in terms of paired samples t-tests revealed a significant distance effect for playing words, $t(57) = -3.035$; p (2-tailed) $< .01$; Cohen's $d = .32$. Participants reacted faster to playing words following proximal toys ($M = 830.69$; $SD = 113.02$) than distant toys ($M = 865.42$; $SD = 106.89$). There was no significant difference between responses to observation words following proximal toys ($M = 876.05$; $SD = 144.93$) and distant toys ($M = 880.69$; $SD = 147.44$, $t(57) = -.333$; p (2-tailed) $= .74$ (See figure 4.).

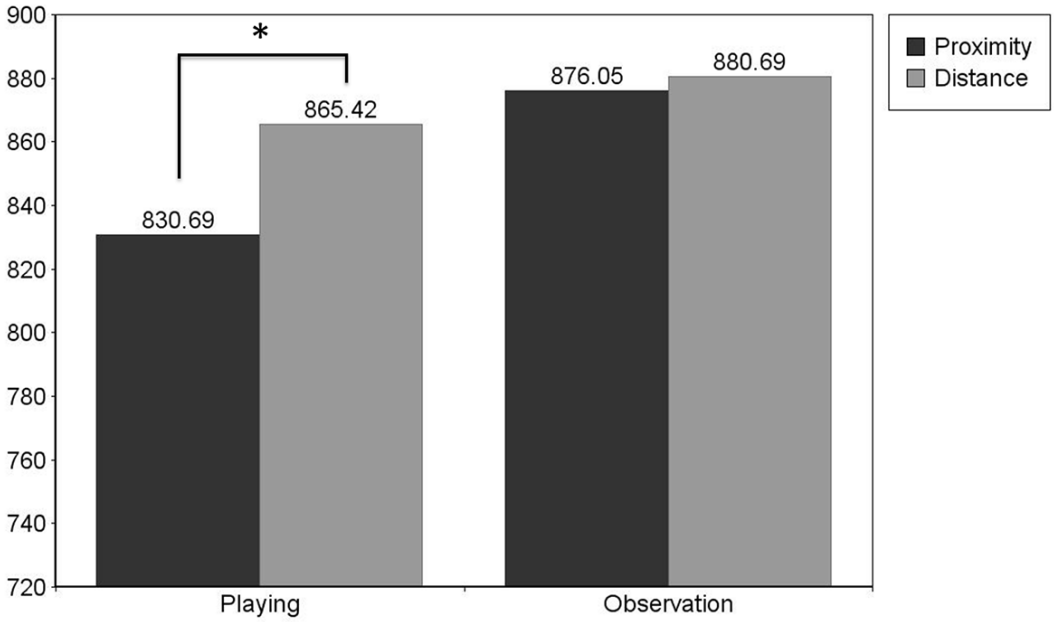


Figure 4. Experiment 2. Mean Reaction Times to Toys.
Mean reaction times to playing and observation words following toy images at proximity and at distance: Reaction times to proximal playing words are significantly faster than reaction times to distant playing words $p<.05$.

Discussion

Experiment 2 provided additional support for the notion that proximal food and toys activate eating- and playing-related information. Participants reacted faster to compatible function words following proximal than distant objects and no distance effect was observed for observation words. As in Experiment 1, participants generally responded faster to compatible function words than observation words, faster to proximal than distant objects, and responded faster to food than to toys. In initial support of the hypothesis that only actionable food activates eating-related information participants responded faster to eating words when the unwrapped food was located at proximity than at distance. This distance effect was not observed for eating responses to wrapped food or observation words. This suggests that only actionable food, in terms of distance and packaging, activates eating-related information. The predicted influence of motivational state on the strength of the activation of eating-related information was not supported by the results. Consequently, we must conclude that affordances exerted by the environment are not impacted by the internal motivational state of the perceiver. Finally, as predicted the distance effect for toys occurred for playing words but not for observation words. This latter result is at odds with the reversed distance effect for observation words found in Experiment 1 but in line with the hypothesis. Considering that the experiment was conducted in the same manner this result remains unexplained at this point.

General Discussion

Both experiments provided support for the notion that images of proximal food and toys activate eating- and playing-related information, respectively. Participants in both experiments responded faster to compatible function words following proximal than distant objects. This distance effect occurred only for function words but not for observation words. Thus, it conforms to the expectations as function words activate information involved in the potential to interact with the object. This suggests that the accessibility of objects influences the activation of potential interactions. When interactions are possible they activate the information related to the interaction, in this case eating and playing. Therefore, eating- and playing-related information was activated upon the sight of proximal food and toys, respectively, whereas the activation of observation-related information did not depend on distance. After all, observing objects does not require objects to be proximal. Based on the rationale that only the activation of the motoric, but not the semantic system should be modulated by distance this finding indicated that proximal food and toys exert affordances for interaction. Concomitantly, the findings replicated the results of previous experiments, showing that the activation of information related to interacting with the object is modulated by the potential interactions with the object (Bub, & Masson, 2010; Costantini, Ambrosini, Scorolli, & Borghi, 2011; Grezes, et al., 2003; Ranganathan et al., 2011). Objects are not merely represented in terms of their physical properties. By contrast, their representation includes the activation of information related to interactions with these objects: their affordances. Despite the original claim that artificial objects activate stronger affordances than natural objects that are represented more in terms of their sensory properties than their function (Ferri et al., 2011), no structural differences in the distance effect between natural and artificial objects were discovered in the current experiments. Examining the individual comparisons for toys and food similar patterns arise. For food both distance (Experiment 1 and 2) and packaging (Experiment 2) of food influenced the activation of eating-related information. Food had to be reachable and readily edible to activate eating-related information and exert eating affordances. Interestingly though, participants generally responded faster to food than to toys regardless of word. This finding could be explained by the higher relevance of food compared to toys. Considering its evolutionary importance food represents a highly relevant object (Pinel et al., 2000). The main difference between the findings for food and toys remained in the reverse distance effect for toys and observation words in Experiment 1 that was not replicated in Experiment 2. At this stage this finding remains unexplained. Additional replications, for example with the inclusion of alternative artifacts, will be necessary to determine the nature of this effect.

In addition to replicating the influence of affordances in general, the current research extended previous findings to the realm of food and eating behavior. Showing that accessible food activates eating-related information does not conclusively show that this activation translates into eating behavior. Yet, this activation shows that whether food exerts eating affordances depends on the potential to eat it in the current context. Consequently, the finding is a first indication of the involvement of potential interaction in eating behavior that could

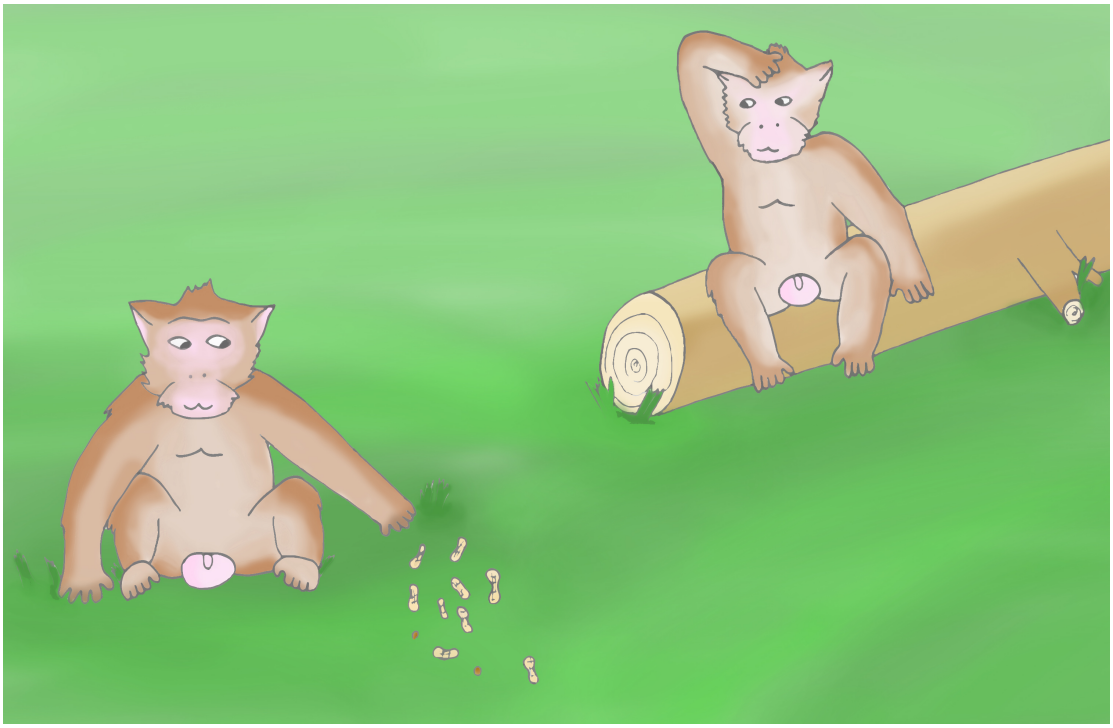
explain the effect of increased consumption of proximal compared to distant food (Maas et al., 2012).

Despite these novel findings some limitations must be addressed. Firstly, participants failed to respond to a relatively large number of compatible trials. Misses were particularly high for observation word trials. This could be related to the findings of both Experiment 1 and 2 showing that participants responded faster to function words than to observation words. While this pattern was not expected it was consistent with the findings of Costantini et al. (2011). Whereas these authors explain the difference by referring to the more functionality-based mental representation of artifacts, it could also be caused by the differences in compatibility scores between objects with function words and objects with observation words. The pre-test showed a higher compatibility for the first than the latter pair. Thus, it can reasonably be claimed that faster reaction times are related to higher compatibility. This reasoning would predict the observed findings: function words should be responded to faster than observation words. Future research should attempt to use words for observation and function that reveal similar levels of compatibility for better comparison. Secondly, alternative artifacts should be employed to examine the reverse distance effect for observation words. Even though this effect was only found in Experiment 1, more research needs to be conducted to understand the reversal. Thirdly, the design of Experiment 2 did not allow to analyze the full factorial design in one full analysis comparing the effect of distance on wrapped food, unwrapped food, and toys directly. This shortcoming occurred due to the factor packaging being nested in the food only but not in toys. Comparing the full factorial design would have provided a stronger test of the hypotheses and future studies should ensure that such comparisons can be analyzed in an appropriate manner. Finally, the results revealed that eating-related information was activated upon the sight or proximal unwrapped but not wrapped food. Although this effect was expected and can be explained it is appears at odds with the fact that none of the objects were realistically actionable as they were presented on images. Previous research had shown that images of objects activate motor responses (Ambrosini & Costantini, 2013; Ferri et al., 2011; Ambrosini et al., 2011; Costantini et al., 2011); yet, the precise difference between the inactionability due to pictorial representation in images and the inactionability due to packaging requires further investigation. It will be necessary to examine the difference between these two kinds of inactionability,

Most importantly, future research should extend these findings to directly include the activation of motor information upon the sight of accessible food. The current results support the claim that verbal information related to the potential interaction is activated upon the sight of objects. Combining our findings with evidence from grounded cognition research showing that language comprehension and motor activation are inextricably linked (Barsalou, 2008; Glenberg & Kaschak, 2002) suggests that the activation of verbal information is neurologically linked to the activation of motor information. However, this was not directly tested in this research. This addition should also examine the effects of actual food at various distances and different kinds of actionability. After all, wrapped food should well

activate action information involved in interaction with food; yet, this interaction should be more related to grasping and unwrapping than to immediate eating. This addition will clarify the effect of eating affordances posed by actual food in the environment on consequent eating behavior and thereby shed light on the reasons for why people experience such difficulties resisting reachable food in more naturalistic settings. Practically, the results suggest an explanation for why people overeat during meals despite being satiated and thereby contribute to understanding the detrimental effect of large portion-sizes on increased consumption. The mere perception of an unfinished portion activates eating, regardless of levels of satiation (Wansink, Painter, & North, 2005).

Overall, the findings show that the representation of food is modulated by its accessibility. Perceiving food in the immediate proximity activates eating-related information more so than distant food. Such effects can explain people's differential behavioral reactions to food within and food outside of reach. The findings invite future research to examine the activation of direct motor activation upon the sight of foods with different degrees of accessibility.



Chapter 5

Defying Food
How distance determines monkeys' ability to inhibit reaching for food

Junghans, A. F., Sterck, E. H. M., Overduin-de Vries, A. M., Evers, C., & De Ridder, D. T. D. (forthcoming). Defying food – How distance determines monkeys' ability to inhibit reaching for food. *Frontiers in Psychology, 7,* 158.

A strong case has been made in the past decades for theories describing an organism's functioning as the result of an interaction between mind, body, and environment (Wilson, 2002). Appropriate body-movements are not based on mere mental computations, but an organism's functioning essentially depends on the environment surrounding it. Previous research involving a number of animal species and humans has shown that objects, including food, in the proximal environment automatically activate and facilitate possibilities for motoric movements in interaction with the objects, so-called affordances (Junghans, Evers & De Ridder, 2013; Costantini, Ambrosini, Scorollo & Borghi, 2011). While affordance effects have been shown consistently, it has recently led to the question of whether affordance activation upon exposure to tempting objects, such as food, may contribute to a reduced ability to resist reaching for them. If observing proximal food leads to automatic activations of reaching movements toward the food, it can be suggested that the movement may be more difficult to override by conscious, goal-driven processing than without automatic movement-activation. Considering that affordances are only activated by objects in the immediate, actionable environment, difficulties in consciously overriding movements should be observed only by proximal but not distant food (Cardellicchio, Sinigaglia & Costantini, 2011). To test this idea, two experiments with long-tailed macaques investigated whether monkeys' difficulties in inhibiting their reaching movements toward a presented food depends on the distance of the food. Monkeys represent a culturally and educationally unspoiled sample, whose response to food is unbiased by health concerns common to human samples. At the same time research has shown that monkeys and humans share neural responses related to reaching movements as well as action-selection mechanisms and action-inhibition processes (Sartori, Camperio-Ciani, Bulgheroni & Castillo, 2014). This makes monkeys an ideal sample to investigate the effect of food in the environment on motoric responses only.

Affordances are possibilities for interaction, which activate the motoric system involved in an interaction between observer and object. These activations do not originate purely in someone's mind, but in the environmental situation in which someone acts (Gibson, 1979; Chemero, 2003; Wilson, 2002). Affordances describe the effect in which the mere observation of an object facilitates an interaction by automatically preparing the motoric system for movements related to an observed object (Tucker & Ellis, 2001; 2004; Ridderinkhoff et al., 2010). The positioning of a mug's handle to the right side affords reaching movements with the spatially aligned right arm, which leads to an activation of the motoric system involved in such a movement (Bub & Masson, 2010). Affordance perception in monkeys has been shown in both neurological and behavioral investigations. Previous research on Japanese monkeys has shown that activation patterns in movement-related neurons depend on how these objects are used, thereby revealing a neurological response to affordances of objects (Taira et al., 1990). Moreover, it has recently been discovered that neurons in the visuomotor area of the dorsomedial visual stream (V6A) in monkeys respond specifically to object affordances (Breveglieri, Falletti, Bosco, Gamberini & Fattori, 2015). On a behavioral level, monkeys have been shown to respond to affordances in objects by recognizing the opportunities these objects provide. Sartori and colleagues (2014) investigated the effect of different sizes of

distractor objects on reaching-to-grasp movements and showed interference effects, such that observing distractor objects smaller or larger than the target affected grasping movements evoked by the target. This observation is compatible with the affordance theory. Gumert and Malaivijitnond (2013) revealed that long-tailed macaques, *Macaca fascicularis*, select stones on the basis of the most appropriate stone mass to process available food; thereby showing that monkeys perceive objects on the basis of actions they afford. Similar results have been obtained in gorillas, *Gorilla gorilla*, and orangutans, *Pongo pygmaeus* (Mulcahy, Call, & Dunbar, 2005), chimpanzees, *Pan troglodytes* (Hihara, 2006), as well as New Caledonian crows, *Corvus moneduloides* (Chappell & Kacelnik, 2004). Similar to the findings in animals, affordance effects have been observed in humans based on more complex experimental designs. Studies based on stimulus-response compatibility designs have revealed shorter reaction times when a motor act is congruent with an observed object than when it is incongruent (Tucker & Ellis, 2001). For example, the presence of a mug with the handle to the right facilitates responses with the right hand rather than the left (Bub & Masson, 2010).

The FARS model (Fagg & Arbib, 1998) describes how affordances are computed in neurons in anterior intraparietal areas of the parietal cortex based on visual information derived from observing the mug. Resulting information about the required movements involved in interacting with the mug is passed on to an area referred to as F5, which is involved in grasping (Arbib, 1997; Gentilucci et al., 1988) and object observation. When an object is observed canonical neurons translate interaction-relevant information into potential motor actions regardless of the intention to execute the action or not (Jeannerod, Arbib, Rizzolatti, & Sakata, 1995; Raos, Umilta, Murata, Fogassi, & Gallese, 2006; Bonini, Maranesi, Livo, Fogassi, & Rizzolatti, 2014). While these activations prepare for the (grasping) movements, organisms do not automatically respond to all affordances available to them in the environment. According to dual-process models action control processes combine automatic with more deliberative processes. In the above-mentioned example with humans the action-selection to grasp may be driven by the strong external stimulus of observing the mug. However, deliberative processing could interfere with these external effects and select action that is more appropriate or goal-relevant (Ridderinkhof et al., 2010). While the inhibition of activated motor movements has been reported to depend on processes in the subthalamic nucleus, it has also been shown that the brain regions involved in the inhibition of activated movements depend on the elaborateness with which the action has been activatied. Using a Go-No Go paradigm, recent research has shown that later stages of inhibition are accompanied by the activation of additional brain areas including the pre-supplementary motor area and the globus palladius pars interna (Aron & Poldrack, 2006). When it comes to food, these deliberative action-control processes may be affected by health considerations and dieting wishes; an influence unknown to monkeys. For that reason monkeys can be expected to show reaching movements to food that are unbiased by these deliberative considerations.

Studies based on human and non-human samples have shown that affordance effects depend on the spatial location of the object in reference to the observer.

Objects need to fall into the peripersonal space, the area around the body that yields immediate interactions to activate canonical neurons that translate object features into action readiness (Bonini et al., 2014; Cardellicchio, Sinigaglia, & Costantini, 2011; Costantini et al., 2011; Costantini et al., 2010). In a previous study involving food, Junghans et al. (2013) showed that eating-related information was more strongly activated by the sight of proximal than distant food. Participants were shown images of proximal or distant food or other objects, followed by words relating to eating, observation, or other content. Participants' task was to respond to words compatible with the observed picture. Thus, they were expected to respond to eating and observation words following food images. The results showed that participants were faster responding to eating words following proximal food than distant food. For observation words the distance of the food did not have an influence on response time. This indicated that eating-related information was more strongly activated by proximal than distant food.

These previous findings from research on both animals and humans consistently support the notion that proximal objects automatically activate a motoric readiness to interact with the object. The automatic nature of affordance activations suggests that movements activated by affordances should lead to difficulties in inhibition. If this assumption is correct, then reaching movements for proximal objects (which afford reaching movements) should be more difficult to inhibit than reaching movements to distant objects (which do not afford reaching movements). This hypothesis is tested in two experiments in monkeys.

If our assumptions are correct, our findings may extend previous research by showing that affordances activation is related to difficulties in inhibiting afforded movements. Moreover, findings may have important implications for strategies aimed at helping people to resist temptations, such as unhealthy food in the environment. In light of the current obesity epidemic many health promotions aim at supporting peoples' self-control in resisting food in the environment; an attempt that may be hindered by affordance activation of proximal food.

Experiment 1: Methods

The first Experiment investigated the degree to which monkeys immediately reach for proximal and distant food presented behind a Plexiglas screen blocking access via the most direct, straight-forward reaching movement (Amici, Aureli & Call, 2008). The set-up of this task was designed in such way that it was necessary to inhibit the immediate forward reaching response in favor of a 'detour' through two holes on the left or right side of the Plexiglas screen to successfully obtain the food. Monkeys were expected to show more immediate reaching movement straight toward the food when it was presented proximally than distally. In the proximal condition, the affordance effect of the food should automatically activate reaching. In this case action selection should be driven by immediate and automatic mechanisms resulting in reaching movements immediately forward to the food despite obstruction by the Plexiglas screen. In the distal condition, the food should not activate an affordance and therefore, the reaching movement should be more easily inhibited and a result

of deliberative and intention-driven processes, which would allow the monkey to reflect on the situation and reach sideways through one of the holes to obtain the food (Ridderinkhof et al., 2010).

Participants. Sixteen healthy long-tailed macaques (5 females; 11 males; the Haas-group) housed in a group of 25 animals at the Biomedical Primate Research Centre, The Netherlands participated in this study. The subjects' age ranged from 2 to 20 years. They were all born in captivity. All monkeys were fed with monkey chow, fresh fruit and vegetables, as well as bread and had constant access to water. The sawdust-covered cages provided enrichments in the form of fire hoses, ladders, tires, and pools. Monkeys had access to indoor and outdoor areas in their cages. All subjects, but one, had participated in training and behavioral studies before and were familiar with clicker procedures, which means that they were familiar with the instruction technique. They were clicker-trained to move to the location where a trainer held a target (a red plastic shoe-horn) against or through the fence of their cage: Upon touching the shoe-horn, the trainer always made a clicker sound and a reward was given. To alleviate suffering, the study took place in their home cage in which monkeys were individually tested in a corridor to which the experimental set-up was attached. None of the monkeys had previously participated in a study with similar design. They had access to food and water prior to and during the experiment (apart from 1-5 minutes during their trial in which only the experimental food was available). Furthermore, participation in this study was on a voluntary basis. Only those subjects voluntarily entering the area with the experimental setup participated in the study to ensure low stress levels. A maximum of two trials were conducted per monkey per day. Trials were terminated early and monkeys were returned to their group in the few cases in which monkeys showed signs of distress. The study was approved by the Animal Ethical Committee of the BPRC (DEC755) and was carried out in accordance with the legal requirements of the Netherlands. All aspects of the studies were covered by this ethical approval. No monkeys were sacrificed in relation to these studies. Upon termination of the experimental period monkeys remained in their groups and housing.

Material & Stimuli. As previously employed by Amici and colleagues (2008), a Plexiglas screen was attached to the front of a separation compartment of the monkeys' cages between the monkey and the experimenter. The Plexiglas screen had two 5.8 cm diameter wide holes on either side at a distance of 53.8 cm. The size of the hole was sufficient for all monkeys to reach through comfortably. In front of the Plexiglas screen, on the experimenter side, a table was placed on which the food was presented. Prior to the experiment it was ensured that all monkeys in each group liked the target food (raisins).

Procedure. Each experimental session consisted of six practice training trials followed by one experimental trial. A maximum of two consecutive experimental sessions was run per day for each monkey. The limitation to two experimental trials per day was based on considerations regarding potential habituation and the desire to limit the trial duration to a minimum. In each experimental session monkeys voluntarily came to the corridor at the front of their cages where the experimental setup (See Figure

1) was placed and where they were separated from the group for a short period of time. Training trials were carried out in order to teach the monkey about the physical properties of the Plexiglas screen and that they could reach the food through one of the holes. In each training trial the monkey was instructed with the shoe-horn to sit behind one of the holes and rewarded with a click when doing so, according to a semi-random order that was the same for each individual. Upon touching the shoe-horn, the monkey was presented with a raisin on a table placed right behind the hole in the Plexiglas screen (i.e. proximally). Once the monkey had reached for the raisin, the next trial started. In cases when monkeys did not reach through the hole spontaneously, the raisin was presented to them by holding it closer to the hole and occasionally presenting it through the hole. However, experimental trials were only conducted when the monkey had previously reached through the hole six times to obtain the food. For the experimental trial (trial 7) the monkey was clicker instructed to sit in the middle between the two holes. The raisin was then placed either proximally (10 cm behind the screen) or distally (25 cm behind the screen), in semi-random order, on the table in front of them (randomization was consistent across monkeys). The distal condition was chosen so that the food was difficult or impossible for the monkey to reach. If monkeys reached through one of the holes in the direction of the food but they had trouble grabbing it, the raisin was handed to them immediately. Each volunteering monkey went through six experimental sessions of seven trials. Each session was video recorded for subsequent coding.

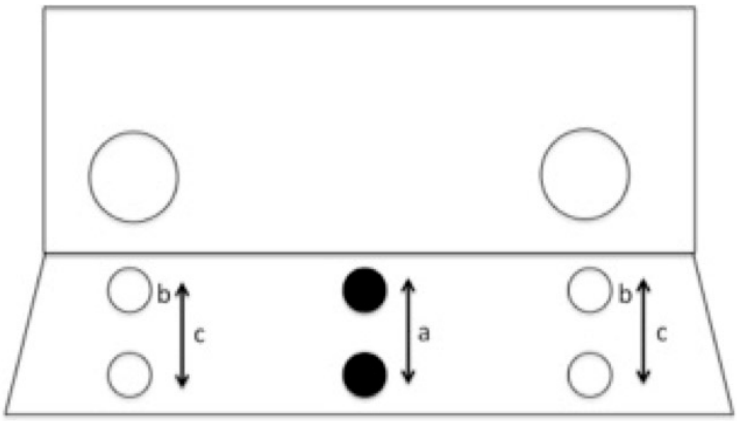


Figure 1. Depiction of the position of food in experimental trials with a proximal or distal food position (a) as well as the position of food in training trials with fixed proximal position in Experiment 1 (b) and varied between proximal and distal in Experiment 2 (c).

Dependent variable. The dependent variable was the number of experimental trials the monkeys showed an onset of a reaching move directly forward toward the food, within 45° of a direct line between the monkey and the food, irrespective of the obstruction formed by the Plexiglas screen. The monkey could stop the movement before or was stopped when touching the screen. In addition, the movement had to

occur within two seconds after exposure to or observation of the food. For the analysis the proportion of reaching movements out of all proximal and distal experimental trials were calculated. To code the dependent variable two independent analysts coded the video footage of the experiments. Intercoder reliability was assessed with the second coder coding 25% of the data. For five experimental trials coders reached different conclusions. Those trials were subsequently conservatively coded opposite to the direction of the hypotheses.

Results & Discussion

Paired samples t-tests were employed to examine whether the proportion of reaching movements in the proximal condition was higher compared to the proportion of reaching movements in the distal condition. As shown in Figure 2, results revealed a significantly larger proportion of reaching movements in the proximal (.79) compared to the distal condition (.14); $t(14) = 7.24$, $p < .001$; Cohen's $d = 2.57$.

The analysis yielded support for the hypothesis that monkeys immediately reached for the food more often when it was presented proximally than distally despite the fact that they could not obtain the food using this movement. Nevertheless, it could be argued that monkeys were more experienced in reaching for proximal food because the six practice trials presented food proximally rather than distally. This could have increased the likelihood for monkeys to reach for the proximal rather than the distant food and thus, presents an alternative explanation for the results. The second Experiment therefore added distant presentations of food to the first six practice trials to ensure that experience could not interfere with the results.

Experiment 2: Methods

Participants. To prevent training effects a new group of monkeys was tested for the second experiment. Housing situation, food availability, as well as familiarity with behavioral studies were similar to the previous group and treatments to alleviate suffering remained the same. Subjects included seven healthy long-tailed macaques (6 females; 1 male; the Roza-group) housed in a group of 24 animals. The subjects' age ranged from 4 to 11 years. As in Study 1, they were all born in captivity, had participated in training and behavioral studies before, and were familiar with shoe-horn instructions. Materials, stimuli, procedure, and dependent variable in the second experiment remained unchanged apart from including distal food to the six practice trials. Moreover, the food was always given to the monkey at the end of each experimental session irrespective of whether they had reached through the hole or not to ensure maintained motivation to participate. In half of the practice trials food was presented proximally, and in the other half it was presented distally, in randomized order. Intercoder reliability was assessed with the second coder coding 33% of the data reaching the same results. For one experimental trial neither could determine the correct code. For that reason it was conservatively coded opposite to the direction of the hypotheses. No monkeys were sacrificed.

Results

Paired samples t-tests were employed to examine whether the proportion of reaching movements in the accessible condition was higher compared to the proportion of reaching movements in the inaccessible condition. As can be observed in Figure 2, results revealed a significantly larger proportion of reaching movements in the proximal (.95) compared to the distant condition (.48); $t(7) = 4.26$ $p = .003$: Cohen's $d = 2.19$.

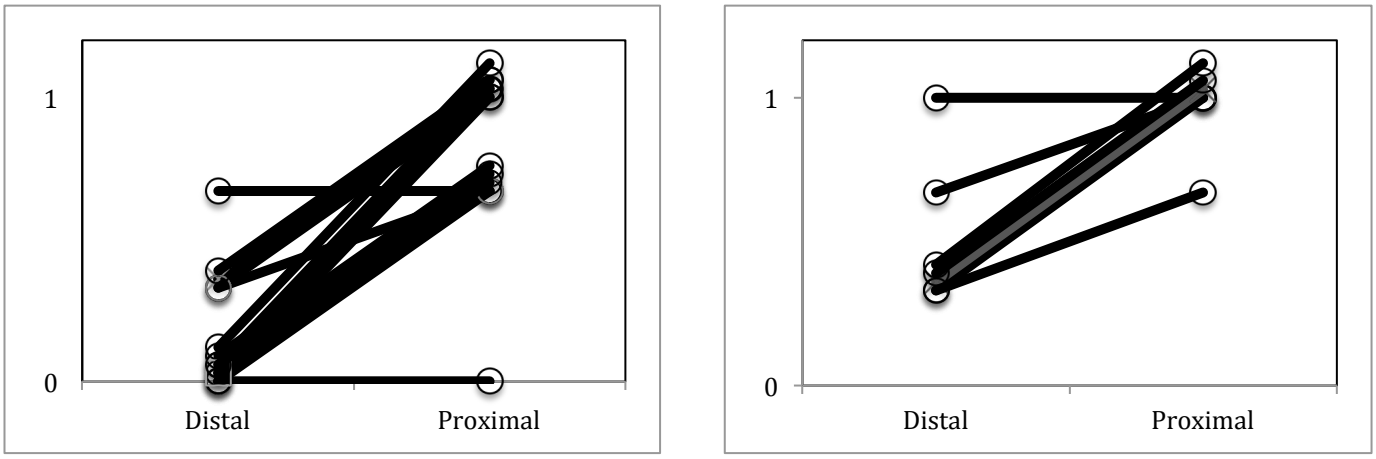


Figure 2. Proportion of forward reaching movements out of all trials for each subject with proximally and distally presented food in Experiment 1 (left) and Experiment 2 (right). To enhance visibility of all lines representing subjects, small numerical additions have been made to scores on both the proximal and the distal value.

General discussion

In both experiments monkeys showed significantly more immediate reaching movements when the food was presented proximally than distally, thereby revealing the influence of proximal food on motoric activations. Despite the fact that this forward reaching for the proximal food could not have led to successful obtainment, monkeys did not successfully inhibit this movement in favor of the detour towards one of the holes in the Plexiglas or no movement altogether. Since previous research has shown that affordances only occur when an object is located proximally (within the peripersonal space) it can be reasoned that proximal objects facilitate automatic affordances and impede more successful, but indirect movement. It can thus be argued that the gravitational appeal that makes proximal, or accessible food so difficult to resist, lies in the foods' affordances, signifying the potential interactions the accessible food suggests to the observer.

The research contributes to the literature by showing differential effects of objects at different distances on motoric behavior in monkeys. While literature had shown affordance effects with monkeys on the basis of choosing appropriate tools (Cummins-Sebree & Fragaszy, 2001) effects of distance had been restricted to human samples (Cardellicchio et al., 2011). Moreover, these findings appear particularly relevant when considering the implications they may have for human

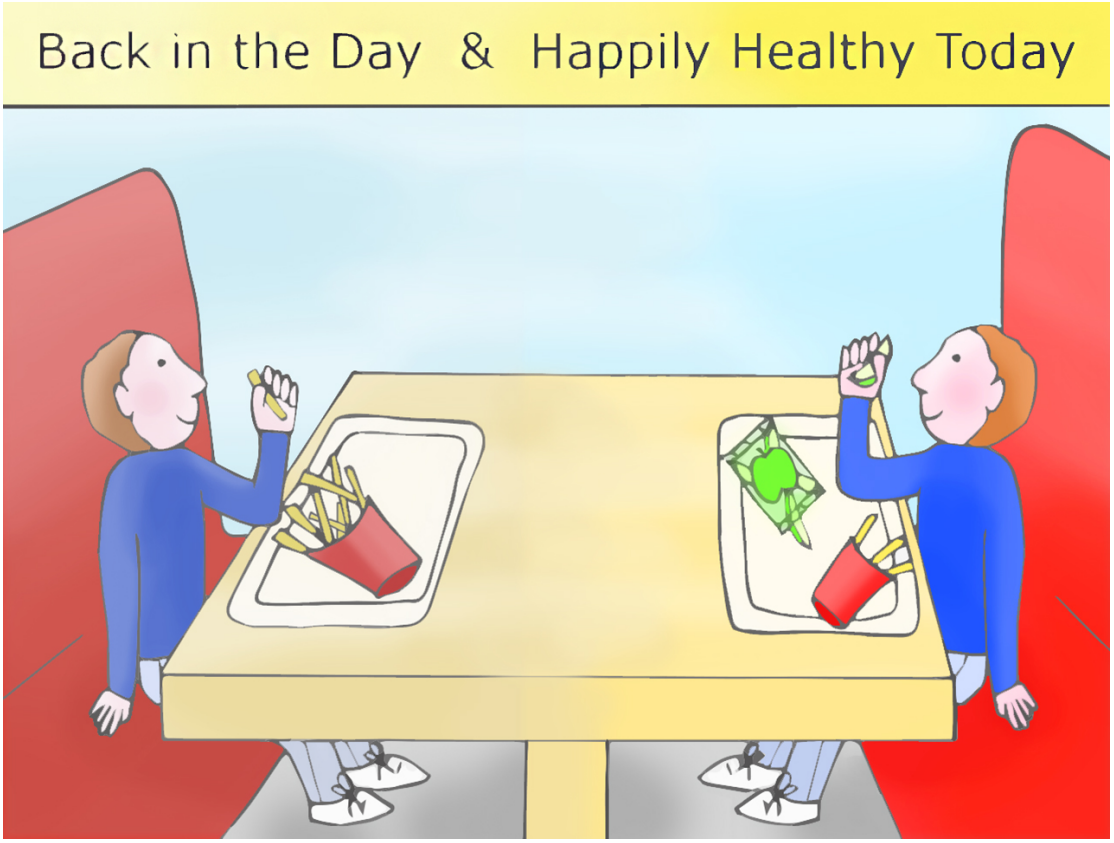
samples. The observation that in monkeys accessible food, located within one's reach, leads to more uninhibited reaching movements than inaccessible food that is located just outside reach highlights the strong influence affordances can have on their failure to inhibit. In humans, a similar failure to resist proximal, or accessible food in the environment has been observed and is often linked to an inability to successfully navigate the obesogenic environment (Allan, Johnston & Campbell, 2010). Affordances, exerted by accessible but not inaccessible food, appear to be the most compelling mechanism underlying this effect. Affordances operate on an immediate, stimulus-driven level that often precedes deliberative processing including consideration of goals and self-control (Ridderinkhof et al., 2010). While people may have the aim to resist temptations, the motoric activation of reaching for food occurs at an earlier motor stage that is less intention driven and may make resistance to temptations more difficult. As such, self-control processes, as they are commonly discussed in the literature on eating behavior (Muraven & Baumeister, 2000; De Ridder, Lensveld-Mulders, Finkenauer, Stok, & Baumeister, 2011), are preceded by the activation of affordances, and may thus be less effective in overriding the already-activated motor plan of reaching for and eating observed food. This is not to imply that action control processes cannot prevent them, however, they need to be strong enough to override the immediate reaching impulse (Ridderinkhof et al., 2010).

The availability and accessibility of food in the obesogenic environment have a strong influence on what and how much people consume (Wansink, 2004; 2014). The current findings suggest that this effect could at least be partially explained by accessible food affording to be reached for on an automatic, motoric level that makes deliberative processes such as self-control less successful in controlling food intake. The monkey results support this claim by showing that accessible food activates more immediate reaching movements and an inability to override these movements even though an obstacle will prevent its success.

Despite the clear and consistent findings the Experiments were subject to a number of shortcomings. Firstly, while monkeys and humans share the same neurological mark-up when it comes to the activation of affordances and interacting with the environment (MacLean et al., 2014) the findings cannot directly be translated into results for humans. Obviously, humans are more capable than monkeys of resisting reaching toward food when an obstacle prevents successful reaching due to enhances self-control capacities (MacLean et al., 2014). Nevertheless, the findings strongly suggest that affordances provide the mechanism by which motoric reaching for accessible food is activated and affordance effects have previously been found to influence both humans and monkeys (Tucker & Ellis, 2001; Sartori et al., 2014). Future research may involve conducting similar experimental designs with young children, who are less concerned with cultural considerations regarding food than adults and yet share their physiological and neural markup with older people. Secondly, it could be argued that the initial reason for conducting the study on long-tailed macaques, the fact that they do not have health and dieting concerns, explains their inability to resist food. Clearly, the human food culture will play a role in better inhibition of motoric responses; however, this does not imply that the motoric

activation has not taken place. The human ability to resist food better than monkeys should be based on healthiness considerations and dieting intentions, which should modulate the immediate and automatic reaching responses via online and anticipatory action control processes. Moreover, the activations may be influenced by an awareness in humans that food is no short resource. Thus, these considerations should provide the basis for enhancing or preempting activated movements (Ridderinkhof et al., 2010). Third, one could consider the Plexiglas screen presented between the monkeys and the food an obstacle that hinders interaction. Previous research has indicated that affordance activation by objects depends indeed on the objects' location within the peripersonal space; however, this peripersonal space was found to be determined by operational possibility to interact rather than a mere metric ability to reach the object (Bonini et al., 2014). They observed weakened affordance activation when objects placed within the peripersonal space were shielded by a Plexiglas screen. However, considering that both our conditions were shielded by a Plexiglas screen the differential effects for proximal and distal condition hold irrespective of these weakened affordances. Finally, it could be argued that the findings of this study can be explained by competition between two alternative motor plans rather than by the inhibition of one motor plan. The observed affordance effect could this be explained by two different mechanisms, the inability to inhibit the afforded movement and/or the larger impact of the forward reaching motor plan in contrast to the sideways reaching motor plan. These potential mechanisms underlying the affordance effect should be investigated in future research to holistically understand the drivers of affordance effects.

In conclusion, the study shows that the observation of accessible food leads to less inhibition of reaching movements to obtain the food than the observation of inaccessible food in long-tailed macaques. This suggests an association between the affordances exerted by accessible food and a reduced ability to inhibit an activated movement. These findings may have explanatory implications for humans living in an environment with constantly accessible food. Despite the fact that people have the capacity to override motoric activations, the constant accessibility of food requires similarly constant action control. In light of the abundance of accessible food it is not surprising that peoples' self-control fails eventually leading to increased consumption and weight gain.


Back in the Day & Happily Healthy Today

Chapter 6

Translating Child Eating Behavior into Happier, Healthier Fast Food Meals

Junghans, A. F. & Wansink, B. (Submitted for publication). Translating Child Eating Behavior into Happier, Healthier Fast Food Meals.

Fast food consumption has contributed to unhealthy eating patterns in the past decades. It constitutes a large part of diets for both children and adults and has been associated with higher intake of fat, saturated fat, energy, sodium, and with lower consumption of vitamins and produce (Paeratakul, Ferdinand, Champagne, Ryan, & Bray, 2003; Bowman, Gortmaker, Ebbeling, Pereora, & Ludwig, 2004). Despite the constant media reporting and growing public awareness about its unhealthiness consumers continue to consume large amounts of food from fast food restaurants. If this information does not impact people's consumption from fast food restaurants, perhaps a more efficient approach may be to increase the healthiness of fast food itself and to lower the portion sizes served. This appears to be particularly essential considering the need to protect children from developing unhealthy eating styles that set standards and habits for the rests of their lives.

Eating behavior and diet during childhood and adolescence is a main predictor for disease development later in life (Birch, Savage, & Fisher, 2015; Draper, Grobler, Micklesfield, & Norris, 2015). Considering the importance of establishing healthy behaviors at young age ensuring that children and adolescents establish healthy eating norms and behaviors is essential to reduce negative health consequences resulting from unhealthy food consumption (Viner, Ozer, Denny, Marmot, Resnick, Fatusi, & Currie, 2012). Recent attempts to improve the quality of children's meals have not met with success. Calls for banning kid's meals or regulating their content or their promotion has met with resistance by both fast food companies as well as consumers. Instead of this regulatory approach to improving what children eat, perhaps a more behaviorally-centered approach would be more tenable. By observing how children eat when at fast food restaurants, this research seeks to examine what possible options there might be to positively influence what a child orders or eats.

To this end, we first report an exploratory observational study where children were observed eating fast food meals. On the basis of these observations conclusions were drawn and the meals at the fast food restaurant were modified with the aim of improving the healthiness of the meals. A second study then used the observations of a much larger national sample of children at the fast food restaurant to investigate how a meal that was altered to be healthier was received in the natural setting. As such the aim of the paper is twofold. Firstly, it examined children's eating behaviors at fast food restaurants to infer potential improvements. Specific attention is directed at the amount children consume and leave behind. Secondly, it investigated the effect of implemented improvements on consumption.

Background

The main drivers for weight gain and obesity are intake of highly caloric food and a general intake of too large portions (Rolls, 2014). The latter aspect has been particularly detrimental to food consumption patterns in the past as portion sizes have increased 10-fold between the 70s and 2000 (Wansink & Van Ittersum, 2007). Not only does this increase in portion size impact the consumption of a single meal that comes in a large portion (Wansink, Painter, & North, 2005), it further influences

the norms of what constitutes a normal portion. Social cognitive theory (Bandura, 1986) assumes that the social environment influences individuals' behavior by suggesting social norms. These social norms propose appropriate behaviors via social proof principles and lead individuals to adjust their own behavior to the perceived standards of others around them (Prinsen, De Ridder, & De Vet, 2013; Draper et al., 2015; Junghans & Wansink, N.d). Portion sizes can be considered such a social norm despite the fact that people do not directly observe others' eating behavior. As such, portion sizes lead customers to adjust their own consumption to what they perceive as others' standards, as a typical and appropriate meal, which can lead to an increase in consumption (Wansink & Van Ittersum, 2007).

In light of these problems arising from large portion sizes the studies described in this paper investigate children's consumption at fast food restaurants with a particular focus on whether and what part of their meal is left over. Specifically, children's consumption at four different locations of a fast food hamburger chain was observed (Study 1). On the basis of this, recommendations were made to Burger King, Jack-in-the-Box, McDonalds, and Taco Bell. McDonalds subsequently adjusted the portion and ingredients of their meals they served to children. Study 2 investigated the eating behavior of children specifically ay McDonalds to examine the potentially impacted eating behavior of kids after the introduction of this new meal.

Study 1. Documenting Fast Food Eating Behaviors

Understanding eating patterns in adults is difficult because many behaviors appear to not involve a great deal of reflection or conscious thought, but instead appear to be mindless (Wansink, 2010). This is further confounded with children who are often not able to articulate even their most conscious rationale for their behavior (Bradburn et al., 2004). To address this, a pilot observational study was conducted of how children eat at fast food restaurants with the goal being to better understand their eating behaviors and to determine how they might be encouraged to eat a healthier meal. The research was not funded and was conducted with the intent on finding a potential set of solutions that would be equally appropriate across all fast food chains.

Methods

As part of a larger investigation into eating behavior at fast food chains we observed 27 children under the age of 14 eating at one fast food chain in 2008. Specifically, we were interested to examine what food children selected, what portion sizes they eat, the social context in which they eat, how they consume their meal, and whether they finish their meals. Observations were conducted over the lunch hours and dinner hours for four consecutive Saturdays at four different fast food restaurants within the same chain within the Washington D.C. area. In the study, every tenth child to enter the restaurant was unobtrusively observed from the time they sat down until they left. The approximate age of the child and their companions was estimated. Coding sheets were used to document when they arrived, who they were

with, the location of where they sat, how far it was from the counter, what they ordered, and how much remained of each item after they had completed their meal. The amount of waste was determined by counting the number of left-over French fries and the proportion of sandwich (or entrée) eaten.

Results

Children spend an average of 27.37 (*SD* = 12.87) minutes at the restaurant. In most cases (*N* = 21, 77.8%) they are accompanied by one adult and most of their visits take place from late morning until early evening. The details of the findings for boys and girls can be found in Table 1. This data shows that most children get the small portions of French fries and soft drinks. Especially the boys have a tendency to consume their meals from the bag, which may be an integral part of the fast food dining experience. Girls on the other hand show a larger tendency to add Ketchup to their meals. A specific aim of the observations was to investigate whether children finish their meals at this restaurant. Considering that most children get the smallest portion size available, this information will be informative as to the appropriate size of the smallest portion for children. The findings indicate that 44% of the children leave some parts of their meal, meaning the burger and/or French fries, behind. Specifically, out of those kids who leave food behind an average of 20.7% of the burgers and 13.33 French fries remain untouched.

Variable		Boys (*N* = 13)	Girls (*N*=13)	t / X^2	p
Size of Fries	S	62%	91%	.2.88	.24
	M	31%	9%		
	L	8%	0%		
Size of Drink	S	73%	100%	.2.89	.24
	M	18%	0%		
	L	9%	0%		
Eat from the bag		92%	69%	2.23	.32
Add Ketchup		69%	23%	5.57	.05
Fries eaten per handful		1.85	1.37	1.41	.17
Bites of burger eaten per handful		1.81	3.09	-1.78	.09
Average number of chews per bite		7.6	7.3	.04	.71
Proportion of burger leftover		.05	.08	2.25	.54
Number of fries leftover		5	5	.17	.81

Table 1. Eating Behavior by Boys and Girls in Fast Food Restaurants.

Discussion

The main conclusions to be drawn from the pilot study relate to the fact that about half of the children do not finish their portions of food despite the fact that they have the smallest portion available at this restaurant. This observation called for a change in the manner in which portions for children are determined.

This appears particularly important for two main reasons: Firstly, a large array of research investigations has revealed the impact of portion sizes on food consumption (Fisher & Kral, 2008). People understand a provided portion as a norm for what is normal to be consumed and will determine their amount of consumption on the portion size, rather than internal cues of satiety (Wansink & Van Ittersum, 2007). Considering that portion sizes have increased tremendously over the past decades, they are commonly considered an important contributor to the obesity epidemic. The observation that many children appear to not follow the portion-size induced norm and leave food behind is an observation suggesting that children are more likely to determine their amounts of consumption based on internal cues of satiety rather than externally suggested norms. As such, children seem to provide valuable information about the amount of food they require as part of a meal. This information could thus be considered an indicator for what a normal portion size for children should be. This appears to be particularly important for kids' meals as the maintenance of healthy eating patterns and healthy weights is essential during childhood and stages of physiological development for the prevention of negative health consequences (Birch & Fisher, 1998). Secondly, the observation is important from an environmental perspective. The prevention of food waste has become a goal for society (Hall, Dore, & Chow, 2009). In the US 30% of all food is wasted every year, representing an enormous loss of resources (UNEP, 2015). From the perspective of food waste prevention the results from the study suggest a reduction in portions for children at fast food restaurants to prevent food going to waste.

Study 2. How Children's Eating Behaviors are Altered with Healthier Children's Meals

On the basis of the observations reported in Study 1, one fast food chain altered their meals by reducing the portion sizes of French Fries and by offering a half serving of apple slices. Specifically, the portion of French fries was reduced from a 250 calorie to a 103 calorie portion. At the same time a serving of apple slices was added to the meal to contribute to children's fruit consumption. Previous research has repeatedly suggested that fruit and vegetable consumption can be increased by increasing availability and accessibility (Hanks et al., 2012; Van Kleef, Otten, & van Tijp, 2012). The addition of apple slices to the kid's meal thus provides an opportunity to investigate these strategies in a real life setting. For that reason, Study 2 involved similar observations of children's consumption in one fast food chain to assess eating behavior both in terms of leftovers and consumption of the healthy addition of apple slices.

Methods

In this second study, 208 children under the age of 14 eating a kid's meal at 27 restaurant locations across the United States. The dataset included 118 boys and 90 girls with an estimated average age of 7.2 years. The data were collected by unobtrusively coding customers' characteristics, meals, and eating behavior. The coding sheets were similar to those in study one, but had been adjusted to investigate the changed kid's meal specifically, which did not include options for different portion sizes.

Results

On average, kids spend 29.82 (*SD* = 12) minutes at the restaurant. The general descriptive information about the sample is provided in Table 2. The data reveal that more than half of the children (54.8%) do not finish their meal. Out of the children who do not finish the respective parts of their meal 18.4% of the burgers and 18.9% of the French fries remain uneaten on average. Interestingly, boys eat significantly less of their French fries than the girls (*p* =.003). At the same time, almost half (46%) of the apple slices remain untouched in total. Out of those children not finishing their apples an average of 72.4% of apple slices remain uneaten. A comparison of the leftovers between the results of Study 1 in 2008 and Study 2 in 2015 can be found in Table 3.

Table 2. Amount of consumption and eating behavior of boys and girls in comparison at the fast food restaurant in 2015 when the new kid's meal had been introduced.

Variable	Boys (N = 118)	Girls (N=90)	t / X^2	p
Eaten from bag (%)	36	45	1.62	.25
Add Ketchup (%)	59	57	.81	.85
Fries eaten per handful	1.59	1.53	.66	.51
Bites of burger eaten per handful	2.06	2.14	-.48	.63
Average number of chews per bite	12.78	11.33	1.61	.11
% of burger leftover	4.49	2.68	1.46	.15
% of fries leftover	7.6	2.76	3	.003
% of Apples leftover	50	39.63	.91	.37

Variable	2008	2015
% of kids who did not finish their meal	44	54.8
French fries left behind	# 5	5.5%
% of burger left behind	5.8%	3.7%
Apple slices left behind	-	46%

Table 3. Comparison of leftovers of the original meal in 2008 and the changed meal in 2015.

General Discussion

At first impression the data collected in the two studies seem to suggest that the reduction in French fries served as part of the kid's meal led to an increase, rather than a decrease, in the amount of food left behind. However, a more detailed analysis of the data suggests that this impression is driven by a large amount of apple slices left behind. The increase in leftovers is due to many children not finishing their apple slices, rather than changes in how many French fries remain uneaten.

These results are particularly interesting considering the above-mentioned norm influence of portion sizes. Despite the fact that the portions served to children in 2015 are smaller compared to the portion served in 2008, similar amounts of food appear to be left behind. Only a small reduction in the amount of burger left behind can be seen. Thus, the findings imply that children overall consume less French fries, due to the strongly reduced portion size and hardly any changes in leftovers of French fries.

In light of the normative portion-size effect discussed above the changes are likely to contribute to healthier consumption in children by reducing their uptake of unhealthy and increasing their consumption of healthy food. This finding could be interpreted along two lines of reasoning. On the one hand, it could mean that children are indeed susceptible to normative external portion-size influences leading them to adjust their consumption to the portion size provided (while some children still do not finishing it). This rationale is corroborated by findings showing that increasing children's portion sizes indeed induce higher consumption (Fisher, Rolls, & Birch, 2003; Patrick & Nicklas, 2005). On the other hand, the findings could be explained on the basis of the additional consumption of apple slices. Specifically, children may eat less French fries because they are replaced with apple slices. While almost half of the serving of apple slices remains uneaten, the consumption may nevertheless have replaced the French fries, while leaving the consumption of the burger largely unaffected. As such, despite not yielding the maximum positive impact on consumption possible, the addition of apple slices has indeed increased the fruit consumption at the fast food restaurant, and may have lowered the consumption of French fries. This finding corroborates previous research on nudging and choice architectures which posits that eating behavior can be improved by

increasing the availability, accessibility, and exposure to healthy food choices (Reinaerts, Nooijer, Candel & De Vries, 2007).

Limitations and Future Research

The precise driver of the change in children's eating behavior cannot be determined on the basis of our studies' observational data. Nevertheless, there is good support for the argument that the portion size reduction and the addition of apple slices to the kid's meal have contributed to lower intake of French fries in children visiting the fast food restaurant. In light of the observation that children's consumption of fried and nutrient-low foods as well as their portion sizes have increased and the consumption of fruits and vegetables have decreased in the past years despite contrary dietary recommendations, these findings provide hope for an improvement of children's eating behavior (Gidding, et a., 2005). Moreover, the addition of apple slices has in fact increased the consumption of fruit for children eating at the fast food restaurant. At the same time it should be noted that the scope of the studies was restricted to the consumption of one meal without providing further insights into the long-term effects of the consumption of this meal on subsequent food choices and portions.

On the basis of previous research on licensing (DeWitt Huberts, Evers, & De Ridder, 2012) and health halo effects (Chandon & Wansink, 2007) it could also be reasoned that the addition of apple slices may have negative implications for children's eating behavior. The addition of the fruit may lead to a health halo that leads customers to believe that the meal at the fast food restaurant is healthier than is actually the case. This may be particularly impactful in light of the observation that only half of the healthy additions are actually consumed by children. The addition of the apple slices may even provide justifications to add additional items to the meal thereby leading to a paradoxical effect of decreasing the healthiness of food choices and increasing consumption as a whole (Chandon & Wansink, 2007). Future research should therefore investigate the impact of apple slice additions on potential health halo effects and determine whether the increased healthiness of the meal leads to the licensing of subsequent unhealthy food choices.

Previous research has shown that children are susceptible to general portion size effects (Fisher & Kral, 2008; Fisher, Rolls, & Birch, 2003; Patrick & Nicklas, 2005). In light of our findings it appears essential to extend this research and to determine the age at which children start being influenced by consumption norms, as well as the extend to which this influence affects their eating behavior both in the short and long run. Moreover, it should be investigated whether the normative influence of serving smaller portions has long-term effects on children's perception of what constitutes a normal portion.

Considering the findings from a food waste perspective reveals both positive and negative aspects. In general, large portions are likely to lead to food waste when the portions are not entirely eaten. In fact, reducing portions of French fries in restaurants has been associated with less plate waste in naturalistic settings

(Freedman & Brochado, 2010). In light of world population growth, food production strains on resources of water and land, as well as negative influences of production and shipping for the environment, reducing food waste has become one of societies' main challenges for the future (Parfitt, Barthel, & Macnaughton, 2010; Hall, Guo, Dore, & Chow, 2009). Post consumer food waste contributes largely to this problem (Parfitt et al., 2010) and could be addressed by lowering portion sizes served at restaurants to ensure that less food remains uneaten by customers. The current results reveal that similar amounts of French fries and burger go to waste with the new kid's meal. However, the large amounts of apple slices that remain uneaten contribute to the overall food waste. In light of the necessity of improving childrens' diets this does not seem to justify lowering the number of apple slices included in the meal. However, attempts to increase children's desire to eat more apple slices may be considered. Current research results provide a large amount of strategies to increase the appeal of particular foods, such as social norm influences (Draper et al., 2015), increasing the visual appeal of the food (Jansen, Mulkens, & Jansen, 2010), or alternative nudges (Hanks, Just, Smith, & Wansink, 2012). These strategies could increase the amount of apple slices consumed at fast food restaurants, thereby contributing both to the overall healthiness of the meal and the avoidance of food waste.

Implications

The implications of the findings are twofold. Firstly, the studies show that restaurants and food providers hold a powerful position with regards to their customers' eating behavior. Subtle changes in portion sizes and meal composition impact their customers' amount as well as the healthiness of their food. As such, they can contribute largely to the required changes in eating behavior and food choices to improve consumers' health. This is particularly important when the customers are children who are vulnerable to external influences (Patrick & Nicklas, 2005) and cannot be held responsible for the healthiness of the healthiness of their food choices. Secondly, the findings provide evidence for the effectiveness of nudging strategies. The reduction in portion size in combination with the addition of apple slices provides an easy accessibility nudge that makes it easier for customers at fast food restaurants to eat more healthily. The nudge does not require customers to exert self-control or to consciously deliberate the healthiness of their order. At the same time it does not exclude the unhealthy French fries from the meal but instead increases the variability of food included. In light of the successful change of the composition of the kid's meal other fast food restaurants may consider altering their meals to adjust portion sizes to actual amounts of consumption and thereby reduce food waste, as well as to contribute to the health of their customers.

Conclusions

In conclusion the studies presented here reveal how subtle changes in meal composition that relate to the reduction of portion sizes and the addition of fruit can influence the healthiness of the consumption of children in fast food restaurants. The reduction of the portion of French fries has resulted in reduced consumption

of French fries. The addition of apple slices, while leading only to partial consumption, has increased children's consumption of fruit during their fast food restaurant meal. Future research will need to determine the long term influences of these changes and aim at the implementation of strategies to increase children's consumption of the provided fruit to further the healthiness of their meals and to reduce the waste of apple slices.

Chapter 7

Consumers' Choice-Blindness to Ingredient Information

Cheung, T., Junghans, A. F., Dijksterhuis, G. B., Kroese, F., Johansson, P., Hall, L., & De Ridder, D. T. D. (2015). Consumers' Choice-Blindness to Ingredient Information. *Appetite*.

When it comes to food products, many consumers often report preferring natural products (Rozin et al, 2004), and assume that products based on natural ingredients without additives are healthier (Bredahl, 1999; Dickson-Spillmann, Siegrist, & Keller, 2011; Evans, de Challemaison, & Cox, 2010; Shim et al., 2011). In response food manufacturers have spent substantial efforts in tailoring the presentation of ingredient list information on food packaging with the underlying assumption that consumers infer the 'naturalness' of a food product by its ingredients. Similarly, policy makers have increasingly focused on providing objective information about the naturalness of ingredients in food products. Nonetheless, the effect that ingredient list information has on consumers remains unclear, as there is a lack of scientific evidence demonstrating that consumers actually prefer products with more 'natural' ingredients. Accordingly, the first objective of the current study is to examine the degree to which consumers take the initial step to actually attend to ingredient information on food packaging. Contrasting the previously employed self-report measures, the novelty of this study is the employment of the choice-blindness paradigm (Johansson, Hall, Sikström, & Olsson, 2005) to investigate whether consumers pay attention to ingredient information on product packaging. Given consumers' limited attention to product labels (Grunert, Wills & Fernández-Celemín, 2010), we furthermore explore whether the provision of subtle reminders could encourage consumers' attention to ingredient lists. By investigating the effectiveness of reminders to consider naturalness, the current findings are relevant for both policy makers and food manufacturers' efforts in enhancing consumers' consideration of ingredient list information.

Favoring 'Natural' over 'Unnatural' Ingredients

While consumers report having a preference for more natural food (Rozin et al., 2004), it is unclear whether they actively seek out information to evaluate the 'naturalness' of different food products. Existing literature has mainly focused on examining consumers' use of ingredient list information on packaging for nutritional value (see Grunert et al., 2007 for review), but not for deducing the naturalness of food products. In order to address this research gap, the current research adopts a novel approach by examining consumers' consideration of E-numbers on ingredient lists of food packaging. E-numbers, which are reference numbers given to identify food additives in the EU, (e.g., pectin is a gelling agent that is commonly used in jam and identified by the code E440), is a topic highly discussed in contemporary media and public discourse, as it captures the increasing trend amongst consumers for more 'natural' food products and concerns over food additives, as well as the responses of food authorities and food manufacturers (Evans, de Challemaison, & Cox, 2010). While E-numbers were initially designed by the European Food Safety Authority to identify all food additives that have been extensively tested against potential health risks (Van Dillen et al., 2003), ironically, consumers often associate them with undesirable, harmful, and unhealthy chemicals (Evans, de Challemaison, & Cox, 2010; Hoogenkamp, 2012; McCarthy, Brennan, Kelly, Ritson, de Boer, & Thompson, 2007; Varela & Fiszman, 2013). Moreover, despite previous findings show that only a minority of consumers look at food labels for nutritional information (Grunert, Wills, & Fernández-Celemín, 2010), manufacturers have been

increasingly pushing for clean label products (Bobe & Michel, 2011; Hoogenkamp, 2012), which are defined by being free of 'chemical' additives, having easy-to-understand ingredient lists, and being produced by use of traditional techniques with limited processing (Edwards, 2013). Indeed, between 2003 and 2012 the number of products with such clean labels has more than quadrupled universally (Edwards, 2013). In spite of all the initiatives taken to satisfy consumers' seemingly growing preference for more natural products, there is a pressing need for scientific evidence to justify these initiatives.

The Validity of Self-Report Measures

Previous studies have indeed reported negative attitudes towards additives and E-numbers (Edwards, 2013; Drichoutis, Lazaridis, & Naygar Jr., 2006; Holm & Kildevang, 1996), but the majority of these studies are based on self-report measures. There are of course observational studies investigating how consumers use information on packaging, yet these studies have focused on front of package or nutrition value information rather than ingredient lists that provide information on the naturalness of the ingredients (Grunert, Fernandez-Celemin, & Wills, 2010). However, self-report measures have been criticized for being vulnerable to task demands and social desirability influences, which result in low predictive power of reported attitudes for actual behavior (Herbert, Clemow, Pbert, Ockene, & Ockene, 1995, Azjen & Fishbein, 2005; Vermeir & Verbeke, 2006). Previous research has shown that, particularly in the realm of health, responses are assimilated towards the socially desired answer (Herbert et al., 1995; Kristiansen & Harding, 1984; Klesges et al. 2004) due to people's motivation to consider and present themselves as healthy individuals (Lindeman & Stark, 1999; Malhotra, 1988; Bailis, Segall, & Chipperfield, 2003). As such, using self-report measures that require participants to provide opinions to topics they do not have stable opinions about further increase the influence of strongly negative discourse, such as the media attention to food additives has mostly framed food additives in terms of risks involved in consuming additives and the contamination of an otherwise natural product (Evans, de Challemaison, & Cox, 2010), to bias opinions and preferences (Reed II, Wooten, & Bolton, 2002; cf. Dijksterhuis, 2004). Consequently, when opinions are spontaneously formed under the influence of such external sources it is not surprising that the resulting opinions do not correspond with behavior.

These issues suggest that product evaluations may depend on whether consumers are specifically asked about whether unnatural-appearing ingredients in product are appreciated (i.e. where the consumer is directly pointed at the fact that the naturalness is the key factor in the evaluation) or whether consumers are asked to evaluate a product that comes with ingredient information but without the trigger to judge the product on its naturalness. For example, as shown by the study by Noussair and colleagues (2001), self-reported negative attitudes toward genetically modified food did not translate into decreased purchasing of genetically modified food. On one hand, part of this lacking association could be explained by influences on the self-reports in terms of demand characteristics, social desirability, and self-concepts as discussed earlier. On the other hand, it may be that consumers

genuinely hold concerns with genetically modified food, but at the actual point of purchase these negative perceptions and attitudes are not acted upon. Accordingly, the current study aims to overcome these shortcomings of self-report assessments by firstly avoiding the direct reporting of attitudes on E-numbers and by manipulating the degree to which participants are guided towards including naturalness as a factor in their product evaluations. In order to achieve these ends the choice blindness paradigm is used in the current study.

The Choice-Blindness Paradigm

It has recently been shown that people often fail to detect a mismatch between a previously expressed attitude and a (different) attitude they are subsequently presented with as their own, a phenomenon known as choice-blindness (Johansson, Hall, Sikström, & Olsson, 2005). In this research paradigm participants are asked to make choices but are subsequently presented with the rejected option as being their selected option. Interestingly, participants often not only fail to detect the mismatch between their initial, actual choice and the presented choice, but they spontaneously confabulate reasons for having made the presented (never made) choice. The lack of detection of such a mismatch has been shown on various dimensions, such as attractiveness of faces, in which participants choose a more attractive face, and are subsequently asked to justify their choice of the originally not chosen other face (Johansson, Hall, Sikström, & Olsson, 2005); product preference, in which participants firstly, do not detect a swap of their chosen product and, secondly, confabulate reasons for having chosen the product they never actually chose (Hall, Johansson, Tärning, Sikström, & Detgen, 2010); as well as moral and political attitudes (Hall, Johansson, & Strandberg, 2012; Hall, Strandberg, Pärnamets, Lind, Tärning, & Johansson, 2013). To illustrate a few examples of the low detection rate, from the aforementioned studies participants only concurrently detected 13% of the trials in which their chosen face had been changed (Johansson et al., 2005), demonstrated a 33% detection rate when the not chosen product was returned (Hall et al., 2010), and correctly identified 41% of the trials when their moral attitude ratings had been manipulated (Hall et al., 2012).

While these previous studies were designed to examine the stability of choices and attitudes, the current study employs the choice-blindness paradigm to investigate the attention to ingredient lists and its importance for product evaluation while overcoming the above-mentioned disadvantages of self-report assessments. The choice-blindness paradigm allows us to infer the degree of attention that is paid towards ingredient lists by presenting the participants with the supposedly same physical product, while in fact changing the ingredient information on the product. We infer that the participant would need to have initially looked at the ingredient list and processed the information to some sufficient degree before they could notice the discrepancy and detect the change on the manipulated ingredient list presented later on in the experiment. Capturing these advantages of the choice-blindness paradigm, the study provides insights into the degree to which the design of more natural products and the accompanying presentation of more natural ingredient lists actually facilitate consumer preference for the more highly valued ‘natural’ products.

It provides a measure to infer whether consumers pay attention to ingredient lists during actual product evaluations. In addition, we explore the possibility that a reminder, in the form of a subtle instruction for consumers to explain their naturalness evaluation of product, could increase the likelihood for consumers to attend to ingredient information on the package, thereby mitigating the change blindness effect if the ingredient information on the packaging of a food product was changed.

Design and Hypotheses

Accordingly, the current study employs the choice-blindness paradigm of Hall et al. (2010) and adopts a 2 (instruction: general vs. specific) × 2 (ingredient list: no change vs. change) between subjects factorial design. The dependent variable of interest, whether participants detect the change to the ingredient list or not (i.e., online detection vs. no detection), is a categorical outcome. During the experiment, participants were first instructed to evaluate two products carefully. Subsequently, participants were returned with the product that had received a higher general evaluation rating and were instructed to explain their evaluations based on either the general instruction to justify the general rating or the specific instruction to justify specifically the naturalness rating of the preferred product. In the ingredient list change condition, unbeknownst to the participant, the experimenter swapped the product that the participant had given higher overall rating to with another product that was identical all aspects of packaging except with a changed ingredient list. Considering that the only way that the participant would have noticed the changed ingredient list on the returned product was if they had initially paid attention to the ingredient list on the product that they had previously evaluated, the detection of such change was used as indicator for attention to ingredient lists. Based on the detection rates found in previous studies using the choice blindness paradigm, it was expected that few participants would detect the change to the ingredient list information. However, it was expected that the detection rate would be higher in the specific instruction condition, in which participants were asked to explain their naturalness rating compared to the general instruction condition in which participants were asked to explain their overall rating of the product.

In summary, the aim of the choice paradigm used in the current study is to demonstrate consumers' inattention to ingredient list information that contributes to their choice blindness to change to the ingredient list. Rather than focusing on what consumers provide or confabulate as reasons for their evaluation of the product, the instruction to explain the general evaluation rating or the specific naturalness rating of the product was simply used as a manipulation to facilitate attention towards the ingredient list information as means to mitigate choice blindness. As such, the choice blindness paradigm aims to reveal which information that consumers attend to (or not), and how to increase attention to relevant information through the form of instructional reminders.

Method

Participants. Participants (*N* = 534) were recruited via a marketing research agency for monetary reward. All participants were residents in the Netherlands and capable of the Dutch language. Forty-two participants were excluded from the analysis due to not following the procedures and providing insufficient data. The final dataset consisted of 492 participants; 37.4% were in the ingredient list no change condition and 62.6% were in the ingredient list change condition. Participants included 53% females and 46.5% males, (remaining 0.5% did not disclose their gender) with a mean age of 39 years (*SD* = 14.17). Educational levels ranged from 2.7% with basic educational, 55.3% vocational training and higher secondary education, and 42% with university degrees. At the time of the study 28.8% were unemployed and 71.2% were employed. The study was conducted in accordance with the ethical standards described by the Medical Research Involving Human Subjects Act (WMO, 2012), according to which research with healthy adults is exempted from the requirement for formal ethical approval. The study was conducted by OP&P Product Research in accordance with ESOMAR code (ESOMAR, 2015).

Procedure. Participants were invited to the marketing research agency to take part in a marketing study on soup. They were randomly assigned to one of four conditions. Upon arrival participants were greeted by the hypothesis-blind experimenter and guided into an experimentation room where they were asked to sit at a table where two cans of soup were presented next to each other, along with a product evaluation questionnaire for each product. The products included a can of soup from the brand Wouda and the brand Stijn, two entirely fictitious brands, which were specifically designed for the present study (the presentation on left and right was counterbalanced). Both products had either 'unnatural' (elaborated descriptions of ingredients with words and E-numbers) or 'natural' (few word descriptions of ingredients) ingredient lists presented on the backside of the can. More information about the information on the soup cans and the precise differences between the natural vs. unnatural ingredient lists can be found in the Materials section. The choice blindness paradigm commenced, and in the first stage participants were encouraged to closely examine both products in order to fill out the product evaluation forms. After the participant has completed the evaluation, the experimenter removed the products and the product evaluation forms from the table. The experimenter then presented the participant with a demographic questionnaire to complete. At the second stage, the experimenter implemented the experimental manipulation. While the participant is filling out the demographic questionnaire, the experimenter examined participants' product evaluation forms, and selected the brand that scored higher on the overall general evaluation rating. Critically, the experimental manipulation where the ingredient list changed (in the ingredient list change condition) or remained the same (in the no change condition) was performed on the brand of soup receiving the higher overall rating. In cases where both products had the same overall rating, the experimenter chose either one of the products to use for the remainder of the experiment but ensured that this choice was counterbalanced between participants (Stijn: 104; Wouda: 114). After the participant had completed the demographic questionnaire, the participant was

returned back with the brand of soup that they had given the higher overall rating to (or one of the brands chosen by the experimenter due to equal ratings) along with the product evaluation form that was previously filled out. Presenting the evaluation form again allowed the participant to see the overall- and naturalness rating that they had previously assigned to that brand of soup that was returned back to them. At this point of the experiment, the participant was presented back either with a can of soup containing the same ingredient list (no change condition), or a can of soup with a different ingredient list (ingredient list change condition) from the product that they had initially evaluated at the first stage of the experiment. To illustrate, in the control, no change condition if the participant had initially rated the unnatural ingredient lists, they were handed their preferred brand with the unnatural ingredient list and likewise for the natural ingredient list. In this no change condition, the ingredient list evaluation order was counterbalanced between natural to natural, and unnatural to unnatural. Contrarily, in the ingredient list change condition, participants were returned with a product that was identical in packaging to the product that they had previously assigned a higher overall rating to, but with a changed ingredient list. For instance, had participants previously given a product with an unnatural ingredient list a higher overall rating, they were handed back an identical product but with a natural ingredient list. Or if they had previously given a product with natural ingredient list with a higher overall rating, they were handed back an identical product but with an unnatural ingredient list. The ingredient list change manipulation was counterbalanced between natural to unnatural, and unnatural to natural. The precise differences between the experimental condition in which the soup cans (in essence where ingredient list evaluation orders) changed and the control condition in which the soup cans did not change are illustrated in Figure 1.

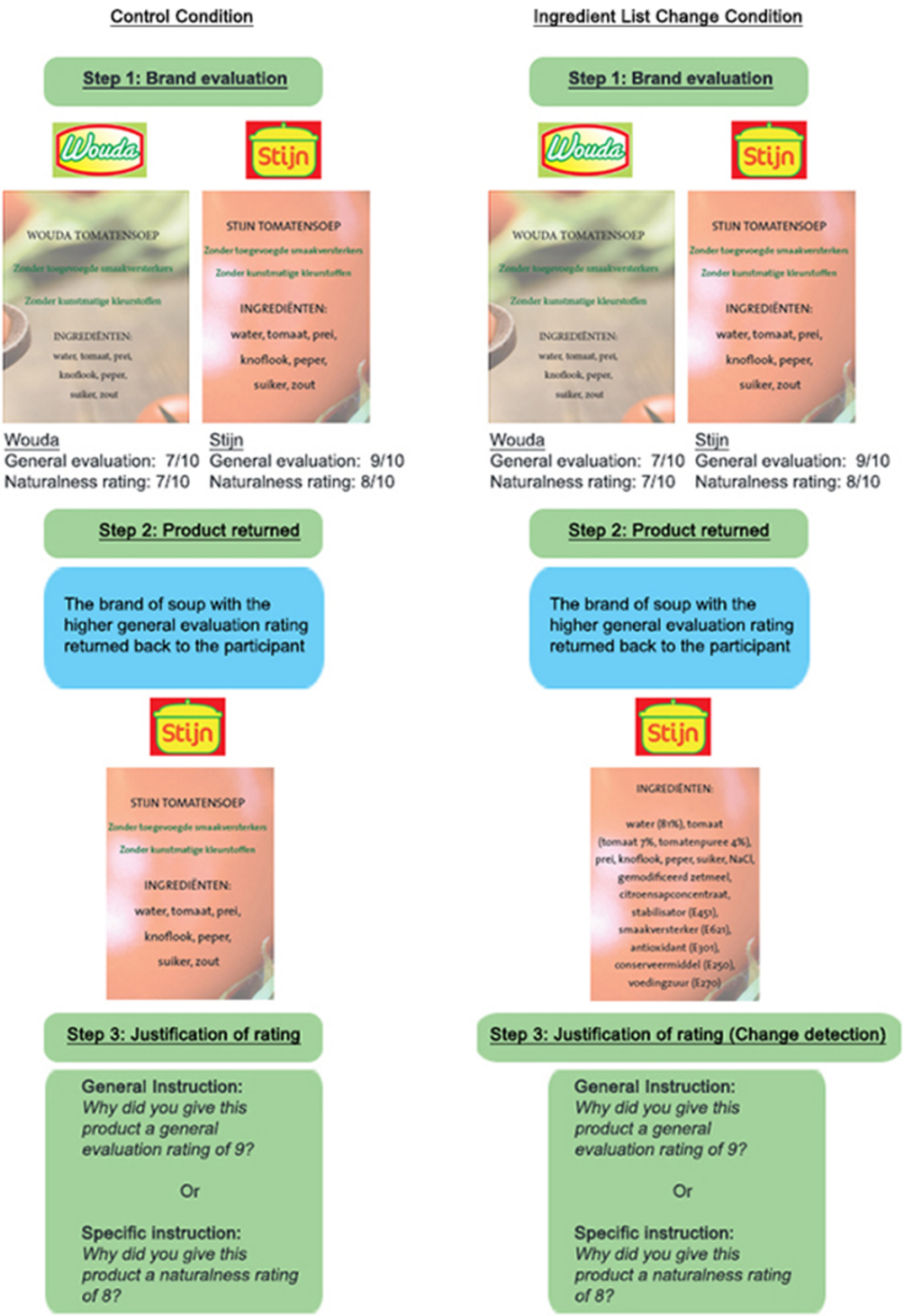


Figure 1. A pictorial depiction of the control condition where the ingredient list does not change (left) vs. the ingredient list change condition (right). In the control condition, the natural ingredient list of the brand with the higher rating is consistently shown at all stages of the experiment (whereas in the counterbalanced version, the unnatural ingredient list would be shown throughout the experiment). Contrarily, in the ingredient list change condition the ingredient list of the brand with the higher rating is swapped from natural (Step 1) to unnatural (at Step 2) (whereas in the counterbalanced version, the swap would be from unnatural to natural.

Subsequently, at the third and last stage of the choice-blindness paradigm, the experimenter assessed for change detection by asking the participant to explain why they had given the product the respective score on the overall rating question (general instruction condition) or on naturalness (specific instruction condition), while referring to this score on the product evaluation form. Afterwards, the experimenter removed all the materials and provided the participant with a tablet computer to fill in the final questionnaire. Had the participant detected the swap of ingredient lists in the experimental condition this was coded as an 'online' detection (detection level code 1), in which case the participant was asked to fill in the final questionnaire and was thanked for their participation. All participants that had not detected a swap online went through a series of detection assessment questions at the end of the experiment. If the participant voiced any detection of the swap following one of these questions, this was coded as follows: The experimenter first asked whether the participant had any questions or comments about the study (detection level 2); whether they had noticed anything during the experiment (detection level 3); and whether they had noticed anything about the products they had evaluated (detection level 4). Finally, participants were thanked and guided toward the exit. Debriefing about the manipulation and aim of the study was done in written form subsequent to the finalization of data collection. The duration of each experimental session was approximately 10 -15 minutes. Each experimental session was conducted with each participant individually. The experimenter remained in the same room as the participant for the entire duration of the experiment, and whenever the participant was filling out questionnaires (i.e., evaluations of the two soups, demographic questionnaires, and final questionnaires), the experimenter remained in the same room but was not in the immediate vicinity of the participant so he or she could complete the questionnaires discretely.

Materials.

Soup can packaging: As previously mentioned, the two brands of soup used in the current experiment, Wouda and Stijn, were fabricated specifically for the purpose of the study. The soup packaging was designed respectively for the two brands (see Figure 2). The soup cans used in the study had a dimension of 12 cm in height and 10 cm in diameter.

Figure 2. An example of the package label with a natural ingredient list for Wouda (top), and a package label with an unnatural ingredient list for Stijn (bottom).

Figure 3. Left: An example of a natural ingredient list. English translation: "STIJN TOMATO SOUP; Without added flavor enhancers; Without artificial colorings; INGREDIENTS: water, tomato, leek, garlic, pepper, sugar, salt". Right: An example of an unnatural ingredient list. English translation: "INGREDIENTS: water (81%), tomato (tomato 7% tomato puree 4%), leek, garlic, pepper, sugar, NaCl, modified starch, lemon juice concentrate, stabilizer (E451), flavor enhancer (E621), antioxidant (E301), preservative (E250), food acid (E270).

Natural vs. unnatural ingredient lists: The natural and unnatural ingredient lists were initially pretested with 40 participants rating a long vs. a short ingredients list' naturalness and healthiness on 10-point scales (1 = not at all natural/healthy to 10 = very natural/healthy). Pre-test results indicated that the short ingredient list was perceived to be significantly more natural (M = 8.6; SD = 1) than the long ingredient list (M = 3.5; SD = 1.7); $t(39) = 15.52$, $p < .001$. The short ingredient list was also perceived as significantly healthier (M = 7.74; SD = 1.37) than the long ingredient list (M = 4.9; SD = 1.7); $t(39) = 7.53$, $p < .001$. Based on these pretest results the short ingredient list was used as the 'natural' ingredient list and the long ingredient list was used as the 'unnatural' ingredient list in the experiment (see Figure 3a & b).

Measures. Throughout the experiment participants were asked to fill out three questionnaires.
Product evaluation forms: Participants were asked to evaluate the two presented products based on two product evaluation forms; one for brand Wouda and one for brand Stijn. These questionnaires included evaluations of the products in terms of healthiness, expected tastiness, naturalness, authenticity, familiarity, appeal, liking of the package, the amount to which this product is consumed (this question was often misinterpreted by participants to ask for how often any soup is consumed; consequently, the question was excluded from the analysis); and overall rating. All these questions were answered on 10-point Likert scales. A sample of the product evaluation form could be found in the Appendix.

Demographic questionnaire: This questionnaire assessed age, gender, level of education, number of people living in their household, employment status, nationality, and how often participants do grocery shopping (ranging from never to every day on a 5-point scale).

Final questionnaire: The final questionnaire assessed participants' concern for health, their typical use of sources of information on product packages, as well as current levels of stress and hunger.

Justification scores. Based on the detection assessment participant were categorized as online detectors (detection level 1) if they noticed the swap of the ingredient lists during the experiment; as retrospective detectors if they referred to the swap of ingredient lists during the detection assessment (detection level 2, 3, and 4), and were categorized as non-detectors if they did not notice the swap at all. An additional measure of whether participants mentioned the ingredient lists during justification for their previously given overall ratings or naturalness ratings was recorded.

Randomization Check. There were no significant differences between participants in the general and specific instruction condition in terms of age, gender, educational level, and employment (all ps > .16). Similarly, there were no significant differences between participants in the control and experimental condition or between participants with the natural and unnatural initial ingredient list information in terms of age, gender, education, and employment (all ps > .05).

Results

Detection rates. Overall, there were very few participants who had detected the change in ingredient lists as predicted. Observed frequencies indicate that only 16.9% of all participants from the experimental, ingredient list change condition detected the change. Furthermore, within the general instruction condition 10.7% of participants detected the change in ingredient list, whereas within the specific instruction condition 23.5% of participants detected the change. See table 1 for an overview of the distribution of online detectors and non-detectors.

	Proportion of online detections
General instruction	17/159 10.7%
Specific instruction	35/149 23.5%

Table 1. Proportion of online detectors in the general and specific instruction conditions respectively

Complimenting the observed frequencies that provide preliminary evidence of a higher proportion of online detectors in the specific instruction condition, a logistic regression analysis further tested the hypothesis that predicted detection rates would be higher in the specific instruction condition than in the general instruction condition. Only the participants (N = 308) in the change condition were included in the analysis. Additionally, the brand (i.e., Wouda vs. Stijn) of the final product that participants handled during the second stage of the experiment and the ingredient list evaluation order were controlled for in the regression model. The logistic regression model was statistically significant, χ^2 (3, N = 308) = 9.60, p = .022. The model was also 83.1% correct in predicting online detection. The predictors and the results of the binary logistic regression analyses are presented in Table 2. In line with hypothesis, results showed that instruction was a significant predictor of detection (p = .003) with an odds ratio of 2.58. This indicated that participants in the specific instruction condition were 2.5 times more likely to be an online detector compared to participants in the general instruction condition. Consequently, observed frequencies as well as the results of the logistic regression analysis provide support for hypothesis stating that participants in the specific instruction condition detect a larger proportion of swaps than participants in the general instruction condition.

Dependent variable: Online Detection			
	B	Sig.[a]	Exp(*B*)
Nagelkerke R Square = .051 Cox & Snell R Square = .031			
Instruction (base: General Instruction)	.947	.003	2.58
Ingredient list evaluation order (base: natural to unnatural)	-.213	.491	.808
Final brand of chosen product (base: Wouda)	.052	.869	1.05
Constant	-2.051	.000	.129

[a] Based on Wald statistic.

Table 2. Predictors of online detection (logistic regression)

Post-hoc analysis.

Consumer characteristics: An exploratory aim of this experiment was to examine whether participants' health concerns, use of information on product packaging and current levels of stress and hunger measured in the final questionnaire would predict their change detection of the ingredient list information. Using Varimax rotation, an exploratory factor analysis revealed six factors with eigenvalues exceeding .6. The suggested factors explained 61.43 % of the variance in the data (N = 492), and ultimately one factor was discarded due to a low Chronbach's alpha in the subsequent reliability test of each factor (see Table 3 for an overview). Along with instruction (general instruction vs. specific instruction condition), these five factors including: (1) importance of healthy ingredients, (2) orientation toward quality food indicators, (3) focus on healthy eating, (4) trust in healthiness information, and (5) knowledge of product packaging information, were entered in a binary logistic regression as predictors of detection as the outcome. The logistic model was statistically significant χ^2 (8, N = 308) = 19.47, p = .013, and was 83.1% correct in predicting online detection. However, as presented in Table 4 results indicated that only instruction (B = .98; Exp (B) = 2.66, p = .003) was a significant predictor of online detection. None of the five factors representing different aspects of consumer characteristics significantly influenced participants' detection of the ingredient list change.

Factor 1: *Importance of healthy ingredients* (α = .532)
1. I base my choice for food on health. 2. I base my food for choice on the total amount of calories. 3. The ingredients have no influence oh my choice of food. 4. My purchase considerations are more based on my gut feelings than on careful deliberations. 5. I always look at the ingredients on the label. 6. I use the information on the label to make a decision if I am buying a new product. 7. I use the ingredient information to decide whether I will buy the product. 8. I am interested in ingredient information. 9. Ingredients are important to assess whether the product is healthy if it is unhealthy
Factor 2: *Orientation toward quality food indicators* (α = .796)
1. If a product carries a Fair Trade label I am more inclined to buy it. 2. If a product is organic I am more inclined to buy it. 3. Do you try to eat organic products?
Factor 3: *Focus on healthy eating* (α = .705)
1. Healthy eating is important. 2. How healthy do you think you usually eat? 3. Do you manage toe at healthily?
Factor 4: *Trust in healthiness information* (α = .598)
1. If a product carries a health label I am more inclined to buy it 2. If product carries a health label, it is healthier than products without the label 3. I trust that the information represented by the product label is correct
Factor 5: *Knowledge of product packaging information* (α = .512)
1. I understand the information of product packaging. 2. I know what E-number means.
Factor 6: *Immediate determinants of purchase* (α = .354; discarded due to low Cronbach's alpha)
1. I base my choice for food on taste. 2. I base my choice for food on price 3. I base my choice for food on feelings of hunger.

Table 3. Factors pertaining to different consumer characters extracted from individual question items assessing health concerns, use of information on product packaging and current levels of stress and hunger

Dependent variable: Online Detection			
	B	Sig.[a]	Exp(*B*)
Nagelkerke R Square = .10 Cox & Snell R Square = .06			
Instruction (base: General Instruction)	.98	.003	2.66
Ingredient list evaluation order (base: natural to unnatural)	-.235	.471	.79
Final brand of chosen product (base: Wouda)	.009	.979	1.01
Factor 1: Importance of healthy ingredients	.32	.154	1.38
Factor 2: Orientation toward quality food indicators	.228	.084	1.26
Factor 3: Focus on healthy living	.030	.898	1.03
Factor 4: Trust in healthiness information	-.260	.070	.77
Factor 5: Knowledge of product packaging information	-.022	.864	.98
Constant	-4.137	.004	.02

[a] Based on Wald statistic.

Table 4. Predictors of online detection (logistic regression)

	Participants who ignored the ingredient list	Non-detectors who referred to the ingredient list	Detectors who referred to the ingredient list
General instruction	106/154 68.8%	31/154 20.1%	17/154 11.0%
Specific instruction	84/146 57.5%	27/146 18.5%	35/146 24.0%

Table 5. Referral to the ingredient list by non-detectors and online detectors from the general and specific instruction conditions respectively

Referral to ingredient list information. An additional analysis was conducted to explore whether participants consider the ingredient make-up of the product in justifying their general or naturalness evaluation of the product. During the third stage of the choice-blindness paradigm, participants were asked to explain their overall rating (general instruction condition) or their naturalness rating (specific

instruction condition) of the product as part of the detection assessment. In the condition where the ingredient list changed, 190 participants ignored the ingredient list information when explaining their rating, 58 participants referred to ingredient information but nonetheless did not detect that change. Only 52 participants referred to the ingredient list information and detected the change concurrently. As expected, there were significantly more participants who referred to the ingredient list information in the specific instruction condition, hence also resulting in more detectors, compared to the general instruction condition (see Table 4), χ^2 (2, N = 308) = 8.85, p = .012. There was missing information from eight participants in the ingredient list change condition. Additionally, one participant was coded as a retrospective detector as they only disclosed at the end of the experiment that they had noticed, but was uncertain, that there was a change to the ingredient list.

Discussion

In line with the expectations, our main findings first show that only a low proportion of participants detected the swap of ingredient lists at all. Second, the observation of a higher proportion of detectors in the specific instruction condition (23.5%) compared to the general instruction condition (16.9%) compliment the results from the logistic model that instruction condition significantly predicted participants' detection status. These findings are consistent with previous research using the choice-blindness paradigm showing that individuals are generally unaware and do not detect the change when presented back with a choice that was not their own (e.g., Hall, Johansson, Tärning, Sikström, & Detgen, 2010; Johansson, Hall, Sikström, & Olsson, 2005). Moreover, this implies that a fairly low proportion of participants considered the ingredient list a source of information for a general product evaluation as well as for an evaluation of the naturalness of the product. Finally, our results are particularly interesting because they indicate that consumers do not attend to ingredient lists unless specifically directed towards it by a question about 'naturalness'. The additional findings from the post-hoc analyses also support this view, as a greater proportion of participants referred to the ingredient list information and were detectors in the specific instruction condition regarding naturalness, and that besides this naturalness instruction no other consumer characteristics such as health concerns and generic use or consideration of product packaging information predicted detection.

The discrepancy between the often-reported preference for natural products and the here observed lack of attention to ingredient lists could be explained in two different ways. Firstly, the mismatch could be attributed to the characteristics of self-report measures. When engaging in self-report measures consumers may over-report their usage of ingredient information and preference for more natural products in order to present themselves in a positive light that they are critical and healthful agents. The choice-blindness paradigm in the current study avoided the shortcomings of self-report measures and allowed an unbiased measurement of the degree to which consumers attend to and use ingredient list information to evaluate a food product overall and on its naturalness. Thus, the findings could be interpreted such that consumers are less attentive to the 'naturalness' of the ingredients in

actual choice-situations than self-reports indicate. Secondly, it could be that consumers are genuinely concerned with ingredient naturalness, as indicated on self-report measures, but require a specific reminder or cue, such as a question specifically about 'naturalness' as employed in the current study, to guide their behavioral information search to the ingredient list on the product packaging. This explanation is supported by the finding that detection rates were higher in the specific instruction condition, which may indeed have reminded participants to consider naturalness. Such reminders or cues therefore may provide an opportunity to increase consumers' attention to information they may otherwise overlook in rather mindless product evaluation situations. They could for example come in the form of nudges or labels.

Consumers have a lot of indirect influence in dictating how food policies are regulated and established, as well as how food products are manufactured and marketed. All food additives used in food products are required by the European Food Safety Authority to be extensively tested against health risks, and subsequently identified by respective E-numbers on the ingredient list of the food-packaging label to further inform and reassure consumers (Van Dillen et al., 2003). However, as the findings in our current study show, consumers generally pay less attention to information on ingredient lists than would be expected based on self-reports. This finding suggests that E-numbers as a source of information do not reach the majority of consumers. On the other hand, our findings do not support the idea that 'clean labels', containing a minimum of additives and limited processing, which food manufacturers have increasingly adopted in recent years (Edwards, 2013; Hoogenkamp, 2012), would have a large impact on consumers. Finally, our study also indicates that consumers may require some reminder to attend to the 'naturalness' of ingredients to take this information into account. Despite the fact that the instruction to attend to naturalness improved attention to ingredient lists only for a small proportion of the participants, this finding can be considered a starting point for future research investigating the effectiveness of employing various cues that remind consumers to consider factors, they themselves consider important, during actual choice situations. Based on the current results the implementation of subtle cues in the environment may be an effective strategy to shift consumers' attention to information on food packaging they consider relevant.

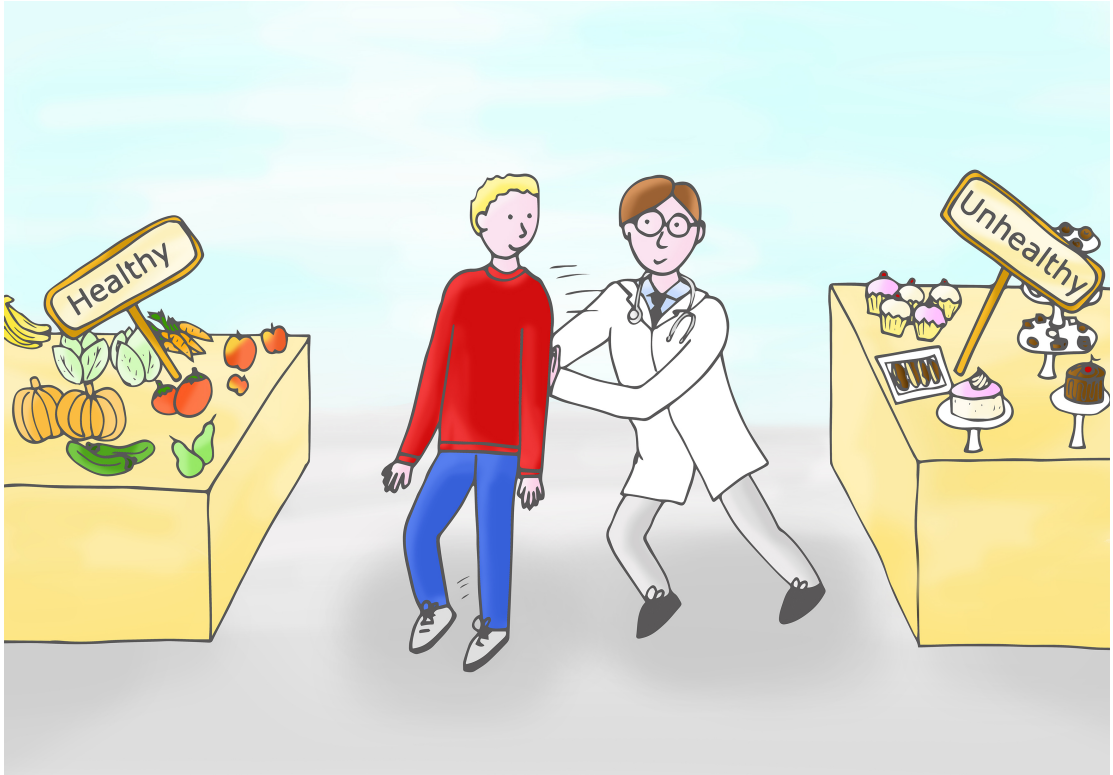
Besides providing insight into consumers' (in)attention towards ingredient lists, the current study contributes to the literature on choice blindness: whereas the paradigm has mostly been used to demonstrate inconsistencies in people's choices, as well as political and moral attitudes (Hall, Johansson, Tärning, Sikström, & Detgen, 2010; Hall, Johansson, & Strandberg, 2012; Hall, Strandberg, Pärnamets, Lind, Tärning, & Johansson, 2013), the current study shows that it can also be a useful strategy to unobtrusively assess consumers' attention to visual components of food products.

Future research is encouraged to develop strategies to understand the (limited) impact ingredient lists have on consumer evaluation and choice of food products. If the aim is to increase the impact of cues in their guidance of consumers' attention to

relevant information, either on food packaging or elsewhere (e.g. at specialized websites) more specific studies are needed. The framework used in the current study (choice blindness) may be suited for this, as it does not rely on self-report nor does it alert consumers to aspects of the products they would normally not consider. However, it should be acknowledged that the design of the choice blindness paradigm does not allow for an examination of the cognitive mechanisms that underlie the resulting lack of change detection, and to the best of our best knowledge this has not been examined in previous research. As such, while it is assumed that participants did not notice the change to the ingredient list on the returned product because they had not attended to the ingredient list on the initial product, it could also be plausible that participants did indeed look at the ingredient list information at first, but a lack of thorough processing of the information, a lack of memory of the information, or a failure to use the information subsequently could be accountable for the choice blindness effect. In any case, the implication remains that participants' visual attention to or depth of processing of ingredient list information is not substantial, thereby challenging the notion that consumers highly involve ingredient list information to deduce a product's naturalness. Moreover, to complement our current research methods, future studies could also employ eye tracking as an alternative method to directly assess consumers' visual attention towards ingredient list information on food packaging. Finally, while the current finding of low change detection is consistent and supportive of previous choice blindness studies, it would be beneficial for future research to further examine and pinpoint the cognitive processes that are culprit to the choice blindness effect. Furthermore, some insight could be drawn from previous literature suggesting consumer's lack of consideration of information on food packaging is not necessarily due to an inability to make use of the information, but rather a lack of motivation (Grunert et al, 2010). Furthermore, it has been acknowledged that consumers do not realize that they make over 200 food-related decisions each day (Wansink & Sobal, 2007), and that many of these consumption decisions are made mindlessly (Bargh, 2002; Dijksterhuis, Smith, van Baaren, Wigboldus, 2005). In light of this, it would be useful for future research to extend on the current study in examining the implementation of subtle cues to motivate and remind consumers to be more cognizant of information on food packaging that would useful in guiding their purchase decisions. Finally it should be noted that neither behavioral intention nor actual purchasing behavior was measured in this present study. Despite the advantages of instructed product evaluations, the experimental setting does obviously not resemble an actual point of purchase situation very closely. Moreover, previous research has suggested that the reading of ingredient list differs from product to product (Grunert et al., 2010; Nordic Council, 2004), but in this study only one food product was evaluated. A final limitation that should be discussed is the possibility that some of the participants did detect a swap but attributed it to their own wrongful memory rather than an actual inconsistency in what they were presented. Despite taking measures against this possibility by following a four-step detection assessment the possibility cannot be ruled out.

In conclusion this study showed that consumers pay much less attention to ingredient lists than self-reported preferences would suggest, and stresses the

limited value of adhering to commonly held beliefs about what ingredient declarations on food products should look like. Cueing considerations of naturalness could be a starting point for increasing consumers' attention to product packaging information they would otherwise neglect.


Healthy
Unhealthy

Chapter 8

Under consumers' scrutiny
An investigation into consumers' attitudes and concerns about nudging in the realm of health behavior

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Policy makers in a number of countries have revealed growing interest in novel strategies to improve consumer decision-making. UK Prime Minister Cameron's Behavioral Insights Team was the first to investigate the possibility of moving from a pure information-driven strategy to improve consumer welfare to behavioral-economics-informed strategies that are no longer based on the image of the purely rational consumer. The United States and Denmark have also recently adopted such innovative approach, while currently both Germany and Belgium are establishing similar groups. These libertarian paternalistic strategies, commonly known as nudges, influence behavior by changing the way choices are presented in the environment by either presenting them in a more salient or interesting light, or by making them the easier or default option rather than enforcing restrictions or by changing people's economic incentives (Thaler & Sunstein, 2008). Importantly, nudges promote choices or behaviors that are assumed to benefit the target individual and society as a whole, thereby distinguishing themselves from marketing techniques that primarily benefit the turnover or profit of companies (Thaler & Sunstein, 2008; Hansen, 2013).

In light of such large-scale interest into the implementation of nudges in combating rising obesity rates, encouraging retirement savings and organ donations, and in improving environmental protection (Vallgårda, 2012), scholars from various academic disciplines have been investigating the appropriateness of nudging as a policy instrument in targeting societal matters. While this multidisciplinary assessment has revealed the high complexity of the question about the appropriateness of nudging, it has nevertheless been deficient of the opinion of the presumably most important group – the consumers themselves, as their concerns and attitudes have remained largely uninvestigated. At the same time though, it remains unclear to what degree consumers have knowledge about ongoing policy interests in employing nudges and about nudges themselves. In response to these missing insights the present article makes a two-fold contribution by employing in-depth semi-structured interviews to investigate UK consumers' attitudes and concerns about nudging in general, and in dedicating particular attention to the domain of health behavior, an area to which many nudges apply (De Ridder, 2014). Consequently, the findings of this study reveal the ideas of the presumably most essential group when examining the appropriateness of nudges, the consumers, which will allow researchers and policy makers to determine when, how, and what nudges are accepted. These findings offer practical implications for researchers and policy makers in the design and implementation nudges.

Throughout the introduction we will first introduce four domains of inquiry, which are based on questions and concerns previously raised by scholars that have provided the foundation for our interviews with consumers. These four domains - 1. the approval of nudging, 2. the origin of nudges, 3. the effectiveness of nudging, and 4. concerns about manipulative aspects of nudging - reflect both questions and concerns in previous scholarly investigations and those relevant to the target group of nudges, the consumers. Furthermore, we explain our choice for investigating attitudes towards nudges in the realm of health behaviors specifically.

Approval of nudging

The concept of nudges is based on libertarian paternalism, embedded between the more extreme ideologies of liberal markets on the one hand and interventionist states on the other. Nudging is described as libertarian in the sense that people are free to choose what to do, and paternalistic in that people's choices are guided in the direction of their own, as well as societies' best interest (Pykett, Jones, Whitehead et al., 2011; Wilkinson, 2013; Goodwin, 2012) – hence, together, nudges could be qualified as soft paternalism. An example that has featured prominently in the previous literature is the promotion of healthy eating in cafeterias. In this example, healthy food is placed more prominently and saliently or is positioned in such way that it is easier to reach compared to less healthy alternatives (Hanks, Just, Smith, & Wansink, 2012; Maas, De Ridder, De Vet, & De Wit, 2012; Rozin, Scott, Dingley et al., 2012). All choices remain available, while the consumer is nudged towards choosing the healthier food via these choice architectural strategies. Thus, the strategy is liberal as the consumer is not coerced into choosing the healthy food, and it is paternalistic in that the consumers' behavior is subtly, and often unconsciously, guided towards the better options.

The discussion about the appropriateness of nudging is rooted in the debate over the state's rights and obligations to promote public welfare. While extreme liberals are reluctant to interfere with the natural rights of people, such as property rights, life, and liberty, utilitarian and social contract perspectives, respectively, contend that the state should attempt to maximize societies' overall welfare, or determine state involvement on the basis of collective decision (Calman, 2009). Additionally, there is a disagreement over how truly libertarian or paternalistic nudges are. Proponents of nudges try to reconcile state intervention with the maintenance of people's liberties and authority (Pykett et al., 2011) by advocating that interventions are not paternalistic when they do not limit a person's choices and liberties to behave in any way, especially when there is an option to 'opt-out'. However, critics argue that although nudges may not restrict the available choices, they limit the possibility to rationally deliberate on the decision-making process of choosing (Hausman & Welch, 2010). These opposing positions regarding the issue of state intervention in the promotion of public welfare as well as the definition of liberty drive the dispute on the appropriateness of nudging, as well as the different levels of concern about the paternalistic aspects of nudging. Nonetheless, it is unclear where consumers position themselves in this debate. Therefore, the first objective of the current study is to investigating the consumer perspective on the first domain of inquiry: Consumers' approval of nudging in general and in the domain of health behaviors. Do consumers approve of being influenced despite lacking awareness? Do consumers feel that their choices are limited or that their autonomy is infringed upon? Findings will therefore shed insight to the questions of debate from a consumers' perspective.

The origins of nudges

The second factor to present here refers to the problem of which body can define what behaviors and choices should be promoted over others. The demarcation of *good* behaviors and choices is problematic. Essentially, the question revolves around the eligibility for the right to declare specific behaviors and choices as good or better compared to others. For critics libertarian paternalistic policies are based on social norms, shared realities, and familiarity that define particular behaviors as superior to others (Vallgårda, 2012). For instance, current societal and medical discourses describe healthy lifestyles as superior to unhealthy lifestyles, where they consider long, healthy lives as the ultimate goal, slim and fit bodies as the indicators of a healthy lifestyle, and all the while promoting behaviors to align with these norms. Such discourse is persistent despite the lack of consistent support for the notion that slimness is a major factor contributing to long-term health (Askegaard, Ordabayeva, Chandon et al., 2014). In promoting these aligned behaviors policy makers reinforce the existing social norms and shared realities (Askegaard et al., 2014; Schnellenbach, 2012), thereby promoting the health of some members of society while simultaneous leading to increased stigmatization of those members not willing or capable of behaving in accordance with these prescribed norms (Seacat, Dougal, & Roy, 2014). In light of these arguments, this study explores the second domain of inquiry: Consumers' opinions regarding the origin of nudges. In other words, do consumers care or have concerns over who designs the nudges? Are consumers concerned about the definition of good behaviors?

The effectiveness of nudging

A factor of more practical relevance refers to the effectiveness of nudging in changing long-term behaviors and value structures. Critics of nudging question whether the design of choice architectures leads to long-term changes in people's behaviors and value structures (Goodwin, 2012). They claim that substantial behavioral impact leading to long-term healthy or sustainable behaviors requires consumers' recognition of the urgency to change lifestyles and subsequent conscious behavioral adjustments. Merely being nudged into these behaviors without deliberation is judged as an insufficient, short-term strategy (Goodwin, 2012). Furthermore, marketers can easily counteract uninformed behaviors caused by nudges in an attempt to increase sales and maximize profit. Consequently, these opposing forces could lead to a system in which large amounts of public finances are invested into nudging behaviors that benefit society and consumers which are simultaneously neutralized by marketing strategies guiding choices and behaviors in the opposite direction (Goodwin, 2012; Seacat, Dougal, & Roy, 2014). This aspect is investigated in the current study by examining the third domain of inquiry: Consumers' perceived effectiveness of nudging. While this perception does by no means translate into an objective evaluation of the effectiveness of nudging, it contributes to an understanding of consumers' attitudes toward the usefulness of nudges.

Concerns over the manipulative aspects of nudging

A final point of concern is the potentially manipulative nature of nudging. This factor of concern is essentially an extension of the considerations raised in the first domain of inquiry, the approval of nudging. As mentioned in that first paragraph, opponents of nudges critique the paternalistic aspect of nudging, the idea that nudging may potentially limit the possibility for consumers to rationally deliberate on the decision-making process by promoting particular choices outside their conscious awareness (Wilkinson, 2013; Goodwin, 2012; Hausman & Welch, 2010). Accordingly, the fourth domain of inquiry explores consumers' opinion on this aspect and whether they have concerns about the manipulative aspects of nudging, as raised by the critics.

The case of health behaviors

Health behaviors are prominent targets of recently implemented nudges that have been subject of scientific investigation. These nudges specifically target behaviors such as smoking, dieting, physical exercise, and alcohol consumption (Diepeveen, Ling, Suhrcke, Roland, & Marteau, 2013). Health behaviors are a good candidate for developing nudging interventions for two main reasons: Firstly, most members of society want to lead healthy lifestyles and at the same time report problems in adhering to this goal, especially in light of short-term temptations. These problems can be the result of health-illiteracy or limited self-regulatory skills, which explains the ineffectiveness of information-based approaches to promoting healthy lifestyles (Marteau, Hollands, & Fletcher, 2012). These factors imply that the promotion of health behaviors is particularly suitable to nudging (Hollands, Shemilt, Marteau, et al., 2013). Secondly, health behaviors are often driven by habits and impulses and are therefore little subject to rational considerations (De Ridder, 2014). As such, health behaviors align particularly well with the functioning of nudging in the sense that they avoid conscious deliberations about choices and instead promote behaviors via relatively unconscious routes, making healthy behaviors easier and healthy choices more salient (Thaler & Sunstein, 2008).

There is good reason for policy makers to be concerned with the promotion of health behaviors considering the increasing number of people with obesity, and especially the increase in overweight children, as well as consequent health problems such as diabetes, cardiovascular diseases, and cancers (Diepeveen et al., 2013). Despite this growing interest in nudging strategies, governments and policy makers are concerned with the acceptability of such interventions by the public, due to the concerns raised in the scholarly debates described above. In response to this, researchers have been calling for investigations into consumers' acceptability of nudges and concerns about being nudged (De Ridder, 2014; Hollands et al., 2013). A first investigation by Diepeveen and colleagues (2013) examined electronic databases and empirical studies reporting attitudes towards health interventions, including nudging strategies in health behaviors. This investigation revealed strongest acceptability of strategies targeting others rather than the self and less intrusive strategies. Yet, this study did not directly assess consumers' attitudes and

concerns related to nudging as is required for a holistic, in-depth understanding of consumers' reasoning. This gap of knowledge is to be filled by the current study.

The aim of this research project was to examine consumers' knowledge of and attitudes about nudging in general and nudging in a health domain as well as their concerns about being nudged. To obtain an understanding of consumers' attitudes and concerns about the aspects of nudging that feature prominently in the scholarly discussions this projects investigated four domains of inquiries, each of which relates to one point of discussion among scholars mentioned previously in the introduction. As such we investigated (1) consumers' approval of nudging by uncovering consumers' familiarity with nudging, their attitudes towards nudging in general and nudging within a health domain; (2) consumers' views on the origin of nudges by exploring their attitudes in regards to who designs nudges and determines behaviors to be promoted, (3) consumers' perception in how they judge the effectiveness of nudging, and (4) and consumers' concerns with nudging, and potential manipulative aspects, as a strategy of improving consumers' behaviors. As no explicit hypotheses about these attitudes and concerns were specified, the research was essentially exploratory in nature and targeted at examining any associations consumers had in relation to nudging.

Methods

Semi-structured interviews. In addressing these research questions a qualitative, exploratory design was implemented. The researchers held semi-structured in-depth interviews with consumers in an informal communication setting in order to obtain as many ideas, associations, attitudes, and concerns people may have in relation to nudging (Bauer, Gaskell, & Allum, 2000). The semi-structured interviewing method was chosen because it allows for both structure and flexibility. The structure of semi-structured interviews allows interviewees to answer questions as set out in an interview guideline addressing the research questions under examination, with their responses fully probed and explored. Meanwhile, the flexibility of semi-structured interviews allows the researcher to be responsive to the relevant issues raised spontaneously by the interviewee (Legard, Keegan, & Ward, 2003). As such, while the interview guideline provided basic questions to be addressed in specific phases of the interview, questions varied between interviews as a natural progression of the situation as well as the input from interviewees. The interview guideline specified four phases to provide a structured framework addressing the domains of inquiry presented in the introduction. In phase 1, interviewees were prompted to explain their familiarity with nudging and their general attitudes without the provision of a clear definition for nudging. For example interviewees were asked whether they had ever heard of the concept of nudging and whether they could explain what they understood it to be. In phase *2* the same questions were asked in reference to nudging in a health behavior domain. In phase 3 the interviewer provided a definition of nudging which included two main aspects. Firstly, nudges were defined as subtle cues designed to help people make better choices and behave more optimally which may or may not occur outside of conscious awareness. Secondly, nudges were defined as influences on behavior by the way choices are presented

rather than by removing choices. To facilitate understanding of the concept examples of nudges were provided including the distancing of color printers to prevent unnecessary use of color prints; the use of colored bin bags to ease the separation of waste; and the provision of smaller plates in a cafeteria to prevent eating large portions. Based on this definition and the examples interviewees' general attitudes and concerns were collected. For example, interviewees were asked what they thought of these nudges, whether they would appreciate being nudged, and whether it mattered to them who designed these nudges. Additionally, attitudes and concerns relating to nudging in the health domain were targeted by providing more examples of health-related nudges such as exchanging unhealthy snacks at the cashier with healthier snacks; placing healthy snacks more prominently on shelves in supermarkets; and downsizing the serving plates at all-you-can eat buffets. In phase 4*,* questions were presented about the acceptance of nudges targeted at the interviewee him/herself. Specifically, interviewees were asked whether they would approve of being targets of nudges, whether there are specific domains in which they do/do not accept behavioral guidance, and whether they believe in the effectiveness of nudges on their own behavior.

Participants and procedure. To ensure access to the attitudes and concerns of a broad range of societal groups, a sample of participants was recruited through a marketing research company that represented a large variety in terms of age, socioeconomic status/educational background, gender, and BMI of the participants. It was anticipated that having interviewees with varying backgrounds in terms of age, socioeconomic status/educational background, and gender would improve the representativeness of the sample. Socioeconomic status (SES) and educational background were accounted for on the basis of the UK demographic classification scheme (National Readership Survey social grades) which classifies citizens as high SES A and B (N = 5), middle SES C1 and C2 (N = 8), and low SES D and E (N = 7). Furthermore, as a particular focus of the current study relates to healthy eating behavior, we included interviewees with varying BMI scores (i.e., normal weight, overweight, obese. Interviewees were matched on their BMI classifying underweight < 18.5 (N = 1), normal weight 18.5 – 24.9 (N = 8), overweight 25–29.9 (N = 10), and obese > 30 (N = 1) interviewees. All interviewees were recruited from public settings in London and invited to participate in interviews for monetary reward. The resulting sample consisted of 21 interviewees of whom one was excluded due to limited English proficiency. Prior to each interviewing session, all participants were informed about the nature of the semi-structured interview. It was explained to participants that they would be asked to discuss and express their opinions on a specific topic, and they would not be obligated to respond should they feel uncomfortable at any stage of the interview. Furthermore, participants were informed that the interviews would be recorded for research purposes (i.e., data analysis at a subsequent stage), and it was emphasized that the contents of interviews would be kept anonymous at all times. It was made known to the participants that there would be a possibility that direct quotes would be presented in a published research report, but that their anonymity would be ensured. The interviewing session began after participants have provided verbal consent for the interview to be recorded. The interviews lasted for a maximum of approximately 40 minutes. At the end of the interview, each participant

were provided with an opportunity to ask questions, thanked and compensated with monetary reward for their participation. This study was conducted in accordance with the ethical standards described by the Medical Research Involving Human Subjects Act (WMO, 2012), which exempts research on healthy human subjects from review for as long as it does not involve any invasion of participants' integrity. Consequently, no formal ethical approval was required according to Dutch national standards. Nevertheless, ethical approval was obtained at Utrecht University for the EU funded FP7 umbrella project Marie Curie Fellowship Consumer Competence Research Training (CONCORT), a European network collaborating the research efforts of 14 Early Stage Researchers from various academic disciplines dedicated to generate research improving consumer welfare. The current study is part of the research effort directed under CONCORT. Furthermore, the UK market research agency operates under and is member of the Market Research Society Code of Conduct.

Thematic Analysis. All recorded interviews were first transcribed and subsequently subjected to thematic analysis. The thematic analysis aimed at finding key patterns of ideas and attitudes in the interviews by coding for recurring codes and themes. Throughout the process coders were interested in those responses by interviewees that related to the research questions. A semantic approach was employed that focused on a description of the interviewees' responses rather than the interpretation of these responses (Braun & Clarke, 2006). The analysis was based on Braun and Clarke's (2006) step-wise procedure. Two coders (the same as interviewers) familiarized themselves with the interviews and transcriptions in the first phase of the analysis. During this phase, using a deductive approach, the coders independently collected preliminary codes that identified extracts of data containing meaningful information relevant to the research questions. These preliminary codes were subsequently compared, discussed, and revised by the two coders. In a subsequent step, codes were connected together based on repeated co-occurrences (i.e., they were frequently detected in natural clusters in the transcriptions) and semantic relationships (i.e., they depicted a concept when manually put into proximity) into overarching themes (Crabtree & Miller, 1999). No numeric requirements were set for determining the existence of a theme or code but their occurrence and prominence determined the classification. These overarching themes were named in a manner that described and interpreted an aspect of the data that was relevant to the research questions. This process led to the final coding scheme including both themes and codes accompanied by a definition and an example (see Table 1). Afterwards, a second round of coding was performed where the established codes from the final coding scheme were independently applied to the transcribed interviews. In cases where codes diverged between coders explanations and discussion led to an agreement in all cases.

Table 1 Coding Scheme

Theme	Code	Definition & Example
Knowledge	Familiarity	Acquaintance with the concept of nudging. E.g., [“The topic that I would like to talk about is nudging. Have you ever heard of nudging?”] “I have never heard of it.”
	Observed Nudges	Examples of nudges. E.g., “There are these signs, neon signs, an electronic sign that shows you a sad face when you’re going above the speed limit or a nice smiley if you’re ok.”
	Novel ideas	Suggestions for domains for new nudges. E.g., “I think walking more around London is a good way. I know they encouraged more cycling but I think people should walk more.”
Individual Differences	Objective	Differences in peoples’ motives. E.g., “I think of people are willing to do the right thing and willing to be healthy, I think…..”
	Indifference	Lack of interest in target behavior. E.g., “There are a lot of people who care about it but you get certain people who don’t. They just do it because they just can’t be bothered to put it into the other bags.”
Self-target	Approval	Level of agreement with being nudged for the self. E.g., [“Would you appreciate it if you were nudged into healthy eating?”] “Yes. I would appreciate it. I think everyone wants to do it and it is great to be encouraged to do it.”
	Effectiveness	Judgment of the extent that nudging would be successful when targeted at the interviewee. E.g., “Personally I don’t think I need any nudges but I guess it helps, yes. I am generally quite healthy anyway.”
General target	- General Approval	Level of agreement with nudging targeted at anyone E.g., “I think the food is an absolutely brilliant idea, absolutely brilliant because we have got so much obesity and it is too easy for them to go and grab a big plate, fill it up and then just go back again but if you have got something smaller then you can only eat what is on the plate if you like and I think that is a good thing. I think that would help a lot of people. The stairs is good too because it makes it fun because sometimes exercise can be so boring.”
	General Effectiveness	Judgment of the extent that nudging would be successful when targeted at anyone. E.g., “No, what I am saying is, it has its benefits so people who alright yeah, who go to the supermarket and take the back and read it looking at the calories because they are health-conscious but for those that are not they can see a healthy food and just pass it back. So being there means nothing to somebody who has no idea.”
	Specific target groups	Potential population segments targeted by nudges. E.g., “So yeah, I think it would be important and from a children’s perspective as well because in supermarkets sweets are deliberately put by the checkout in order for a child to spot them and also last minute shopping so it is all psychological.”
Origin	Actors	Individuals or groups implementing or designing nudges. E.g., [“Would it matter for you who is deciding on what is a good behaviour?”] “Probably the dieticians or the doctors.”
	Expertise	Required level of knowledge in the targeted behavior.

		E.g., “Someone who, maybe a nutritionist or something like that because they obviously knows about health things or someone who has done psychology as well and knows why people are going to pick things. Perhaps a psychologist and a nutritionist.”
	Intention	Motives of the agents involved in designing nudges. E.g., [“Does it matter who implements these health nudges or who decides on what the good behaviour is?”] “It doesn't matter as long as the goal is clear that it is to help people lead healthier lives.”
	Trust	Degree of confidence in agents’ motives related to the design of nudges. E.g., “I would trust somebody that had done their research and it is maybe Government funded or maybe a Government initiative or a health initiative so something that has got a sort of, a reputable backing.”
Behavior	Habit	People’s routine behaviors. E.g., “In retrospect, the nudges then hopefully become part and parcel of your life and your everyday working life or home life.”
	Individual Capacity	People’s extend of influence on their own behavior. E.g., “Yes actually yes, because we try to push ourselves but sometimes something else influences it, you know what yeah I am going to do it.”
	Facilitation	Supportive effects of nudges on behavior. E.g., “As long as people have opinions but make it easier for them to choose the more healthier option.”
	Social environment	The relationship between people’s behavior and their social surrounding. E.g., “It might change you one day to say “Come on, everybody is so I might as well” and it is good for the future.”
Freedom of Choice	Coercion	Oppressive influences of nudges on behavior. E.g., “What you do is you manipulate their decision making whereby it is them noticing that you are doing it or them not noticing that you are doing it, it doesn’t matter. You just manipulate them to do what you want them to do.”
	Nudging-suitable domains	Appropriateness of behavioral domains for nudging. E.g., “I don’t know how you can nudge in those areas because there is so much out there, there’s so much and it is personal choice isn’t it? It is personal belief in terms of religion.”
	Choice-set limitation	Restricting the availability of choices and possible behaviors. E.g., “I think alternative options are always good like if you had an alternative option but I don’t think they should take anything that is currently there and then say you can’t have that any more.”
Cognition	Reactance	Counter-reaction to the promoted behavior. E.g., “There are people who are set in their ways and bringing in anything that is going to be far from their norm, even if it is a simple task, is not going to go down well with them and there are those people who just don’t like change. Even if you bring it, you might want to resist.”
	Awareness	(No) Realization of the influence of nudges. E.g., “I think we are nudged every day in life and we don’t realise we are being nudged.”
	Need for information	Required level of information on being nudged and/or the targeted behaviors. E.g., “Because they are trying to encourage healthy eating and it is educating people because information is power. If you know the good and the bad things, I hope there are going to be loads of advertisements about these things because people need to be educated and they need to be aware of things before they can be applied in practice.”

Results

The results are structured according to the four domains of inquiry based on information extracted from the interviews using deductive coding, for an overview of the codes and resulting themes that were used to identify relevant information pertaining to the research questions, see Table 1. We would like to emphasize that the goal of this investigation was to learn about any representations, thoughts, attitudes, and concerns consumer may have on the matter of nudging rather than to provide a numerical overview of the distribution of these opinions. Citations provide examples of responses from interviewees but are selected for demonstration purposes rather than representativeness.

Consumers' approval of nudging. This first domain of inquiry uncovered consumers' familiarity with nudging, their attitudes towards nudging in general and nudging within a health domain. Despite the vivid discussion around nudging in the scientific community as well as frequent coverage on media outlets, interviewees were largely unfamiliar with the concept of nudging as influences on behavior. If interviewees voiced any interpretation of what nudges could be understood it in its literal sense of poking or (gentle) shoving.

"In a poking kind of sense or some applications to send someone a nudge"
(Male, 27, high SES, overweight)

Due to this general unfamiliarity most interviews moved directly into phase 3 of the interview guideline in which interviewees were introduced to nudging via the provision of a definition and examples from first the general nudging domain and later the health-related nudging domain. While some interviewees could relate to these examples, i.e. reported having observed similar nudges, it did not remind them of having heard of the concept of nudging as influence on behavior prior to the interview. Nevertheless, some interviewees reported being familiar with the concept of the subtle, unconscious influences, however, more in the context of marketing techniques that surround people in everyday life.

"Advertising in a sense is a nudge about a product"
(Male, 29, middle SES, normal weight)

During the interview a distinction was made between approval of nudges in general, approval of nudges in the domain of health behaviors, nudges applying to people in general as well as those applying specifically to the interviewee. Additionally, interviewees were asked whether there were any domains in which they would consider nudging inappropriate.
In principle, interviewees reported to appreciate the idea of nudging as a whole without seeing negative aspects.

"No. I don't think there is a disadvantage because at the end of the day it is to create a safer and a better environment. If they don't agree with it then I guess they just

don't have to do it if they don't want to but at the end of the day it is a benefit for everyone"
(Female, 28, middle SES, normal weight)

While the initial responses were mostly positive, some interviewees also reported these nudges to be related to manipulations. Nevertheless, throughout the interviews a strong majority appreciated nudging as a whole and even more so when they target health behaviors. Interviewees could relate to the difficulties revolving around health behaviors on a societal level as well as related to their own health behaviors.

"I am all for it. Anything to do with health behaviour and improving people's health in general, I am always supporting that. I think it is a very clever idea because no one likes change because if you tell people "Do this" then they will do that. There won't be a good reaction. But I think nudging is in some ways subconsciously trying to get people to do or to make a better choice, so yeah I support it"
(Male, 27, high SES, overweight)

While interviewees differed in the degree to which they consider health-related nudges applicable and necessary for themselves this did not reduce their support. Even in cases where interviewees considered health-related nudges unnecessary for themselves they remained supportive of nudges targeting society as a whole including themselves.

"Yes. I would be more in favour. I think it's needless for me. In the country everyone is getting fatter so the teenagers coming into these buffets, if they were having smaller plates and they had smaller plates at home they wouldn't think "I will eat more". It might help"
(Male, 24, high SES, normal weight)

Considerations of manipulations when investigating attitudes to health-related nudges specifically remained very rare. Approval of nudges appeared to be related to the intentions of the nudging body/institution. The positive attitudes towards nudges were driven strongly by the idea that nudges are designed with the intention of improving peoples' behaviors for the better of society and themselves. This requirement was often mentioned as the basis for approval and became most evident in the case of health-related nudges were good intentions were understood as helping people behaving in a more health-promoting way. For nudges in the general domain, interviewees were particularly appreciative of nudges relating to environmentally friendly behaviors such as separating waste and keeping streets clean.

"Like I said before, anything that promotes good behaviour and living healthily is part of good behaviour, I think it's good, it is a good idea"
(Male, 48, low SES, overweight)

Disagreements with the concept of nudging as a whole or in relation to health-behaviors were not encountered during the interviews. Nevertheless, some interviewees raised concerns, mostly upon probing for negative aspects of nudges, that nudges and behavioral influences were similar to manipulations, which raised concerns with the concept. However, interestingly, these concerns were described as manipulations common to standard marketing practices, such as placing products in shelves to increase attention to particular choices. These considerations will be further discussed in the results on *concerns about manipulative aspects of nudging*.

"It depends on what kind of thing it was, I suppose and what kind of decision it was that they were trying to force you into. If it was an environmentally good thing then I wouldn't mind if someone is making these nudges but if it was something to do with making me pay out for something that I don't necessarily need and they are just trying to force it upon me then I would find that negative"
(Male, 24, high SES, normal weight)

Whereas interviewees had difficulty reporting any behavioral domains for which they would not appreciate nudges, with few exceptions mentioning financial domains, they did raise concerns regarding nudges targeted at particular groups such as children, while in other examples children are considered a particularly good target group. Based on the argument that children are easily manipulated nudges targeting children were rejected by some of the respondents. This rejection was irrespective of the fact that nudges were defined as based on good intentions and with behaviors improving outcomes for the target population in mind. There were both expressed support and concern over the exposure of nudging to children:

"So yeah, I think it would be important and from a children's perspective as well because in supermarkets sweets are deliberately put by the checkout in order for a child to spot them and also last minute shopping so it is all psychological"
(Female, 59, low SES, normal weight)

"With children maybe and maybe that is too pushy in that sense because it is not being explained. It is just being forced on them if you like. Yeah, maybe in children but not in adults, no. I think it is fine"
(Female, 46, low SES, overweight)

The origin of nudges. Interviewees generally expressed that if the intention behind the nudge was good, as most agreed in the case of health behavior and healthy eating, they would not be particularly concerned with the actors who design or implement the nudges. Furthermore, interviewees also mentioned that because they would not be immediately aware of the presence of the nudge due to its subtle nature, the actor hence becomes irrelevant for them to consider. Nonetheless, some interviewees suggested that if the nudges were targeted particularly at healthy eating, they would have greater trust in actors who have a reputable backing and specialized expertise in the subject. For example, in the domain of health and food, some interviewees expressed their trust in doctors, dieticians, or nutritionists. Psychologists were also considered as good candidates for designing nudges as they

would have knowledge of consumer behavior and the factors that shape people's choices. To illustrate, when discussing potential actors for nudges for healthy eating, one respondent said,

"Someone who, maybe a nutritionist or something like that because they obviously know about health things or someone who has done psychology as well and knows why people are going to pick things. Perhaps a psychologist and a nutritionist" (Male, 29, middle SES, normal weight)

Trust in governments or politicians was mixed. On one hand, the Government was spoken about as an actor who has the authority and the responsibility to guard and improve the welfare of its citizens, and therefore should exercise its influence by directing health behavior initiatives though the implementation and design of nudges. On the other hand, as one respondent quoted,

"…anything Government-related or anything that comes from the Government people instantly distrust. Because the Government is coming from a discredited stance a lot of times to start with. So based on that people are not going to take what they say. They said about the meat that people were eating and how it was the Government knew that was all this type of meat that we were being served and they said – Let them still eat it – and stuff like that"
(Male, 56, high SES, overweight)

Interviewees also voiced that they would not appreciate being nudged into behaviors or choices by actors such as marketers with commercial purposes of gaining profits for a company. Nonetheless interviewees recognized that this is inevitable, and is in fact quite an existing mundane scenario in everyday situations.

"I mean it is all about marketing in this particular case. And since here is always going to be somebody trying to, I guess the word is manipulate other people so it might as well to be somebody who has, thinks of ways to help them and somebody else that might think a bit more about the money and not so much about what is good for people"
(Male, 34, middle SES, overweight)

This quote described a general sense of consensus amongst interviewees in approving actors in designing and carrying out nudges, given that they are dedicated to promoting the wellbeing of consumers and the general public, as counter efforts to companies and marketers whose aim is to increase commercial profits and private gains.

Consumers' the perceived effectiveness of nudging. Nudging was overall approved by interviewees, but as a general concept it was too abstract for interviewees to judge its potential/expected effectiveness. However, given some examples interviewees discussed the effectiveness of nudges more fluently. According to interviewees, what made nudges potentially effective was that they subtly facilitated the targeted behaviors. Similarly for health behaviors and healthy food choices, nudges were

regarded effective because they made healthy behaviors easier or more fun to perform, and made healthy food choices more salient. As such, the nudged behavior became easy to adopt and to carry out as a habit, and eventually be integrated into the social environment that further endorses the behavior. Furthermore, targets' individual objectives and capacity to influence their own behavior were considered as important contributing factors. Interviewees acknowledged that considering the recent focus on issues surrounding food, health, and obesity in the media and public discourse, most people generally have an awareness of behaving healthily, although the level of intention varies between individuals. As such, nudging was rated as effective for those who already have an intention to eat healthily and are taking actions to fulfill this goal.

On the other hand, interviewees who, in their opinion, already have a successful individual capacity for healthy behaviors evaluated nudges to be less effective when applied on themselves, but nonetheless would appreciate the potential benefits.

"Personally I don't think I need any nudges but I guess it helps yes. I am generally quite healthy anyway"
(Male, 29, middle SES, normal weight)

Overall interviewees considered nudges to be effective for the society as a general target, and in most cases for themselves as targets. Nonetheless, nudges were not considered useful for individuals who have no intention or are indifferent to healthy eating.

"Someone that really doesn't care, it is going to be quite hard to nudge them"
(Female, 28, middle SES, normal weight)

Furthermore, price was considered as a significant determinant in people's food choices. As such, some interviewees saw price as a potential obstacle to the effectiveness of nudges in promoting healthy food choices, considering that some people choose the cheaper option regardless of the food product's nutritional value. Finally, the need for information was mentioned as a factor that could contribute to the effectiveness of nudges. Although nudges were intended to be subtle and not explicitly instructive, interviewees felt that people would need to have an initial understanding of the importance of health behaviors before they could benefit from a nudge. For example, it was suggested that complimentary information such as the benefits of healthy eating could be presented adjacent to the nudge in order to increase its effectiveness.

Concerns about manipulative aspects of nudging. When examining consumers' concerns as to the manipulative aspects of nudges a minority of interviewees showed concerns over the freedom of choice offered by nudges. The main hesitation was that the interviewees would potentially lose autonomy over their decisions or that there would be a limitation to their choice set.

"There will be a problem if you are saying people shouldn't eat junk food or if you take away the elevator"
(Female, 30, high SES, overweight)

When discussing nudges without a particular context, only a few interviewees demonstrated skepticism and hesitation, as they understood the influences of nudges and manipulations as employed but actors such as marketers in a similar light. Interviewees also expressed that they would not appreciate if they realized that they had been led to a decision that was out of their awareness. This did not necessarily mean that they did not want to be nudged, but if so, they did not want to detect the influence.

"But the disadvantage of it is if it is something negative and if the customer of the person finds out that things are actually strategically placed or done for that reason and they might be offended"
(Female, 27, middle SES, overweight)

Nonetheless, this feeling of coercion was mainly limited to nudges intended for marketing purposes, or that the intention behind the nudge was not to the best of their interests. Considering that, by definition, these influences are not nudges, they should not be understood as resistance to appropriately implemented nudges but to other external influences on behavior.

"but if it was something to do with making me pay out for something that I don't necessarily need and they are just trying to force it upon me then I would find that negative"
(Male, 24, high SES, normal weight)

"Although it was the right thing that I had got but I had been maneuvered there. Some people would rather take the wrong thing but it was their choice"
(Male, 56, high SES, overweight)

On the other hand, nudging in the domain of health behavior, there were no concerns about coercion from the part of the interviewees. Particular to healthy eating, the general perspective was that nudging was more of a facilitation of better choices rather than a manipulation of choices. Interviewees also indicated that there were clear benefits to healthy eating; therefore they would not be concerned if they were nudged into healthier choices out of their awareness. Additionally, interviewees implied domains such as religion, politics, and contraception would not be suitable nudging domains as they involved individuals' expression of personal beliefs.

"For example in schools now, I am of Christian and I have been brought up to understand§ that marriage is between a man and a woman. I am being told, I have come to know that there are silent nudges that try to force same-sex marriage or same-sex down the throats of people at churches […] no matter what orientation you

choose but they are slowly taking away that freedom. How do I explain it, sometimes nudging feels like a propaganda by certain people in the Government to force"
(Female, 30, high SES, overweight)

Discussion

The main conclusion of the interviews is that consumers are generally appreciative of nudging both as a general concept and when targeting health behaviors. While a surprisingly high unfamiliarity with the concepts was revealed this unfamiliarity further justifies the study's rationale in involving consumers in the discussion over the appropriateness of nudging and the implementation of nudges. At the same time it raises the question of whether consumers are sufficiently familiar with nudging strategies to provide sophisticated and elaborate attitudes toward the concept. Considering the lacking familiarity with nudging prior to the interviews consumers may have provided a rather crude attitude toward a concept defined and explained to them. This issue by no means implies that consumers should not be involved in judging the appropriateness of nudging. It does, however, indicate a need for increased consumer information about these already ongoing strategies and stronger consumer involvement in determining their appropriateness. Thus, the findings yield the question: Who should judge a nudge? And are policy makers sufficiently informing and involving the target group of nudging to ensure Thaler and Sunstein's (2008) requirement of transparency and the possibility to opt out?

Looking into the general attitude towards nudging most eloquent approvals were encountered when communicating about examples of nudges, which may have aided interviewees' understanding of the concept as well as the reasons for the promotion of particular behaviors. Employing examples, especially examples of health behavior, helped demonstrating the difference between a good behavior that should be promoted and a bad behavior that should be avoided. As such, it may be the case that nudging receives particular support when consumers understand the reasons for promoting, as is the case for health behavior, but lower support when it is discussed in general, abstract terms, which are more complex to grasp. Despite the general approval interviewees were hesitant in forming an opinion regarding the appropriateness of nudging in areas such as religion and politics, as these domains were subjective to personal beliefs and moral value. Good intention behind nudges was the main driver for approval of the concept. When interviewees reported negative aspects they mostly referred to restricting choices (which by definition is not part of nudging) or a disapproval with being influenced in principle. On the other hand, standard marketing techniques were sometimes compared to nudges, but people readily distinguished marketing as a source of negative external influence, because unlike nudges, the targeted behaviors by marketing techniques were not always in the interests or advantage of the consumers. At the same time, consumers did not question how and why a promoted behavior would be considered a good behavior. Yet, it remains unclear to this point whether this lacking scrutiny derives from a strong trust in the sources of nudging, a general disinterest, or an uncritical acceptance of the existing discourses about health behaviors. While there was no clear preference for who should design or implement nudges, this was only under

the general assumption that the origin of nudges endorsed good intentions. Interviewees generally perceived an intention to be good if it pursued a clear objective in promoting positive behaviors for individuals and society. Given this circumstance, nudging for the promotion of health behaviors was widely approved considering that there are clear distinguishable benefits and negative consequences associated with health. Related to this was the notion of freedom of choice. A minority of interviewees voiced concerns over the potential choice limitations or coercive directions imposed by nudges. However, these concerns were not weighted as heavily given that nudges ought to be based on good intentions to benefit the recipients or the greater society, such as the case for promoting healthy or environmentally friendly behaviors. Finally, there was awareness that while nudging could be implemented to promote positive behaviors amongst the masses, its effectiveness was sensitive to individual differences of the recipients. Specifically in the context of health behavior, nudging was judged to be less effective for those who already have a good personal capacity and are successful in managing and conducting these behaviors. For example, interviewees who, in their opinion, already have a successful individual capacity for healthy behaviors evaluated nudges to be less effective when applied on themselves, but nonetheless would appreciate the potential benefits. Furthermore, a disregard or indifference to the value of health was suggested to potentially undermine the influence of nudges toward health behavior or choices. Nonetheless, the outlook on nudges was that they would be an effective strategy because they are subtle and could be easily integrated in the everyday environment; and since the general public has a fundamental understanding of the advantages and values of good health, most people could benefit from the facilitation of nudges in performing healthy behaviors.

In light of the ongoing current debate surrounding the ethics and implementations of nudges in the academic and political arena, there is a dearth of research investigating the perspectives of consumers, who are the ultimate targets of nudging. Responding to the call for research investigating acceptability of nudges and concerns over being nudged (De Ridder, 2014; Hollands et al., 2013), the current research is the first to our knowledge to examine this topic by directly reaching out to consumers. While the findings of the current study shed light into a less-explored research territory, it contains certain limitations. First, the interview questions included in the semi-structured interview schedule were strictly linked to the current research's overarching research questions. This choice could have potentially limited the findings that may have emerged if the interviews were open-ended and fully participant directed. Similarly, only deductive coding was employed in order to extract data from the interviews that were directly relevant in answering the main research questions, which may have prevented interesting, but less research topic-relevant findings to surface. Another inherent limitation of qualitatively interviewing is that interviewees' responses are subjected to social desirability and demand-characteristic effects of the interview situation (Orne, 1962). Finally, as our findings revealed the extent to which consumers were familiar with the concept of nudging was minimal, this raises the question as to how much and how accurately consumers would be able to convey their attitudes and perspectives on a concept that they do not have substantial knowledge in. The issues mentioned above may have influenced

the validity of the data, but the findings of the current research serve as a first starting point to examine consumers' attitudes and concerns about nudging and to stimulate future research using more rigorous scientific methods in examining a topic that requires much research attention.

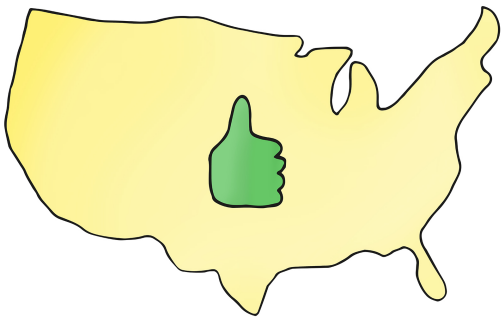
Conclusions

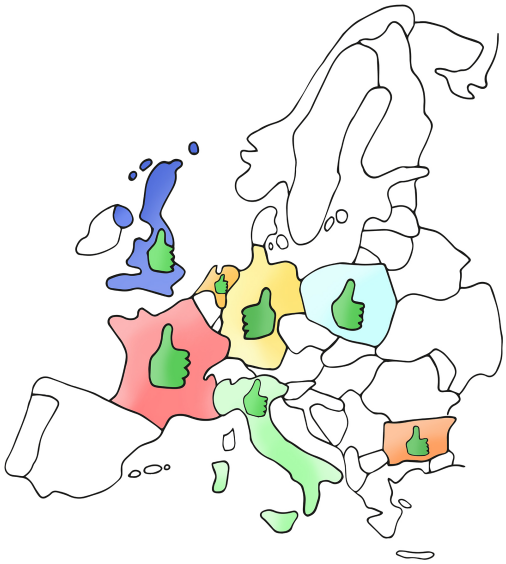
These revelations are particularly important in light of the current scholarly discussion as to the appropriateness of nudging. While this discussion is relevant and theoretically interesting, it should not function as a basis for deciding for or against the implementation of nudges. In contrast, the attitudes, concerns, and requirements of the target group – the consumers - should be considered as an additional source of such decision-making. At the same time, this study uncovered a lacking familiarity with the concept of nudging and possibly insufficiently critical reflections of these strategies on the side of the consumers. Considering the moral need of including consumers into the process of judging nudges this finding calls for improved consumer information about nudging strategies and stronger consumer involvement into judging their appropriateness to ensure safeguarding mechanisms such as the possibility to opt out of unappreciated influences on behavior.

Meanwhile, in contrast to the scientific debate, we find no direct justification to reject nudging, especially within the realm of health behavior for which consumers understand the benefits of promoted behaviors nudging strategies. However, these conclusions cannot be conclusively drawn for other behavioral domains. Additional research will be required to determine consumers' acceptance and concerns with nudges in the domains such as financial decision making, fund raising, organ donations, and many more. Furthermore, due to the qualitative nature of the study no deliberate procedures were taken to obtain quantitative data. Our findings suggest a majority of approval for nudges but there is no precise quantitative information about the distributions of these opinions. Future research is encouraged to employ quantitative measures to explore and measure the distribution of public opinion on nudging in order to compliment the current findings.

For governments currently employing or considering the implementation of nudges and paternalistic strategies into their range of policy instruments the findings speak in favor of such strategies despite criticisms from some scholars and media while simultaneously call for more information about nudges. However, the findings shows that nudges are particularly accepted in behavioral domains consumers comprehend. Consequently, information-based approaches and nudging strategies should go hand in hand to achieve both acceptance of the strategies and improvements of consumer welfare. Nudges should neither be rejected on the basis of philosophical concerns, nor be implemented blindly, without providing information to the consumer as requested by proponents of traditional information-based approaches.

Nudge?





Chapter 9

The Who and How of Nudging
Cross-national Perspectives on Consumer Approval in Eating Behavior

Junghans, A. F., Marchiori, D. R., Cremers, J., Evers, C., & De Ridder, D. T. D. (Submitted for publication). The Who and How of Nudging: Cross-national Perspectives on Consumer Approval in Eating Behavior.

Policy makers across the world have revealed increasing interest in the implementation of nudging in policy. Nudging is a strategy based on libertarian paternalism that aims at influencing consumers' behaviors in predictable ways without excluding any options from the choice array or meaningfully changing the costs involved in any option (Thaler & Sunstein, 2008). An example of such a nudge is the prominent placement of healthy food choices near the cash register in supermarkets. In contrast to traditional marketing techniques, nudges are intended to influence consumer behavior in line with their own best interest. Yet, policy makers are experiencing difficulties in the implementation of nudges for two main reasons. Firstly, they are facing resistance by opponents to nudging and secondly, they are lacking insights into consumers' attitudes towards nudging (Sunstein, 2015c; Local Government Association, 2013, Rebonato, 2014; Kersh, 2015; Skov, Lourenço, Hansen, Mikkelsen & Schofield, 2012). To address the latter issue, the current study investigated the conditions for consumers' approval with nudging strategies in healthy eating. Comprehending consumer attitudes, policy makers may be able to address criticisms by opponents of nudging.

Many people are aware of the impact of eating behaviors on general health and hold the goal to maintain a healthy diet (Roininen, Lähteenmäki, & Tuorila, 1999; Dickson-Spillmann & Siegrist, 2010). Yet, in today's obesogenic environment this long-term goal is challenged by temptations that fulfill short-term goals of indulgence. What is required to adhere to long-term rather than fall for short-term goals is self-control: The capacity to override immediate impulses in favor of long-term goals (Muraven & Baumeister, 2000). Much research has been conducted on people's (in)ability to self-control eating behavior, revealing that self-control is a limited resource that depletes through usage leaving people vulnerable to temptations (Muraven & Baumeister, 2000). Nudging has the potential to support adherence to long-term goals without requiring self-control by changing the environment in such way that unhealthy temptations become less and healthy choices become more appealing. Thus, eating behavior yields itself particularly well to the influence by nudging due to its habit-driven, often un-reflected nature and the fact that many people have long-term eating goals that are challenged by immediate temptations (Luoto & Carman, 2014; Wansink, Just & Payne, 2009; De Ridder, 2014). Eating habits trigger the consumption of food in specific situations: Popcorn in the movie theater, coffee in the morning, and chips in front of the TV. This implies that many of the 200 eating-related choices per day (Wansink & Sobal, 2007) occur without conscious reflection. Nudging strategies, helping consumers to adhere to their long-term goals, can entail replacing unhealthy temptations in supermarkets, cafeterias, and people's homes with more healthy options. As such, the often-detrimental susceptibility of eating behavior to external cues, which mostly induces unhealthy choices, can be employed to promote healthy choices through nudging (Kersh, 2015). Consequently, eating behavior is prototypical for the application of nudges as shown by previous successes: External cues such as plate size (Wansink, 2006), accessibility of food (Wansink, Painter & Lee, 2006), distance (Maas, De Ridder, De Vet, & De Wit, 2012) and attractiveness of food (Van Kleef, Vrijhof, Polet, Vingerhoeds & de Wijk, 2015), package size (Wansink, 2006), and social norms (Salmon, De Vet, Adriaanse, et al., 2015) have shown to successfully improved eating behavior.

Despite these examples large-scale applications of nudges require a more in-depth understanding of consumers' perspectives on nudging and the conditions for their approval. After all, nudges target consumers' behavior and consequently consumers' opinions should be considered during the design of nudges. Researchers have thus called for investigations into consumer' attitudes to and conditions for approval with nudging to alleviate policy makers' remaining reluctance (Diepeveen et al., 2013). In a first review Diepeveen and colleagues (2013) found positive attitudes towards nudging strategies in the realm of health behavior. Consumers' approval depended on the behavioral domain and field of application in which the nudge was meant to influence behavior as well as on the type of intervention. Similarly, Junghans and colleagues (2015) reported moderately high levels of approval based on in-depth interviews with consumers on health-related nudging. They observed that consumers' approval is contingent upon the source of the nudge, with highest approval for experts in the respective domain, and the good intentions of the source. This difference could be related to the degree of trust consumers have in the different sources. Further, approval depended on the behavioral domain in which nudging was employed and was strongest in domains in which consumers understood the decision-making contexts. This is the case for eating behavior, because consumers understand the reasons for why healthy eating is important and have a fairly good idea what a healthy diet entails (Dickson-Spillmann & Siegrist, 2010). Notwithstanding these positive consumer attitudes, research by Arad and Rubinstein (2015) showed that consumers display a degree of psychological reactance to being nudged upon learning that they have been influenced. This suggests that one cause for disapproval is not the promoted behavior itself, but the mere fact that it is externally induced. On this basis one could reason that consumers' approval of nudges depends on the intrusiveness of the nudge.

Rationale & Hypotheses

We predicted that consumers reveal a moderate to high level of approval with nudges and that the level of approval is predicted by the perceived intrusiveness of the nudge: Higher intrusiveness should be associated with lower approval (Hypothesis 1). Moreover, we expected approval to depend on the source of the nudge with highest ratings for experts in the respective field, compared to industry and policy makers (Hypothesis 2). Consumers have previously reported to require nudges to originate from sources with the intentions to improve consumer welfare (Junghans et al., 2015), suggesting a need for trust. Therefore, we expected the effect of source on approval to be mediated by the trustworthiness of the source (Hypothesis 3). Lastly, we explored whether political orientation, such as liberalism or conservatism, is associated with approval and whether approval is contingent upon consumers' country of residence, gender, age, and BMI. While no specific differences between countries were predicted, we included countries with different historical, geographical, and cultural backgrounds to increase the generalizability of the findings.

Methods

Participants. 1441 participants were recruited in eight countries using the crowdsourcing platforms Amazon Mechanical Turk (for the US) and Crowdflower for Germany, the Netherlands, France, Italy, Poland, Bulgaria, and the UK. Sample sizes varied between countries due to different participation rates in the survey. The number of participants per country, as well as their age ranges, gender ratio, and BMIs are summarized in Table 1. In total 32 participants were excluded from the analysis for not providing all required information and two participants for reporting to be younger than 16 years of age.

Country		N	Age	BMI
Germany	Male	156		
	Female	46	38.2 (12.84)	25.36 (4.87)
	Total	202		
UK	Male	79		
	Female	77	37.5 (10.8)	24.95 (5.96)
	Total	156		
France	Male	140		
	Female	59	33.84 (10.59)	23.93 (4.97)
	Total	199		
Poland	Male	94		
	Female	34	33.24 (10)	24.43 (4.36)
	Total	128		
USA	Male	83		
	Female	54	35.98 (10.85)	28.38 (11.15)
	Total	137		
Bulgaria	Male	200		
	Female	157	35.39 (9.68)	23.52 (3.89)
	Total	357		
Netherlands	Male	60		
	Female	23	35.96 (11.8)	26.58 (8.37)
	Total	83		
Italy	Male	96		
	Female	83	32.57 (9.08)	23.2 (3.64)
	Total	179		

Table 1. Sample size by Gender, Age, and BMI for each country. Data are mean scores (SD).

Survey design & Measures. All national languages of the participating countries were available for participants and had been translated from an original English version either by researchers who understood their intention, or questions were back translated to ensure equivalency of meaning. After providing official consent, participants were introduced to three examples of nudges promoting healthy eating which are common in the literature (Van Kleef, Otten, & van Trijp, 2012; Robles, Wood, Kimmons, & Kuo, 2013; Wansink & Van Ittersum, 2013) (without mentioning of the term nudging):

Example 1: *To help people eat healthily, the manner in which healthy and unhealthy foods are presented could be changed. For example: When shopping for food, healthy food could be placed more visibly (at eye level or near the cash register) than unhealthy food to help people resist the temptation of buying unhealthy food. In this example people could still choose any food they like, healthy and /or unhealthy; all options would remain available.*

Example 2: *To help people eat healthier amounts of food, the available tableware could be changed. For example: When getting dinner, smaller plates could be given to people to help them choose smaller portion sizes and eat less. In this example people could still choose any amount of food they like; all options would remain available.*

Example 3: *To help people eat healthily, the manner in which healthy and unhealthy foods are presented could be changed. For example: In situations where people like to snack, healthier snack options could be made more available (for example in vending machines) to help people choose a healthier snack. In this example people could still choose any snack option they like, healthy and /or unhealthy; all options would remain available.*

Following each randomly presented example participants were asked "*To what degree would you approve if this measure was implemented by…?*" (1 = Very much disapprove – 7 = Very much approve). This question was posed three times, once for each source including *the food industry, policy makers,* and *independent experts in the field*, at random order. Subsequently, each example was repeated in random order without reference to a specific source and participants were asked "*How intrusive do you find this measure?"* (1 = Not at all intrusive – 7 = Very intrusive). Furthermore, the trustworthiness of each source was assessed by asking "*To what degree do you regard [the source] as trustworthy?"* (1 = Not at all trustworthy – 7 = Very trustworthy) in random order. Finally, demographic variables, including age, gender, BMI, political orientation (liberal – conservative), and country of residence were assessed. Participants were debriefed and thanked.

Analytic Strategy. A mixed effects regression model was fit using the lme4 (Bates, Maechler, Bolker & Walker, 2015) package in R (R Core Team, 2015). Approval scores of each participant were averaged over nudges resulting in three measurements (one for each source) per participant. Participant was the grouping factor in the analysis. After checking the assumption of linearity for the relations between the outcome and each predictor variable both the linear and the quadratic effect of intrusiveness were included. The variables Intrusiveness and Trust were not centered but 0 was included in their scale by subtracting 1 unit (the new range is 0 to 6). Further, two mediation models were estimated, one for the mediation of political orientation on the effect of country of residence on approval and one for the mediation of trust on the effect of source on approval using the mediation package

(Tingley, Yamamoto, Hirose, Keele & Imai, 2014; Imai, Keele, & Tingley, 2010). More detailed information about the Analysis can be found in the Appendix.

Results

Main Analysis. The 99.9% confidence intervals revealed significant main effects of Trust, Intrusiveness, Source, and Gender, and a quadratic effect of Intrusiveness, as well as an interaction between Trust and nudges implemented by industry (*B* = -0.08, *CI* = -0.13; -0.02). The results of the main effects from the mixed-effects regression are given in Table 2.

Variable		**B**	**99.9% CI***
Intercept		4.27	3.71; 4.83
Trust		0.32	0.27; 0.36
Intrusiveness		-0.69	-1.10; -0.25
Intrusiveness^2		0.09	0.01; 0.17
Source	Industry	0.51	0.35; 0.67
	Experts	0.29	0.07; 0.50
Sex	Female	0.35	0.20; 0.51
BMI		0.00	-0.01; 0.01
Age		-0.00	-0.01 0.00
Political Orientation		-0.03	-0.17; 0.10
Country of Residence	UK	0.07	-0.74; 0.94
	France	-0.43	-1.25; 0.37
	Poland	0.39	-0.55; 1.30
	USA	0.17	-0.49; 0.89
	Bulgaria	-0.12	-0.68; 0.46
	Netherlands	-0.73	-1.75; 0.29
	Italy	0.52	-0.21; 1.25

Table 2. Coefficients and Confidence intervals for the main effects of the mixed effects regression model. * These are confidence intervals based on a parametric bootstrap of 10000 samples. CI's were corrected for multiple testing using a Bonferroni correction, the adjusted alpha level is 1-(0.05/42); there were 40 fixed effects and 2 variances to be estimated in the model.

Approval and Intrusiveness. The results revealed moderately high degrees of approval with nudges in eating behavior (*M* = 5.1; *SD* = .97). This corroborates previous research suggesting that attitudes towards nudging are positive in domains in which consumers understand the decision-making context. The perceived intrusiveness of the nudges was low to moderate (*M* = 3.38; *SD* = 1.41). As predicted by Hypothesis 1 perceived intrusiveness was negatively associated with approval (*B* = -0.69; *CI* = -1.1; -0.25) (See Figure 1 and 2). The analysis further revealed a quadratic

effect of intrusiveness on approval (See Figure 3). Generally, approval was highest when intrusiveness was lowest. As expected, approval rates declined when intrusiveness increased from low to moderate levels. However, a further increase in intrusiveness surprisingly led to an increase in approval. Since the intrusiveness ratings used in this analysis were averaged across the three nudges, individual models for each nudge were fit. In each model intrusiveness was negatively associated with approval. Only for the second example did the linear effect of intrusiveness disappear when adding the quadratic effect.

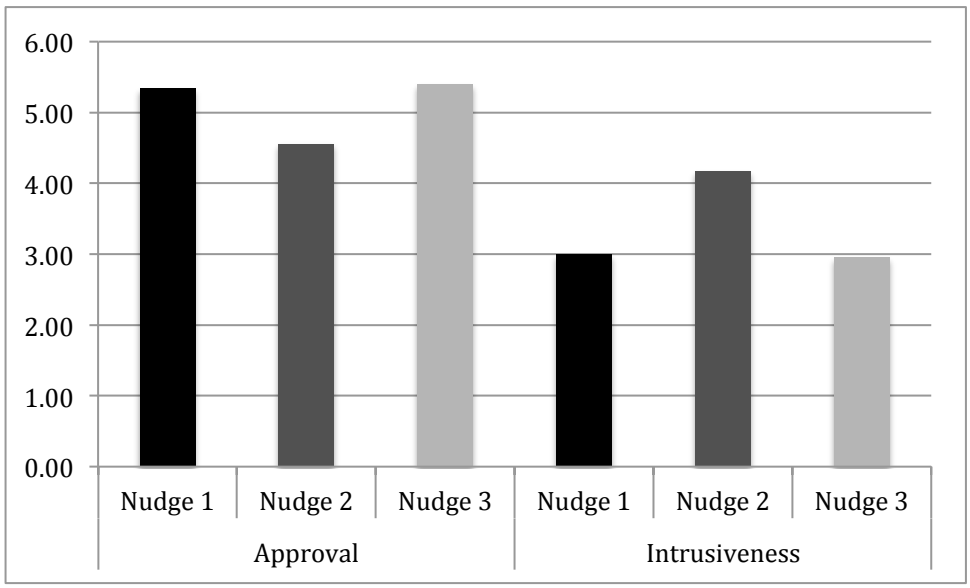


Figure 1. Mean ratings of Approval and Intrusiveness for each nudge across sources.

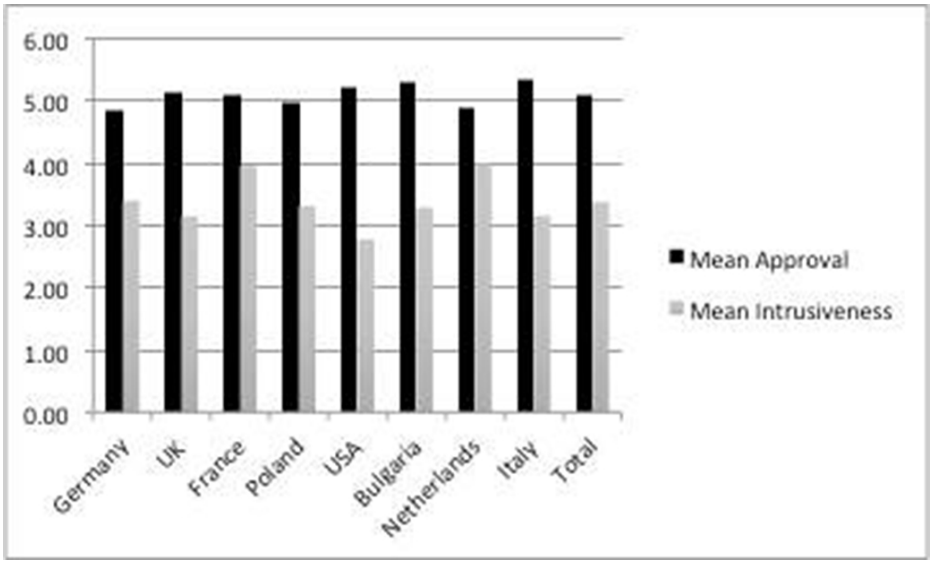


Figure 2. Mean scores of the three nudges for perceived intrusiveness and approval per country.

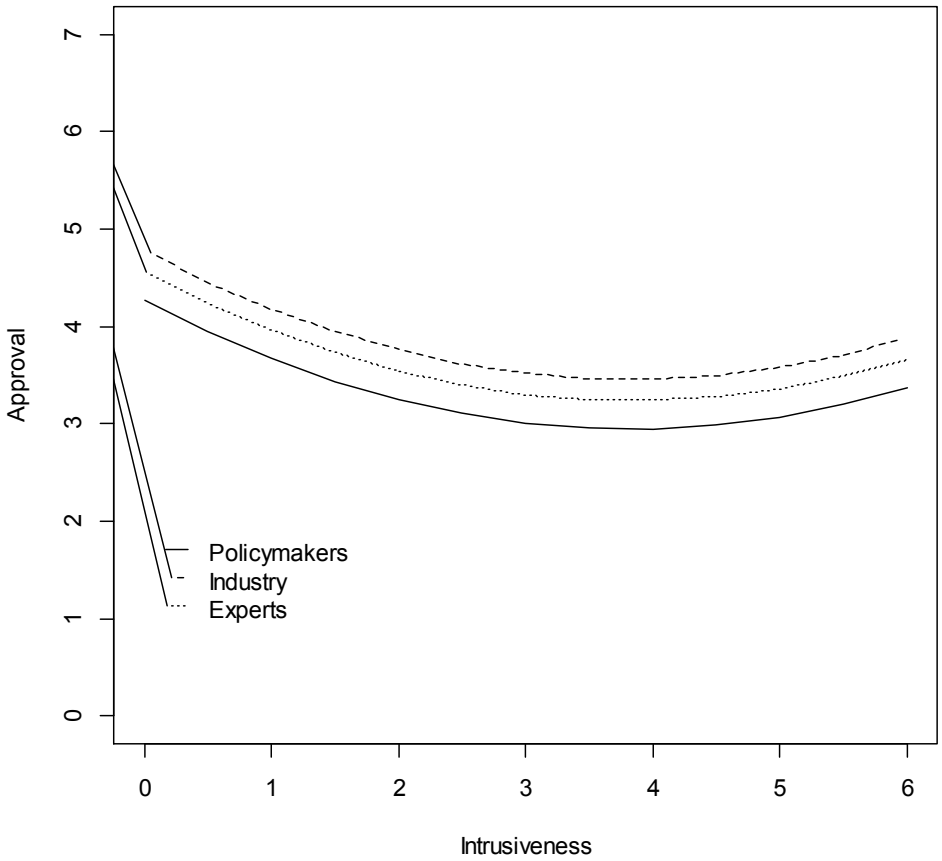


Figure 3. The quadratic effect of intrusiveness on levels of approval.

Source and Trustworthiness. As predicted by Hypothesis 2 ratings of approval were affected by the source of the nudges (Industry: *B* = 0.51; *CI* = 0.35; 0.67; Experts: *B* = 0.29; *CI* = 0.07; 0.5). On average ratings of approval were higher for experts (*M* = 5.05; *SD* = 1.32) and industry (*M* = 3.68; *SD* = 1.58) than for policy makers (*M* = 3.4; *SD* = 1.48). Hypothesis 3 was supported as trust was a significant predictor of approval (*B* = 0.32; *CI* = 0.27; 0.36). The higher participants rated the trustworthiness of a source the more they approved of nudges implemented by that source (See Figure 4). The precise relationship between trustworthiness, source, and approval was revealed by the mediation analysis that showed that the effect of source on approval is mediated by the trust in the source ($ACME_{experts}$ = 0.45, *CI* = 0.42; 0.49, $ACME_{industry}$ = 0.09, *CI* = 0.07; 0.12).

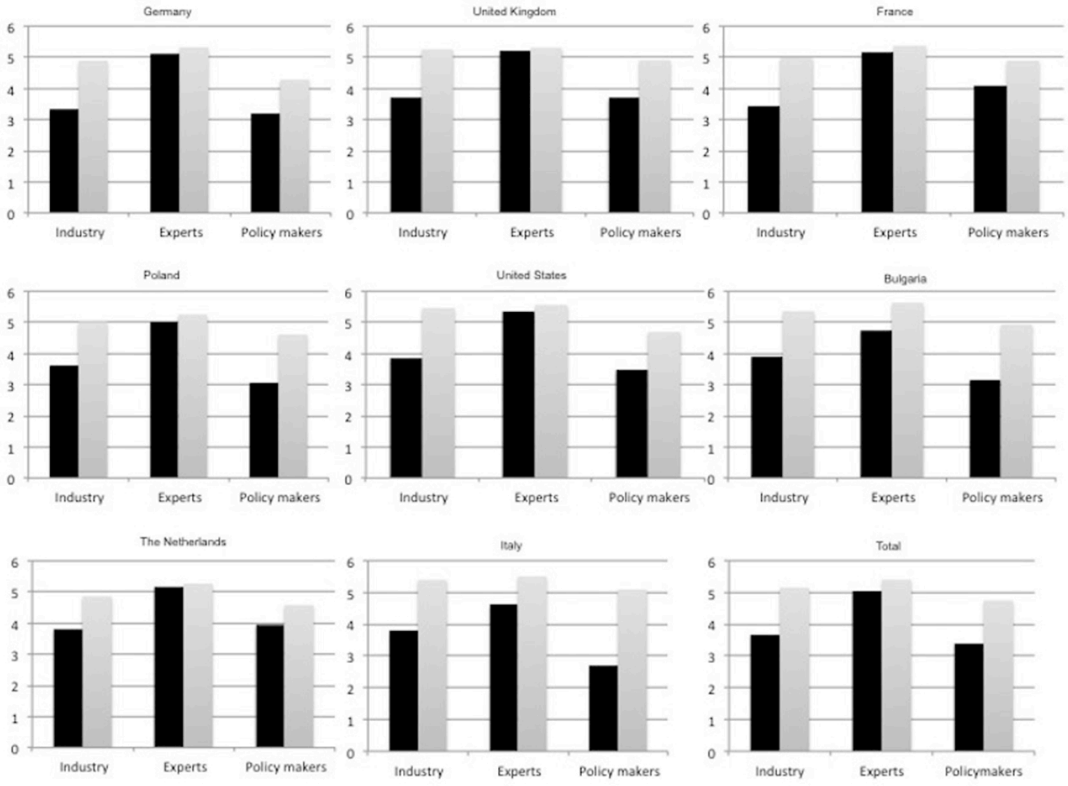


Figure 4. Mean Trustworthiness (black bars) and approval (grey bars) per source per country.

The results further reveal a significant interaction between trustworthiness and nudges implemented by industry (*B* = -0.08, *CI* = -0.13; -0.02) (See Figure 5). Whereas increases in trust were associated with similar slopes in approval for policy makers and experts, the slope for industry was lower. Approval for nudges by industry was comparatively high even at low levels of trust, but also relatively low for high levels of trust. As such, it appears that trust is less important when evaluating nudges implemented by industry as compared to nudges implemented by policy makers and experts.

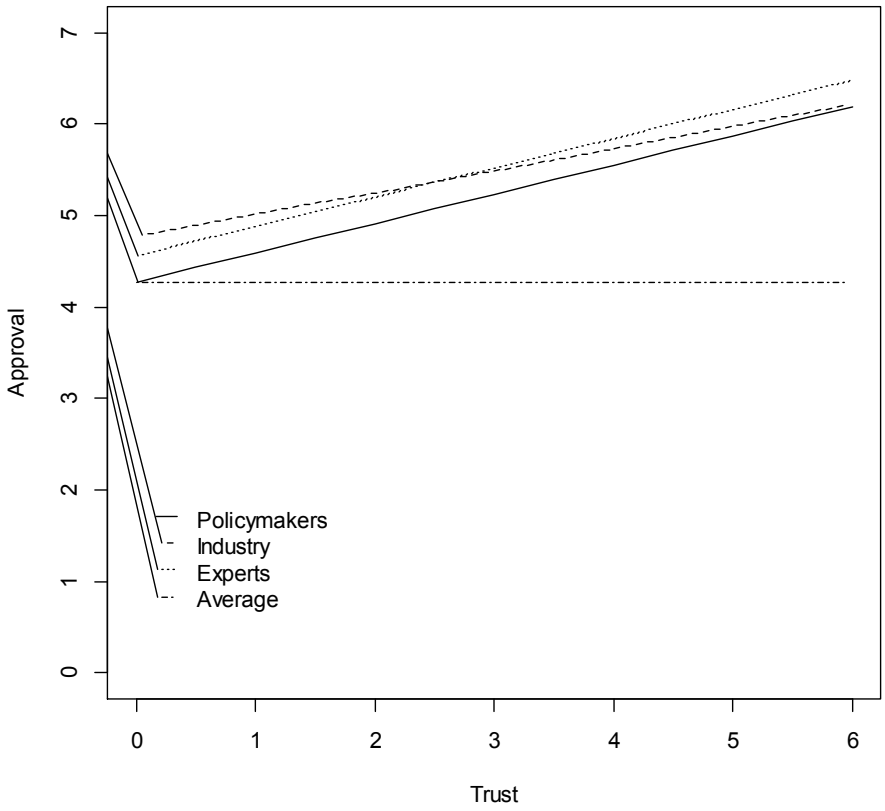


Figure 5: Regression lines for the relation between Trust and Approval in the different sources.

Political Orientation and Demographic effects. The current data do not provide evidence for a relationship between political orientation and approval in neither the regression (*B* = -0.03; *CI* = -0.17; 0.1) nor the mediation model. In contrast to previous research, the data revealed an effect of gender with higher approval for nudges in eating behavior by women than men (*B* = 0.35; *CI* = 0.2; 0.51).

General Discussion

The findings provide information for policy makers considering the implementation of nudging strategies by revealing moderate to high approval with nudges promoting healthy eating. Consumers' approval was influenced by the perceived intrusiveness of nudges, consumers' gender, and the source of the nudge mediated by the degree to which sources were trusted. Overall levels of approval were higher when perceived intrusiveness was low and when the source was more trusted. Nudges implemented by experts and industry, as opposed to policy makers, were more approved and approval by women was higher. Furthermore, consumers' political orientation was not associated with approval.

It should be noted that perceived intrusiveness was a measure of consumers' perception of nudges rather than a measure of each nudging example. The predictor was averaged over three nudging examples. However, a similar association between intrusiveness and approval was observed in separate models for each nudge. Hence, the intrusiveness measure can be considered both a characteristic of the consumer and of the individual nudges.

In addition to the predicted linear relationship between intrusiveness and approval, we found a quadratic relationship in which levels of approval were highest for consumers who rate intrusiveness comparatively low and high, as compared to consumers who rate nudges as moderately intrusive. This observation suggests the involvement of a moderating factor not assessed in this study. Future research should investigate, for example, whether the perceived effectiveness of more and less intrusive nudges plays a role in this relationship.

Across all countries, consumers approved more of nudges implemented by experts and industry compared to those implemented by policy makers. The effect of source on approval was further mediated by consumers' trust in the source. However, the effect of trust differed between the sources. For approval for nudges from policy makers and experts trust was more important compared to approval for nudges from industry. Even at low levels of trust consumers were comparatively approving of nudges by industry. At the same time approval was relatively low when levels of trust were high. For policy makers in comparison trust was an important driver of approval with nudges. On the basis of these findings, practitioners implementing nudges in the field could involve experts in the target behavioral domain during the design of nudges and the decision which behaviors and choices ought to be promoted.

In contrast to previous research showing no gender difference in approval (Arad & Rubinstein, 2015), our data further showed that women were more approving of nudges than men. The effect could be driven by the fact that eating, body size and image often are a stronger concern for women than men and that the preparation of food is a traditionally female role, which could drive the stronger approval of nudges supporting healthy eating for women (Wardle, Haase, Steptoe, et al., 2004; Beardsworth, Brynan, Keil, et al., 2002).

Finally, neither was political orientation associated with approval, which supports similar observations by Tannenbaum, Fox and Rogers (working paper), nor did consumers' country of residence play a role. As such, it can be argued that political orientation should not be a concern for policy makers considering the implementation of nudging strategies to alter consumers' behavior. The correspondence of results across countries, especially between the US and European countries, stands in contrast to the reasoning by Sibony and Alemanno (2015) that Europeans should be more "intervention-friendly" (p.23) than the US due to differences in their legal cultures. Yet, this lacking difference could be explained by consumers' unawareness of these legal differences in combination with the import

of relatively negative US terminology and framing of nudging strategies into European settings.

Some limitations regarding the data collection and analysis should be mentioned. Firstly, the correlational nature of the data forbids causal interpretations of the findings. Secondly, while the data collected in each country are informative for the specific country in and of its own, direct comparisons are not allowed due to the non-representative sampling and the nature of the analysis, in which country was included as a random, not a fixed factor. Finally, the results are specific to the realm of eating behavior. On the one hand, this restriction avoided previously observed differences in consumers' attitudes towards nudging in different behavioral domains (Junghans et al., 2015) and ensured that policy makers can draw direct conclusions for the realm of eating behavior. On the other hand, generalizability to other behavioral domains cannot be guaranteed. From a theoretical perspective the relationship between the investigated factors should be similar in other domains; yet this prediction was not tested in the current study.

In conclusion, this study makes a theoretical advance by revealing the conditions for consumers' approval with nudging healthy eating behavior and provides practical information for policy makers considering the inclusion of nudging in their policy repertoire in a number of European countries and the US.

Chapter 10

General Discussion

Purpose

The purpose of this dissertation was twofold. It intended to understand the cognitive mechanisms underlying the environment's influence on consumers' eating behavior. Moreover, it set out to investigate whether this influence could be employed to promote healthy behavior and whether consumers would approve of such nudging strategies. The availability and accessibility of food in the environment has repeatedly been shown to contribute to overconsumption, unhealthy food choices, and, as such, to negative health consequences. The first part of the dissertation applied the theories of embodied cognition and affordances to explain what drives these influences and to understand why consumers are so vulnerable to the sight of accessible, immediately edible food. An essential aspect of this investigation concerned the contribution of visual exposure to immediately accessible food on subsequent consumption. The studies set out to reveal whether the increased consumption of food upon visual exposure is not only driven by the visual information about the food's properties, but additionally, by the activation of the motor system involved in interacting with food.

In extension of these investigations, the studies in the second part examined whether environmental influences on consumers could be employed for the promotion of health behaviors. Designing environments in such ways that consumers are exposed to healthy food could increase consumers' health and welfare. To test these ideas both the effectiveness of nudging strategies, as well as the conditions for consumers' approval with nudging were assessed.

Summary of the Findings – Part 1: Environmental influences on eating behavior

Chapter 2 examined children and adults' differential attention to healthy and unhealthy food. The results of this eye-tracking experiment showed that both children and adults initially attended visually to the unhealthy food. Unhealthy food appeared to have a stronger attention attracting capacity than its healthy counterpart. Adults, in contrast to children, directed their visual attention away from the unhealthy food after the initial fixation. These results suggest that the people's stimulus-driven and bottom-up processing that is largely inaccessible to goals and consciousness, is directed towards the more tempting food. Later stages of visual attention that are influenced by more deliberative top-down processing, allow adults to disengage from the unhealthy food, whereas children do not reveal such visual disengagement. The findings imply that the tempting food consumers encounter in the environment may have attention attracting capacities from which adults appear to be more capable of withdrawing than children. This is particularly important considering that visual attention can increase the likelihood for choosing the attended object (Armel, Beaumel, & Rangel, 2008). As such, the visual attention to unhealthy food may increase the chance for people, and especially children, to consume unhealthy food they see in the environment.

Results from Chapter 3 extended these findings to actual eating behavior. The reported study manipulated two factors. Firstly, participants were placed either in a

fully darkened room or a normally lit room to manipulate the visibility of their environment. Secondly, it manipulated the ease of interaction with the utensils by providing glow-in-the-dark bowls and spoons. The study showed that people consume less when they do not see their food. Moreover, it showed that this reduced consumption could be overcome by the highlighting of the utensils. These findings can be explained by two different but related mechanisms. On the one hand, reduced consumption in the dark room can be explained by the lacking information about the properties of the food. On a neurological level this should be the information processed in the ventral stream that has been shown to process information related to 'what' it is people are seeing. People do not see the food's tempting qualities and do not experience an activation of physiological responses and appetite that normally results from visual exposure to food (Van den Laan et al., 2011). On the other hand, reduced consumption could be explained by the fact that people cannot perceive the food's affordances in the dark room. The motor system that should be activated upon seeing food and guide interaction does not exert an influence leading to higher difficulty maneuvering. This is the information that should be processed via the dorsal stream, which handles information about 'where' the food is located and 'how' one can interact with it (Goodale & Milner, 1992). This latter explanation brings to attention the importance of body – environment interactions in influencing behavior. The findings suggest that visual exposure to food influences eating behavior not merely through the provision of information about the food's properties, but also through the facilitation of motor interaction.

The observation that the ease of motor interaction is associated with consumption raises the question about the mechanisms that underlie the relationship. Theories of embodied cognition and affordances posit that the observation of objects automatically activates the motor system involved in engaging with the object (Wilson, 2002). Chapter 4 applied this theoretical framework to investigate whether exposure to accessible and readily edible food activates eating-related information. The results of two experiments showed that reachable and readily edible food does indeed activate information related to the motor interaction with food. The findings suggest that reachable, readily edible food as it is often encountered in the environment, affords to be eaten. The experience of these affordances leads to an activation of the information involved in the motor interaction with food, thereby preparing the body for eating. This mechanism could provide an explanation for people's difficulty in resisting food they encounter in the environment. If the mere observation of reachable and readily edible food prepares the body for eating, the enactment of this eating behavior may be more difficult to inhibit.

This latter notion was put to the test in Chapter 5. These experiments were conducted on long-tailed macaques rather than humans for two reasons. Firstly, monkeys represent a culturally unbiased sample in regards to their responses to food. Secondly, monkeys share the biological markup relevant to the experiments with humans. Previous research has indicated that processes involved in action-selection and action-inhibition follow the same basic principles in monkeys and humans (Sartori et al., 2014). The two experiments specifically tested monkeys' ability to resist a reaching movement towards food depending on whether the food

was presented within reach or just outside of reach. The results showed that inhibiting the reaching movement towards food was less successful when the food was reachable compared to when it was just outside of reach. These results corroborated the findings of Chapter 4. The difficulty in inhibiting a reaching movement towards reachable food can be explained by the food's affordances. If the affordances activate the motor information involved in interacting with the food (i.e. reaching or eating) the execution may be more difficult to inhibit – the effect shown in Chapter 5. On the basis of these studies it can be argued that food in the environment automatically activates motor information involved in reaching for food and eating, which may contribute to the difficulty of resisting food. However, the effect is contingent upon the distance and accessibility of the food. According to the findings, affordances reveal their impact on the motor activations only when the food is sufficiently proximal to fall within the reachable sphere and that the impact is strongest when the food can be immediately interacted with (i.e., when it is immediately edible).

In today's environment, in which readily edible food is constantly available, these mechanisms may contribute to consumers' struggle resisting food. They provide an explanation for why people continue eating when food is placed in front of them even though they are satiated (Wansink, Painter, & North, 2005), why people mindlessly finish the bowl of chips in front of the television without noticing, and why placing food out of sight and reach is a successful strategy to reduce consumption (Wansink, 2014).

These mechanisms do not suggest that consumers are helplessly exposed to food they cannot resist. The activation of the motor system does not automatically lead to execution of the movement towards food and eating but can be overridden (Ridderinkhof et al., 2010). Nevertheless, understanding these mechanisms raises the question of whether changing consumers' responses to food in the environment is the most effective strategy to promote consumer health. These mechanisms have evolved to maximize the body's effective interaction with its environment and they function on an automatic level seemingly inaccessible to conscious interference (Martin, 2007; Grèzes et al., 2003). As such, they appear to be difficult to alter. A more obvious strategy to promote consumer health would be to piggyback on these evolved mechanisms and adjust the environment in such a way that it promotes healthy behaviors.

Overall the first part of the dissertation revealed that visual exposure to food not only provides information about the food's properties. In addition, visual exposure prepares the body for interaction by activating the motor system that is involved in potential interactions with the food with likely consequences for the ability to resist. Thus, the embodiment of food influences consumption behavior via the food's exertion of affordances that facilitate motor interaction such as reaching and eating.

Summary of the Findings – Part 2: Nudging healthy eating behavior

Chapter 6 examined whether the influence of the environment, specifically the accessibility of food, could be employed to promote healthy consumption. When a new kid's meal was introduced at a large fast food restaurant chain, an observational study investigated whether the reduction in portion size of French fries in combination with adding apple slices would influence children's consumption. The results showed that children consumed less French fries than before the introduction of this kid's meal. Additionally, children consumed more apple slices than before they were added to the kid's meal as a default option. Thus, both the default and the accessibility nudge applied in a fast food restaurant successfully reduced children's consumption of unhealthy, but increased the consumption of healthy food. These findings show how nudging can effectively change consumers' behavior in a natural setting that is generally known to induce rather unhealthy eating behaviors. As such, the results provide evidence for the effectiveness of nudging strategies: The environment at the fast food restaurant was designed in such way that healthy food was more accessible, which improved the overall healthiness of children's meals. Thereby, the often-negative consequences of the environment's influence on consumer behavior were reverted to achieve the opposite effect. Since consumers are drawn to the consumption of food that is accessible in their environment, the more accessible placement of healthy food facilitates healthy eating without relying on self-control strategies or the need for active contemplation of all available options.

Alternate nudging strategies, which do not rely on accessibility, focus on the manner in which consumers process information. An example of this type of nudge was explored in Chapter 7. The aim of this study was to determine whether consumers' adherence to their own preference could be enhanced using subtle reminders to consider particular pieces of information. Specifically, this study tested whether consumers' attention to ingredient lists of food products could be increased by providing a subtle reminder, or cue, to consider the naturalness of a food product; a factor consumers generally report to be particularly important in their evaluation of products. The results showed that consumers pay very little attention to ingredient information or do not process the information at much depth. However, their attention can be directed toward the ingredient information with a subtle reminder to consider naturalness when evaluating the food. Hence, the nudge to consider naturalness enhanced consumers' attention to ingredient list and/or positively impacted the depth at which this information was processed. This nudge thereby supported consumers' ability to evaluate food along a dimension they commonly report as important but appear to forget when actually evaluating a product. On the basis of this finding it can be concluded that nudges can be employed to help consumers act in line with their own interests.

Taken together the findings of these two studies suggest that nudging can be used to promote healthy consumption via the design of smart food environments. Increasing the accessibility of healthy choices and reminding consumers to consider their own interests have shown to promote healthy consumption and consumer welfare. Yet,

despite repeated successful demonstrations of nudging strategies (Cheung et al., 2015; Junghans & Wansink, N. d.), the implementation of nudging on a larger societal scale has met with reluctance for two main reasons. Firstly, an ongoing philosophical and theoretical discourse about nudging and its conceptual stance has caused uncertainty as to the appropriateness of nudging in policy making (Sunstein, 2015a). Nudging often influences consumers without their conscious awareness (De Ridder, 2014). They employ people's reliance on cognitive biases and heuristics and are determined by an external source that decides which behaviors and choices ought to be promoted. Critics are concerned with these aspects of nudging and do not approve of their implementation in society. Secondly, the targets of behavioral economics derived interventions, the consumers, have remained largely uninvolved in these discussions. Consumers' attitudes towards and concerns about nudging remain largely unknown causing an information vacuum. One step in the alleviation of this reluctance should thus entail a better understanding of consumers' perspectives on nudging, their attitudes, concerns, and boundary conditions for approval. For that reason Chapter 8 reported a qualitative study that investigated consumers' attitudes to and concerns with nudging in the realm of health behavior. The results revealed that consumers generally appreciate nudging strategies under two conditions. Firstly, nudges should benefit individuals and society and secondly, they should be employed in behavioral domains in which consumers understand the decision-making context. A prototypical example of a well understood behavioral domain is eating, as consumers understand both what constitutes beneficial behavior and the reasons for why this behavior is important. Consequently, nudges find large-scale support in this domain in spite of theoretical criticisms.

These findings were further corroborated by the results of Chapter 9, which reports findings from a large cross-national survey into consumers' approval, and conditions for approval, with nudges designed to promote healthy eating behavior. Across eight countries, which included European countries with varying cultural, historical, and geographical backgrounds, as well as the US, the results revealed consumers' moderate to high approval with nudges in eating behavior. According to these findings, approval is higher for nudges implemented by experts and industry rather than by policy makers; an effect that is driven by consumers' trust in these actors. The more consumers trust the actor, the more they approve of them implementing nudges. Furthermore, consumers' approval is related to the perceived intrusiveness of nudges. The more intrusive a nudge, the less consumers approve of its implementation.

Overall, the two studies highlight two essential requirements for consumers' approval with nudges for healthy eating. Firstly, nudges need to be designed to promote behaviors in line with consumers' best interest. Secondly, consumers require nudges to be of a more proposing than coercive nature. The former aspect requires trust in the sources of nudges and trust in their acting on behalf of the consumers rather than on behalf of other players. Considering that consumers are often unaware of the influence of nudges on their behavior at the given moment, consumers need to feel at ease with the external influence on behavior and trust that this power is not abused. The latter aspect requires the careful design of nudges

to ensure that beneficial behaviors are promoted by nudges through mechanisms of limited intrusion, such as suggestion, reminders, and attraction rather than force and coercion. In principle, this requirement raised by consumers is by definition an integral part of nudging strategies. After all, nudges are coined as subtle strategies that promote behaviors without excluding any option and significantly changing the economic incentives involved in any option (Thaler & Sunstein, 2008). Nevertheless, the fact that this requirement is fundamental to concerns by consumers, as well as to criticisms raised by theorists and philosophers, calls for particular attention to the degree of intrusiveness of nudges.

Overall, the second part of this dissertation has shown that the effect of accessibility on behavior that has been shown in Chapter 2-5 can be employed to promote healthy eating behavior in natural settings. Alternate nudging strategies, such as cues and reminders, can similarly improve consumer welfare by helping consumers act in line with their own interest. In addition to showing the effectiveness of nudging, the knowledge obtained through these studies fills the information vacuum that has contributed to previous reluctance to implement nudging strategies on large societal scales. By uncovering consumers attitudes and conditions for approval with nudging, policy makers and other actors can employ this knowledge to design effective nudges that meet consumers' approval.

Theoretical Implications

The research conducted in this dissertation exemplifies an application of a theoretical framework to the investigation of consumer behavior and nudging strategies. The theoretical framework into which nudging has been embedded most commonly to this date is the Dual Process Model (Chaiken & Trope, 1999; Milkman, Chugh, & Bazerman, 2008). This model distinguishes between two different systems for information processing. While the precise definition of System 1 and System 2 depend on the respective field of application (Evans, 2008), the general idea is that within System 1, information processing functions relatively intuitively, effortlessly, and mindlessly. It relies on heuristics and mental shortcuts rather than careful evaluation and systematic contemplation. In contrast, information processing in System 2 is more deliberative, effortful, and systematic and entails rational evaluation and conscious weighing of all available information (Strack & Deutsch, 2004). Despite the wide-spread depiction of consumers as rational agents who process information in System 2, research has shown that many daily decision are based on System 1 processing (Gigerenzer & Gaissmaier, 2011). This implies that a large amount of information processing and decision-making is relatively mindless, unsystematic, and prone to external influences and habits. When people are processing information in System 1 nudging strategies could optimally exert their influence on behavior (Sunstein & Thaler, 2003). On the one hand, consumers often fail to act in line with their long-term goals when operating in System 1 because their behaviors are to a lesser degree determined by conscious goals and self-control, leaving consumers vulnerable to externally-induced, impulsive, and habit-driven behaviors. On the other hand, operation in System 1 entails a susceptibility to external suggestion, thereby allowing nudges to influence behavior in line with

consumers' interests and long-term goals (Thorgeirsson & Kawachi, 2013). While the Dual Process Model describes the cognitive states in which nudges are most effective in influencing behavior, its conceptualizing reach does not extend beyond these cognitive information-processing mechanisms. It does not incorporate conceptualizations of how environmental influences relate to the cognitive mechanisms. In contrast, theories of embodied cognition can provide insights into the cognitive and neurological underpinnings of external influences on behavior, upon which nudging is founded. As such, these theories provide a rich addition to the application of Dual Process Models to the understanding and investigation of nudging.

However, it should be noted that the application of embodied cognition to nudging is adequate for specific types of nudges only. In this dissertation two kinds of nudges have been investigated: The use of subtle reminders and the design of smart environments. While the introduction of a new classification system for nudges is beyond the scope of this dissertation, the two above-mentioned nudges will be treated as examples for two different types of nudges (For a review on classifications of nudging see: Münscher, Vetter, & Scheuerle, 2015). Using a reminder has shown to be a successful strategy in helping consumers consider decision-making aspects they tend to forget during actual decision-making processes. The mechanism of this type of nudge relies solely on cognitive processing. Using an environmental design to influence behavior, on the other hand, involves both the cognitive system and the environment in which it is situated. This interaction has show to impact the manner in which information is processed. Thus, this second type of nudge is based on an interaction between the environment and cognitive processing, thereby yielding itself to an embodied cognition approach.

For this type of nudge theories of embodied cognition may provide a suitable framework to investigate the effectiveness, mechanisms, and boundary conditions of nudges. These theories describe, on the basis of decades of research from various disciplines, how behavior depends on the interaction between bodies, minds, and environments (Barsalou, 2003). Traditionally, cognition was depicted as mental computations on the basis of abstract representations of the outside world to which the body's senses provide input. In this view, the body was considered the channel through which the outside world was perceived, but which did not influence cognition in and of its own. Similarly, the environment in which the body is situated has no impact on cognitive functioning according to these traditional perspectives. In contrast, embodied cognition theories ascribe an essential role to the body and the environment in which it is situated for cognitive processing. Cognitive processing essentially depends on the body's properties and abilities in the environment and the potential interactions with this environment (Wilson, 2002; Gibson, 1979). This conceptualization of cognition and resulting behavior matches the ideas underlying nudging strategies. If behavior depends on a person's body situated in a particular environment, then one can design that environment in such a way that leads to positive behavioral changes. This is precisely the approach of nudging strategies that focus on environmental designs. When consumers do not rationally deliberate their choices and behaviors, they often rely on biases, heuristics, and cues (Kahneman,

2003). These mental shortcuts depend on the environments in which cognition and behavior take place. People are inclined to accept default options presented to them, pay attention to saliently placed objects, interact with objects on the basis of what action these objects afford, and conform to behaviors they observe in other people. As such, people's behaviors depend on the environment in which they are situated and nudging involves the design of these environments with the aim to promote behaviors in consumers' best interest.

The application of an embodied cognition framework to the delineated type of nudges promises to enrich the understanding of the mechanisms through which nudges exert their influences on behavior. This advancement should further allow for the design of nudges with optimized effectiveness. Understanding how consumers' behavior is shaped by the interaction between mind, body, and the environment can therefore enlighten practical application of these influences with impact for consumers' well being, on both individual and societal scales.

Practical Implications

On a more practical level, the findings in this dissertation could provide the foundation for policy makers trying to employ nudging strategies to promote healthy eating behavior and inform those involved in the design of nudges. Policy makers face criticisms and resistance towards nudging on the basis of the discussed theoretical and philosophical considerations. The finding that nudges can effectively alter consumers' behavior and that they receive large-scale approval by consumers (under certain conditions) may be the founding argument for policy makers against these critics and for the integration of nudging into their policy repertoire. For those involved in the design of nudges, the dissertation provides a framework within which nudging can be conceptualized. Having understood part of the environmental influences on consumer behavior can be a starting point for the design of new nudges and for increasing the effectiveness of already existing nudges. Moreover, designers can focus on those types of nudges that are accepted and appreciated by consumers to reduce reactance. Based on the findings, this means that policy makers should involve experts in the respective behavioral fields into the design of nudges and the decision what behaviors ought to be promoted. For eating behavior, nutritionists, medical doctors, and health psychologists could constitute such experts. Furthermore, consumers' trust in the sources of nudges was an essential factor determining approval. Policy makers' trustworthy behavior should be a general requirement rather than a tool to achieve approval with nudging. However, the importance of trust can be interpreted as consumers' concern about the potential abuse of nudging strategies to promote behaviors that are not in line with consumers' best interest. For that reason, policy makers need to carefully evaluate nudges and their choice for behaviors to be promoted in order to ensure beneficial outcomes for consumers. An additional step in enhancing consumers' trust may be the development of guidelines for the implementation of nudging strategies that ensure adherence to the requirement of acting in consumers' best interest. Finally, designers of nudges should focus on the development of nudges that optimize the relationship between effective influence on behavior and intrusiveness.Consumers

appreciate nudges more when the perceived intrusiveness of the nudge is low. Thus, the aim should be to develop nudges that are perceived as little intrusive while simultaneously exerting successful influences on behavior.

With a focus on these requirements nudging strategies promise effective influences on consumers' behavior on large scales. With regards to health behavior, these nudges not only promise effective improvements of health on an individual level but also a reduction in health costs on a societal scale. Moreover, they promise to support consumers' individual wellbeing by facilitating healthy lifestyle without requiring the execution of self-control on behalf of the consumer.

Concluding comment

In conclusion this dissertation provided insights into the mechanisms by which the environment influences consumers' behavior. By investigating consumers' reactions to food exposure from an embodied cognition perspective the findings revealed the collective influence of mind, body, and environment in shaping consumer behavior. The effect of visual exposure to immediately edible and reachable food in the environment is not limited to the provision of information about the properties of the food. The visual exposure further activates the motor system involved in interaction with the food, thereby preparing the body to interact with, while impeding the ability to inhibit interaction with the food. On the basis of this, it can be argued that consumers' difficulty in resisting food temptations in the obesogenic environment may partially be driven by the automatic activation of interactions with food, with negative consequences for resistance to food temptations, overconsumption, and resulting negative implications for health.

Albeit these negative implications for eating behavior, the effect of mind, body, and environment interactions can be strategically employed for the promotion of healthy behaviors. Through nudging strategies, which employ environmental designs to promote behaviors that benefit the consumer via the increase of availability, accessibility, or saliency of healthy food, consumers' behavior can be improved. Despite the fact that such nudging strategies often function without consumers' conscious awareness, consumers largely approve of nudging strategies that promote healthy eating under the conditions that nudges target behaviors that benefit consumers. On the basis of this appreciation, policy makers can add nudging strategies that support healthy eating behaviors to their policy repertoire. To maintain consumers' high levels of approval the design and implementation of nudges should firstly involve experts in eating behavior, and secondly, aim at nudges with optimal effectiveness-intrusiveness ratios.

Adhering to these criteria, nudging strategies promise the improvement of consumers' healthy eating behavior with advantageous consequences for individual consumers as well as societies as a whole.

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Appendix

Chapter 7.1. Sample Product Evaluation Form: Wouda

Consumenten survey

PP _____ Datum_____ Tijd_____

Geef uw antwoord aan op de onderstaande schaal zoals in het voorbeeld: Give your answer on the scale like the example

Helemaal niet belangrijk / Not at all important ○ ○ ○ ✓ ○ ○ ○ Heel erg belangrijk / Very important

Hoe gezond vindt u dit product? How healthy do you find this product?

Helemaal niet gezond / Not at all healthy ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ Heel erg gezond / Very healthy

Hoe natuurlijk vindt u dit product? How natural do you find this product?

Helemaal niet natuurlijk / Not at all natural ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ Heel erg natuurlijk / Very natural

Hoe lekker denkt u dat dit product zal smaken? How tasty do you think this product tastes?

Helemaal niet lekker / Not at all tasty ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ Heel erg lekker / Very tasty

Hoe bekend bent u met het merk van dit product? How familiar are you with the brand of this product?

Helemaal niet bekend / Not at all familiar ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ Heel erg bekend / Very familiar

Consumenten survey

PP _____ Datum_____ Tijd_____

Hoe authentiek vindt u dit product? (een authentiek product is een puur en een eerlijk product dat je met een gerust hart koopt) How authentic do you find this product? (an authentic product is one that is pure and honest)

Helemaal niet authentiek ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ Heel erg authentiek

Not at all authentic — Very authentic

Hoe vaak gebruikt u deze tomatensoep? How often do you use this tomato soup?

○	○	○	○	○	○	○
Nooit	Een paar keer per jaar	Een keer per maand	Een paar keer per maand	Een keer per week	Een paar keer per week	Elke dag
Never	A few times per year	Once a month	A few times per month	Once a week	A few times per week	Everyday

Hoe aantrekkelijk vindt u dit product? How attractive do you find this product?

Helemaal niet aantrekkelijk ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ Heel erg aantrekkelijk

Not at all attractive — Very attractive

Hoe mooi vindt u de verpakking van dit product? How nice do you find the packaging of this product?

Helemaal niet mooi ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ Heel erg mooi

Not nice at all — Very nice

Hoe beoordeelt u deze soep in z'n geheel? How would you rate this soup overall?

Zeer slecht ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ Zeer goed

Very bad — Very good

Chapter 9.1. Variables included in the mixed regression model

Variable	Type	Centered	Categories
Approval	Continuous outcome	no	-
Trust	Continuous, predictor	no	-
Intrusiveness	Continuous, predictor	no	-
Source	Categorical predictor	no	Policy-makers (reference)
			Industry
			Experts
Sex	Categorical predictor	no	Male (reference)
			Female
BMI	Continuous, predictor	yes	-
Age	Continuous, predictor	yes	-
Political Orientation	Continuous, predictor	yes	-
Country of Residence	Categorical predictor	no	Germany (reference)
			UK
			France
			Poland
			USA
			Bulgaria
			Netherlands
			Italy

Chapter 9.2. The final model for the approval score of measurements i (I = 1, 2, 3) of participant j (j = 1, …, 1441) :

$$
\begin{aligned}
Approval_{ij} &= b_0 + b_1 Industry_{ij} + b_2 Experts_{ij} \\
&+ Trust_{ij}\left(b_3 + b_4\, Industry_{ij} + b_5 Experts_{ij}\right) \\
&+ b_6 Intrusiveness_j + b_7 Intrusiveness_j^2 + b_8 Sex_j + b_9 BMI_j \\
&+ b_{10} Age_j + (b_{11} - b_{17}) Country\ of\ Residence_j \\
&+ Political\ Orientation_j \left(b_{18}\right. \\
&+ \left.(b_{19} - b_{25}) Country\ of\ Residence_j\right) \\
&+ Intrusiveness_j \left((b_{26} - b_{32}) Country\ of\ Residence_j\right) \\
&+ Intrusiveness_j^2 \left((b_{33} - b_{39}) Country\ of\ Residence_j\right)
\end{aligned}
$$

Chapter 9.3. Mediation models with 95% confidence intervals for the average causal mediated (ACME), average direct (ADE), and total effects (TE) assessing the mediation of the effect of Source on Approval by Trust, based on 1000 quasi-Bayesian Monte Carlo simulations.

	ACME*	ADE*	TE*
Industry vs. Policy makers	0.09 (0.07; 0.12)	0.31 (0.26; 0.36)	0.40 (0.35; 0.46)
Experts vs. Policy makers	0.45 (0.42; 0.49)	0.21 (0.15; 0.27)	0.66 (0.61; 0.72)

Nederlands Samenvatting (Dutch Summary)

Onze hedendaagse omgeving bevordert overconsumptie van voedsel en heeft nadelige gevolgen voor de volksgezondheid, met name doordat eten constant en in overvloed beschikbaar is. Dit veroorzaakt zelfbeheersingsproblemen voor consumenten die proberen om de consumptie van veelal ongezond, maar zeer verleidelijk voedsel in te perken. Consumenten blijken vooral kwetsbaar te zijn voor voedselverleidingen wanneer ze ermee geconfronteerd worden in een omgeving waar het verleidelijke voedsel zichtbaar is en makkelijk kan worden verkregen en geconsumeerd. Er is dan ook aangetoond dat visuele blootstelling aan voedsel een belangrijke prikkel is voor consumptie. Dit is niet geheel verrassend gezien het feit dat het visuele systeem een fundamentele rol speelt in het vermogen van mensen om met hun omgeving om te gaan en te interacteren met objecten.

'Belichaamde cognitie' (*embodied cognition*) theorieën stellen dat er een sterk verband bestaat tussen cognitie, het lichaam en de omgeving, in die zin dat elk van deze componenten elkaar beïnvloedt. Dit betekent dat cognitie afhankelijk is van het lichaam en de omgeving waarin het zich bevindt en dat deze omgevingsinvloed meestal wordt ervaren via visie; het gezichtsvermogen. Eerder onderzoek heeft laten zien dat het louter waarnemen van objecten in de omgeving reeds zorgt voor een automatische activatie van het motorische systeem dat betrokken is bij de motorische interactie met deze objecten. Het zien van een mok met het handvat naar rechts zal bijvoorbeeld het motorische systeem activeren dat betrokken is bij het reiken naar de mok met de rechterhand, terwijl het zien van een mok met het handvat naar links het motorische systeem van de linkerhand zal activeren. Deze zogenaamde 'toelatingen' (*affordances*) van objecten, de mogelijkheden tot interactie tussen waarnemer en object, kunnen bijdragen aan de moeite die het consumenten kost om voedsel te weerstaan waaraan ze worden blootgesteld. Eerder onderzoek suggereerde dat het waarnemen van voedsel in de omgeving automatisch het motorische systeem kan activeren dat betrokken is bij het reiken naar en het consumeren van voedsel. Daarnaast zou deze motorische activatie er toe kunnen leiden dat het meer moeite kost om de geactiveerde beweging te onderdrukken, wat vervolgens bij kan dragen aan een mislukte poging het voedsel te weerstaan.

Deze ideeën werden grotendeels ondersteund door de studies zoals beschreven in het eerste deel van dit proefschrift. Ten eerste werd aangetoond dat ongezond voedsel meer visuele aandacht trekt dan gezond voedsel bij zowel volwassenen als kinderen. Volwassenen lijken beter dan kinderen in staat hun visuele aandacht van het ongezonde voedsel af te houden na een eerste glimp te hebben opgevangen. Gezien het idee dat mensen eerder producten kiezen of consumeren waar hun aandacht naar uitgaat, zou deze toegenomen visuele aandacht voor ongezond voedsel vooral bij kinderen negatieve consequenties kunnen hebben voor voedselkeuzes en gezond eetgedrag. Het onderzoek in dit proefschrift toonde ook aan dat consumenten meer eten wanneer ze het voedsel kunnen zien dan wanneer ze eten in een volledig verduisterde ruimte. Het blijkt dat dit effect wordt veroorzaakt door twee mechanismen. Enerzijds leidt het zien van voedsel tot een verhoogde eetlust en tot het in gereedheid brengen van het lichaam voor eten, bijvoorbeeld door de ontwikkeling van speekselvorming. Anderzijds helpt het zien

van voedsel om ermee te interacteren, in de zin van het vergemakkelijken van het proces om het voedsel te vinden en het naar de mond te brengen met bestek. Dus, hoeveel voedsel mensen eten wordt beïnvloed door de mogelijkheid om te interageren met voedsel. Zoals eerder vermeld zou dit ook verklaard kunnen worden door de 'toelating' of *affordance* van het voedsel. Het louter zien van voedsel zou kunnen zorgen voor een automatische activatie van het motorische systeem dat betrokken is bij eten, waardoor het lichaam geholpen wordt om succesvol te interacteren met het voedsel. Deze veronderstelling werd ondersteund door onderzoeken die lieten zien dat het menselijke motorische system dat betrokken is bij het reiken naar voedsel en het eten ervan inderdaad geactiveerd wordt wanneer mensen voedsel zien binnen hun fysieke bereik, onder voorwaarde dat het voedsel direct eetbaar is, zoals wanneer het geschild en onverpakt is. Aanvullend onderzoek met apen wees daarnaast uit dat de blootstelling aan bereikbaar voedsel het moeilijk maakt om een reikbeweging te onderdrukken. Deze bevinding suggereert dat het extra moeilijk kan zijn om een beweging in de richting van voedsel te beheersen zodra deze ingezet is. Indien, zoals wordt gesuggereerd door de bevindingen, zuiver en alleen de visuele blootstelling aan bereikbaar voedsel deze activatie veroorzaakt, dan kan dit deels (op het niveau van visuele en motorische verwerking) verklaren waarom consumenten zoveel moeite hebben met het weerstaan van ongezond voedsel in de omgeving.

Terwijl deze invloed van de omgeving op eetgedrag bovenal negatieve gevolgen heeft voor de consument, bestaat er ook een populaire benadering, 'nudging' genaamd, die juist de invloed van de omgeving gebruikt om keuzes en gedragingen dusdanig te stimuleren dat het de consument ten goede komt. Nudgingstrategieën hebben betrekking op de inrichting van de omgeving op dusdanige manier dat gunstige keuzes en gedragingen prominenter, makkelijker, meer vooraanstaand, of aantrekkelijker worden, terwijl gelijktijdig geen enkele van de minder gunstige keuzes uitgesloten wordt. Beleidsmakers zijn uitermate geïnteresseerd om nudges te gebruiken en deze toe te voegen aan hun repertoire om beleid te maken, maar tegelijkertijd zijn ze terughoudend. Deze terughoudendheid is vooral gebaseerd op het feit dat er niet veel onderzoek is naar de effectiviteit van nudgingstrategieën, hun randvoorwaarden en hun impact op gedrag op de lange termijn. Daarnaast zijn critici bezorgd over de autonomie van de consument, omdat nudges worden ontworpen door een externe entiteit die beslist over welke gedragingen en keuzes gestimuleerd worden en omdat de invloed van nudges op de consument vaak optreedt zonder dat de consument zich daarvan bewust is. Om die reden richtte het tweede deel van dit proefschrift zich op onderzoek naar zowel de effectiviteit van nudgingstrategieën op het stimuleren van de consumptie van gezond voedsel als de opvattingen van de consumenten en hun zorgen over nudgingstrategieën in het domein van gezondheidsgedrag.

De resultaten lieten positieve effecten zien wanneer een gezonde voedselkeuze (appelschijfjes) werd toegevoegd aan een voor kinderen bestemde Happy Meal bij McDonalds. Ook werd aangetoond dat het aanbieden van een subtiele cue om kenmerken te onthouden die consumenten over het algemeen belangrijk vinden met betrekking tot hun voedselkeuzes, zoals bijvoorbeeld de natuurlijkheid van

ingrediënten, resulteerde in meer aandacht voor de ingrediënt-gerelateerde informatie op voedselproducten. Dus, nudges die gezonde consumptie stimuleren en consumenten bij hun voedselkeuzes aan hun voorkeuren helpen herinneren kunnen een succesvolle bijdrage leveren aan het welzijn van de consument. De consument zelf is ook grotendeels voorstander van nudgingstrategieën die een stimulans vormen voor gezond gedrag, maar wel onder voorwaarde dat de bron die ten grondslag ligt aan de nudgingstrategie handelt in het belang van de consument. Gebaseerd op rapportages van consumenten in de VS en zeven Europese landen kan bovendien geconcludeerd worden dat consumenten nudges beter waarderen wanneer de nudges als minder ingrijpend worden beschouwd en wanneer ze worden ontworpen door deskundigen uit het betreffende gedragsmatige domein, omdat de consument deze deskundigen het meest vertrouwt.

Het onderzoek in dit proefschrift heeft implicaties op zowel theoretisch als praktisch niveau. Op theoretisch niveau bieden de bevindingen aanvullend bewijs voor 'belichaamde cognitie' theorieën die een sterke invloed veronderstellen van het lichaam en de omgeving op cognitie. Aangetoond werd dat het waarnemen van voedsel in de omgeving automatisch het motorische systeem activeert dat betrokken is bij het interageren met objecten, met denkbare consequenties voor de mogelijkheid om bewegingen te onderdrukken wanneer ze eenmaal geactiveerd zijn. Vanwege deze omgevingsinvloed op cognitie en het daarop volgende gedrag, zouden nudgingstrategieën onderzocht dienen te worden binnen het 'belichaamd cognitie' perspectief, om zo ons begrip te vergroten over hoe keuzeontwerpen gedrag beïnvloeden en onder welke voorwaarden.

Op praktisch niveau suggereert het onderzoek dat visuele blootstelling aan voedsel, en de daaruit voortvloeiende activatie van motorische interacties die betrokken zijn bij het reiken naar en eten van voedsel, kan bijdragen aan de moeite die het consumenten kost om voedselverleidingen in de omgeving te weerstaan. Consumenten lijken bijzonder kwetsbaar te zijn en vaak weinig weerstand te kunnen bieden in situaties waar voedsel makkelijk toegankelijk is, zoals bij buffetten, cafetaria's en borrels. Aangezien de motorische activatie optreedt op een basaal en fundamenteel verwerkingsniveau dat voorafgaat aan de bewuste inachtneming van doelen, is het niet zo verrassend dat consumenten ongezond voedsel consumeren terwijl ze eigenlijk gezond willen eten. Op basis van de bevindingen gerapporteerd in dit proefschrift kan worden gesteld dat het stimuleren van gezond eetgedrag beter bereikt kan worden door omgevingen dusdanig in te richten dat gezonde consumptie wordt gestimuleerd in plaats van slechts te vertrouwen op zelfbeheersing van consumenten. Dit kan bereikt worden middels nudgingstrategieën. Gezien de grootschalige steun van consumenten voor nudging van gezond gedrag zouden beleidsmakers de toepassing van deze strategieën moeten overwegen in hun beleid gericht op het ontwerpen van omgevingen, aangezien hierdoor gunstige keuzes en gedragingen gestimuleerd worden zonder dat er een beroep wordt gedaan op bewuste en inspannende poging van de consument om zich gezond te gedragen.

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It should be noted that the conceptualization of the past years of *me* working on a PhD project is actually quite misleading. *I* came in a team, a team of the two non-Dutchies or the two Concorties. *We* entered the department and Concort together; *we* shared H1.52, our projects, highlights, and frustrations; and *we* travelled through Europe from Concort meeting to summer schools and endless conferences. I remember goggling the girl that was meant to share the experience in Utrecht with me four years ago. Never could have guessed you'd play the role of my partner in crime, my friend more than colleague, the international allegiance within the Stitch, and my daily reason for looking forward the office. Thank you, Tracy, for keeping up with me, my bipolar shifts from excitement to ranting, for being my companion, and despite all these traits (or states?) for never judging.

Despite the large contribution of Denise, Catharine, and Tracy, the experience of working in the selfregulation lab would not be the same without the other Stitchies. Floor, Marleen, Marieke, Sanne, David, Jeroen, Tina, Sosja, Lot, Laurens, Popi, and Anouk: You are the ones that make the team unique. Thanks to all of you, and the past Stitch members, for all the shared meetings, lunches, coffees, and conferences, for all the feedback and brainstorming sessions, but most importantly for creating an environment in which working is so much fun. I continue to be impressed by the

supportiveness and friendliness of this group (especially considering the disproportionate number of females).

Throughout these acknowledgments the name *Concort* has already been mentioned a number of times. Undoubtedly, this Marie Curie network played a major role in shaping the PhD project. The endless opportunities to meet and work with accomplished scholars, the network of supportive and engaged researchers never tiring of providing feedback to presentations and experiments during long bi-annual meetings (Yes, these are thanks to Siegfried, Simona, Andrea, Enrico, Efthy, Martin, and Luc for their criticism, insights, and support), and of course the ESRs. We have done this before in Fontainebleau, but Peter, thank you for your never-ending drive; Nina, for your persistence in light of difficulties; Zeynep, Olga, Michelle, and Justin for integrating me into Leuven; Dion, for the positive approach to life; Ning for your sweetness; Jeeva, for keeping up with my mathematical inabilities; Cara, for bringing the luxury to our meetings; Sam, for keeping me up to date regarding the ethics of nudging; and, last but not least, Popi, for all that dancing!

Even though it was Concort that provided access to many accomplished scholars, their own openness to let me join their teams and work with me was just as important to shaping the project. Without their perspectives on the topic and insights into different methods the thesis would have been much more limited and the project much less exciting. These special thanks thus go to Siegfried for inviting me to Leuven, to Liesbeth for introducing me to primate research, to Ignace for all the eye-tracking, and to Brian and the Food and Brand Lab for thinking big.

It should not be forgotten that some of the contributions to this work started way beyond the official project onset. Mama, Dein Beitrag begann schon zu Schulzeiten als Du mich, trotz meiner angeblichen Unfähigkeit zu abstraktem Denken, zum Einhard geschickt hast. Deine bedingungslose Unterstützung hat sich auch nicht geändert also es darum ging nach Holland (!) zu ziehen um mich der (Ernährungs)-psychologie zu widmen. Auch wenn Du nicht genau nachvollziehen kannst “wo ich das her habe“, finde ich schon, dass ich damit in die Fußstapfen der Diät Nanny trete. Damit geben wir dem Sprichwort „Der Apfel fällt nicht weit vom Stamm“ eine ganz eigene, ernährungswissenschaftliche Konnotation.

Zu guter Letzt möchte ich diese Arbeit meinem Opa Lothar widmen, dem ich die Möglichkeit verdanke all die Erfahrungen machen zu dürfen, die mir erfahrenswert erscheinen. Ich hoffe du wärst stolz und froh zu sehen, dass ich immer noch *monkey* spiele.

Astrid Junghans was born on January 14th 1985 in Aachen, Germany. After obtaining her Abitur from Einhard Gymnasium Aachen, she started her academic studies in Communication Science and Psychology at RwtH Aachen. After an initial exchange semester she decided to fully transfer to Jacobs University Bremen to complete her Bachelor degree in Integrated Social and Cognitive Psychology, which was awarded in 2009. To continue her studies in Psychology, she subsequently proceeded to the London School of Economics where she obtained her first class degree in Social and Cultural Psychology in 2010 (MSc).

Knowing she wanted to pursue a career in academia Astrid explored various sub-disciplines in psychology during an internship at the Max-Planck Institute for Evolutionary Anthropology with Prof. Michael Tomasello and during a post-graduate certification in Forensic Psychology and Clinical Investigation from the University of Liverpool.

In 2012 Astrid joined the Consumer Competence Research Training Network (ConCoRT) funded by the Marie Curie Framework Programme as a PhD candidate at the Self-regulation Lab of Utrecht University. Under the supervision of Prof. Denise De Ridder and Catharine Evers she set out to investigate environmental influences on health and eating behavior. During her time within the ConCoRT network she was a visiting scholar to the Department of Marketing at KU Leuven, Belgium, where she collaborated with Prof. Siegfried De Witte and to the Cornell Food and Brand Lab where she worked with Prof. Brian Wansink. Moreover, she collaborated with the Biomedical Primate Research Center (BPRC) in Rijswijk where she conducted studies with Prof. Liesbeth Sterck.

International Publications

Junghans, A. F., Marchiori, D. R., Cremers, J., Evers, C., & De Ridder, D. T. D. (submitted). The Who and How of Nudging: Cross-national Perspectives on Consumer Approval in Eating Behavior.

Junghans, A. F., Stok, F. M., Evers, C., De Ridder, D. T. D., & Renner, B. (Under Review). Highlights in the Dark: How the Ability to Maneuver Influences Consumption in the Dark.

Junghans, A. F. & Wansink, B. (submitted). Translating Child Eating Behavior into Happier, Healthier Fast Food Meals.

Junghans, A. F. & Wansink, B. (submitted). Heavy Baristas, Heavy Orders: Starbucks Customers Order More Calories from Overweight Baristas.

Junghans, A. F., Sterck, E. H. M., Overduin-de Vries, A. M., Evers, C., & De Ridder, D. T. D. (2015). Defying Food – How Distance Determines Monkeys' Ability to Inhibit Reaching for Food. *Frontiers in Psychology*, *7*, 158.

Cheung, T.*, **Junghans, A. F.** *, Dijksterhuis, G. B., Kroese, F., Johannson, P., Hall, L., & De Ridder, D. T.D. (2015). Consumers' Choice-Blindness to Ingredient Information. (* First authors). *Appetite.*

Junghans, A. F.*, Cheung, T.*, & De Ridder, D. T. D. (2015). Under consumers' scrutiny – An Investigation Into Consumers' Attitudes and Concerns About Nudging in the Realm of Health Behavior. *BMC Public Health, 15*, 336.

Junghans, A. F., Hooge, I. T., Maas, J., Evers, C., & De Ridder, D. T.D. (2015). UnAdulterated – Children's and Adults' Visual Attention to Healthy and Unhealthy Food. *Eating Behaviors, 17,* 90-93.

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Junghans, A. F., Evers, C., & De Ridder, D. T. D. (2013). Eat Me If You Can: Cognitive Mechanisms Underlying the Distance Effect. *Plos One, 8*(12).

Conference presentations

Junghans, A. F. & Wansink, B. (January, 2016). Extra Whip, please! Effects of Barista weight on orders and calorie consumption at Starbucks. Paper presented at the Association for Researchers in Psychology and Health Annual Conference, Maastricht, The Netherlands.

Junghans, A. F. (September, 2015). *Future Food.* Presentation at the Leidse Nacht van Kunst en Kennis, Leiden, The Netherlands.

Junghans, A. F., Cheung, T., De Ridder, D. T. D. (September, 2015). *Do Consumers Look At Ingredient Information on Food Packaging? Using the Choice-Blindness Paradigm to Assess Consumers' Attention.* Paper presented at the Annual Conference of the European Health Psychology Association. Limassol, Cyprus.

Junghans, A. F. (May, 2015). In the eye of the consumer. Assessing consumer approval of nudging. Presentation at the European Marketing Association Conference, Leuven, Belgium.

Junghans, A. F., Cheung, T., De Ridder, D. T. D. (March, 2015). *Do Consumers Look At Ingredient Information on Food Packaging? Using the Choice-Blindness Paradigm to Assess Consumers' Attention.* Paper presented at the Conference for Consumer Behavior in A Changing World: Food, Culture, and Society. Naples, Italy.

Junghans, A. F., Cheung, T. (February, 2015). *Who Should Judge A Nudge? Conditions for consumer acceptance of nudging*. Paper presented at the Association for Researchers in Psychology and Health Annual Conference, Ghent, Belgium.

Junghans, A. F., Marchiori, D., Evers, C., De Ridder, D. T. D. (January, 2015). *Predictors of Nudging Acceptance.* Presentation at the Consumer Competence Research Training Network Bi-Annual Conference. Amsterdam, The Netherlands.

Junghans, A. F., Cheung, T., & De Ridder, D.T. D. (October, 2014). *Who Should Judge A Nudge? Conditions for consumer acceptance of nudging*. Paper presented at the Nudging Masterclass, Utrecht, Netherlands.

Junghans, A. F., Sterck, L., Evers, C. & De Ridder, D. T. D. (September, 2014). *Monkey See, Monkey Reach? Measuring motoric inhibition upon exposure to accessible and inaccessible food temptations.* Presentation at the Consumer Competence Research Training Network Bi-Annual Conference, Berlin, Germany.

Junghans, A. F. & Cheung, T. (September, 2014). *Who Should Judge a Nudge? An Investigation Into Consumer's Attitudes and Concerns About Nudging in the Realm of Health Behavior.* Paper presented at the Consumer Competence Research Training Network Bi-Annual Conference, Berlin, Germany.

Junghans, A. F., Hooge, I., Maas, J., Evers, C., & De Ridder D. T. D. (August, 2014). *UnAdulterated: Children's and Adults' Visual Attention to Healthy and Unhealthy Food*. Paper presented at the European Health Psychology Society Conference, Innsbruck, Austria.

Junghans, A. F. (2014, March). *Healthy and Unhealthy Food Exposure*. Presentation at the Consumer Competence Research Training Network Bi-Annual Conference, Utrecht, Netherlands.

Junghans, A. F., Maas, J., De Ridder, D. T. D., De Vet, E., Hooge, I. (2013, November). *The Influence of Distancing from Food. Results from eye-tracking and experimental research.* Presentation at the Kurt Lewin Institute Social Cognition Annual Meeting, Groningen, The Netherlands.

Junghans, A. F., Evers, C., & De Ridder, D. T. D. (2013, November). *The Effect of Accessibility: Influences of distance and packaging on Eating Information Activation.* Presentation at the Helmholtz Research Institute PhD Day 2013. Universiteit Utrecht, The Netherlands.

Junghans, A. F., Evers, C., & De Ridder, D. T. D. (2013, September). *The Influence of Food: Potential Mechanisms Underlying the Distance Effect in Food Consumption.* Presentation at the Consumer Competence Research Training Network Bi-Annual Conference, Leuven, Belgium.

Junghans, A. F., Evers, C., & De Ridder, D. T. D. (2013, July). *Eat me if you can: How Reachable Food Activates Eating Affordances.* Paper presented at the annual European Health Psychology Society, Bordeaux, France.

Junghans, A. F., Evers, C., & De Ridder, D. T. D. (2013, March). *Eat me if you can: The influence of distance to food on eating behavior*. Paper presented at the Kurt Lewin Institute Social Cognition workshop, Utrecht, The Netherlands.

Junghans, A. F., Evers, C., & De Ridder, D. T. D. (2013, February). *Concort Update: Progress, Results, and Outlook.* Presentation at the Consumer Competence Research Training Network Bi-annual Conference, Eindhoven, The Netherlands.