Nudging and Attitude: Exploring Nudges in an Online Food Choice Environment

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201600170

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June 25th, 2021

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Abstract

Introduction: Despite over a decade of nudging research, various questions regarding its effectiveness and underlying mechanisms remain unanswered. The aim of this study was to expand the growing pool of nudging research by (a) evaluating the impact of nudging on the healthiness of food choice and (b) post-choice satisfaction as well as (c) investigating the interaction between nudging and people's healthy food attitudes.

Methods: 231 European adults were randomly assigned to either a social reference, affordance, or control condition in a simplistic, randomized online grocery shopping task to assess their healthy food choice behaviour. Next, participants satisfaction and healthy food attitude was measured in form of self-reported questionnaires. The data was subjected to two separate 3 (nudge: control, social reference nudge, affordance nudge) x 3 (healthy food attitude: low, medium, high) ANOVAs for the outcome measures of food choice healthiness and food selection satisfaction.

Results: The employed nudges did not significantly impact participants food choice healthiness or food choice satisfaction. People with comparatively high scores on the measure of healthy food attitude decided more often for the healthier alternative than people in the low (p = .01) and medium (p = .03). Also, people with low healthy food attitudes were more satisfied than participants in the medium condition (p = .04). There was no interaction between nudging and healthy food attitude for either outcome measure.

Conclusion: The findings of this study support the relevance of the personal factor of healthy food attitude for participants food choice behaviour. Various reasons for the lack of nudging effects, such as a biased choice set, or a too simplistic online environment are discussed. No conclusions can be drawn regarding the interaction of nudging and healthy food attitude since the nudges were ineffective. Future studies should further investigate both nudges in a realistic online grocery shopping environment. Furthermore, participants food preferences should be considered when creating a choice set to avoid bias.

Key words: nudging, food choice, health behaviour, social reference, affordance, attitude, satisfaction preference, light food

Contents

Most people nowadays live in countries where the consequences of overweight lead to more deaths than underweight (Dobbs et al., 2014; World Health Organization, 2020). In 2014 overweight and obesity were the number one causes of global preventable, yet lethal diseases (World Health Organization, 2020), such as cardiovascular diseases (Eurostat, 2020). According to estimates of the World Health Organization, more than half of the European adults are overweight and 25.3% are obese (World Health Organization, 2017a, 2017b, 2019). The current situation is critical to a point that it has been labelled 'obesity epidemic' (Dobbs et al., 2014; Kopelman, 2000; Swinburn, Sacks, Hall, McPherson, et al., 2011). Obviously, there is a high demand for effective interventions with long-lasting effects to fight unhealthy body states (Chen & Antonelli, 2020; Haddad & Hawkes, 2016).

The root of excessive bodyweight is a continuous imbalance of an individual's energy intake and exertion as a result of unhealthy lifestyle behaviours (WHO, 2020; Papas et al., 2007), such as unhealthy diets. Healthy diets are usually 'high in fruit, vegetables, legumes, nuts, and grains, but lower in salt, free sugars, and fats, particularly saturated and trans fats' (World Health Organization, 2020b). Unhealthy diets, on the other hand, are associated with foods 'high in sugars, saturated and trans fats, low fibre foods and high-sugar drinks' (de Ridder et al., 2017; Willett, 1994; Wirt & Collins, 2009; World Heart Federation, 2000). A person's diets and energy intake are determined their daily food choices, hence the process of selecting one or multiple food product(s) from a pool of different options. Food choice changes towards weight reduction can either constitute a reduced selection of unhealthy items or a facilitated selection of healthy choices.

This study contributes to the intervention on overweight and obesity by investigating the interventional approach of nudging with respect to the problem of unhealthy food choices in the adult European population. Therefore, it specifically deals with an individual's choice between more and less healthy foods, its relation to their explicit attitude towards healthy foods and the extent to which small changes in the environment can be utilized to increase healthy food choices.

Food Choice

When selecting an item, people go through a decision-making process that can be more or less conscious and that involves past experiences, needs, sentiments and values (Franchi, 2012). The processes underlying food choice is highly complex. In fact, there are multiple books and theories from different scientific fields dedicated to the topic of food choices specifically (e.g. Shepherd & Raats, 2006, MacDie & Meiselman, 1996; Marshal, 1995). In their recent review, Chen & Antonelli (2020) found 59 publications that proposed a conceptual model of food choice. Based on their review the authors

proposed three main categories of food choice determinants: food-related features (including both food-internal and -external factors such as palatability or other sensory features and the social and physical environment), individual differences (as in biological features, habits and attitudes of a person) and socio-cultural factors (Chen & Antonelli, 2020).

Amongst other theories, such as the food choice process model (Furst et al., 1996) or the Random Utility Model (Baltas & Doyle, 2001; Hanemann, 1984), the Theory of Planned Behaviour is one of the most popular and frequently employed frameworks for modelling food choice behaviour (Ajzen, 1991; Gorton & Barjolle, 2013; McDermott et al., 2015). The theory describes an individual's intention as the most proximal predictor of behaviour. Between the intention to avoid unhealthy or approach healthy foods, the latter has been indicated to have a stronger association with actual food choice behaviour (McDermott et al., 2015). Intentions are determined by the three concepts attitude, subjective norm, and perceived behavioural control.

Attitude

Out of the three, attitude has been shown to be the factor with the strongest predictive value for food choice behaviour (Gorton & Barjolle, 2013; McDermott et al., 2015; Nardi et al., 2019). In line with Eagly and Chaiken (1996), the definition of healthy food attitude in this study is an individual's "psychological tendency [towards the health aspects of foods] that is expressed by evaluating [food items] with some degree of favour or disfavour" (p.598). Peoples food and diet-related attitudes correlate with their dietary intake, diet quality and food choices (Aggarwal et al., 2014; Demarque, et al., 2015; Roininen & Tuorila, 1999; Scheibehenne et al., 2007; Zandstra et al., 2001). In fact, participants with a positive attitude towards healthy aspects of food have been indicated to be five times more likely to adhere to healthier dietary patterns and food choices than to less healthy diets (Kowalkowska et al., 2018). Negative attitudes towards healthy food on the other hand have been associated with less healthy dietary patterns (Kowalkowska et al., 2018; Roininen et al., 2001). Although food and diet-related attitudes are not the sole predictor of food choice behaviour, they give an indication of an individual's common behaviour.

Attitudes can be either implicit or explicit. While explicit attitudes are suggested to be particularly relevant for conscious decision making and deliberate action, implicit attitudes are more relevant in spontaneous and involuntary behaviour and complex or taxing situations (Deutsch & Strack, 2006; Friese et al., 2006; Perugini, 2005; Wilson et al., 2000). Whereas people are typically aware of their explicit attitudes, they might be unaware of their implicit ones (Friese et al., 2006). The two

attitude forms are said to co-exists, yet sometimes contradict each other (Marteau et al., 2012; Perugini, 2005; Vecchio & Cavallo, 2019). For instance, a dieting person might report an explicit negative attitude towards high fat and sugary food items sweets, but might hold an intrinsic positive attitude towards such items due to the pivotal human preference for hedonic and palatable food sensations (Breslin, 2013; Drewnowski & Almiron-Roig, 2010). Extremely positive or negative attitudes are more likely to guide behaviour than in situations of conflicting attitudes (Gorton & Barjolle, 2013).

Obesogenic Environments

Next to personal factors, the environment has a relevant influence on food choice behaviour (Hollands et al., 2013; Nestle et al., 1998; Papas et al., 2007; Stuart, 1967, 1971), as it determines the type, availability, and accessibility of food items (Morland & Evenson, 2009). Contemporary food choice environments, such as supermarkets, have been identified to be obesogenic (Allan et al., 2016; Marteau et al., 2012; Vecchio & Cavallo, 2019), as they facilitate unhealthy weight gain and maintenance through the promotion and efficient distribution of cheap, palatable and energy-dense foods (Swinburn, Sacks, Hall, Mcpherson, et al., 2011). For example, supermarkets often strategically place small candy items at the checkout counter to initiate a last minute purchase while consumers are waiting in line to pay (Reisch et al., 2017). By consciously shaping the influence of the consumer environment to make the selection of healthy over unhealthy food items effortless, it might be possible to initiate beneficial daily food choices and contribute to the move on overweight and obesity.

Nudging

About a decade ago, nudging was introduced as an interventional approach to shape people's environment and consequently influence their behaviour. Originally, the term was described as a way of altering "people's behaviour in a predictable way without forbidding any options or significantly changing their economic incentives" (Thaler & Sunstein, 2008, p. 6) or in short liberal paternalism. Nudges should require only low effort and cost of the target group and need to be positive, voluntary, avoidable, and transparent (French, 2011; Sunstein, 2014). Designed choice environments which are hard to avoid, mandatory, or force a form of economic, social or timely strain on the consumer do not count as nudges (Allan et al., 2016; Marchiori et al., 2017; Sunstein, 2014; Vos, 2015), but rather manipulation and trickery.

Economists have argued that humans are 'homo oeconomicus' (Hansen & Jespersen, 2013; Beck, 2014), a profit focused and logically thinking being. Nevertheless, this does not seem to hold up in

reality (Kelly & Barker, 2016). In fact, consumers seem to make most of their food choices unconsciously, based on heuristics or rules of thumb, biased by environmental influences, and focused on maximizing short-term pleasure over long-term health gains (Dijksterhuis et al., 2005; Hofmann et al., 2009; Marteau et al., 2011, 2012; Swinburn, Sacks, Hall, McPherson, et al., 2011; Vlaev et al., 2016). This claim is underlined by the fact that most people intend to follow a healthy diet (de Ridder et al., 2014), yet often fail to implement their intentions in everyday life (de Ridder et al., 2017).

In light of the prevailing obesity crisis and obesogenic environments, healthy lifestyle nudges are presented as an opportunity to redesign environments so that they facilitate healthy over unhealthy behaviour (Van Kleef et al., 2012; Wilson et al., 2016). Nudges are considered to help consumers to heuristically make the choices they want to or at least the ones that benefit their health (Allan et al., 2016; de Ridder et al., 2016; Vallgårda, 2012). This is especially true in highly taxing situations with plenty choice options such as supermarkets (Just & Gabrielyan, 2018; König et al., 2016; Wansink et al., 2009).

Nudging is an umbrella term for a conglomerate of environmental interventions (Marchiori et al., 2017; van Kleef et al., 2018) rather than a step-by-step interventional approach. Common examples of nudging in the food choice sector are the provision of information through nutrition labels, changes of the physical environment regarding a products placements or salience, or the use of social norms to indicate popular food items (Allan et al., 2016; Bauer & Reisch, 2019; Ledderer et al., 2020). The effectiveness of nudging interventions varies with regard to the utilized context (e.g. food choice, physical activity, organ donations), environment (e.g. online or real-life) and nudging type (Cadario & Chandon, 2019; de Ridder, 2020; Hummel & Maedche, 2019; Vecchio & Cavallo, 2019). Consequently, there is a need to differentiate across these axes.

Social Reference Nudge

One of the most commonly utilized nudges are social reference nudges (Hummel & Maedche, 2019). The nudge typically gives people an indication of a choice consensus (Aldrovandi et al., 2015; Cheung et al., 2019; Salmon et al., 2015) or of what the public approves or disapproves. A prime application of social reference nudges is the comment section and star ratings on common online retailer websites (Courtney, 2021). In a real-life environment visual cues such as a ‘people’s choice’ label can be placed to make it seem like people chose a healthier food item to increase the frequency and likelihood of healthy choices (Prinsen et al., 2013). Salmon et al. (2015), for example, showed that

indicating a low-fat over a high-fat cheese as the 'best-selling' option in a supermarket environment increased the purchases of the low-fat alternative.

The underlying idea of social reference nudges is that people generally trust that choices which are frequently made by others are less likely to turn out wrong or might have a higher hedonic benefit for themselves, for example in terms of health or enjoyment (Rimal et al., 2007). Consequently, they are expected to orientate their behaviour according to the normative influences of a group, tend to conform to the popular behaviour, or at least deduct the appropriate behaviour in a specific context from their social environment (Bicchieri & Dimant, 2019; Higgs, 2015; Robinson et al., 2014; Salmon et al., 2014).

Social reference nudges are most commonly utilized in an environmental context (Hummel & Maedche, 2019), but have been proven to be effective in multiple scenarios such as the facilitation of green (Demarque et al., 2015) and healthy product choices (Templeton et al., 2016), healthy diets, energy conservation (Allcott et al., 2015; Yun & Silk, 2011) or even charity donation (Bartke et al., 2017). For a comprehensive overview of social reference nudging studies on food choice see Robinson et al. (2014).

Affordance Nudge

Recently, a new perspective on nudging has been proposed in combination with the notion of affordances (Blom et al., 2021). The general idea of affordance is that the physical features of an object and peoples inherent associations with it represent opportunities for action (Gibson, 1986) and tell people how to interact with it (Hsiao et al., 2012). As a result, people might feel subconsciously invited to sit down on a knee-high surface or seat. An example of affordance in the supermarket context, are the hip high displays of price-reduced snack products which invite people to grab an item while they are walking past it. The concept of affordances might be used to increase the efficacy of nudging by inviting people to interact with the desired rather than undesired option.

Solely one paper by the University of Utrecht deliberately focused on the connection of affordances and nudging to develop and investigated an affordance nudge (Blom et al., 2021). The researchers developed an animated figure to be displayed on a screen behind a vegetable shelf. A camera was attached to the screen, so that the figure could react when people approached and reached out to grab an item. As a reaction to consumers momentary behaviour, the figure had essentially three displays: (1) a default phase where the figure just looked ahead with a neutral facial expression, (2) the figure leaning and gazing at a desired food option as soon as a customer approached, and (3) a thumbs up and smile after people chose the desired option. The underlying notion was to heighten the

affordance and subsequent selection of a healthy food item by drawing people's attention through the displayed figure and cueing them to initially gaze towards the healthy food item. The researchers found an increase of 13% on people's weekly vegetable purchases in a real supermarket environment after accounting for price reductions (Blom et al., 2021). Obviously, there is a need to further investigate the effectiveness of the illustrated affordance nudge.

State of the Art

The same claim holds for nudging in general. While the majority of published nudging interventions show significant effects (Allan et al., 2016; Arno & Thomas, 2016), most were associated with modest effect sizes (de Ridder, 2020). Recent cross-context reviews indicated a moderate standardized nudging mean difference of 0.30 between nudged and control groups across a variety of desired outcome measures and contexts (Broers et al., 2017; Hummel & Maedche, 2019). A review specifically investigating the influence of nudging on adults food choices, found a smaller average mean difference of 15.3% of nudging on healthier dietary or nutritional choices (Arno & Thomas, 2016). Social reference nudges have been associated with an overall standardized mean effect size of 0.30 (Hummel & Maedche, 2019).

It has been claimed that there is a lack of high-quality evidence with regard to the effectiveness of nudging (Allan et al., 2016; Hollands et al., 2013). In fact, nudging research has been frequently criticized (Gigerenzer, 2015). For example, many studies do not apply power analyses, preregister their studies or refer to a theory (Skov et al., 2012; Szaszi et al., 2018). The definitions of nudge and non-nudge interventions often overlap (Bauer & Reisch, 2019), making it difficult to source for and generalize findings of nudging studies. Lastly, various reviews and meta-reviews (e.g. Arno & Thomas, 2016; Broers et al., 2017; Ingendahl et al., 2020a; Tørris & Mobekk, 2019) point out a disproportionately high number of significant nudging interventions, possibly indicating a publication bias in nudging research due to unpublished non-significant findings (Vecchio & Cavallo, 2019). Consequently, the reported effect sizes need to be considered with caution as they might be inflated.

Nudging is not merely a concept anymore but has found its way into the public sphere and political decision-making process (Benartzi et al., 2017; Halpern & Sanders, 2016; Hummel & Maedche, 2019). It is also widely used in real-life environments such as supermarkets (Bucher et al., 2016; Marteau et al., 2011) and other food choice environments (Dobbs et al., 2014; Ledderer et al., 2020), to change various nutritional behaviors, such as the selection and consumption of fruits and vegetables or healthy

snack choice (Arno & Thomas, 2016; Broers et al., 2017; Bucher et al., 2016; Tørris & Mobekk, 2019; Wilson et al., 2016).

Despite over a decade of research, various questions in nudging remain unanswered. The research on nudging is an ongoing process (Cadario & Chandon, 2019) and there is a general need for further investigation (Arno & Thomas, 2016; Broers et al., 2017; Szaszi et al., 2018; Vecchio & Cavallo, 2019), especially regarding its underlying mechanisms (Szaszi et al., 2018). Other fruitful venues for future research might be the evaluation of nudges long-term consequences (e.g. with regard to compensatory behaviour) on people's behaviour, the extensive evaluation of the effect of generic nudging interventions (Bucher et al., 2016; de Ridder et al., 2016; Kallehave et al., 2011; Marchiori et al., 2017; van Kleef et al., 2018) or digital nudges (Mirsch et al., 2017). Also, the question to whom nudges are effective needs to be explored (Arno & Thomas, 2016; Cadario & Chandon, 2019; Ingendahl et al., 2020; Sunstein, 2017; Szaszi et al., 2018; Vecchio & Cavallo, 2019; Venema, 2019).

In summary, the obesity pandemic underlines the need for effective interventions to create a public shift towards healthier food-related lifestyles. An individual's food choices are a relevant problem behaviour, which is partly determined by their attitude and affected by their environment. Nudging, as a part of holistic and interdisciplinary interventions, has been indicated to facilitate behaviour change and maintenance towards healthy diets. However, there is a need to further investigate nudging interventions. This study contributes to the current pool of research in multiple ways.

Current research

Nudging and healthy food choice

First, this study focuses on the influence of the affordance and social reference nudges on supermarket-item food choices in an online environment. This setup offers the benefit of investigating each nudge in detail, while also giving an indication whether the novel affordance nudge is more effective than traditional nudging approaches. The respective questions are:

1. *Does the social reference nudge lead to healthier food choices in an online-retailer environment?*
2. *Does the affordance nudge lead to healthier food choices in an online-retailer environment?*

While both nudges are expected to have a beneficial effect in comparison to a non-nudged condition, it is proposed that the social reference nudge will have a larger effect on the healthiness of

food choice than the affordance nudge. This expectation is based on the notion that the social reference nudge is well established in contrast to affordance nudging.

Nudging and food selection satisfaction

Second, nudges and attitudes are explored regarding food selection satisfaction. The focus is on investigating whether nudges influence how content people are with their choice. The outcome measure has been recommended for nudging research to evaluate whether nudges have an impact on participants shopping experience (Cadario & Chandon, 2019), as a person's satisfaction may be a predictor of repeated future behaviour (Wirtz et al., 2003). The findings might be used to argue for commercial implementation of nudges. The respective research questions are:

3. *Does nudging lead to different levels of food selection satisfaction in an online-retailer environment in comparison to a control group?*

Only two studies investigated participants satisfaction with their choice after being nudged (van Gestel et al., 2020a, 2020b). In the laboratory study of van Gestel et al. (2020a) the utilized proximity nudge, hence placing a desired item physically closer to a person than undesired options, did not significantly impact participants satisfaction with their choice of one out of multiple chocolates. The second study reported that the employed default nudge increased participant satisfaction with their choice of environmentally friendly items (Gestel et al., 2020b). To the authors knowledge, there is no article investigating participants satisfaction as an outcome measures in the context of social reference and affordance nudges on healthy food choices. Considering that nudges are said to be highly dependent on context and nudge (Cadario & Chandon, 2019; Johnson et al., 2012; Vecchio & Cavallo, 2019), it is difficult to make assumptions regarding the outcome.

Nudging and Attitude

Third, this study explores for whom nudges are effective. Measures of attitudinal valence have been indicated to be a valid means of identifying different consumer segments (Contento et al., 1988). Providing insights on whether the effectiveness of nudging differs for people with a positive, neutral, or negative attitude towards healthy food, could help intervention designers to target future interventions and heighten their effectiveness (Arno & Thomas, 2016; Szaszi et al., 2018; Vecchio & Cavallo, 2019). The respective research question is:

4. *Does the effect of nudging on the healthiness of participants food choice differ for people with varying healthy food attitudes?*
5. *Does the effect of nudging on participants selection satisfaction choice differ for people with varying healthy food attitudes?*

The questions of whether nudging effectiveness varies for people with different attitudes towards healthy food posed above have not been investigated in previous research. However, it has been found that the effectiveness of nudging interventions is limited by peoples preferences (Venema et al., 2019). Hence, it might be that nudging is most effective for people with mixed attitudes towards healthy foods and nutrition, as opposed to people with a strong positive or negative valence.

Methods

Design

To answer the research questions an online experiment with a food choice task and several questionnaires was constructed and conducted via the Gorilla Experiment Builder (www.gorilla.sc), a cloud-based research platform (Anwyl-Irvine et al., 2020). The study utilized a 3 (nudge condition: control, social reference nudge, and affordance nudge) x 3 (healthy food attitude: high, medium, low) between groups design to investigate the interaction of nudging and a person's healthy food attitude regarding their food choices behaviour. Food choice behaviour was investigated through the health of participants food choices as well as their satisfaction with their overall selection.

The study took place over the course of 26 days between the 2nd and 28th of April 2021. Participants were expected to take approximately 15 to 20 minutes to finish the questionnaire and could quit the study anytime without reason. The study was approved by the Ethics Committee of the Faculty of Social and Behavioural Sciences of Utrecht University (approval number: 21-0145).

Computation of Sample Size

Two a priori power analyses were conducted in G*Power 3.1 to determine the group sizes needed to investigate the main effect of nudging on food choice and the interaction effect of nudging and healthy food attitude. A review of 15 experimental social reference studies an average standardized

mean difference of .41 and -.39 was found for groups exposed to high and low intake norms respectively in comparison to a control group (Robinson et al., 2014). Only one study reported the effect size of the affordance nudge (Blom et al., 2021). Since the effect size of a single study is more prone to type 1 and 2 errors than a combination of multiple studies, the social reference nudges mean effect size of .40 was used to compute the necessary sample size.

The determined sample size for investigating the effect of nudging through a one-way ANOVA with 3 groups (nudging conditions) was $N = 234$, hence a group size of $n = 78$ for each condition. The interaction of nudging and healthy food attitude by means of a factorial ANOVA with 9 groups and a numerator *df* of 4 resulted in a total sample size of $N = 289$, hence a group size of $n = 32$ for each of the conditions.

Participants

Participants were approached through convenience sampling via social media with a pre-written invitation template (see Appendix A1) and via face-to-face interaction. The social media message was published in English as well as German and gave a quick overview of the study along with a link to the study-specific Gorilla website. Furthermore, people were asked to share the template on their social networks. There was no incentive for people to complete the study. Participants were required to be 18 or above and to have a basic understanding of the language since all questionnaires were only available in English. Furthermore, a phone, tablet, or computer was needed to be able to access the study.

In total, 410 people clicked on the provided hyperlink. After excluding those who did not consent to participate ($n = 25$), did not complete every questionnaire ($n = 142$), had technical difficulties ($n = 9$) or who, on average, took longer than 15 seconds to make a choice ($n = 3$), the final sample contained 231 people. The cut-off score was based on an outlier analysis, which showed that participants above an average of 15 seconds were 3 or more standard deviations away from the sample mean. These participants were deleted to reduce sample bias and because it was expected that they encountered problems such as technical issues, disruptions, or distractions.

Participants were predominantly German (72%; n=166) and female (80%; n=184). Participant's age ranged from 18 to 74 years ($M = 36.23$; $SD = 14.11$). A detailed summary of participant characteristics has been added in Table 1.

Table 1

Sample characteristics of included participants (n=231)

	Category	n	%
Age	18 to 29	112	49
	30 to 39	23	10
	40 to 49	33	14
	50 to 59	53	23
	60 to 69	6	3
	70 and above	3	1
Gender	Female	184	80
	Male	46	20
	Other	1	1
Nationality	German	166	72
	Dutch	22	10
	Austrian	9	4
	Swiss	6	3
	Other[a]	28	12
Diet	No special diet	146	63
	Vegetarian	50	22
	Vegan	17	7
	Other[b]	18	8
Occupation	Student	63	27
	Employed (full-time)	62	27
	Employed (part-time)	47	20
	Self-employed	20	9
	Unemployed	19	8
	Stay at Home Parent	9	4
	Retired	6	3
	Unable to work	3	1
	Other[c]	2	1
Education	Bachelor's degree	88	38
	Master's degree	81	35
	Secondary Education or High School	43	19
	PhD or higher	11	5
	Unsure regarding fit	4	2
	Other[d]	4	2
Living situation	Shared flat	62	27
	With Partner	50	22
	With Partner and Children	67	29
	Alone	39	17
	With Parents	7	3
	With Children	6	3

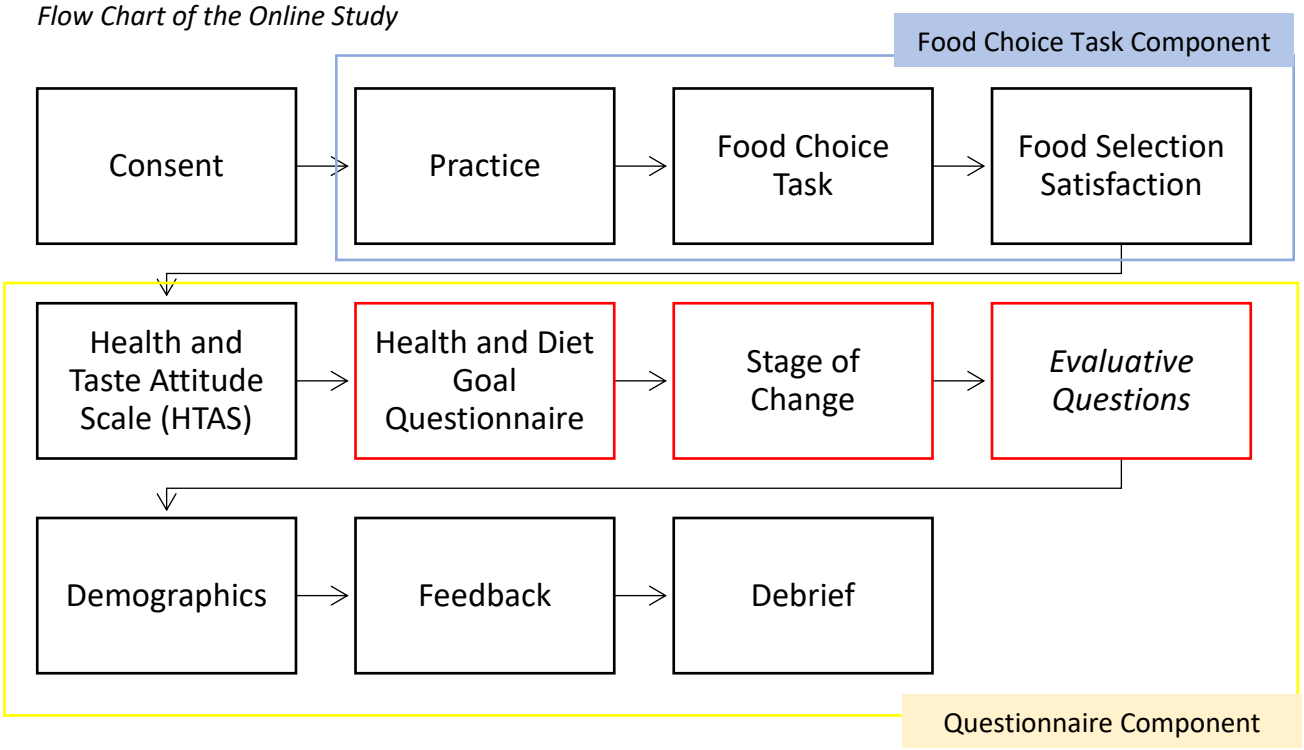
[a]Brazil, Great Britain, Canada, Finland, France, Hungary, Italy, Portugal, Romania, Scotland, Spain, Sweden, Turkey, or USA; [b]Flexitarian, Pescatarian, Dieting, or avoiding a certain nutritional component such as sugar or fat; [c]Unable to work, volunteer or on sabbatical leave; [d]Primary education, vocational training, or no formal education.

Procedure

This study had two overarching components: the food choice task and subsequent questionnaires (Figure 1). After signing the informed consent (Appendix A2), participants went through an instruction and practice block to avoid misunderstandings and confusions with the subsequent food choice task. Participants were asked to imagine "being in the process of doing [their] everyday groceries in a (online) supermarket of [their] choice". Next, participants went through a demonstration of how to choose between items in the task while being instructed to choose their preferred item out of the item pairs. It was pointed out that it would not be possible to change one's choice once the clicked on one of the items. Lastly, a disclaimer for vegans was added, asking them to pretend that the dairy-based products would be a vegan variation.

Figure 1

Flow Chart of the Online Study



Note. Red boxes indicate components which were not relevant for the further analysis.

Next, participants were subjected to the food choice task as the main component for analysing participants food choice behaviour. Participants were randomly sorted into three nudging conditions via a randomisation function in the Gorilla Experiment Builder. The randomization was not balanced,

meaning that for each participant the randomization was done individually with equal chance ratios for each condition, disregarding the previous sorting.

After the food choice task participants completed five questionnaires, assessing personal factors such as participants food selection satisfaction, health attitudes, health and diet goals, stage of change, and demographics. Additionally, some evaluative questions regarding the food choice task and nudges as well as questions to evaluate the study were posed. Participants in the affordance nudge condition were asked to fill in two extra questions, evaluating the affordance nudge specifically. It was not possible to skip questions with exception of the height and weight measurements as elaborated below. Only the measures of the food choice task, food selection satisfaction, health attitude, demographics, and feedback questions were relevant for the specific research questions of this study. Irrelevant measures are disregarded in the following.

After finishing all tasks and questionnaires, participants had the opportunity to read a debriefing text (see Appendix A3). The final dataset was stored at a server of the BMS faculty of the University of Twente.

Food Choice Task

The 'Food Choice Task' simulated a food choice situation by displaying 2 different food images and names in the lower third of the screen (see Figure 2). Each participant was assessed on three blocks containing five choice situations.

Figure 2

Example of the nudging conditions in the food choice task

(a) No Nudge Condition (b) Social Reference Condition (c) Affordance Nudge Condition

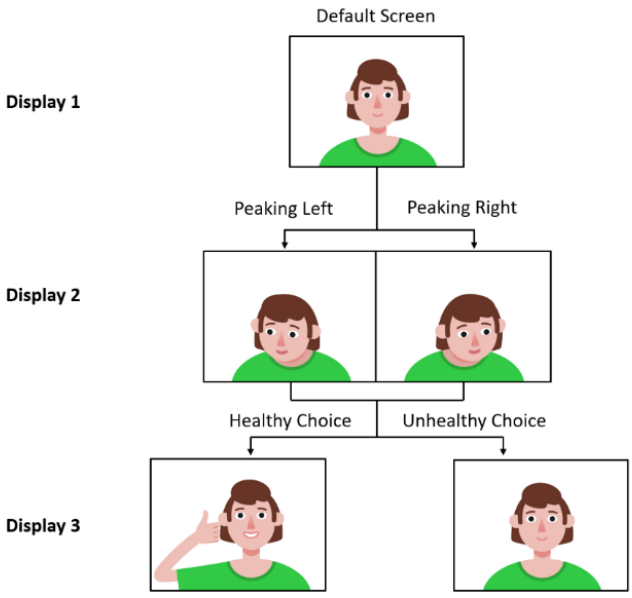
The food images, categories and nutritional profiles were retrieved from the online website of 'COOP', a renowned supermarket in the Netherlands. Each item was matched to have a similar appeal, for example a product and its light version, as well as varying degrees of healthiness. For the latter, food item pairs were classified into being healthier or less healthy.

Each food choice situation started with a fixation cross (750 milliseconds) followed by a choice screen with the food items. Participants selected one of the two items by clicking on it. After each food choice situation, a blank screen was displayed for 500 milliseconds.

A participant's experimental condition influenced the layout of the food choice situation (see Figure 2). In the social reference nudge condition, a 'peoples' choice' label was added to the healthier option of the presented pictures. Adding a sign or label indicating the popular choice is a common form of social reference nudging (Cheung et al., 2019; Cialdini, 2009; Lun et al., 2007; Salmon et al., 2015). The affordance nudge was displayed by adding an animated figure in the upper centre of the screen that gazed at and leaned towards the preferred food item (Figure 3). When participants selected the desired item, the figure transitioned into a thumbs-up gesture, otherwise it fell back into its default state. Both response video clips had a length of 4 seconds. The design of the nudge was drawn from Blom, Gillebaart, De Boer, & de Ridder (2021) and adapted to the online environment.

Figure 3

Flowchart of the subsequent displays in the affordance nudge conditions of the food choice task.



Each food item was scored on the nutritional profiling system of the British Food Standard Agency (FSA) for an objective differentiation into more and less healthy choices. The measure provided a single score ranges from -15 to 40, a higher score indicating a lower nutritional quality, for each food, based on the amount of energy (KJ), sugars (g), saturated fatty acids (g), sodium (g), percentage of fruits, vegetables, pulses, nuts, and rapeseed, walnut and olive oils (%), fibres (g) and proteins (g) per 100 gram (FPS Public, 2020; Julia & Hercberg, 2017). The nutritional profiles for each item in this study were drawn from the Coop online supermarket and the NEVO online-database of the National Institute for Public Health and the Environment (2019).

The FSA-score has frequently been indicated to be a highly reliable and validated approach for nutritional profiling (Azaïs-Braesco et al., 2006; Julia et al., 2014; Poon et al., 2018). Most recently, it has been recommended for use on food products by various European governments, such as France (Santé Publique France, 2021), Belgium (FPS Public Health, 2021), the Netherlands (Ministerie van Volksgezondheid, Welzijn en Sport, 2021) and Germany (Bundesministerium für Ernährung und Landwirtschaft, n.d.) in form of the front-of package labelling system 'NUTRI-score'. The NUTRI-score uses the FSA-score as a basis for a scale ranging from A to E (green to red) and is placed on a products package to provide consumers with the general healthiness of a food or drink. Comprehensive guidelines on the NUTRI-score computation can be found at FPS Public (2020).

The food choice task was divided in three blocks. In block A and B, all but one of the food item pairs differed at least one NUTRI-score from one another, indicating a clearly healthier and a clearly less healthy option. The differences in FSA-scores ranged from 2 to 13 with a mean FSA-score difference of 7.7. In block C, the food items did not differ in their degree of healthiness, indicated by a FSA-score difference of 1 or below. However, this block is omitted in further analysis.

The item order (left – right), sequence of displayed item category as well as order of Block A and B were randomized and counterbalanced through the Gorilla Experiment Builder. The utilized items, their respective FSA- and NUTRI-scores, as well as the specific food images are added in Appendix B.

Measures

All measures have been added in Appendix C.

Food Choice Task

Throughout the Food Choice task participants food choice time were recorded to control for temporal outliers and possible technical difficulties.

Healthiness of Food Choice. Participant's choice in each situation was recoded into a binary healthy choice variable (1 for healthier and 0 for less healthy items). The main outcome measure for an individual's tendency to choose healthier over less healthy food was their summed number of choices for healthier food items throughout the first two blocks. Participants scores could range from zero, indicating solely less healthy choices, to ten for only more healthy item choices

Food Selection Satisfaction. Directly after the food choice task, participants food selection satisfaction was assessed by asking 'How satisfied are you with the food items you have chosen?'. In line with a previous study by van Gestel, Adriaanse, and de Ridder (2020) the question was rated on an ordinal 7-point Likert scale, ranging from 'Not at all' to 'Very much' (1 to 7).

Questionnaires

Health and Taste Attitude Scale (HTAS) – Healthy Food Attitude. The Health and Taste Attitude Scale (Roininen et al., 1999; Roininen & Tuorila, 1999) consists of two different scales, focused on participants attitudes towards the health or taste related food attributes. For this study, only the health scale was relevant. As in this study ($\alpha = .76$), the measure has frequently been indicated to have an acceptable to good internal consistency ($\alpha = .74$ to $\alpha = .89$; Roininen et al., 1999, 2001; Saba et al., 2019). With over 500 citations on Semantic Scholar (n.d), the assessment seems to be widely used.

The Health-scale consists of 20, equally positively and negatively phrased statements, divided over three subscales. The focus of the analysis was on the General Health Interest subscale (8 items; e.g. "I am very particular about the healthiness of food.") as a global indicator of participants attitude towards healthy foods. However, since multiple light items were used in the food choice task, the light product interest subscale (6 items; e.g. "I believe that eating light products keeps one's body in good shape") was also considered in the exploratory component of the analysis. The Natural Product Interest subscale was irrelevant for this study. Both, the General health interest ($\alpha = .82$) and Light Product Interest ($\alpha = .83$) subscales were found to be reliable in this study.

The extent to which participants agree with each of the statements was measured on an ordinal 7-point Likert scale ranging from 'strongly disagree' to 'strongly agree'. A mean score for each subscale was computed. Following the example of other studies (Roininen et al., 1999; Roininen & Tuorila, 1999), the sample was divided into groups along the 33rd and 66th percentile of the HTAS subscale scores.

Hence for both subscales participants were sorted into a low, medium, or high group, indicating their score on the attitudinal measures (Table 2). In the following the label healthy food attitude is used for the General Health Interest subscale. and healthy food attitude are used interchangeably.

Table 2

Mean, standard deviation, lowest and highest scores as well as range of scores across the subscales of the Health and Taste Attitude Scale.

	Mean (SD)	Minimum	Maximum	Range
General Health Interest	37.15 (7.61)	12	54[a]	42
Low (n = 72)	28.46 (4.84)	12	33	21
Medium (n = 77)	37.06 (2.05)	34	40	6
High (n = 82)	44.87 (3.53)	41	54	13
Light Product Interest	17.15 (6.87)	6	36[b]	30
Low (n = 77)	9.69 (2.36)	6	13	7
Medium (n = 82)	17.04 (2.05)	14	20	6
High (n = 72)	25.25 (3.87)	21	36	15

[a]average item rating: 4.64 [b]average item rating: 2.14 [c]highest possible score: 56 [d]Highest possible score 42

Demographics. As already displayed in Table 1 participants were asked to indicate their age in years, gender, nationality, diet, education, occupation and living situation. Additionally, participants Body Mass Index was assessed through participants indications of their height and weight. However, the measure was dropped, since it was skipped by all participants, most likely because it was explicitly pointed out to them that they were not obliged to answer.

Feedback. In the final component participants were asked whether they had any additional comments or remarks about the study, particularly whether something went wrong, something was unclear or whether they had any points of improvement. Answers were given in written form through a text box below each of the questions.

Analysis

Data was downloaded in CSV format from The Gorilla Experiment Builder, cleaned and all variables and mean scores were computed as elaborated above in Microsoft Excel. IBM SPSS Statistics 27 was used for all further analyses.

Participant demographics were subjected to descriptive analyses. The qualitative answers to the feedback question were recoded into categories with the respective frequencies of reference. Additionally, participant's healthiness of food choice and food selection satisfaction were illustrated through descriptive statistics to characterize the sample behaviour in the food choice task. Cronbach's alpha tests were conducted to assess the reliability of the general HTAS scale as well as the General Health Interest and Light Product Interest subscales.

For the main analysis, a 3 x 3 independent ANOVA was conducted with the independent variables of nudging condition and health attitude on the outcome measure of healthy food choice to test for between-group differences regarding the main and interaction effect of nudging and healthy food attitude. The same ANOVA was repeated for the outcome measure of food choice satisfaction. Tukey HSD-corrected post-hoc tests were used to separately investigate the relationship of each nudge to the control group and one another.

Every statistical test was checked for violations of the respective assumptions if suitable (Appendix E). All outcome measures violated the assumption of normal distribution of outcome measures across independent variables as indicated by multiple significant Shapiro-Wilk tests ($p < .05$). Hence, all following one-way and factorial ANOVAs were bootstrapped with 1000 samples in further analyses.

In line with the golden standard of statistical testing (Cohen, 1988), the cut-off score of statistical significance was set at $\alpha = .05$. The effect size partial eta squared (η_p^2) was reported for all significant results, supported by the less commonly used, yet less biased omega squared (ω^2; Lakens, 2013). In line with Cohen (1988) and Field (2013) an effect size of .01 was interpreted as a small, .06 as medium and scores of .14 and above as large effect. The comprehensive analysis plan can be found in Appendix D.

Results

Food Choice Task

Healthiness of Food Choice

Generally, people decided more for unhealthy (56%) rather than healthy (44%) food items. In eight out of 10 food choice situations the unhealthy alternative was preferred over the healthy one. No participant chose only healthy or unhealthy items. An overview of the sample's choice behaviour across food choice situations is characterized in the Appendix B.

Nudging, Attitude and Healthy Food Choice

A 3 x 3 between-groups ANOVA was utilized and confirmed by bootstrapping to investigate the main effects of the independent variables nudging (no nudge, social reference nudge, affordance nudge) and general healthy food attitude (low, medium, high) as well as their interaction on the healthiness of food choice. The respective mean scores for each condition are added in Table 3.

Table 3

Means and standard deviations of the healthiness of food choice for the cells of the interaction of the nudging and Healthy Food Attitude group as well as their respective F-test statistics.

Nudging Condition[a,c]	Healthy Food Attitude[b,c]			
	Low (n = 72)	Medium (n = 77)	High (n = 82)	Total
	Mean (SD)	*Mean (SD)*	*Mean (SD)*	*Mean (SD)*
No nudge (n = 70)	4.04 (1.36)	4.28 (1.60)	4.97 (1.94)	4.49 (1.71)
Social Reference Nudge (n = 92)	4.04 (1.90)	3.86 (1.75)	4.72 (2.09)	4.18 (1.92)
Affordance Nudge (n = 69)	3.86 (1.40)	5.00 (1.90)	5.50 (2.00)	4.83 (1.89)
Total	3.99 (1.58)	4.31 (1.81)	5.04 (2.01)	

[a]Main Effect Nudging: (F(2,222) = 2.02, p = .14, η_p^2 = 0.02, ω^2 = 0.01). [b]Main Effect Healthy Food Attitude: (F(2,222) = 7.06, p = .001, η_p^2 = 0.06, ω^2 = 0.05). [c]Interaction Effect of Nudging and Healthy Food Attitude: (F(4,222) = 1.11, p = .35, η_p^2 = 0.00, ω^2 = 0.00)

There was no significant main effect of nudging or interaction effect of nudging and healthy food attitude on the healthiness of participants food choice. A Tukey HSD-corrected post-hoc test indicated that neither the social reference nudge (p = .55) nor the affordance nudge (p = .51) significantly differed from the control group or from one another (p = .07).

Participant's healthiness of food choice significantly differed across healthy food attitude groups at a small to medium effect size (Table 3). A Tukey HSD-corrected post-hoc test showed that participants with comparatively high scores on the General Health Interest subscale of the HTAS chose significantly more healthy food items in comparison to the medium (p = .03) and low (p = .01) groups. Hence, while there is evidence that participants acted according to their attitude towards healthy foods, the utilized nudges did not lead to healthier food choices in the sample. Also, the effect of the employed nudges on the healthiness of food choice was not moderated by participants attitude towards healthy food.

Nudging, Attitude, and Food Selection Satisfaction

On average, participants indicated a satisfaction with their food selection above the mid-point (M = 4.90, SD = 1.25). For the exploration of participants satisfaction with their choices, a 3 x 3 ANOVA was utilized and confirmed by bootstrapping to investigate the main effects of nudging and general healthy food attitude as well as their interaction on food selection satisfaction. The respective mean scores for each condition are added in Table 4.

Table 4

Means and standard deviations of food selection satisfaction for the cells of the interaction of the nudging and Healthy Food Attitude group as well as their respective F-test statistics.

Nudging Condition[a,c]	Healthy Food Attitude Group[b,c]			
	Low	Medium	High	Total
	Mean (SD)	*Mean (SD)*	*Mean (SD)*	*Mean (SD)*
No nudge	5.26 (0.96)	4.72 (1.23)	4.48 (1.48)	4.79 (1.30)
Social Reference Nudge	5.07 (1.10)	4.80 (1.23)	4.79 (1.32)	4.88 (1.21)
Affordance Nudge	5.38 (1.20)	4.58 (0.97)	5.21 (1.47)	5.04 (1.27)
Total	5.22 (1.08)	4.71 (1.15)	4.79 (1.44)	

[a] Main Effect Nudging: (F(2,228) = 0.75, p = .47, η_p^2 = 0.01, ω^2 = 0.00). [b] Main Effect Healthy Food Attitude: (F(2,222) = 3.73, p = .03, η_p^2 = 0.03, ω^2 = 0.02, [c] Interaction Effect Nudging and Healthy Food Attitude: (F(4,222) = 0.93, p = .35, η_p^2 = 0.02, ω^2 = 0.00)

There was no significant main effect of nudging and no significant interaction effect of nudging and healthy food attitude on participants food selection satisfaction. However, participants food selection satisfaction significantly differed across healthy food attitudes with a small to medium effect size. A Tukey HSD-corrected post-hoc test indicated that the 'Low' group (M = 5.22, SD = 1.08) had a significantly higher (p = .04) satisfaction score than the 'Medium' group (M = 4.71, SD = 1.15) as the only between-group difference. Consequently, nudging does not seem to influence people's level of post-choice satisfaction, while participants with a comparatively weak attitude towards healthy foods were most satisfied with their food choice in this study. Furthermore, the effect of the employed nudges on food selection satisfaction was not moderated by participants attitude towards healthy food.

Feedback

Turning to the qualitative analyses, participants general comments and remarks were explored. While most participants chose not to comment on the study (81.38%; n =188), some of the remarks need to be noted. First, two people correctly remarked that the exclusion criteria should be expanded to people with an eating disorder, since it might be harmful for them to participate, and it might influence the dataset. Furthermore, 9 participants mentioned that the displayed food options were mostly irrelevant to them, 5 reported the same for light products explicitly.

Discussion

Key Findings

This online experiment had three goals. First, to assess the effectiveness of the utilized social reference and affordance nudge regarding their ability to induce healthy food choice behaviour. Second, to explore the effect of nudging on participants food selection satisfaction and third to investigate whether the effectiveness of nudging might differ based on people's attitude towards healthy foods.

This study provides evidence that both, the social reference, and affordance nudges might not be effective in inducing healthier food choices for the specific food choice situation used in this study. As expected, participants healthy food attitude determines their healthy food choices, as the people in the high healthy food attitude group chose more healthy food items than people with medium or low interest, however at a small to medium effect size. The data does not support an interaction between nudging and a person's healthy food attitude on the outcome measures of food choice healthiness. However, it is not possible to sufficiently answer the question regarding an interaction of nudging and

attitude since the nudges themselves did not have an effect. The claims about a lack of interaction of nudging and healthy food attitude also hold true for the non-significant findings on the outcome measure of food selection satisfaction. People in the nudging groups did not report significantly different levels of satisfaction with their food selection, indicating that the employment of the social reference and affordance nudges did not lead to negative post-choice sentiment in the posed online environment. While this finding might be used to argue for an implementation of nudges, it needs to be viewed with caution since the employed nudges also did not significantly impact the healthiness of food choice behaviour.

Nudging and healthy food choice

This study contributes two non-significant nudging interventions to a scientific field in which most nudging interventions have been indicated to have a small to modest, yet significant effect on people's behaviour (Arno & Thomas, 2016; Broers et al., 2017; Cadario & Chandon, 2019; Hummel & Maedche, 2019; Ingendahl et al., 2020; Tørris & Mobekk, 2019). It needs to be pointed out that the standardized mean difference of 0.4 which was utilized in the power analysis (Robinson et al., 2014) turned out to be higher than the mean difference of 0.2 and 0.3 proposed in many other reviews (e.g. Broers et al., 2017; Hummel & Maedche, 2019). The review of Robinson et al. (2014) had initially been chosen for the power analysis since it was the most closely related to the researched nudge and context. Hence, it might be argued that the effect size utilized in the power analysis was inflated, resulting in a failure to detect the small differences induced by nudging in the employed study design. However, the study had a relatively large sample size in comparison to most nudging studies. In fact, the sample size was higher than most of the nudging interventions (66%) on adult dietary behaviour considered in a review (n = 42) by Arno and Thomas (2016). Consequently, it can be assumed that the lack of evidence is related to the design of the utilized nudges and general study rather than an insufficient sample size.

Affordance nudge

This study failed to replicate the findings of the proof of concept study by Blom, Gillebaart, De Boer, and de Ridder (2021), who found that the affordance nudge significantly increased consumers weekly vegetable purchases in a real-life supermarket environment. While Hummel and Maedche (2019) indicated that digital nudges do not differ in effect size when compared to more conventional settings, natural grocery shopping settings offer more influences (EY et al., 2014), such as prices and advertisements, that might cognitively overtax consumers and make their choices more intuitive (König

et al., 2016; Wansink et al., 2009). Effective nudging has traditionally been associated with biases on intuitive choice processes (Allan et al., 2016). Additionally, while it has been found that images can indeed be used as valid proxies for real foods (Blechert et al., 2014; Toet et al., 2019), it can be argued that this studies food images did not have the same hedonic and palatability trigger as the real foods in the study by Blom et al. (2021). Hence, the failure to replicate the findings of Blom et al. (2021) might be due to the fact that this study adapted the affordance nudge in a much simpler online environment.

The affordance nudge has been proposed as a new theoretical approach to nudging. Blom et al. (2021) mentioned that, while some existing nudges draw from the same concept of steering attention to the desired product, none of the more traditional nudges are developed, tested, and researched in relation to the concept of affordance. While this might be true, this study provides evidence that the intentional integration of affordances might not influence the effect of nudges in a simplistic online food choice context. In fact, it can be argued that the social reference nudge employed in this study is a very similar, yet less sophisticated, version of the animated affordance nudge. For example, both nudges try to draw the gaze of participants to the healthy option to increase its desirability, only that the social reference additionally inflicts the factor of normative influence.

Consequently, in view of the findings of this study, the added benefit of the utilization of affordances for the effectiveness of nudging intervention, at least in the employed online context, can be questioned. However, this is merely the second study on this nudge and Blom et al. (2021) found a more promising results effect in a their field study. A thorough scientific basis is crucial for behaviour change interventions (Michie & Johnston, 2012), so the contrary findings need to be further evaluated.

Social reference nudge

The lack of evidence for an effect of the social reference nudge is reflected in the review by Osman et al. (2020), who indicated social references to be the intervention that fails most of all the fail behaviour change interventions. There seem to be barely any studies investigating the influence of a social reference nudge in an artificial online grocery setting. In fact, no other study was found that utilized an artificial online grocery environment as simplistic as this. The most proximal studies created a more realistic online environment by adding design elements that could be found on a real online grocery, such as an increased number of food items in a choice set, price and weight indications, a checkout section, the ability to select higher quantities of food items, the opportunity to navigate between different categories of food items, or detailed product descriptions (Berger & Nüske, 2020;

Demarque et al., 2015; Ingendahl et al., 2020). However, while some of the studies found an effect of nudging on food choice (Demarque et al., 2015; Ingendahl et al., 2020), Berger and Nüske (2020) did not, despite the elaborate online environment. Furthermore, there are two Master theses from the University of Twente (Demmer, 2017) and Utrecht (Bostanci, n.d.) which investigated the effects of social reference nudges on healthy food choice in an artificial grocery shopping setting failed to find evidence for an effect of the nudge.

There is a diverse range of further explanations for the non-significant effect of the social reference nudge in this study. For example, it has been found that social norms only influence dietary-behaviours as long as they involve psychologically salient in-group members (Cruwys et al., 2012). While the in-group of 'other participants' has been frequently utilized as a sufficient reference group for social norms (Herman et al., 2003; Pliner & Mann, 2004), participants might have not perceived the reference groups as an in-group and hence might have had no or little interest in conforming with the majority (Bicchieri & Dimant, 2019).

Furthermore, it has been found that social reference nudges are especially effective in moments of low self-control (Salmon et al., 2014, 2015), for example when encountering an especially tempting snack. Furthermore, Higgs (2015) suggests that that the usage of social norms is especially effective in situations with high uncertainty in which following the crowd is perceived as a safe option. Since this online study merely employed images of food and participants did not expect to physically receive the selected food items, the temptation of food items as well as the stakes of making a wrong choice were low. Consequently, participants self-control might have not been challenged adequately and the situation might not have been enough to induce an orientation along the group's behaviour.

Finally, a possible cause for the non-significant effects of nudging is provided by Stibe and Cugelman (2016). The authors indicated that one of the most common factors for backfiring interventions might be that participants suspect hidden intentions (Stibe & Cugelman, 2016). It might be possible that the repeated implementation of the "popular choice" label on healthy food items led people to realize the hidden agenda behind the label. However, no conclusive statement can be drawn regarding the question why the social reference nudge failed in this study due to an insufficient number of comparable, peer reviewed nudging studies with the specific design of the food choice task.

Nudging and Attitude

In contrast to nudging, participants attitude had a significant effect on the healthiness of their food choices. People with a high score on the General Health Interest scale of the HTAS acted according

to their measured explicit attitude and chose more healthy food items than people in the medium or low group. Hence, the findings support the claim that attitudes towards healthy foods are a relevant predictor of healthy food choice behaviour in a field, that is riddled with conflicting evidence on the impact of explicit attitudes on food choice (Asbridge et al., 2021; Prestwich et al., 2011; Richetin et al., 2007).

Healthy food attitudes did not moderate the effect of nudging on the healthiness of food choice. However, this finding has no interpretational value since both nudges did not influence the healthiness of food choice. Yet, there is some anecdotal evidence that participant might have had strong preferences against some of the items displayed in the food choice task.

While participants preference strength was not measured regarding each food choice situation, the mean score for the light product interest subscale in this sample is very low in comparison to the means of other studies. For example, Roininen et al. (2001) reported individual light product interest subscale item mean ranging from 3.9 to 4.7 (*N* = 1305) in comparison to the mean of 2.14 found in this study. In line with the assumption that people decide congruent to their attitudes, most people chose the unhealthier option in food choice situations with light products (only 23% to 45% healthy choices). Furthermore, some participants (n = 5) indicated a predominantly negative attitude towards or low interest in light products in the final remarks section. Four out of ten displayed choice situations contained light products as a healthy alternative. In these situations, participants might have selected the unhealthier options due to a dislike of light-products. By means of that, the nudges might have not had a significant effect, because participants choice was swayed by their dislike in light products. The presented anecdotal evidence underlines the assumption that nudging is particularly effective for people with conflicting or ambiguous attitudes towards healthy foods (Venema et al., 2019). However, this explanation should be viewed with caution since the influence of light products was not the focus of this study.

Nudging and food selection satisfaction

Turning to the exploratory component of the study, evidence suggests that nudged participants were not less satisfied with their choices than people in the control group. As mentioned above, a person's satisfaction may be a determinant of their future behaviour (Wirtz et al., 2003). There is a lack of long-term studies in the nudging field (Marchiori et al., 2017), so there is no evidence whether the continuous implementation of nudging will induce a gradual change towards healthy choices. However, based on the gathered data it is not possible to draw conclusions regarding the influence of effective

nudging interventions on participants satisfaction with their food choice, since the nudges were ineffective.

Interestingly, people with a comparatively low healthy food attitudes reported a higher satisfaction with their food selection in the food choice task than people in the medium healthy food attitude group, indicating that people with comparatively weak attitudes towards healthy foods felt has the most positive sentiments towards their choices. While one might claim that people with a weaker focus on healthy food choice might be easier to please, a thorough interpretation of this finding is difficult based on the evidence gathered through the one-item measure.

Limitations

There are certain limitations of this study besides the ones of ecological validity regarding its generalizability and the validity of utilized measures which need to be considered for the evaluation of this study. First, investigating the sample characteristics, the sample contained participants from various age groups, yet a majority was below 30 (48.5%, n = 122). Also, most participants were females and German. Scholars should be aware of these characteristics since the study's findings might not be transferable to other sexes or food cultures.

Furthermore, the order of food choice task and health attitude measure might have influences participants self-reported answers on the HTAS questionnaire. For example, participant could have been aware that they chose predominantly healthy items in the food choice task and consequently indicated a higher score on the general health interest subscale measure, which would artificially heighten the main effect of healthy food attitude on healthy food choice.

Third, the self-reported measures in the questionnaire component needs to be considered with care. The grouping along the General Health Interest subscale measure merely provides an indicator of the relative valence of healthy food attitudes as the scores on the subscale were high and unevenly distributed. For instance, the medium group spanned over 6 HTAS subscale score points, while the low group had a range of 21 points. Hence, the participants groups are based on their subjectively reported interest in healthy food products in comparison to other participants rather than an indication of a true decisional uncertainty or disregard of healthiness in food choice.

Lastly, participants food selection satisfaction was measured through a single-item measure, which are typically met with criticism regarding reliability and validity (Fisher et al., 2016). Furthermore, satisfaction has been indicated to be multidimensional, especially in situations where the right choice is

not obvious (Sainfort & Booske, 2000). Turning to recommendations for future studies could utilize a more complex, multi-item satisfaction measure to gain more robust results.

Conclusion

The current study was one of the first to simultaneously investigate the effectiveness of two nudges, a well-established social reference nudge in form of a 'popular choice' label and a newly developed, animated affordance nudge. Furthermore, to the authors knowledge there is no other study investigating nudging in respect to participants attitude towards healthy food and satisfaction with their food choice.

Healthy food attitudes were found to be significantly related to participants choice behaviour, highlighting its relevance as a determinant of food choice behaviour. However, both nudges did not significantly influence the healthiness of participants food choices. Possible explanations for the missing effect of nudging were elaborated regarding the effect size of nudges, the utilized sample size, and the design of each nudge individually. There seems to be a lack of effective nudging intervention studies for the employed nudges in an artificial grocery shopping environment. Consequently, it was not possible to provide more than suggestions and speculations on how the study design might have rendered the employed nudges ineffective. Overall, the employed nudges did not have an impact on participants food choice behaviour which lead to an inability to answer the later research questions regarding its effect on post-choice satisfaction and interaction with attitude.

Future Studies

Since attitude has turned out to be a relevant determinant of food choice behaviour in this study, investigating its interaction to nudging remains an interesting venue for future studies. However, it is suggested that future studies should further investigate both nudges in a realistic online grocery shopping environment to make the study findings more relevant and comparable to other studies. An open source research platform providing such a grocery shopping can be drawn from Engelbrecht et al. (2021).

Furthermore, it might be useful to adapt the choice set used in the food choice task to the preferences of each participant to make sure that they do not bias their decisions. This might be done, for example through a baseline measure.

Next, a possible improvement for future studies might be to add a qualitative component to the measure of food selection satisfaction and ask participants why they are satisfied or dissatisfied with their choices. By means of that a more in-depth analysis of the effect of nudging on food selection satisfaction would be possible in contrast to the simplistic one-item measure in this study.

Lastly, the findings underline the high need for valid indications of the determinants of nudging effectiveness in specific contexts to avoid ineffective nudging interventions. Considering the suspicions of publication bias in the nudging field (Broers et al., 2017; Hummel & Maedche, 2019; Vecchio & Cavallo, 2019), researchers are urged to publish well-designed studies even when their findings are not significant to make sure that future reviews and meta-reviews get an unbiased picture of the actual effect and effect size of specific nudges.

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Appendices

Appendix A –Study Promotion, Informed Consent & Debrief

Figure A1.

Message for Study Promotion

I am looking for participants for my online study regarding people's **grocery shopping behaviour**. The study consists out of a **shopping task** and several **questionnaires** clarifying certain aspects of your shopping behaviour.

Participants usually take **about 15-20 minutes**, so it is the perfect activity for a procrastination break or while answering the call of nature. While you will most likely not change the world by participating, you will make a certain irksome little Psychology student very happy.
Just **copy and paste this link** into your **web-browser** (simply clicking on it sometimes messes with the layout):

https://research.sc/participant/login/dynamic/4317DC7F-9E3D-4FAE-9CF4-49ED708FD2D8

Considering that I need around 240 participants I would appreciate it if you could **forward this message to everyone** you genuinely love, hate or anything in between. Co-workers, friends, family, secret love affairs, enslaved house-elves (don't worry, information won't be shared with third parties); Anybody that is **18+ years old** and has a **basic understanding of English** is more than welcome to participate.

Thank you for your time! I genuinely appreciate it.

Florian

Figure A2.

Informed Consent

Thank you for showing interest in participating in a research study about grocery shopping behaviour. This text gives you a short, preliminary overview of the following research study conducted by the Social, Health, and Organizational Psychology Department of Utrecht University. **Please read the following information carefully.**

Requirements

Participants of this study need to be ***18+ years*** old.

You should be using either a ***phone***, ***computer***, or ***tablet*** to fill in the study.

You will need a basic understanding of the English language.

Participation

Your participation in this study is ***voluntary***.

You can withdraw from this study at ***any time*** and ***without any reason*** or ***consequences***.

Following Steps

After agreeing to participate, you will be forwarded to a quick grocery choice task. Afterwards, you will be asked to answer some questions and questionnaires. It will take you ***about 15-20 minutes*** to complete the study. Please make sure that you are undisturbed and have a ***stable internet connection*** during this time. We ask you to answer all questions truthfully.

CONFIDENTIALITY

All collected information will be kept confidential. Only the researchers have insight into your answers. You will not be asked to provide your name or personal information that make it possible to retrace your data to your identity, nor will such information be gathered or saved covertly. All data will be retained for a minimum of 10 years for research purposes.

ANY QUESTIONS

In case of **any questions or problems regarding this study**, feel free to **contact me via email (*f.cordts@student.utwente.nl*).** I'll make sure to reply as soon as possible.

☐ **I agree to voluntary take part in this study. I have read and understood the provided information. I understand that my participation is voluntary and that I am able to withdraw at any time, without a reason or cost.**

Figure A3.

Debrief

You Are Done!!!

Thank you for taking part in my study 😊

(The following information are just for your information)

Thank you for participating in the study. The overall purpose of this research project is to gain some insights on peoples food-related decision making and the effect of the direct environment on their choice behaviour.

You were subjected to 1 out of 3 conditions in this study:

1. A task with a 'normal' choice situations with 2 food items.
2. The same task as in condition 1, but with an additional 'popular choice' label on 1 of the 2 items.
3. The same task as condition 1, but with an animated figure staring in the direction of 1 of the 2 items.

(It should be mentioned that the social reference used in condition 2 was fictitious for the purpose of promoting the healthy product.)

We are going to examine to what extent participants in conditions 2. and 3. behave differently compared to the first condition. In addition to recording the selected food items, we measured how long it took participants to make decision. We expect participants to make healthier and faster choices through a small change in the online environment.

The gathered data will be used to investigate to what extent the specific environmental changes (called *Nudges* in scientific literature) influence people's food choices with regard to personal factors *(e.g. their attitude towards healthy food and stage of behaviour change)*. By means of that it will be possible to give recommendations for future food choice interventions.

If you have any questions about this research project you can contact Florian Cordts via email: f.cordts@student.utwente.nl

We kindly request you not to discuss the content of this study with people who are (maybe) going to participate in the study. It is important for the research that participants are not aware of the research question and research methods beforehand. **Thanks again!**

Appendix B – Food Choice Task

Table B1.

Overview of the items used in Block A, B, and C of the Food Choice Task with their respective FSA- and NUTRI-scores

Category	**Block A**				
	Healthier	NUTRI-Score	Less Healthy	NUTRI-Score	Difference
Ice Cream	Ice Cream (light)	5 (C)	Ice Cream	15 (D)	10
Soft Drink	Cola Light	1 (B)[a]	Cola	14 (E)[a]	13
Dairy Product	Cream Cheese (Light)	8 (C)	Cream Cheese	11 (D)	3
Bread	Baguette	0 (B)	Garlic Baguette	13 (D)	13
Salty Snack	Peanuts	1 (B)	Peanuts (salted)	10 (C)	9
Category	**Block B**				
	Healthier	NUTRI-Score	Less Healthy	NUTRI-Score	Difference
Ice Cream	Calippo	5 (C)	Kaktus Ice	7 (C)	2
Soft Drink	Fanta Zero	2 (C)[a]	Fanta	11 (E)[a]	9
Dairy Product	Skyr Yogurt	-5 (A)	Greek Yogurt	5 (C)	10
Bread	Whole Grain Bread	-2 (A)	Toast	1 (B)	3
Salty Snack	Cashews	2 (B)	Cashews (flavoured)	7 (C)	5
Category	**Block C**				
	Item 1	NUTRI-Score	Item 2	NUTRI-Score	Difference
Chips	Chips (natural)	11 (D)	Chips (paprika)	12 (D)	1
Peas	Peas (Frozen)	-11 (A)	Peas (Jar)	-10 (A)	1
Spaghetti	Spaghetti	-5 (A)	Whole Grain Spaghetti	-4 (A)	1
Beans	Beans (Kidney)	-12 (A)	Beans (brown)	-12 (A)	0
Pudding	Pudding (Caramel)	6 (C)	Pudding (Chocolate)	6 (C)	0

[a]The norm tables and computational guidelines of the NUTRI-score differ for drinks and solid foods.

Table B2.

Proportion of Healthy Choices and average, standard deviation as well as median of food choice time for each specific food choice situation.

	Displayed Items (unhealthy vs. healthy)	Percentage of Healthy Choices
Block A	Ice cream vs. Ice Cream (light)	35%
	Cola vs. Cola (light)	42%
	Cream Cheese vs. Cream Cheese (light)	23%
	Herb Butter Baguette vs. Baguette	29%
	Spiced Peanut Snack vs. Peanuts (unsalted)	48%
	Total Block A	35%
Block B	Cactus Ice vs. Calippo Ice	41%
	Fanta vs. Fanta Zero	43%
	Yogurt (Greek Style) vs. Skyr Yogurt	43%
	Toast vs. Bread (Waldkorn)	81%
	Cashews (Garlic & Rosemary) vs. Cashews (no salt)	62%
	Total Block B	54%
	Total Block A and B	45%

Figure B1.

Food images used in the food choice task, their respective names and block.

Ice Cream (light)[a]

Ice Cream[a]

Peanuts[a]

Peanuts (salted)[a]

Cola Light[a]

Cola[a]

Calippo[b]

Kaktus Ice[b]

Cream Cheese (Light)[a]

Cream Cheese[a]

Fanta Zero[b]

Fanta[b]

Baguette[a]

Garlic Baguette[a]

Skyr Yogurt[b]

Greek Yogurt[b]

Whole Grain Bread[b]

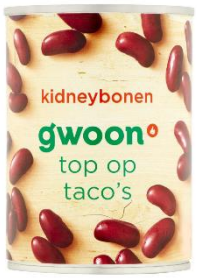
Toast[b]

Spaghetti[c]

Whole Grain Spaghetti[c]

Cashews[b]

Cashews (flavoured)[b]



Beans (Kidney)[c]

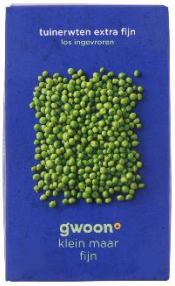
Beans (brown)[c]

Chips (natural)[c]

Chips (paprika)[c]

Pudding (Caramel)[c]

Pudding (Chocolate)[c]



Peas (Frozen)[c]

Peas (Jar)[c]

[a]Block A [b] Block B [c] Block C

Appendix C – Questionnaires

Food Satisfaction

- How satisfied are you with the chosen items?
- Selecting the products was … (1-7; Very difficult to Very easy)
- Selecting the products was … (1-7; Very unpleasant to Very pleasant)
- Was there anything about the task that stood out to you? (text response)

Health and Taste Attitude Scale (HTAS)

Statements to be rated on a 7-point Likert scale ranging from 'strongly disagree' to 'strongly agree'. Statements marked with (R) need to be recoded for analysis.

General Health Subscale

1. I am very particular about the healthiness of food.
2. I always follow a healthy and balanced diet.
3. It is important for me that my diet is low in fat.
4. It is important for me that my daily diet contains a lot of vitamins and minerals.
5. I eat what I like and I do not worry about healthiness of food. (R)
6. I do not avoid any foods, even if they may raise my cholesterol. (R)
7. The healthiness of food has little impact on my food choices. (R)
8. The healthiness of snacks makes no difference to me. (R)

Light Product Subscale

9. In my opinion, the use of light products does not improve one's health. (R)
10. I do not think that light products are healthier than conventional products. (R)
11. I believe that eating light products keeps one's cholesterol level under control.
12. In my opinion, light products don't help to drop cholesterol levels. (R)
13. I believe that eating light products keeps ones body in good shape.
14. In my opinion by eating light products one can eat more without getting too many calories.

Natural Product Subscale:

15. I do not care about additives in my daily diet. (R)
16. In my opinion, organically grown foods are not better for my health than those grown conventionally. (R)
17. In my opinion, artificially flavoured foods are not harmful for my health. (R)
18. I try to eat foods that do not contain additives.
19. I would like to eat only organically grown vegetables.
20. I do not eat processed foods, because I do not know what they contain.

Health and Diet Goal Questionnaire

Statements to be rated on a slider ranging from 0 (not at all) to 100 (very much).

Individual Goals

An individual goal is something that one generally tries to achieve. Individual goals can be positive as well as negative; implying that they can be concerned with something that a person desires or something that a person tries to avoid.

On the next screens you will find 8 goal statements. Under each statement you're asked to indicate to what extent this goal is relevant to you.
Drag the slider to the position which indicates best how much you associate with the respective goal.

Questions:
1. I try to take others into account when making a decision.
2. I try to eat healthy every day.
3. I try to see as much as possible of the world.
4. I always try to look good.
5. I try to be as successful as possible
6. I try to avoid negative people.
7. I always try to avoid unhealthy food.
8. I try to be frugal with my money.

Stage of Change Measure
- My current diet would generally not be described as healthy and I am not interested in changing it.
- My current diet would generally not be described as healthy but I think about changing it.
- My current diet would generally not be described as healthy but I know how to eat more healthily and I am planning to do so in the next month.
- My current diet would generally be described as healthy, but I have not maintained a healthy diet for 6 months or longer.
- Having a healthy diet is already a part of my lifestyle for 6 months or longer.

Evaluative Questions
When I was deciding between the products, it felt as if:
- The setup of the products threatened my freedom to choose
- The setup of the products tried to make a decision for me
- The setup of the products tried to manipulate me
- The setup of the products tried to pressure me

All items were rated on a scale ranging from Strongly disagree (1) to Strongly Agree (7)

The presentation of the products was …

Very unattractive	1	2	3	4	5	6	7	Very attractive
Very uninviting	1	2	3	4	5	6	7	Very inviting

Not salient at all	1	2	3	4	5	6	7 Very salient

Selecting the products was …

Very difficult	1	2	3	4	5	6	7 Very easy
Very unpleasant	1	2	3	4	5	6	7 Very pleasant

What do you think of the manner in which the products were presented in the online supermarket?

1	2	3	4	5	6	7
Negative		Neutral			Positive	

How did you feel when selecting a product?

I felt:

	Strongly disagree						Strongly agree
… stimulated	1	2	3	4	5	6	7
… patronized	1	2	3	4	5	6	7
… directed	1	2	3	4	5	6	7
… like I was being watched	1	2	3	4	5	6	7
… taken seriously	1	2	3	4	5	6	7

Additional Affordance Nudge Evaluation Questions:

About the animation on the screen: [this question only for participants in the affordance nudge condition, and in any case AFTER asking what stood out, cause otherwise they will all say that this is what stood out]

I liked the animation	1	2	3	4	5	6	7
I identified with the animation	1	2	3	4	5	6	7

Real-life applicability

Both measures rated on a 7-point Likert scale (1-7; Not at all – Very much)

- To what extent did the task contain items that you would purchase in your everyday grocery shopping?
- To what extent do your choices in this task resemble your decisions in a real supermarket environment?

Demographics

Please indicate your:

- **Age** (Years in Numbers)
- **Gender**
  - Male
  - Female
  - Other
- **Nationatlity**
  - Dutch
  - German

    - Other, namely: _____
- **Do you follow a specific diet?** (e.g. Vegan or Vegetarian)
    - No
    - Yes, namely
- **Highest Attained Formal Education** (or equivalent education in your country) - Drop-down list:
    - No formal education
    - Primary education
    - Secondary education or High School
    - Bachelors degree
    - Masters degree
    - PHD or higher
    - Other, namely... (OR: unsure which one fits best)
- **Employment Status - Drop-down list:**
    - Unable to work
    - Unemployed (looking for job)
    - Unemployed (not looking for job)
    - Student
    - Employed (part-time)
    - Employed (full-time)
    - Retired
    - Other, namely...
- **Current Living Situation - Drop-down list:**
    - Living alone
    - Living with partner
    - Living with partner and child(ren)
    - Living in a shared flat
    - Other, namely…
- ***You can skip the following two questions*** if you feel uncomfortable answering them. However, remember that all data is kept confidential and anonymous and will not be shared with third parties.
    - **How tall are you?**
    - **How much do you weigh?**

Aim of Study

Both to be answered in written form:

- If you had to guess, what would you say is the aim of this study?
- Do you have any remarks or comments regarding the study? (e.g. did something go wrong, points of improvement, is something unclear?)

Appendix D - Analysis Plan

Table D1.

Research Questions and Hypotheses

Research Question	Hypothesis
1. *Does nudging lead to healthier food choices in an online-retailer environment?*	Yes
2. *Does the social reference nudge lead to healthier food choices in an online-retailer environment?*	Yes
3. *Does the affordance nudge lead to healthier food choices in an online-retailer environment?*	Yes
4. *Does the effect of nudging on the healthiness of participants food choice differ for people with varying healthy food attitudes?*	It is expected that people in the medium group of the HTAS General Health Interest subscale will be most affected by the nudges. People with strong healthy and unhealthy attitudes will choose accordingly to their attitude.
5. *Do the social reference an affordance nudges lead to different levels of food selection satisfaction in an online-retailer environment in comparison to a control group?*	Exploratory, no hypothesis
6. *Does the effect of nudging on participants selection satisfaction choice differ for people with varying healthy food attitudes?*	Exploratory, no hypothesis

Exclusion criteria:

- Did not consent to participate
- Did not complete every questionnaire
- Did have technical difficulties
- On average took longer than 15 second to make a choice in the food choice task.

Variables Main Analysis:

- Independent variables:
  - Nudging condition:
    - No nudge
    - Social Reference Nudge
    - Affordance Nudge
  - HTAS group:
    - Low
    - Medium
    - High
- Outcome Measures:
  - Sum of Healthy Food Choice
    - Block A, B, and C
    - Combination Block A and B
    - First and Second displayed block
  - Food Selection Satisfaction

Key Statistical Analysis:

All analysis done in SPSS 27. Computation of ω^2 effect size done in JASP.

Differences between blocks:

- repeated measure ANOVA for:
  - Independent Variable
    - Nudging
  - Repeated Measure:

- First two displayed blocks
- Block A and B

Healthiness of choice

- Checking for normal distribution, homoscedasticity, homogeneity of regression slopes

  mean, SD for each condition

  - Factorial ANCOVA:
    - significant difference between nudging conditions?
      - if yes, post-hoc test
        - difference between social reference and no nudge?
        - difference between affordance and no nudge?
        - difference between social reference and affordance?
    - significant difference between HTAS conditions?
      - if yes, post-hoc test
        - difference between low and mid?
        - difference between mid and high?
        - difference between low and high?
    - significant interaction effect nudging and HTAS?
      - if yes, Bonferroni-corrected post-hoc test
        - difference between low/mid/high and SRN/AFF/NN?

Food selection satisfaction

- Checking for normal distribution, homoscedasticity, homogeneity of regression slopes
- mean, SD for each condition
  - mean, SD for each condition
  - Factorial ANCOVA:
    - significant difference between nudging conditions?
      - if yes, post-hoc test
        - difference between social reference and no nudge?
        - difference between affordance and no nudge?
        - difference between social reference and affordance?
    - significant difference between HTAS conditions?

    - if yes, post-hoc test
        - difference between low and mid?
        - difference between mid and high?
        - difference between low and high?
- significant interaction effect nudging and HTAS?
    - if yes, Bonferroni-corrected post-hoc test
        - difference between low/mid/high and SRN/AFF/NN?

Appendix E – Assumptions and Main Analyses

Table E1.

Test statistics of multiple Shapiro-Wilk Test to test normality of the dependent variables (healthy food choice and food selection satisfaction) across each cell of the interaction between nudging condition and healthy food attitude.

Sum of Healthy Chosen Items				
		HTAS group		
		low	mid	high
Nudge	NN	W(23) = 0.84, p < .02	W(18) = 0.93, p = .21	W(29) = 0.96, p = .46
	SRN	W(28) = 0.92, p = .04	W(35) = 0.94, p = .04	W(29) = 0.97, p = .52
	AFF	W(21) = 0.93, p = .14	W(24) = 0.89, p = .01	W(24) = 0.95, p = .25
Food Selection Satisfaction				
		HTAS group		
		low	mid	high
Nudge	NN	W(23) = 0.88, p = .01	W(18) = 0.80, p < .01	W(29) = 0.86, p < .01
	SRN	W(28) = 0.80, p < .01	W(35) = 0.93, p = .03	W(29) = 0.90, p < .01
	AFF	W(21) = 0.88, p = .02	W(24) = 0.88, p < .01	W(24) = 0.90, p = .02

Table E2.

Homogeneity of variance of the outcome measures across the independent variables nudging conditions, general health interest group, and the interaction of the two as determined by Levene's tests.

Outcome Measure	**Independent variable**	**F**	**Df1**	**Df2**	**p**
Healthy food choice	Nudge	1.27	2	228	0.28
	HTAS	2.24	2	228	0.11
	Nudge*HTAS	1.28	8	222	0.26
Food Selection Satisfaction	Nudge	0.28	2	228	0.77
	HTAS	2.84	2	228	0.06
	Nudge*HTAS	1.18	8	222	0.31

Table E3.

Shapiro Wilk tests for each condition of the independent variables on the outcome measure healthy food choice in block 3.

	Statistic	df	Sig.
Nudging			
No Nudge	.907	70	<.01
Social Reference Nudge	.907	92	<.01
Affordance Nudge	.859	69	<.01
Healthy Food Attitude			
Low	.907	72	<.01
Medium	.912	77	<.01
High	.839	82	<.01

Table E4.

Homogeneity of variance of the outcome measures across the independent variables nudging conditions, and general health interest group as determined by Levene's tests.

	Statistic	Df1	Df2	Sig.
Nudging	0.840	2	228	.43
Healthy Food Attitude	4.714	2	228	.01

Table E5.

Shapiro-Wilk test for the repeated measures regarding differences between Block A and B as well as the first displayed and second displayed block.

	Statistic	df	Sig.
Block A	0.91	231	<.01
Block B	0.92	231	<.01
First 5 choices	0.93	231	<.01
Choices 6 to 10	0.93	231	<.01

Outcome measures

Table 5.

Tukey HSD corrected post-hoc test and bootstrapped mean comparison for the independent variables nudging and healthy food attitude on the outcome measure sum of healthy food items.

					Bootstrap			
							BCa 95% Confidence Interval	
Ind. Variable	Condition I	Condition J	Mean difference (I-J)	Sig.	Bias	Std. Error	Lower	Upper
Nudge	No Nudge	Social Reference nudge	.30	.55	-.01	.29	-.28	.86
		Affordance nudge	-.34	.51	-.01	.31	-.92	.23
	Social Reference Nudge	Affordance nudge	-.64**	.07	.00	.30	-1.21	-.05
General Health Attitude	'Low'	Medium	-.33	.52	.00	.28	-.85	.21
		High	-1.05*	.001	.01	.29	-1.57	-.48
	'Medium'	High	-.72	.03	.00	.30	-1.30	-.13

Note. * Significant **Marginally significant

Table E6.

Sample means, standard deviations, as well as bootstrapped 95% - confidence intervals for each cell of the interaction between nudging and healthy food attitude on the outcome measure of healthy food choice.

Nudging Condition	General Health Interest Group (n)	Number of Healthy Choices		Bootstrap for Mean BCa 95% Confidence Interval	
		Mean	*SD*	*Lower*	*Upper*
Low	No Nudge (n = 23)	4.04	1.36	3.42	4.57
	Social Reference Nudge (n=28)	4.04	1.90	3.32	4.77
	Affordance Nudge(n = 21)	3.86	1.40	3.25	4.50
	Total (n = 72)	3.99	1.58	3.61	4.36
Medium	No Nudge (n=18)	4.28	1.60	3.50	5.11
	Social Reference Nudge (n=35)	3.86	1.75	3.33	4.46
	Affordance Nudge (n=24)	5.00	1.90	4.30	5.79
	Total (n= 77)	4.31	1.81	3.97	4.82
High	No Nudge (n = 29)	4.97	1.94	4.18	5.63
	Social Reference Nudge (n = 29)	4.72	2.09	4.00	5.48
	Affordance Nudge (n = 24)	5.50	2.00	4.71	6.35
	Total (n = 82)	5.04	2.01	4.63	5.46
Total	No Nudge (n = 70)	4.49	1.71	4.0	4.79
	Social Reference Nudge (n = 92)	4.18	1.92	3.83	4.61
	Affordance Nudge (n = 69)	4.83	1.89	4.36	5.23

Table E7.

Tukey HSD corrected post-hoc test and bootstrapped mean comparison for the independent variables nudging and healthy food attitude on the outcome measure sum of food selection satisfaction.

					Bootstrap			
							BCa 95% Confidence Interval	
Ind. Variable	Condition I	Condition J	Mean difference (I-J)	Sig.	Bias	Std. Error	Lower	Upper
Nudge	No Nudge	Social reference nudge	-.09	.88	.01	.19	-.51	.31
		Affordance nudge	-.26	.44	.00	.21	-.67	.18
	Social Reference Nudge	No nudge	.09	.88	-.01	.19	-.24	.43
		Affordance nudge	-.16	.69	.00	.19	-.54	.18
	Affordance nudge	No Nudge	.26	.44	.00	.21	-.17	.67
		Social Reference Nudge	.16	.69	.00	.19	-.18	.54
General Health Attitude	‘Low’	Mid	.51*	.04	.00	.17	.18	.85
		High	.43**	.08	.00	.20	.02	.82
	‘Mid’	Low	-.51*	.04	.00	.17	-.86	-.17
		High	-.08	.92	.00	.20	-.45	.29
	‘High’	Low	-.43**	.08	.00	.20	-.81	-.03
		Mid	.08	.92	.00	.20	-.32	.48

Table E8.

Sample means, standard deviations, as well as bootstrapped 95% - confidence intervals for each cell of the interaction between nudging and healthy food attitude on the outcome measure of healthy food choice.

General Health Interest Subscale Group	Nudging Condition			BCa 95% Confidence Interval	
		Mean	*SD*	*Upper*	*Lower*
Low	No Nudge (n=23)	5.26	0.96	4.90	5.62
	Social Reference Nudge (n=28)	5.07	1.10	4.62	5.50
	Affordance Nudge (n=21)	5.38	1.20	4.84	5.90
	Total (n=72)	5.22	1.08	4.99	5.49
Medium	No Nudge (n=18)	4.72	1.23	4.07	5.28
	Social Reference Nudge (n=35)	4.80	1.23	4.42	5.20
	Affordance Nudge (n=24)	4.58	0.97	4.18	4.96
	Total (n=77)	4.71	1.15	4.42	4.97
High	No Nudge (n=29)	4.48	1.48	3.82	5.04
	Social Reference Nudge (n=29)	4.79	1.32	4.30	5.21
	Affordance Nudge (n=24)	5.21	1.47	4.63	5.84
	Total (n=82)	4.79	1.44	4.50	5.13

Table E9.

Test statistics of the two-way ANOVA for the main effect of the independent variables nudging, General Health Interest, and the interaction of nudging and general health interest on the outcome measures

Outcome Measure	Cases	*df*	MS	*F*	*Sig.*	Effect Size	
Healthy Food Choice	Nudging	2	6.61	2.02	.14	.02	.008
	General Health Interest	2	23.07	7.06	.001*	.06	.05
	Nudging x General Health Interest	4	3.04	.93	.45	.02	.00
	Error	222	3.27				
Food Selection Satisfaction	Nudging	2	1.099	.72	.49	.006	.00
	General Health Interest	2	5.716	3.73	.03*	.03	.02
	Nudging x General Health Interest	4	1.696	1.11	.35	.02	.00,
	Error	222	1.532				

healthiness of food choice food choice time and food selection satisfaction.

Note. df = degrees of freedom, MS = Mean squares, Effect Size = partial η^2. * Significant at $p < .05$

partial omega squared computed through JASP

Table E10.

F-statistic for one-way ANOVAs on the independent variables Nudging condition and Healthy Food Attitude on the outcome measure healthy food choices in block C.

Independent variable	Cases	*df*	MS	*F*	*Sig.*
Nudging Condition	Between groups	2	.011	0.012	.988
	Within Groups	228	.899		
	Total	230			
Healthy Food Attitude	Between groups	2	.071	0.079	.924
	Within Groups	228	.898		
	Total	230			