Towards healthier choices: The effect of visual and verbal nudges on consumer behavior in supermarket applications.

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Abstract

Approximately, 1.5 million Dutch citizens suffer from chronic cardiovascular disease, mostly caused by a poor diet. Additionally, over half of the Dutch population is overweight. Despite these concerning numbers, a third of individuals say they want to improve their eating habits. However, many individuals still struggle to make healthier choices. This shows the importance of investigating strategies to encourage and simplify the decision-making process for healthier food choices.

Nudging has been proven to be an effective tool for promoting behavioral change. While various forms of nudging exist, the introduction of websites and applications has changed the environment in which people make food choices, and as a result, nudges have emerged as digital nudges. Specifically verbal and visual nudges have shown to be promising tools for behavioral change.

A limited body of research exists on the impact of these nudges in the food environment, specifically within the context of supermarket applications. Therefore, this study has the following research question: *"What is the effect of verbal and visual nudges on healthy food choices on supermarket applications among Dutch residents?"*.

An experiment with 128 participants was conducted, to study the influence of the verbal nudge, visual nudge, and the combination of these nudges on food choices. Each participant had to choose twelve times between a regular product and a healthier alternative. The results showed that neither the verbal nudge, visual nudge, nor their combination, had a significant effect on food choices. The only significant factor influencing food choices was net income, suggesting that economic factors play an important role in selecting healthier food choices. Finally, implications, limitations, and suggestions for future research are discussed.

Keywords: verbal nudge, visual nudge, intention-behavior gap, healthy food choices

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1. Introduction

The primary cause of deaths in Europe are cardiovascular diseases, and the numbers keep rising (World Health Organization, 2014, p. 29). Currently, approximately 1.5 million Dutch residents suffer from chronic cardiovascular disease (Health Council of the Netherlands, 2023, p. 2), mostly caused by a poor diet (World Health Organization: WHO, 2021). Over the last decades the food industry has shifted from unprocessed foods to ultra-processed foods, which are now a big part of the Dutch daily diet (Vellinga et al., 2022, p. 2). According to Vellinga et al. (2022, p. 12), ultra-processed foods and drinks account for 29% of the daily consumption and 61% of energy consumption in the average Dutch diet.

Kloosterman et al. (2023) demonstrate that approximately 36% of the Dutch population aims to improve their eating habits, mainly to minimize the risk of illnesses. In comparison, 58% of the population does not acknowledge the need to improve their eating habits, as they state that they already maintain a healthy enough diet (Kloosterman et al., 2023). Nevertheless, the numbers show otherwise, as in 2022 half of the Dutch adult population is overweight, with 15% being severely overweight (Kloosterman et al., 2023). Additionally, research shows that between 70 to 80 percent of supermarket products are not a part of The Wheel of Five (Hermans, 2021). Therefore, it may be assumed that people are unaware of the best products to buy and whether they are healthy or unhealthy, and they are also easily tempted to make unhealthy choices. All in all, it seems that the intention to make healthier choices is there, but that the behavior is not adding up to this. This contradictory state of affairs is called the *intention-behavior gap* (Webb & Sheeran, 2006).

According to Folkvord (2019, p. 97), a tool for stimulating behavioral change regarding food consumption is *nudging*. Nudging serves as a method to influence an individual's behavior and choices in a way that is beneficial for them and often also for society (Mont et al., 2014, p. 85). Nudging focuses on the environment in which decisions are

made (Thaler & Sunstein, 2009, p. 2), without restraining individuals' freedom of choice (Mertens et al., 2021). The decision environment can be changed by altering the social or physical surroundings, or adjusting how choices are presented. This can result in a specific option becoming more appealing, favored, or chosen by default (Mont et al., 2014, p. 12).

Nudging has been shown to be an effective tool for behavioral change in many domains (Mertens et al., 2021, p. 7). Regarding food, nudging involves making the healthier choices the more convenient options, without forbidding or removing the other options, so people's freedom of choice is not threatened (Adkisson, 2008, p. 700). An example of an experiment on nudging in food consumption involved differently displaying the order of the items on the shelfs of a cafeteria. In one scenario, desserts were positioned before the vegetables, while in another scenario they were placed after the vegetables. This change resulted in a 25% increase in vegetable consumption and a decrease in the consumption of desserts (Adkisson, 2008, p. 700).

There are different types of nudges to promote behavioral change, such as verbal nudges which are nudges that provide textual information (e.g., this product is healthy), and visual nudges which show this information as a visualization (e.g., smileys, green stickers, and traffic-light labeling systems (Cadario & Chandon, 2020, p. 7; Theunis, 2023, p. 5)).

Visual nudges have been studied over the years in various domains (Cadario & Chandon, 2020, p. 7). Research on behavior showed that consumers are more prone to behaving sustainably due to visual labeling (Onwezen et al., n.d., p. 6). Moreover, a study regarding behavioral change through nudging for the fashion industry used verbal and visual nudges to influence consumers (Roozen et al., 2021, p. 1). The study showed that these nudges had a positive effect on the sustainability of the fashion choices of consumers (Roozen et al., 2021, p. 1).

So, in what contexts would nudging be a good tool to change behavior toward food choices? According to research, nowadays, around 83% of Dutch consumers use a supermarket application (Albert Heijn & PanelWizard, 2022) and this number keeps rising (Deloitte Branchegroep Retail, 2023, p. 36). Most consumers use the application to find offers and save points. However, an increasing number of consumers are using the applications to make their grocery lists and they use digital leaflets for orientation of what they will buy in the supermarket (Deloitte Branchegroep Retail, 2023, p. 36). So, supermarket applications may be a promising platform to implement nudges to encourage individuals to make healthier choices. Although nudging has been shown to be an effective strategy for changing behavior, little research has been done on the effects of verbal and visual nudging on making healthier food choices in supermarket applications. Therefore, the research question of this study is: *"What is the effect of verbal and visual nudges on healthy food choices on supermarket applications among Dutch residents?"*

The results of this study may inform supermarket retailers, who might use the insights gained from this study to enhance sales and also to support public health goals. This could potentially result in a healthier population and a reduction in the number of individuals with cardiovascular disease, which is a key objective of the National Prevention Agreement (Kloosterman et al., 2023). Moreover, this study contributes to the existing understanding of the effects of nudging on food choices, demonstrating how subtle changes in the choice environment can alter the decision-making process positively.

The remainder of this thesis is structured as follows. In chapter two, the relevant concepts for this research emerge, and hypotheses are formulated. The third chapter describes the design and methods used in the study. In the fourth chapter, the results of the experiment will be reported, followed by the fifth chapter with the conclusions and discussion.

2. Theoretical Framework

This chapter provides the theoretical base of this study. In section 2.1 the food industry will be discussed. In addition, section 2.2 will provide more detail on the intention-behavior gap and the decision-making process. Section 2.3 dives deeper into what nudging is, what types of nudges there are, and what is currently known about the effects. Then in section 2.4 the verbal nudge will be discussed and in 2.5 the visual nudge. Finally, the research question and hypotheses will be presented in section 2.6.

2.1 The food industry

Over the last century, the food industry has undergone a massive change. It went from small-scale food production to automation, mass production, and in the end processed foods (Welch & Mitchell, 2000, p. 1). Processed foods are food products that have undergone a process to improve the products' preservation, flavor, or convenience in preparation (Abdisa, 2023). They often contain high levels of added sugars, salt, and fat, which makes the products high in energy and therefore unhealthy (Zhang & Giovannucci, 2022). According to Vellinga et al. (2022, p. 12), ultra-processed foods and drinks account for 29% of the daily consumption and 61% of energy consumption in the average Dutch diet.

Over a third (36%) of the Dutch population says they want to improve their eating habits, but the majority (58%) say they don't have to improve anything as they state they already eat healthy enough (Kloosterman et al., 2023). However, half of the Dutch adults are overweight and 15% are severely overweight (Kloosterman et al., 2023). Over the last years, the behavior regarding food has changed. In comparison to the Food Consumption Survey of 2012-2016 (Van Rossum et al., 2020), which reported only 19% of the Dutch population adhered to the guidelines for fruit and vegetable consumption, the recent study of 2019-2021 shows an increase to 27% of the consumption (Van Rossum et al., 2023, p. 86). Moreover, the most recent study shows that the Dutch population has increased the consumption of plant-

based foods, like fruits and vegetables, and decreased the consumption of red or processed meat and sugary drinks (Kloosterman et al., 2023). If this positive trend keeps going then the risk of cardiovascular diseases will decrease (Van Rossum et al., 2023, p. 3).

In the National Prevention Agreement, the Dutch government agreed to the goal of reducing the number of obese people in the Netherlands by 2040 (Kloosterman et al., 2023). The current obesity numbers are that 35% of the Dutch population is overweight and 15% is severely overweight (Kloosterman et al., 2023). By 2040, these numbers must be reduced to a maximum of 38% being overweight (Kloosterman et al., 2023). However, the percentage of overweight people has remained stable in recent years (Centraal Bureau voor de Statistiek, 2022). All this stresses the need to find ways to influence people to make healthier choices to reduce the number of overweight people and the associated health risks.

2.2 The intention-behavior gap and the decision-making process

Wanting to behave one way but behaving differently is called the intention-behavior gap (Sheeran & Webb, 2016). Over 90% of the Dutch population say they know which products are healthy and which are not (Kloosterman et al., 2023). However, they still struggle to make healthy choices. They give various reasons for consuming unhealthy foods, including other people convincing them to eat something unhealthy (36%), finding it difficult to resist unhealthy foods (22%), and not having enough money to buy healthy products (9%) (Kloosterman et al., 2023).

The intention-behavior gap exists in many ways. For example, if a person wants to increase their fitness by jogging multiple times a week, but instead they do not even jog once. An example of the intention-behavior gap related to food is when a person wants to eat healthier, but due to the influence of other people does not choose the healthy option. To help overcome this intention-behavior gap regarding food choices Plaete et al. (2015) advise using self-regulation techniques, such as planning a weekly menu and making a grocery list.

According to Davydenko and Peetz (2020, p. 17) when people make a grocery list before going to the supermarket, they buy significantly fewer products and spend less money.

But how do people make decisions and how can we influence them? According to Kahneman (2011), people have two different thinking processes, which are called system 1 and system 2 thinking. System 1 thinking works fast and unconsciously. This system works automatically and effortlessly, without us being aware of its existence, and there is no control over it. System 1 thinking evaluates situations and constantly gives updates. It makes up almost all of our thinking. System 2 thinking on the other hand is slow, deliberate, and conscious. It uses controlled and rational thought that requires effort. This system is embedded in self-awareness and logic. It is aimed at finding new information and decision-making and makes up only a small part of our thinking (Kahneman, 2011).

Daily there are a lot of decisions to make. If one would make all these decisions deliberately and consciously, the brain would be overwhelmed by all the information. System 1 helps to prevent such a cognitive overload. It helps in various ways, such as by making routines, which result in repetitive tasks being completed automatically and without conscious thought. However, system 1 thinking is also continuously evaluating and making decisions about what is relevant or irrelevant (Kahneman, 2011). Irrelevant information is filtered by heuristics, which are mental shortcuts that enable quick decision-making without requiring much time or in-depth analysis (Dale, 2015). People tend to rely on heuristics in situations where they are required to make decisions that differ from their routines and habits (Kahneman, 2011).

To influence behavior, it is important to consider how individuals think. Often when trying to influence another, one uses a rational approach, relying on arguments and facts. Nevertheless, it is many times forgotten that other people are also irrational (Kahneman

(2011). As Kahneman (2011, p. 402) notes, individuals need assistance to make better and more accurate decisions and judgments.

So how can one influence the decision-making process? According to Thaler et al. (2012), the decision-making process can be influenced by the choice architecture. The choice architecture is the context or environment in which people make decisions (Thaler et al., 2012). In other words, the way in which choices are presented to individuals can influence their decision-making process (Weinmann et al., 2016).

An example of the choice architecture can be found in the work of Beraldo and Karpus (2021) on organ donation. In certain countries, individuals are automatically enrolled as organ donors unless they actively indicate otherwise. In contrast, in other countries, citizens are not automatically enrolled as organ donors, and thus must actively choose to become one. This difference results in higher rates of organ donation in countries where individuals are automatically enrolled as organ donors (Beraldo & Karpus, 2021). This illustrates the significant impact on the way in which choices are presented, the choice architecture, can have on the outcomes.

In light of the intention-behavior gap regarding food choices, Plaete et al. (2015) recommend using self-regulation techniques, such as planning a weekly menu and making a grocery list. Given the high cognitive demand of this task, it may be beneficial to give people a push in the right direction to simplify the decision-making process (Stuber et al., 2022). To simplify the decision-making process and influence people's decisions, the choice architecture could be changed through *nudging*. According to Thaler and Sunstein (2009), nudging could be a good tool to push people in the right direction.

2.3 Nudging

In general terms, nudging is a tool to push people in the right direction (Thaler & Sunstein, 2009). Nudges are subtle interventions to improve people's decision-making by

changing how the options are presented, without changing the options or restraining people's freedom of choice (Schmidt & Engelen, 2020). This means that small tweaks are made to the choice architecture, while choices remain the same and people still have the freedom to choose between the same available options (Weinmann et al., 2016). So, freedom of choice ensures that all options remain available and that individuals are not hindered in making autonomous decisions (Thaler & Sunstein, 2009).

The nudge theory is based on the idea that people make many decisions instinctively rather than logically, which can be influenced by nudges. In making decisions, individuals often use heuristics, which are mental shortcuts that enable quick decision-making without needing too much thinking (Dale, 2015). An example of where nudging was used is in the piano stairs experiment. The goal of this experiment by Volkswagen was to stimulate people to take the stairs instead of taking the escalator (Rolighetsteorin, 2009). For this experiment, the stairs of a subway station were transformed into a functional piano. Each step of the stairs acted as a piano key. The experiment aimed to see if people would choose the piano stairs over the escalator, by making taking the stairs more fun to use. As a result, 66% of the people chose the stairs over the escalator (Ortmann et al., 2016, p. 55; Peeters et al., 2013). This shows that changing the way the choices are presented can effectively change behavior positively, without removing options or restricting freedom of choice, such as taking the elevator instead.

Nudging has been shown to be effective in various contexts (Mertens et al., 2021, p. 5). A meta-analysis of choice architecture interventions for physical activity levels showed a positive impact of nudging on behavioral change (Landais et al., 2020). In this meta-analysis, the researchers combined 88 studies that all focused on behavioral change toward physical activity by nudging. In 68% of the studies, there was an effect on behavior when a nudge was

used. Upon removal of the nudges, the result was only 47%. This analysis demonstrates that nudging can be an effective tool for behavioral change.

Another context in which nudging has been demonstrated to be an effective tool for behavioral change is in the consumption of tobacco and alcohol. Nurchis et al. (2023) analyzed 20 studies through a scoping review of the literature on the use of nudges to influence alcohol and tobacco consumption. The analyzed studies revealed a variety of nudges, such as increasing the salience of information or incentives, providing default choices, and offering feedback. A salience nudge increases the visibility of certain information, thereby influencing the decision-making process (Noggle, 2017). The default nudge entails setting a specific option as the default choice. For instance, in the example of organ donation, individuals are automatically enrolled as organ donors unless they actively choose otherwise (Beraldo & Karpus, 2021; Noggle, 2017). Moreover, the feedback nudge is designed to provide individuals with information on their behavior and the consequences of their actions, to encourage positive behavior (Cappa et al., 2020). The results of the analysis conducted by Nurchis et al. (2023) showed that especially the salience nudge, but also the feedback nudge had a positive effect on behavior. However, the default nudge showed a positive effect in only one study, making it a less effective nudge in this context. In conclusion, the analysis of Nurchis et al. (2023) demonstrates that nudging strategies are effective in promoting behavioral change toward tobacco and alcohol consumption.

However, over the years the choice architecture has changed with the introduction of websites and applications (Mirsch et al., 2017). As a result, nudges have emerged into digital nudges to influence behavior in online environments (Schneider et al., 2018; Weinmann et al., 2016). Digital nudging aims to influence people's behavior online by using various design features (Weinmann et al., 2016). This change calls for new nudging tools because traditional

nudges may not be as effective or applicable online as they are offline (Mirsch et al., 2017; Hummel & Toreini, 2017).

This introduction of websites and applications has also led to a transformation in the environment in which people make their food choices, as an increasing number of people now make their food choices online. A study conducted in the Netherlands revealed that 60% of respondents use (digital) supermarket pamphlets, 22% use applications, and 8% rely on promotions on their phones to decide on their purchasing decisions (Deloitte Branchegroep Retail, 2023, p. 20). Research from Albert Heijn indicates that 83% of consumers use a supermarket application, and it is likely that this number will keep on rising (Albert Heijn & PanelWizard, 2022). Consequently, a supermarket application may therefore be an optimal digital environment for influencing people's behavior towards making healthier food choices.

A study on digital nudging for online food choices when selecting a recipe explored a variety of nudges. Respondents used a web application and were asked to select recipes they would be interested in trying (Jesse et al., 2021). The researchers investigated various nudge techniques, such as highlighting, default, social information, and warnings. In this study, the term highlighting refers to the salience nudge, which was implemented by applying a colored background to the nudge option. The default nudge was implemented in a way that ensured that the desired option was already selected when the page opened. The social information nudge uses people's tendency to seek social acceptance and to adhere to the norms and expectations (Caraban et al., 2019, p. 7). The social information nudge in this study was applied as an additional text above the nudged recipe stating: "90% of other people liked this." (Jesse et al., 2021). The warning nudge differs from the previously mentioned nudges of this study, in that it aims to influence respondents' choices after they have already made their initial decision. Jesse et al. (2021) do this by providing additional information to the respondents regarding their chosen option. The findings of the study show that all nudges had

a positive impact on healthier recipe choices. The effect was especially strong when nudges were combined, as shown in the hybrid nudge, which combined the default and social information nudges. This study demonstrates that nudges can be an effective tool in the domain of food choices in digital environments (Jesse et al., 2021).

In their study, Jesse et al. (2021) examined a variety of nudges, part of which can be described as verbal and visual. Roozen et al. (2021) used a combination of verbal and visual nudges in their study to promote behavioral change in the fashion industry. Respondents were directed to a simulation of a website from H&M. They were asked to choose between two black t-shirts, one of which was more sustainable. The more sustainable option was nudged, except in the control condition where no nudge was used. For the verbal nudge, a text was added next to the sustainable t-shirt stating that it is a conscious choice that helps improve sustainability in the fashion industry. For the visual nudge, participants were first shown a webpage featuring visuals from H&M's conscious collection, including a sustainability icon and green colors to emphasize the eco-friendly nature of the collection. After viewing this page, participants were directed to the product page with the two t-shirt options, as in the control condition. The results showed that mostly the verbal, and to a lesser extent the visual nudge, both had a positive effect on participants choosing the more sustainable product (Roozen et al., 2021). This study demonstrates that nudges can be an effective tool in the domain of sustainable fashion.

Next two promising types of nudges will be discussed: the verbal nudge in section 2.4, and the visual nudge in section 2.5.

2.4 The verbal nudge

Previous studies have shown that nudging is an effective tool for behavioral change (Jesse et al., 2021; Landais et al., 2020; Nurchis et al., 2023; Ortmann et al., 2016; Peeters et al., 2013; Roozen et al. 2021). There are many ways of nudging, but verbal nudges have

emerged as promising tools for behavioral change (Jesse et al., 2021; Roozen et al. 2021). Verbal nudges use spoken or written language to influence people's behavior or decision-making in a positive direction without restricting their freedom of choice (Jesse et al., 2021; Mehenni et al., 2020; Roozen et al. 2021). There exist various kinds of verbal nudges. It can be for instance a descriptive norm, a warning, or additional information.

Descriptive norms are rules that people feel inclined to follow to fit in with the crowd (Cialdini et al., 1990). Goldstein et al. (2008) investigated the use of descriptive norms in environmental conservation programs. The researchers wanted to examine the difference in descriptive norms on traditional messages, to encourage guests to reuse their towels to promote environmentally friendly behavior. The guests were either exposed to a descriptive norm message or a traditional message on the bathroom towel rack. Guests were informed by the descriptive norm message which states that 75% of other guests engage in the program of reusing towels to save the environment (Goldstein et al., 2008, p. 474). In the traditional message guests were not presented with descriptive information and only the general message to respect nature and contribute to environmental conservation by reusing towels (Goldstein et al., 2008, p. 473). The results showed that descriptive norms were significantly more effective than traditional messages for promoting environmentally friendly behavior (Goldstein et al. 2008).

Another form of verbal nudging is the warning message. Rene and Nuria (2016) tested the effectiveness of warning messages in minimizing cybersecurity risks. An experiment was conducted using an online store where participants were instructed to purchase a desktop wallpaper. In the warning condition, participants were confronted with a series of warning messages which appeared on their screen. These warning messages alerted them to various cybersecurity risks. In the control condition, the pop-ups only reminded participants to navigate the online environment safely, not warning them of specific risks. The results

showed that the warning messages had a positive effect on the behavior of the participants, encouraging them to take steps to minimize cybersecurity risks (Rene & Nuria, 2016).

In addition to the descriptive norms and the warning messages, informational nudges are another verbal nudge approach to promote behavioral change. Nelson et al. (2021) used an information nudge to study plastic bag use aimed at promoting pro-environmental behavior at convenience stores. The researchers used positive, negative, or no informational messages to assess whether there were differences in the number of individuals purchasing a plastic bag. Additionally, the researchers instructed cashiers to ask customers whether they wanted a bag, while in the other condition, they were instructed not to ask this question. The informational nudge was presented in the form of a display on the counter, featuring a turtle eating a plastic bag. The text on the display was either positively or negatively framed, stating in the positive condition "Do you really need a plastic bag? Refuse it! And you will save the ocean!" and in the negative condition "Do you really need a plastic bag? Refuse it! Or you will destroy the ocean!). The results indicate that regardless of whether the cashier asked about the customer's preference for a plastic bag, the informational nudge had a positive effect on environmentally friendly behavior and reduced plastic bag purchases. Moreover, the positively framed message showed a slightly greater effect on plastic bag purchases compared to the negatively framed message, although this was not significant (Nelson et al., 2021).

Another example of the efficacy of the verbal nudge as a tool for behavioral change can be found in the study by Roozen et al. (2021), which was described in section 2.3. They used the additional information nudge approach to influence positive behavior on sustainable fashion choices, which was significantly effective.

The effect of a verbal nudge on healthier food choices was also examined by Mazza et al. (2017). Multiple choice interventions were studied alongside traffic light labeling, including health messages. The researchers implemented the choice interventions

independently of one another throughout a 21-month field study conducted in a cafeteria. The researchers specifically focused on the products drinks and chips. In the health message interventions, customers of the cafeteria were unknowingly subjected to health messages in the cafeteria stating the percentage of daily calories for drinks and how much exercise was needed to burn off the calories of the chips. The results indicated that only the health message regarding the amount of exercise required to burn off the calories in chips demonstrated a significant impact in the desired direction (Mazza et al., 2017). This suggests that health messages may be an effective tool for promoting behavioral change regarding food choices.

As has been seen, verbal nudges can take on various forms. The effects of verbal nudges in the context of supermarket applications, however, still await further study. Previous studies in other domains suggest that verbal nudges may be a promising tool.

2.5 The visual nudge

In addition to verbal nudges, visual nudges have also emerged as a promising tool for behavioral change (Jesse et al., 2021; Roozen et al. 2021). Visual nudges use graphics, colors, and symbols to influence people's behavior or decision-making in a positive direction without restricting their freedom of choice (Cadario & Chandon, 2020; Jesse et al., 2021; Roozen et al. 2021). Visual nudges exist and have been studied in various domains (Cadario & Chandon, 2020, p. 7). It can be for instance an emoji, highlighting salience, or additional information.

De Brouwer (2022) tested the use of the emoji nudge on consumer behavior towards meat consumption. Participants were instructed to select one of two products from a simulated supermarket application. The more sustainable product was presented with an emoji and was placed alongside the more sustainable product on the product page. The results show that the emoji had a positive effect on green consumer behavior, as participants were more likely to select the nudged option (De Brouwer, 2022). This indicates that using emojis as a visual nudge can be an effective tool to promote behavioral change.

Another example of the efficacy of the visual nudge as a tool for behavioral change can be found in the study by Blom et al. (2021). They tested the effect of the salience nudge on making healthier food choices. The participants were instructed to buy four products from different categories in an online supermarket environment. In each product category, the healthier option was made more salient using an orange frame around the product, which was not present in the control condition. Framing the product in this way highlights and differentiates it from the other products in the category. The results of the experiment show that the salience nudge significantly increases healthy food choices (Blom et al., 2021). This indicates that the salience nudge could be a good tool for positively influencing behavior regarding food choices.

A similar experiment was conducted by Van Gestel et al. (2021). They tested the effect of default and salience nudges on healthier product choices. In one of the conditions, they set the healthier option as the default option and made it more salient by making the product appear larger on the screen than the other products. The results show that these nudges had a significant effect on the healthier product choice. This indicates that the salience and default nudge combined are promising tools for behavioral change.

Another approach to encourage positive behavioral change is providing information. This information can be provided visually as Lee et al. (2020) did in their experiment. In this experiment, the researchers wanted to test if applying a green logo would promote sustainable fashion choices. In the experiment, the researchers implemented a green logo on a product label, which was either present or absent. The participants were instructed to select their preferred fashion product, with the sustainable options being presented with the logo and the other product without the logo. The results demonstrated a significant increase in the number of participants choosing a sustainable fashion item when seeing the green logo (Lee et al.,

2020). The results show that an informational nudge, in the form of a logo, can positively influence sustainable behavior.

Another example of the efficacy of the visual nudge as a tool for behavioral change can be found in the study by Roozen et al. (2021). They used green visualizations on a simulated website page from H&M to promote sustainable fashion choices. These visualizations turned out to be significantly effective in promoting positive behavioral change. This study by Roozen et al. (2021) is described in more detail in chapter 2.3.

Visual nudges can take on numerous forms, as demonstrated by the previous examples. Most research has not yet been done on the effects of visual nudges in the context of supermarket applications. Nonetheless, prior research indicated that visual nudges could be an effective tool for behavioral change.

2.6 The research question and hypotheses

As demonstrated by prior studies on nudging, both verbal and visual nudges have shown potential to influence behavioral change towards healthier food choices. So far, no research has been done on verbal and visual nudges in the context of healthier food choices in supermarket applications. Therefore, this study has the following research question:

RQ: *"What is the effect of verbal and visual nudges on healthy food choices on supermarket applications among Dutch residents?"*.

Based on the studies from Goldstein et al. (2008); Jesse et al. (2021); Mazza et al. (2017); Mehenni et al. (2020); Nelson et al. (2021); Rene and Nuria (2016); Roozen et al. (2021), hypothesis 1 has been formulated:

H1: *Verbal nudges will lead people to choose more healthy choice options than no verbal nudges within supermarket applications.*

Based on the studies from Blom et al. (2021); Cadario & Chandon (2020); De Brouwer (2022); Jesse et al. (2021); Lee et al. (2020): Roozen et al. (2021); Van Gestel et al. (2021), hypothesis 2 has been formulated:

H2: *Visual nudges will lead people to choose more healthy choice options than no visual nudges within supermarket applications.*

To see whether the effect of healthy choices is even stronger when both nudges are combined, hypothesis 3 has been formulated:

H3: *Verbal and visual nudges combined will lead people to choose the healthy choice options the most than no verbal and visual nudges within supermarket applications.*

3. Method

3.1 Design

To test the hypotheses and to answer the research question a 2x2 within-subjects design was used, with "*verbal nudge*" (present or absent), and "*visual nudge*" (present or absent) as independent variables. They were tested with a within-subjects design, so all participants would be presented with all conditions. The dependent variable of the study was the *purchase choice*, which indicates the extent to which participants choose the healthier/more sustainable option or not. The four conditions of the experiment are displayed in Table 1.

Table 1:

Conditions experiment

Condition	Verbal nudge	Visual nudge
1	Present	Absent
2	Absent	Present
3	Present	Present
4	Absent	Absent

3.2 Participants

In total 167 participants were recruited. However, 39 participants were excluded from the analysis as they did not meet the requirements. Of these participants 23 did not finish the survey, 10 had another diet than omnivore, and 6 did not live in the Netherlands. Consequently, the data of 128 participants were included in the study of which 64.8% identified as female ($N = 83$) and 35.2% as male ($N = 45$). Participants' ages ranged from 19 to 77 years old ($M = 35.27$ years, $SD = 16.47$), and most participants were highly educated and had a University (Bachelor/Master/PhD) degree. Most participants had a monthly disposable income between 2000 to 3000 euros ($N = 32$). The next largest group had an income between 500 to 1000 euros ($N = 29$), followed by those with an income between 1000 to 2000 euros ($N = 23$). Additionally, 68.8% of the participants indicated that they use a supermarket application, which they mostly use to seek offers. The participants were randomly assigned to one of four lists. See Table 2 for the distribution.

Table 2:

Distribution of participants per condition

	List			
	1	2	3	4
Number of participants per list	($n = 33$)	($n = 30$)	($n = 32$)	($n = 33$)

The respondents were recruited through convenience sampling by using the network of the researcher (Treadwell, 2010, p. 255) and by snowball sampling (Treadwell, 2010, p. 256). The data was collected and stored in a safe environment and will be deleted at the end of the study.

3.3 Stimuli

The experiment took place in a self-created online simulation of the Albert Heijn application in Qualtrics. The product search page of Albert Heijn was shown to participants. Albert Heijn is the leading supermarket in The Netherlands for grocery shopping, both online and in-store (Deloitte Branchegroep Retail, 2023, pp. 8–9). The Albert Heijn application (Appie) was selected for the experiment as it is the most-used supermarket application among Dutch consumers in 2022 (Deloitte Branchegroep Retail, 2023, pp. 37).

Participants were presented with twelve product pages, each featuring a 'regular' food product and a healthier/more sustainable alternative. The featured products were derived from supermarket food categories, such as fruits & vegetables, meat, fish, dairy, bread, and snacks (Deloitte Branchegroep Retail, 2023, pp. 31–32). Respondents were presented with twelve choices in total. Making multiple choices was necessary for this research because the effect of the manipulation becomes apparent only through the repetition of the test. Moreover, it was interesting to see whether the effect differs across the presented products. An overview of all stimuli can be found in Appendix A. The order of the presented products was the same in all the lists, but the presence or absence of the nudges differed for each product in the lists. The four lists were made to ensure that each product would be shown three times with every type of nudge. The participants were randomly assigned to one of the four lists. The distribution of the conditions across product categories and the lists is shown in Table 3. The numbers in the cells refer to the condition codes in Table 1.

Table 3:

Distribution of conditions across product categories per list

Product category	List 1	List 2	List 3	List 4
Tomatoes	4	1	2	3
Bananas	1	2	3	4
Chicken filet	2	3	4	1
Minced meat	3	4	1	2
Shrimps	4	1	2	3
Salmon	1	2	3	4
Quark	2	3	4	1
Yogurt	3	4	1	2
Bread	4	1	2	3
Bake-off bread	1	2	3	4
Potato chips	2	3	4	1
Candy	3	4	1	3

To offer participants a realistic situation and to avoid offering the more sustainable option for free, the healthier/ more sustainable product was higher in price than the regular product. This is based on reality as healthier/more sustainable products are often more expensive than unhealthier alternatives (Lewis et al., 2023, pp. 12–13). The shown prices were based on the actual prices from Albert Heijn (Albert Heijn, n.d.-b). Moreover, the pictures next to the regular and healthier/more sustainable products were the same to minimize the risk of bias toward choosing a certain product due to familiarity or preference for the picture. Furthermore, to prevent interference and to ensure that the results were only influenced by the nudges, the Nutri-Scores displayed next to the products were removed.

The participants saw each of the four conditions three times. The product page of the verbal nudge condition contained the sentence "This product promotes a healthy lifestyle and contributes to a more sustainable society" by the healthier product. A similar statement was used in previous research to influence food choices among consumers positively (Thomas et al., 2017, p. 1028; Theunis, 2023, p. 11). An example of a verbal nudge used in the experiment is shown in Figure 1.
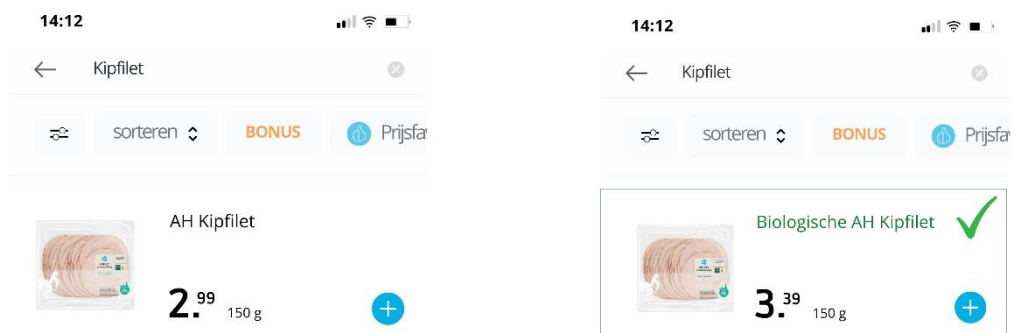
Figure 1

Condition 1: verbal nudge
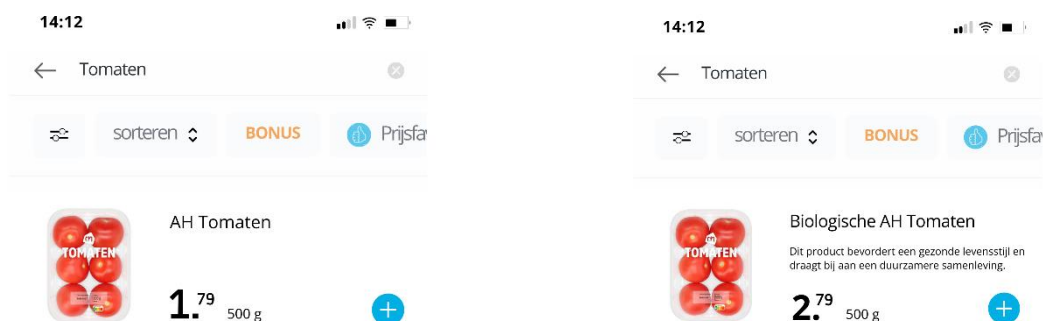
The visual nudge design was inspired by Van Gestel et al. (2021, p. 11), which showed that consumers are more prone to purchasing healthier products when they stand out from others, such as being highlighted by a box. Also, the healthier products were highlighted with a green check mark, as people hold positive associations with the check mark (Yoon & Vargas, 2018, p. 686). The color green was chosen as people associate green with sustainability and health (Sun & Wu, 2023, p. 7). An example of a visual nudge used in this experiment is shown in Figure 2.
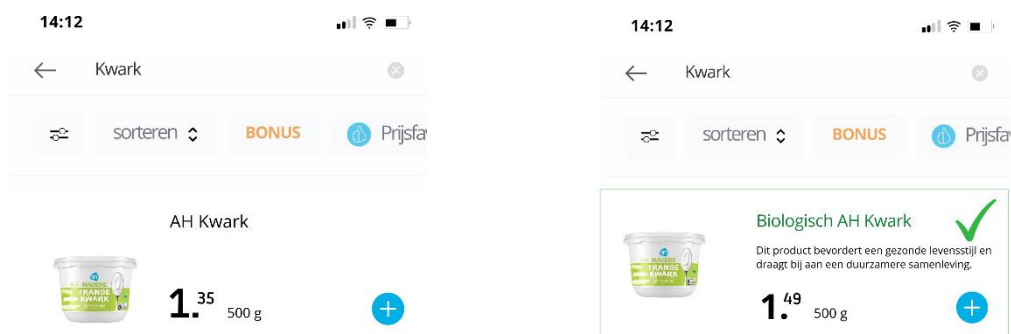
Figure 2

Condition 2: visual nudge

The third condition was a combination of the visual and verbal nudges. This involves using the same verbal text as in condition 1, combined with the check mark and the green box from the visual nudge, in condition 2. An example appears in Figure 3.
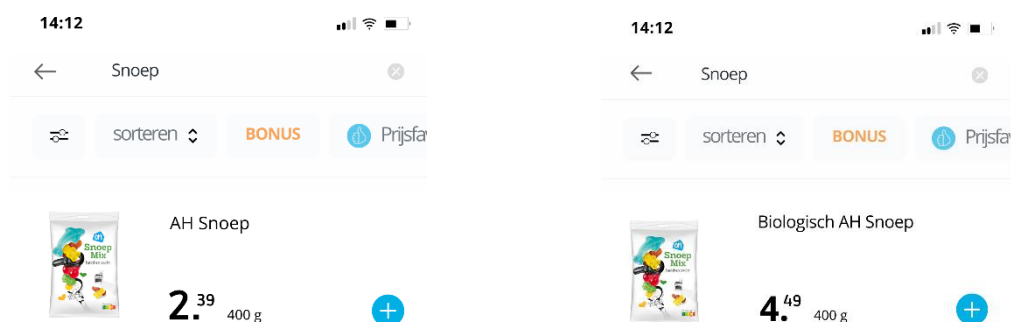
Figure 3

Condition 3: verbal and visual nudge

In the fourth control condition, no nudges are present. Here only the price and the name of the healthier/more sustainable alternative are different in comparison to the regular product. An example is shown in Figure 4.

Figure 4

Condition 4: control condition

3.4 Instruments

The main dependent variable was participants' actual choices, which were to be made twelve times for each product combination. Moreover, to find out information on participants' familiarity with supermarket applications, additional questions were asked. Whether and for what purpose participants used supermarket applications was measured by six 5-point Likert scale questions (1= *never*, 5= *always*). These included questions like; "How often do you use a supermarket application to find products" and "How often do you use a supermarket application to make a shopping list".

Finally, to find out how healthy participants perceive their behavior toward food to be, additional questions were asked. Participants' attitude towards sustainability and health was measured by eight 5-point Likert scale questions (1= never, 5= always) (α = .72). These included statements like; "I read food labels to decide which products to buy" and "I am aware of my eating habits".

3.5 Procedure

Participants received a link that led them to the cover page of the survey. This cover page contained information about the study, the expected duration, the procedure, and the informed consent. See Appendix B for the whole survey. When participants gave consent,

they were led to demographic questions regarding their gender, age, highest earned degree, location, type of diet, and disposable income. Respondents with a diet other than omnivore were excluded from the study due to the strong likelihood that they would choose the healthier/more sustainable option when it comes to meat and dairy products. Moreover, participants living outside The Netherlands were excluded from the study.

After the demographic questions, participants were informed about what a supermarket application is. This explanation was followed by the question of whether they use a supermarket application. If this was the case, they were directed to a Likert scale which questioned for what purpose participants use a supermarket application.

After these questions, participants were randomly assigned to one of the four lists. Then participants were informed what the experiment entailed (*e.g., "You will be doing groceries in the Albert Heijn supermarket application. You will be shown 12 products, each with two choice options."*) and what they had to do (*e.g., Choose the item you want and click the arrow at the bottom of the page to move on to the next product.*). They then moved on to the actual experiment where they had to select one of the two shown products.

After this they were asked a control question, to see whether they paid attention and if they noticed differences between the choice options. Hereafter, participants were presented with a 5-point Likert scale to measure their attitude towards health and sustainability. Finally, participants were thanked for their participation and debriefed about the purpose and the experiment in the survey.

3.6 Statistical analysis

All collected data was exported to SPSS version 28.0.1.0 and all non-relevant information such as IP addresses and personal data were removed. The hypotheses are tested through a factorial ANOVA. This test was relevant as the data had a continuous dependent variable (sum score healthy choices) and two independent variables (verbal nudge, visual

nudge, and combination of the verbal and visual nudge) (Field, 2018, p. 900). Moreover, a loglinear analysis was performed to test whether the nudge types had different effects on food choices across the twelve product categories. The loglinear analysis is the appropriate method to examine the relation between multiple categorical variables (Field, 2018, p. 1246). Furthermore, a simple-linear regression was used to test whether the self-perceived health behavior influences the food choices respondents made. Finally, a one-way ANOVA was performed to test whether the height of the net income influences the food choice.

4. Results

This chapter will present the results of the data analysis. First, in section 4.1 the effects of the verbal nudge, visual nudge, and the combination of both nudges will be tested against the control condition. Then in section 4.2, it will be tested whether there is a different effect across the product categories for the nudge types. Moreover, in section 4.3 it will be analyzed whether self-reported health behavior influences food choice. Finally, in section 4.4 it will be tested whether the height of one's net income influences the food choice.

4.1 The effects of the verbal and visual nudges

To test the hypotheses; verbal nudges will lead people to choose more healthy choice options than no verbal nudges within supermarket applications (H1), visual nudges will lead people to choose more healthy choice options than no visual nudges within supermarket applications (H2), and verbal and visual nudges combined will lead people to choose the healthy choice options the most than no verbal and visual nudges within supermarket applications (H3), a factorial ANOVA was performed. The effect of the verbal, visual, and the verbal and visual nudges combined, was tested against the control condition (no nudge). This was tested by a summation of the two choice variables, which are (0) the regular product and (1) the healthier/ more sustainable product. The summation resulted in the formation of a

scale variable with a possible worth range of 0 (representative of 12 times the regular product is chosen) to 12 (representative of 12 times the healthier product is chosen).

First, the assumptions of the ANOVA were examined. The sum scores were normally distributed for the verbal nudge (z-score skewness = 0.77 and z-score kurtosis = -0.85), the visual nudge (z-score skewness = 1.43 and z-score kurtosis = 0.37, the combination of the verbal and visual nudge (z-score skewness = 1.80 and z-score kurtosis = -0.22), and the no-nudge condition (z-score skewness = 1.56 and z-score kurtosis = -0.10). And the assumption of homogeneity was met, because Levene's test of equality of error variances was not significant, $F(3, 116) = 0.321$, p = .810).

The mean choice scores are shown in Table 4.

Table 4:

Means and standard deviations of the sum healthy food choice per type of nudge.

	Verbal nudge ($n = 30$)	Visual nudge ($n = 30$)	Verbal & visual nudge ($n = 30$)	No nudge ($n = 30$)	Total ($n = 120$)
Sum score healthy food choice	2.07 (1.68)	2.17 (1.77)	2.10 (1.79)	1.73 (1.41)	2.03 (1.64)

The factorial ANOVA showed no main effect of the verbal nudge, $F(1, 116) = 0.08$, $p = .782$, $\eta_{partial}^2 = .001$. The sum scores for the no-verbal nudge condition were lower ($M = 1.98$ $SD = 1.61$) than for the verbal nudge condition ($M = 2.07$ $SD = 1.68$). However, this difference was not significant. Therefore, the first hypothesis (H1) that verbal nudges will lead people to choose more healthy choice options than no verbal nudges within supermarket applications, is not supported.

The ANOVA showed also no main effect for the visual nudge, $F(1, 116) = 0.89$, $p = .348$, $\eta_{partial}^2 = .008$. The sum scores for the no-visual nudge condition were lower ($M = 1.88$ $SD = 1.50$) than for the visual nudge condition ($M = 2.17$ $SD = 1.77$). However, this difference was also not significant. Therefore, the second hypothesis (H2) that visual nudges

will lead people to choose more healthy choice options than no visual nudges within supermarket applications, is also not supported.

Finally, there was no interaction effect between the verbal and visual nudge on healthy food choices, $F(1, 116) = 0.52$, $p = .473$, $\eta_{partial}^2 = .004$. Therefore, the third hypothesis (H3) that verbal and visual nudges combined will lead people to choose the healthy choice options the most than no verbal and visual nudges within supermarket applications, is also not supported.

Figure 5 illustrates the interactions between the verbal and visual nudges. The graph shows that the nudged conditions, whether combined or single, are higher than the control condition. However, the differences are not significant.

Figure 5

The interaction effect of the verbal and visual nudge on food choices
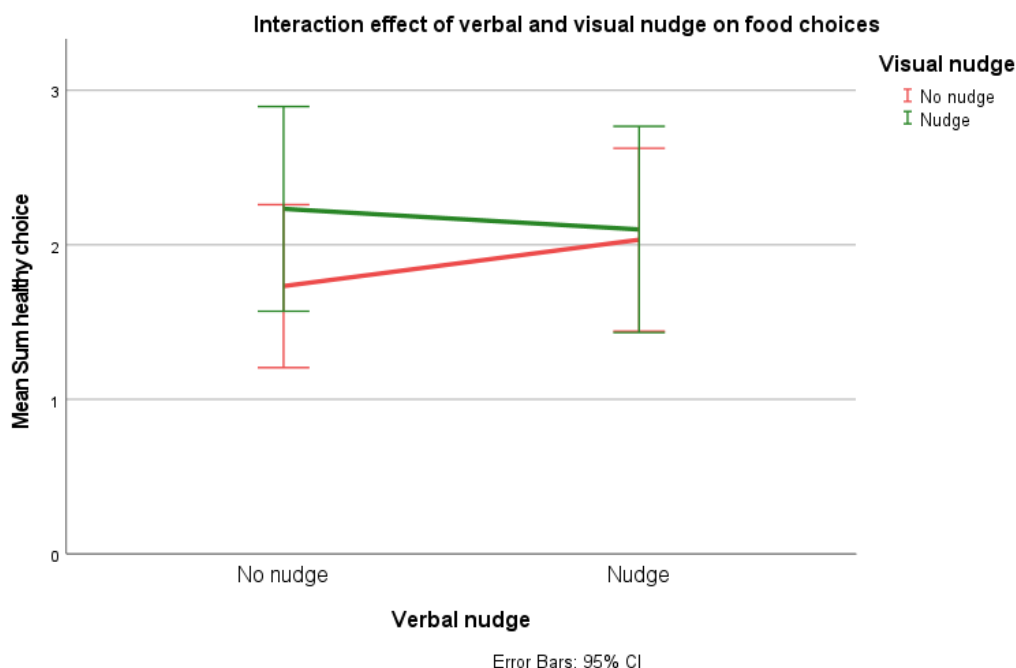
4.2 The effects of the verbal and visual nudge across product categories

To see whether the nudge types produced effects on the food choices, a loglinear analysis was performed. The analysis concerned choices for the 12 products separately. The

effects on the food choice were tested by the two food choice variables, which are (0) the regular product and (1) the healthier/ more sustainable product.

The loglinear analysis produced a final model that retained the verbal x visual x food choice interactions. The likelihood ratio of this model was $\chi^2(0) = 0$, $p = 1$. This indicated that the highest-order interaction (the verbal nudge x visual nudge x food choice interaction) was significant, $\chi^2(1) = 6.23$, $p = .013$. However, the two-way interactions (verbal nudge x food choice) and (visual nudge x food choice) were not significant, $\chi^2(3) = 2.68$, $p = .443$.

Moreover, loglinear analyses for each product separately were performed. However, none of these analyses produced significant two-way interactions. So, all in all these analyses confirm the previous analysis that the nudges did not influence people's separate product choices.

4.3 The effect of self-reported health behavior on healthy food choices

As there is no effect of the nudge types on food choice, further testing is needed to determine what may make a difference. Therefore, the study will look at whether self-perceived health behavior influences the choices respondents made. Since the within-subject design of the study does not allow the use of standard mediation analysis techniques, a simple linear regression was used to test to what extent self-reported health behavior influences people's food choices.

First the assumptions were tested. There were six cases (4.7%) with standardized residuals larger than 2 and the largest Cook's distance was 0.19, so there are not too many outliers or influential cases. The residuals were independent (Durbin-Watson = 1.94), but the distribution of the residuals showed skewness (z-score = 7.13) and kurtosis (z-score 5.52). Therefore, the regression was run again to get a bootstrapped confidence interval of the coefficient.

The regression model was run with the mean score of the self-reported health behavior scale as a predictor and the sum score of healthy choices as outcome variable. The self-reported health behavior scale had an acceptable reliability ($\alpha = .78$). It was measured with eight statements (e.g., *I choose healthier products over cheaper alternatives*) on a 5-point Likert Scale (1 = never, 5 = always). On average, participants scored 3.45 ($SD = 0.45$) on the self-reported health behavior scale. Given that it was measured on a 5-point scale, this means that people score relatively average on this scale. The mean residuals of the healthy choices were 2.15 ($SD = 2.84$).

The regression model was not significant ($R^2 = .01$, $F (1, 126) = 1.45$, $p = .231$), and it explains only 1% of the variance in food choices could be explained. Self-perceived health behavior is not a significant predictor of healthy food choices ($b = 0.67$, $\beta = .11$, $t(126) =$

1.20, $p = .231$). One point higher on the self-perceived health behavior scale increases the difference between predicted and actual preferences by 0.67 points.

Bootstrapping was performed to get a bootstrapped confidence interval of the coefficient. The bootstrapped 95% confidence interval ranged from -0.62, 1.90 so we can be 95% confident that self-perceived health behavior is not related to healthy food choices. Overall, it can be concluded that self-perceived health behavior does not influence healthy food choices. A scatter plot of the frequencies of healthy choices by the mean scores of the self-perceived health scale can be seen in Figure 6.

Figure 6

Scatter Plot of frequencies of healthy choices by mean scores of self-perceived health scale
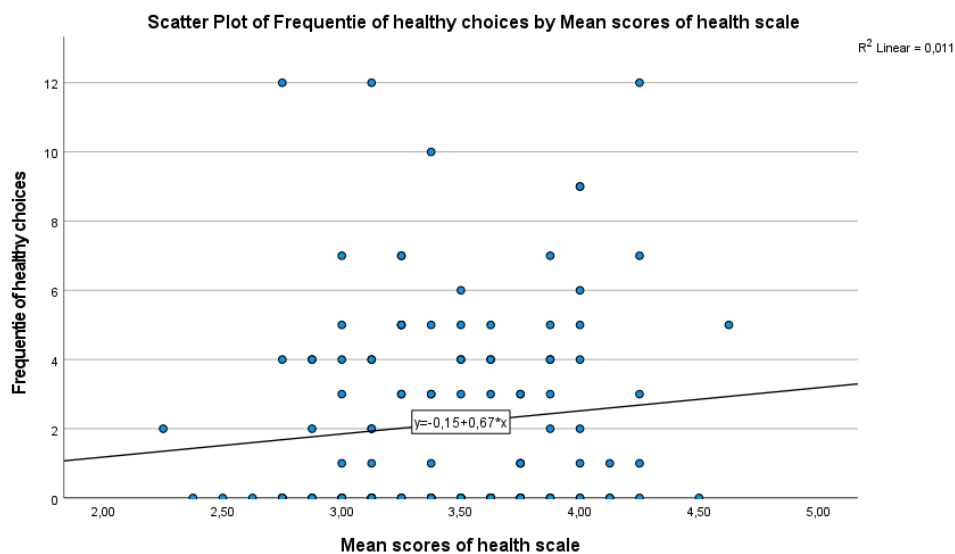
4.4 The effect of net income on food choice

A one-way ANOVA was used to test to what extent the height of the net income influences people's food choices. Net income scores were converted into three equal income groups: low net income (0 to 1000 euros, $n = 47$), medium net income (1000 to 3000 euros, $n = 55$), and high net income (3000 and higher, $n = 24$).

Food choice scores were not normally distributed for low net income (z-score skewness = 4.76 and z-score kurtosis = 6.04) and medium net income (z-score skewness = 6.03 and z-score kurtosis = 6.78), but they were normally distributed for high income (z-score skewness = 1.43 and z-score kurtosis = -0.61). Therefore, the bootstrapped confidence intervals of the differences will be reported. The assumption of homogeneity was met. The Variance Ratio was 2.24.

On average respondents with a low income had a mean score of 2.00 ($SD = 2.49$), respondents with a medium income of 1.73 ($SD = 2.59$), and respondents with a high income of 3.50 ($SD = 2.86$). The overall ANOVA was significant, indicating that there are differences

in the healthy food choices respondents make depending on the height of their net income, F (2, 123) = 3.47, p = .034, η^2 = .05.

Post hoc tests using Bonferroni correction indicate that the mean score for the respondents with a medium net income was significantly different than the respondents with a high net income, $Mdif$ = -1.77, p = .033, d = -0.17, BCa 95% CI [-3.44, -0.11]. No significant differences were found for respondents with low net income and a medium net income, $Mdif$ = 0.27 p = 1.000, d = 0.04, BCa 95% CI [- 1.08, 1.62], and low net income and high net income $Mdif$ = - .0.13 p = .105, d = -0.15, BCa 95% CI [- 3.21, 0.21]. In general, the data suggests that the height of the income influences healthy food choices. Specifically, the results suggest that when respondents have a high income, they are more prone to making healthier food choices than people with a medium net income.

5. Conclusion and Discussion

To study the effects of verbal and visual nudges on healthy food choices of consumers, the following research question was addressed: *"What is the effect of verbal and visual nudges on healthy food choices on supermarket applications among Dutch residents?"*.

This section will present the conclusions of this study. Additionally, some explanations for the results will be discussed, as well as some limitations and suggestions for future research, and the study's practical implications.

5.1 Conclusion

The study focused on the effects of verbal and visual nudges on consumer's healthy food choices. The results of the experiment showed that net income is the primary factor influencing healthy food choices, rather than the verbal and visual nudges. The analysis showed that individuals with higher net income tend to make more healthy choices. Since healthier/ more sustainable products are often higher in price, consumers are more likely to buy the regular, cheaper alternatives. This result occurred regardless of the presence of a

verbal nudge, therefore no support was found for hypothesis 1: V*erbal nudges will lead people to choose more healthy choice options than no verbal nudges within supermarket applications.* Also, no support was found for the second hypothesis: V*isual nudges will lead people to choose more healthy choice options than no visual nudges within supermarket applications.* Finally, the third hypothesis: V*erbal and visual nudges combined will lead people to choose the healthy choice options the most than no verbal and visual nudges within supermarket applications,* was also not supported. The results indicated that both nudges combined did not have the strongest effect on healthy food choices. In fact, the strongest effect on healthy food choices came from the visual nudge, without the verbal nudge present. Therefore, it can be assumed that the combination of the verbal and visual nudge also did not significantly push people into making healthier food choices.

In addition, analyses were conducted for each product to determine if there were different effects between products. However, this was also not the case. Furthermore, analyses for self-perceived health behavior showed no effect on healthy food choices. In other words, whether people perceived they had healthy or unhealthy health behavior towards food, did not affect the food choices they made.

So, to answer the research question, verbal and visual nudges have no effect on healthy food choices in supermarket applications among Dutch residents.

5.2 Discussion

No support was found for the first hypothesis, which predicted that verbal nudges would lead to more healthy food choices. This is in contrast with previous literature, that did find a positive effect of verbal nudges on positive behavioral change (Goldstein et al., 2008; Jesse et al., 2021; Mazza et al., 2017; Mehenni et al., 2020; Nelson et al., 2021; Rene and Nuria, 2016; Roozen et al., 2021). One possible explanation for the lack of support for the first hypothesis may be that the information provided by the nudge was too general, and not

tailored to the presented product. It is suggested that the effectiveness of verbal nudges depends on how precise the information reflects the specific product (Goldstein et al., 2008). Perhaps that more tailored information may actually influence people's choices, rather than general verbal messages (Goldstein et al., 2008; Van Der Laan & Orcholska, 2022). This tailored information could be added to enhance the beneficial components of for example a healthier bread product. It can be emphasized that the bread contains an increased number of fibers, highlighting that the product is a healthier alternative compared to other types of bread.

Additionally, in contrast to what was the case in previous research, here no support was found for the second hypothesis, which predicted that visual nudges would lead to more healthy food choices (Blom et al., 2021; Cadario & Chandon, 2020; De Brouwer, 2022; Jesse et al., 2021; Lee et al., 2020; Roozen et al., 2021; Van Gestel et al., 2021). A possible explanation as to why visual nudges do not affect healthy food choices may be the visuals used in the experiment. It is suggested that the effectiveness of the nudge depends on the attractiveness of the product images. The more visually attractive the image is, the higher the effect of the nudge (Cadario & Chandon, 2020; Kees et al., 2006). This study used green text, a green box, and a check mark to enhance the healthier alternative. However, the study did not address how people perceived these interventions. It may be that people did not perceive the interventions as visually attractive and therefore opted for the other product that did not have these interventions.

Finally, no support was found for the third hypothesis, which predicted the strongest effect being of the verbal and visual nudges combined on healthy food choices. A possible explanation for this result may be that the two nudge types canceled out the positive effect. As can be seen in Figure 5 the visual nudge scores the highest on healthy food choices. However, when the verbal nudge and the visual nudges are combined, the score of healthy food choice is lower. It is suggested that overemphasizing the healthier alternative threatens individuals'

freedom of choice, leading them to choose the non-nudged option instead (Brehm & Brehm, 1981; Van Der Laan & Orcholska, 2022).

Perhaps the non-significant results can also be explained by the experimental design of the study. Roozen et al. (2021) used a simulation of the H&M website in their study. A website is a common platform for purchasing clothes. In contrast, this study focused on nudging healthier choices in supermarket applications, yet participants completed the survey via a laptop or phone browser, which differs from an actual application. This discrepancy in not using an application for the experiment could be a critical factor in the observed outcomes. The lack of an actual application for the experiment may have affected its validity, as the different environment may have influenced participants' behavior.

Furthermore, the lack of effects could be due to how the products were displayed in the experiment. In this study, the regular product, which was mostly chosen, was consistently displayed on the left, while the healthier/more sustainable alternative was on the right. However, Vecchio and Cavallo (2019) demonstrated that displaying healthy items to the left of unhealthy items increases the preference for the healthy options.

Additionally, the lack of support for the hypotheses could be because predetermined products were presented in the experiment. Individual differences in food preferences may mean that not all participants would be interested in purchasing the presented products. In the experiment, it could have been the case that participants did not desire the products in the experiment and therefore chose the cheaper option for those products.

Moreover, the price differences between the products could have been of great influence. For some products, the price differences between the regular option and the healthier alternative were substantial. Therefore, the higher prices of healthier options may have reduced the impact of the nudges, as participants might have been discouraged from choosing these options due to the price.

5.3 Limitations and suggestions for future research

This study has several limitations and therefore also suggestions for future research. First, for the verbal nudge, it is recommended to tailor the information added to the product specifically to that product. A limitation of this study is that for the verbal nudge general statements were added to the healthier/ more sustainable alternative. However, previous research indicates that tailoring the message to products specifically increases the effect of the verbal nudge (Goldstein et al., 2008). Therefore, future research may consider customizing the verbal nudge information for each product.

In addition, for the visual nudge, more focus should be placed on making the images of the healthier alternative products more visually attractive. This study only limitedly investigated how the visualizations would be perceived, and it may be that participants did not find the interventions visually attractive. Previous studies have indicated that an attractive image leads to a higher effect of the nudge (Kees et al., 2006). Therefore, future studies should focus more on the design features of the visual nudge and how participants perceive these designs.

Moreover, future research should take freedom of choice more into account when combining the two verbal and visual nudges. A combination of these nudges may overwhelm individuals, leading to them restoring their autonomy and resisting the influence (Brehm & Brehm, 1981; Van Der Laan & Orcholska, 2022). Therefore, while combining these nudges may have potential, the balance between the presentation of the two together should be carefully considered.

Furthermore, the experimental design of the study should be taken into further consideration. A limitation of this study is that participants did not complete the experiment in an actual supermarket application. Future research that aims to conduct a similar experiment

on supermarket applications, should consider designing a working application for the experiment, as this adds to the authenticity and maybe even the outcome of the experiment.

Moreover, the order of how the products are displayed should be taken into account. Another limitation of the study is that the regular item was consistently displayed on the left and the healthier alternative on the right. To test whether the results depend on the nudges rather than how the products are displayed, it would be advised to vary the order in which the regular products and the healthier/more sustainable alternatives are presented.

Furthermore, focus should be put on what products would be visible in the experiment. Now the study used pre-selected products in the survey, which may not be desired by everyone. Future research could consider allowing participants to select products themselves before applying the nudges. This approach ensures that the nudges are applied to products that participants are actually interested in, which may make the experiment more reliable and realistic.

Finally, a limitation of the study was the price differences between the regular and healthier alternatives, which were substantial for some products. To verify whether the choices people make are solely dependent on the nudges, future research could remove the price differences completely. This may enhance the effect of the nudges and give more information on which nudge types are effective and which are not.

5.4 Implications

The findings of this study suggest several practical implications for improving healthier food choices. As mentioned in section 5.1, it were not the nudges that influenced healthy food choices. Instead, it was observed that a higher net income results in more healthy food choices. Therefore, future studies are encouraged to use the findings from this study to further investigate what nudges would be effective in promoting healthier behavior toward food.

The effect of verbal and visual nudges on food choices within supermarket applications has not been studied over the years. This study has contributed to existing literature on consumer behavior regarding verbal and visual nudges in this domain.

Moreover, the finding that self-perceived health behavior does not affect food choices could be valuable for organizations aiming to promote healthier behavior. It suggests that regardless of how healthy individuals perceive their behavior to be, their actual food choices are unaffected.

All things considered, this study adds to the current literature on verbal and visual nudges and the effect they have on positive behavioral change toward food. The findings can be used by companies to consider the design of their applications to promote healthier behavior toward food, which is in line with the National Prevention Agreement (Kloosterman et al., 2023).

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Appendix A: Stimuli

The following link leads to the stimuli of the experiment: [click here to see the stimuli](#).

Appendix B: The survey

This research forms the basis of my master's thesis that I am writing for my degree in Communication and Information Sciences at Tilburg University. I would really appreciate it if you would like to participate in my research. The purpose of the research is to investigate people's behavior regarding supermarket applications. Your participation in the study consists of completing a survey about supermarket applications, which will take about 10 minutes. You will be asked to answer some demographic questions, followed by viewing a supermarket application. You will then be asked to provide feedback based on your experience.

The data will be collected and stored in a secure environment and will be deleted at the conclusion of my research. If you have any questions, please do not hesitate to send me an e-mail at the following e-mail address: l.tiebout@tilburguniversity.edu.

By selecting the "I consent" button, you confirm that your participation in this study is completely voluntary, that you are at least 18 years old and that you understand that you have the option to withdraw from the study at any time and for any reason. Thank you in advance for your time and participation.

- o Yes, I consent
- o No, I do not consent

Demographic questions

What is your gender?

- ○ Male
- ○ Female
- ○ Non-binary/third gender
- ○ I prefer not to say that

What is your age?

[   ]

What is your highest earned degree?

○ No degree

○ Primary School

○ Pre-vocational secondary education

○ Senior general secondary education

○ Pre-university education

○ Secondary vocational education

○ Higher professional education bachelor/master

○ University education bachelor/master

○ PhD

Do you currently live in the Netherlands?

○ Yes

○ No

What type of diet are you following?

○ Omnivore (eats both meat and plant-based foods)

○ Vegetarian (does not eat meat but does eat other animal products such as dairy and eggs)

○ Vegan (does not eat animal products, including meat, dairy, eggs and honey)

○ Pescotarian (does not eat meat except fish)

What is your monthly disposable income?

○ up to 500 euros

○ 500 to 1000 euros

○ 1000 to 2000 euros

○ 2000 to 3000 euros

○ 3000 to 4000 euros

○ 4000 to 5000 euros

○ 5000 to 7500 euros

○ 7500 to 10.000 euros

○ more than 10.000 euros

Supermarket application

A supermarket application, or supermarket app, is an application that allows customers to easily shop for groceries. Through this app, they can find products, make shopping lists, browse advertising folders, discover new recipes and view their discount coupons and offers. You will shortly be taken to the Albert Heijn application.

Click the arrow at the bottom of the page to continue.

Do you use a supermarket application?

- ○ Yes
- ○ No

If yes then

How often do you use the supermarket application to...

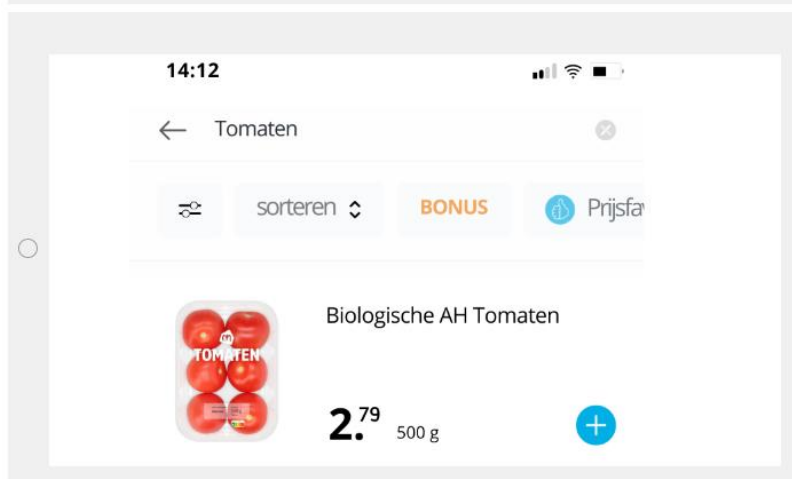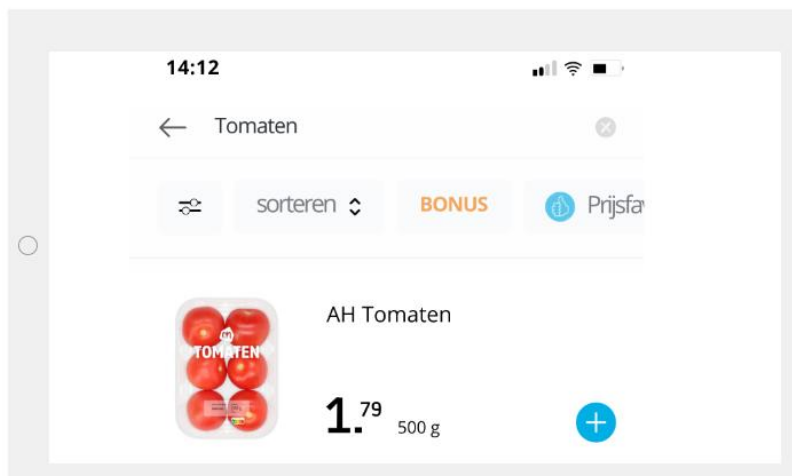|	Never	Rarely	Sometimes	Often	Always
...find products	○	○	○	○	○
...make a shopping list	○	○	○	○	○
...seek offers	○	○	○	○	○
...look up opening hours	○	○	○	○	○
...save points or redeem coupons	○	○	○	○	○
...find recipes	○	○	○	○	○

Explanation experiment

You will be doing groceries in the Albert Heijn supermarket application. You will be shown 12 products, each with two choice options.

Choose the item you want and click the arrow at the bottom of the page to move on to the next product.

Participants will now get to choose twelve times between two products. An example is shown below.

Choose a product

14:12

← Tomaten

sorteren ⬍   BONUS   Prijsfa

AH Tomaten

1.⁷⁹ 500 g

14:12

← Tomaten

sorteren ⬍   BONUS   Prijsfa

Biologische AH Tomaten

2.⁷⁹ 500 g

Control question

What differences did you notice between the two choices?
(multiple answers possible)

☐ One product was healthier than the other

☐ The product picture was different

☐ The price difference

☐ The product name differs

☐ Nutrition labels differ

☐ I did not notice any differences

Self-reported health behavior

Please indicate the extent to which you agree with the following statements

	Never	Rarely	Sometimes	Often	Always
I choose healthier products over cheaper alternatives	○	○	○	○	○
I eat according to The Wheel of Five	○	○	○	○	○
I make unhealthy choices	○	○	○	○	○
I read food labels to decide which products to buy	○	○	○	○	○
I cook unhealthy meals myself	○	○	○	○	○
I eat ready-made meals	○	○	○	○	○
I am aware of my eating habits	○	○	○	○	○
I make healthy choices	○	○	○	○	○

End of the survey and debriefing

Thank you for participating in my research. The purpose of my research is to see how people's choices can be influenced in an online supermarket environment. I am investigating this by manipulating the caption and visualization of various products. I have made these manipulations solely for research purposes. The results of this research will contribute to existing research on nudging in the digital environment. To avoid influencing the results, the purpose of the research has not been disclosed in advance. If you have any questions about this research, please feel free to contact me.

Thank you again for your time and interest.

Lianne Tiebout

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