Which Graphical User Interface Aspects Can Guide Users to an Environmentally Friendly Behaviour? Using Digital Nudging in an E-commerce Shop

Bachelorarbeit

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Abstract

In the course of this thesis, an overview will be given on which way developers can guide users into acting environmentally friendly without the users realizing they are being nudged. In the last couple of years, our private and work-life have been more and more shifted away from reality into a digital context. Since the start of the Covid – 19 pandemic in 2019, even more aspects of everyday life have been shifted to an online context, one of them being groceries shopping. Even though online groceries shopping is not yet common in Germany, there is a trend toward the online purchase of groceries visible. This can be seen as a possibility to tackle another challenge the world is facing, the climate crisis. One reason for the climate crisis is mindless consumption and purchasing of too much food. This paper aims to combine the need for more aware consumption with the newly rising trend of online supermarkets. Furthermore, a supermarket will be provided to show if the implementation of environmentally–friendly nudges is technically possible. To eventually prove the effectiveness of a nudge, it needs to be tested.

Keywords: Nudging, Environment, Online supermarkets

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BWK - Bundesministerium für Wirtschaft und Klimaschutz

GUI - Graphical User Interface

IS - Information System

SDK – Software Development Kit

1 Introduction

Since the beginning of 2020, the entire world has been living in a situation that is a novel experience for every individual. Because of the Covid – 19 pandemic, even the most mundane tasks such as grocery shopping have become a challenge for many people. For this reason, online supermarkets have become increasingly popular in society[1]. This is partly because it is more convenient to order groceries from home for a certain group of people to reduce the risk of a Covid – 19 infection by reducing contact with other people.

Apart from the Covid – 19 pandemic, another undeniable challenge that we are facing today is global warming. Since 2015 with the Paris climate agreement, attempts have been made to reduce CO2 production.

Interior designers and economy psychologists have been trying for years to design supermarkets' aisles in ways to encourage customers to buy the more expensive alternative or for children to insist on adding more candy to their carts.[2]In times of the growing presence of online supermarkets, however, this arrangement now needs to be adapted to a digital context and can be used by developers to guide users by using design elements, to make environmentally-friendly purchases.

This thesis focuses on the need to reduce Greenhouse Gases, especially CO2, produced by the food industry. Since online food shopping has increased over the last few years, the possibilities provided by an online application will be taken into consideration, and a prototype will be designed. The main cause of this work is:

- to find out how an online supermarket can be designed and implemented,
- to guide users into buying environmentally-friendly options without losing customers by depriving them of food choices.

An important aspect of this work will be the understanding and usage of *nudges*, *Gestalt principles,* and *biases*. By using those principles in a prototype, the question whether developers can guide users into acting environmentally-friendly without the users realizing they are being nudged is to be answered.

The authors of recent studies have already proposed that nudging in an online food context can guide participants into choosing a healthier option or choosing ecologically sustainable nutrition.

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1 In 2018 the turnover in online grocery sales have been 1.360 million euros in 2020 it doubled to 2.667 million euros and in 2021 it has risen up to 3.923 million euros Ahrens (2022)

2 In a study from the year 2022. 1715 participants were asked if they buy sweets from the checkout area and 48,69 % stated to frequently buy sweets at the checkout Ahrens (2021).

Chapter 2 will provide a closer look at how much grocery shopping and online grocery shopping influence the environment to show the importance of an environmentally-friendly online supermarket.

2 Why is a more environmentally-friendly behaviour important?

To understand why the development of an environmentally-friendly online supermarket is important, the results of an environmentally – unconscious behaviour will be highlighted below.

Since 2015 with the Paris climate agreement, around 197 countries try to work against their Greenhouse Gas production to bring a hold on climate change. The Paris climate agreement follows three goals captured by the Bundesministerium für Wirtschaft und Klimaschutz (BWK) in 2022.

1. The first goal noted by the BWK (2022) is to keep global warming below two degrees Celsius compared to the pre-industrial era, with efforts to limit it to 1.5 degrees Celsius.
2. Secondly, the ability to adjust to climate change is to be enhanced and is established as an equal goal alongside the reduction of Greenhouse Gas emissions.
3. Lastly the funding flows should be aligned with climate goals (Bundesministerium für Wirtschaft und Klimaschutz, 2022).

The higher the temperature rises, the more extreme the weather conditions are going to get. In the last ten years, there have been more extreme weather occurrences since the beginning of weather records (Umwelt Bundesamt, 2021). One example is the flood that destroyed parts of North Rhine-Westphalia which was caused by heavy rain.

Furthermore, extremely hot weather and heatwaves have also increased significantly since the 1950s (Masson-Delmotte et al., 2021). Apart from those occurrences, the sea levels are rising because of glaciers and ice-sheets melting. “The rate of ice-sheet loss increased by a factor of four between 1992–1999 and 2010–2019” (Masson-Delmotte et al., 2021, p. 11), and many different ecosystems are slowly degenerating. All of these events are happening because society, more specifically the economy, produces too many Greenhouse Gases like carbon dioxide, methane, and other gases (Britannica, T. Editors of Encyclopaedia, 2020). This leads to even more severe weather events.

All in all, the problem with Greenhouse Gases is that sunlight passes through the atmosphere to earth and warms its surfaces. Part of the radiation will be reflected in the atmosphere, where it gets trapped by the Greenhouse Gases mentioned before. As a consequence, this contributes to an additional warming of the atmosphere. (Britannica, T. Editors of Encyclopaedia, 2020) The more Greenhouse Gases there are in the atmosphere, the more sunlight or warmth gets caught in the atmosphere. This leads to more severe weather events occurring.

2.1 How does online grocery shopping influence the environment?

The following paragraph will explain how much the food industry contributes to climate change and how much food choices influence the climate crisis further, followed by the rise of online shopping in the past years. All in all, the next paragraph further shows how important the development of an environmentally-friendly online supermarket is.

2.1.1 How does the food industry affect the environment?

According to Clark and Tilman in their work from 2017, agriculture activities emit around 25% to 33% of all Greenhouse Gases per year. Nonetheless, not each grocery item produces the same amount of Greenhouse Gases. Fruits and vegetables grown in greenhouses, for example, emit almost three times more Greenhouse Gases compared to a vegetable or fruit grown on a field (Clark & Tilman, 2017). Despite the production method, it is vital to consider the impact of the types of groceries that are consumed. To elucidate, Röös and colleagues (2020) analysed Swedens' meat consumption. According to their results, replacing 50 % of the meat consumption with legumes would reduce Swedens' climate impact by 20% (Röös et al., 2020).

Apart from Greenhouse Gases produced by meat production, there are also emissions caused by transport. On the one hand, there is transportation from the production facility to the grocery store, and on the other hand, there is individual transportation from the supermarket to the buyers' homes. According to Nabot and Firas (2016), when using cars to get to the grocery store, they emit around 3.3 kg of CO2. When using online grocery shopping, on the way from the distribution centre to the customers' house, it produces around 0.164 kg of CO2.

Those aspects mentioned above are important to understand the goals an environmentally-friendly supermarket has to achieve or which product it wants to highlight for the customer. Those products are seasonal fruits and vegetables grown in Germany or the product with the least CO2 emissions.

2.1.2 The current online supermarket situation

The main objective of this thesis is to design and develop an environmentally-friendly online supermarket. For this purpose, the current online sopping situation needs to be displayed.

In the last decade, online shopping has become a huge part of the worldwide economy (Koptyug, 2021). Since 1999 the business-to-customer commerce revenue in Germany has risen from 1.1 billion euros to 72.8 billion euros in the year 2020 (Koptyug, 2021). In 2021 an estimated part of 82% of Europeans purchased goods or services online. Apart from purchasing books and other material goods, online shopping for groceries has become more popular among the 25 - to 54-year-old Europeans. While 18% of all

Europeans purchased food or beverages from stores or from meal-kits providers, it has been 25 % of the 25 to 54 years old (Eurostat, 2022).

Since the start of the corona pandemic, the number of customers using online supermarkets had risen by about 34 % in the United States (Arm et al., 2022). In Germany, the customers are more secure with going to a supermarket to purchase their groceries, but since the Covid – 19 pandemic, the number of German citizens purchasing some or all grocery items online has risen from around 16% to 26% (Burgsted & Schweikert, 2021).

A research with about 2500 participants in 2022 by *Appino* in cooperation with *Spryker*, 17,4 % of the participants stated to use the REWE online shop regularly. In their mobile app, customers can select their grocery items from the supermarket and are either able to pick their food items up from the nearest supermarket or, in some areas, get their food items delivered to their homes.

The online supermarket *Flink* was used by 14.4 %, and the start-up *Gorillas* was used by 9 % on a regular basis (Thedens & Hachiniti, 2022). *Gorillas* were founded in 2020 and grew in one year to an online supermarket with 100 + warehouses, around 10.000 employees in 2021 and currently in early 2022 with 25 established delivery areas around Germany, including Berlin, Cologne, and Stuttgart. But *Gorillas* not only delivers around Germany but has grown to also act in 9 different countries including Denmark, France, the Netherlands and also abord in the United States. (Gorillas, 2022)

Another online supermarket delivering in Germany is *Flink,* with around 46 delivery areas around Germany. (Flink, 2022) Followed by the delivery service *Picnic,* which is only based in North-Rhein Westphalia.

The age group which purchases the most groceries online are the 30 to 49 years old. Around 36% of this age group uses online supermarkets. They are followed by the 16- to 29-year-old. Only 32 % in this group purchase food items online. In the age group over 65, only 8% purchases groceries online (Burgsted & Schweikert, 2021).

Furthermore, the need for environmentally-friendly behaviour becomes more and more apparent to the general population. In the year 2019, people under the age of 35 recognized climate change as a serious problem with the estimated choice of an 8.6 on a scale from 0 – not at all serious to 10 – very serious. With this rating, they ranked the climate crisis the highest, followed by the age group of people between the age of 25 to 64 years old, who overall chose the number 8.5. The age group above 65 years old only given a rating of 8.2 in 2019. Overall, the age group under 35 had the highest rise in awareness. In 2014 they rated the climate crisis with an estimated 8.0 and with, which being on the same level as the above 65 years old. All in all, the estimation of the fatality of the climate crisis has risen from 8.1 in 2014 to 8.5 in 2019. (Lübke, 2021)

The creation of an environmentally-friendly online supermarket would be the next step to combining the rise of online grocery shopping and the rise in environmental awareness.

2.1.3 Why are new online supermarkets so successful?

To further understand the impact a developer can have on the success of an application, the following Gestalt principles need to be presented. Apart from nudging described in chapter 3, a developer can use Gestalt principles to influence the users' perception. Figures 5 to 7 show the landing pages of popular online supermarkets. They will be abbreviated to G, F, and R.

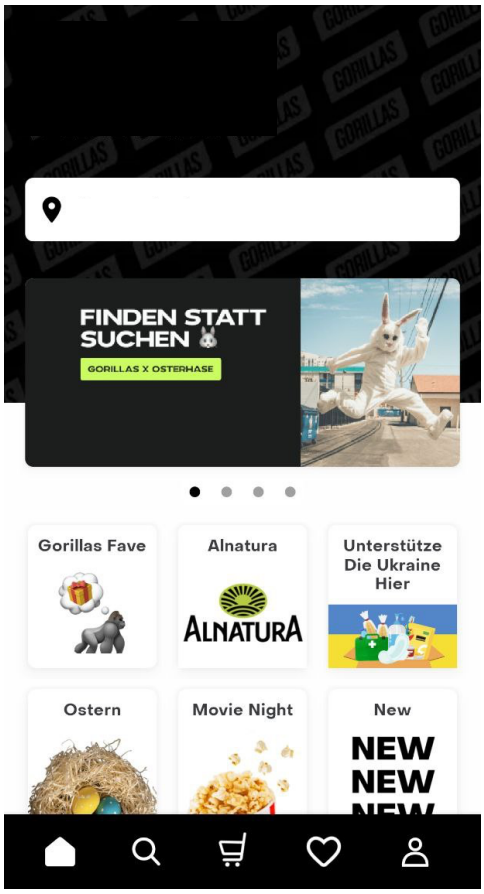

Figure 1. G Landing Page

Figure 2. F Landing Page

Figure 3. R Landing Page

As seen in Figure 1, *G* offers various subcategories such as "movie night" or "Easter" to make it easier for customers to search for specific topics and occasions and aims to increase impulse purchases. In 2016 Adobe questioned 5026 participants on different design-related questions. One outcome was that 59 % of the 5026 participants agreed with the statement, "I will choose a product or service over its competitors because of a good design" (Adobe, 2016, p. 38)

2.2 Gestalt principles

A good design can lead to an increased willingness to buy more on the customer side. (Adobe, 2016) Seven different Gestalt principles can be used to achieve a good user interface.

2.2.1 Similarity

The principle of similarity describes how humans classify objects based on similarities in shape, colour, or form as being related to each other. As Figure 2 shows, the online supermarket *F* uses this law to visually separate special rations from the normal categories like Fruits and Vegetables. The special categories such as “Easter” are shown in a uniform pink, while the normal categories are delineated by a blue tone (Wertheimer, 1923)

2.2.2 Proximity

The *principle of proximity* describes how objects that are physically closer to each other or next to each other are seen as a group. The special subcategories from the online supermarket shown in Figure 2 are not only divided by a different colour but also by a physical distance. Apart from the main categories, categories such as fruit and vegetables are separated by whitespace in the online supermarket *G*, as can be seen in Figure 5 (Wertheimer, 1923).

2.2.3 Conciseness

The user subconsciously eliminates user interface aspects that seem to not have any use for them. Using the *G* online supermarket as an example, this is primarily noticeable when the supermarket in the area is closed. If this is the case, a concise red “closed” text is placed at the beginning of the screen next to the current location. Because this feature is so concise, the user most likely will not try to buy anything (Wertheimer, 1923).

2.2.4 Closure

The principle of closure describes the coherence of different elements by framing them in a kind of box, in one way or another. In the case of the *R* app, it can be seen that the individual subcategories are represented by individual lines that are separated from each other by dividing lines. The delimitation of the individual categories of the *G* and *F* app also represents the law of closure (Wertheimer, 1923).

2.2.5 Continuity

This principle can be seen in the navigation on the product selection screens. In the upper part of the screen, as can be seen in Figure 4, there is, on the one hand, the selection option between the upper categories such as “Fruit and vegetables”, “Bakery”, and “Cheese & cheese substitutes”. This is on one level, while on the level below, there is also a selection option for the subcategory such as “Fresh fruit” or “Fresh vegetables” (Wertheimer, 1923). Since both selection menus have several scrollable subcategories.

However, one thinks here of a scroll line, which describes the law of continuity (Wertheimer, 1923).

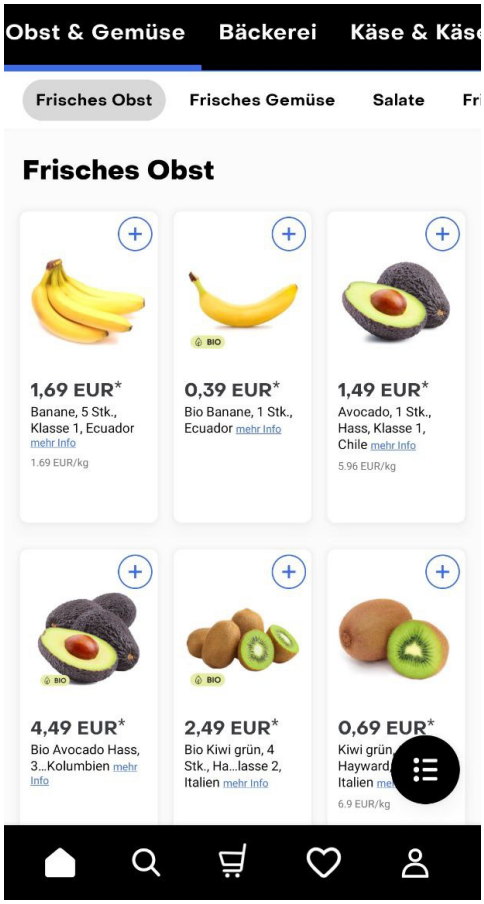

Figure 4. G category page

2.2.6 Common fate

In Figure 5 of the *G* home page, a slider menu can be seen in the middle of the image, which shows different banners when swiped to the right - in this case, different collaborations and promotions that the *G* app is currently offering. It can also be seen something similar on the *R* homepage. There are also slider banners that inform users about current offers and promotions (Wertheimer, 1923)

2.2.7 Common region

The law of common region refers to the separation of related information by lines or by colours. This can be seen in the information cards that represent the online supermarkets. Here, on the one hand, as can be seen in Figure 4, the categories such as “fruit and vegetables” are combined with a picture to form a category. Furthermore, as shown in Figure 4, the information about a product, in this case, bananas, avocados, and kiwis, are combined into a category (Wertheimer, 1923).

All in all, the design laws describe a way to simplify the use of certain applications for users without spending a lot of money on an elaborate design. Often, various Gestalt laws are combined, as the presented examples show, to separate the individual components as good as possible. The category cards are combined into one category by using a different colour as well as by separating them with a border.

Different design principles like the gestalt laws can help developers to guide or nudge users in a specific direction. Nudging describes a way of guiding people into acting or choosing in a predetermined manner without them having to realize it. Nudging is a great pillar for developing an online supermarket, which guides users to buy more environmentally-friendly products without actively choosing them.

In the following section, nudging will be addressed more specifically.

3 The definition and use of nudging

Due to rising numbers of customers using online supermarkets, the need for developers to be able to guide customers into acting in an environmentally-friendly manner appeared as well. Consequently, the need for a nudging online supermarket becomes apparent.

The term nudging was first introduced by Thaler and Sunstein (2009) in their book 'Nudge about Health, Wealth, and Happiness. The basic meaning of nudging describes that someone can guide another person/group of people to act in a "good manner" in the eyes of the choice architect[3] (Johnson et al., 2012, p. 488).

Therefore, this architect does not hide any resources or options from the people but makes the superior opportunity look more appealing than the other ones (R. H. Thaler & Sunstein, 2021). Sunstein (2014) used the example of someone wanting to guide people to eat healthier the choice architect should not remove the unhealthier options in the supermarket but highlight the healthier option (e.g., put fruit on eye level to make it more attractive for buyers).

We encounter nudges everywhere in our daily life. From "an app that tells people how many calories they ate during the previous day, to a text message, informing customers that a bill is due or that a doctor's appointment is scheduled for the next day; so is an alarm clock; so is automatic enrolment in a pension plan; so are the default settings on computers and cell phones" (Sunstein, 2014, p. 583).

3.1 The Definition of Nudging according to Thaler and Sunstein

Nudges do not aim to force users to decide but to guide them to a decision. Nudges are widely used in a non-digital context, and even governments use nudging to guide citizens in the desired direction. The United Kingdom has a Behavioural Insights Team[4] which focuses on nudging UKs citizens in e certain direction (Sunstein, 2014). There are different possibilities to guide a user to a certain behaviour. Thaler and Sunstein (2021) provide five nudging strategies, which will be described below. Not each category is useful for the environmentally-friendly supermarket. Still, the description of each possibility is useful to show in which ways developers can influence users.

3.1.1 Defaults

Thaler et al. (2010) state that as soon as a decision architect gives users default options in their decision making, the user will most likely use the default without going through

[3] A choice architect is someone who can influence choices for instance by using defaults or the order of choices Johnson et al. (2012).

[4] Also called the Nudge Unit, was founded in 2010. The Behavioural Insights Team takes part in altering and improving different fields including 'Consumers & finance', 'Education & Skills' and 'Energy, environment & sustainability'. They use nudging to improve society without high costs and publish articles like 'The Power of TV: Nudging Viewer to Decarbonise their Lifest yles' (The Behavioural Insights Team)

the thought process of changing it to a better outcome. *Defaults* can be sectioned into an *opt-in* and an *opt-out* principle (R. H. Thaler et al., 2010, 2010)

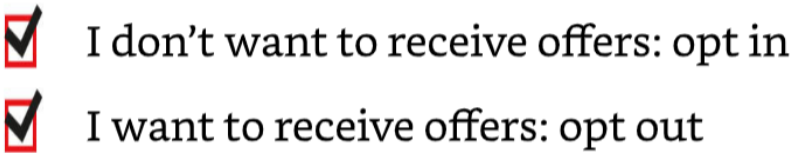

Figure 5. Opt-out example (Pereira, 2019)

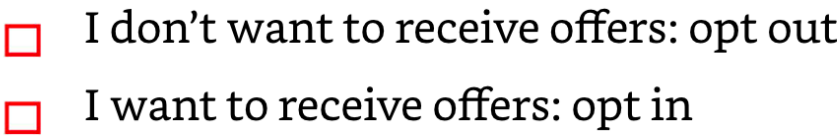

Figure 6. Opt-in example (Pereira, 2019)

As shown in Figure 5 and Figure 6 from Pereira (2019), *opt-in* describes the scenario where the user must actively decide on an option by unchecking the "I don't want to receive offers" option or to decide on one option by checking the checkbox. In this example, the "I want to receive offers". Meanwhile, in the *opt-out* approach, the user must decide against something by changing the default. In this example by Pereira, the user must either uncheck the "I want to receive offers" or has to check the "I don't want to receive offers" option. Pereira (2019), Thaler et al. (2021), and Heitmann et al. (2008) use the example of organ donor approaches in different countries, which is an offline example for an *opt-in* and *opt-out* default.[5] In an online context, the common cookie approach of different websites can be seen as an *opt-out* approach. Users can either accept the default of selected cookies or must actively decide against them. Out of 2.045 subjects, 41% answered the question "how do you handle cookie notices in general?" with "I do not read through the contents of the cookie notices and simply click "okay" or "accept cookies" (Rabe, 2021). Defaults also show that even though a designer or a programmer doesn't want to influence a user, they still take a big part of a user's choice process.

3.1.2 Error handling

An example of expected *errors* in a nudging context is using a cash machine, the card will be returned before the money. This is related to the fact that a lot of people forget their cards in the machine because as soon as the actual task of getting money is done,

[5] Pereira (2019, p. 31) in Austria there is an *opt-out* approach towards organ donations. One is automatically an organ donor and must *opt-out*. Because of this 99% of Austrians are organ donors. Meanwhile in Denmark there is an *opt-in* approach where people have do decide to become an organ donor there for only 4% of Denmark's citizens are organ donors. In Germany only 12% of the citizen are organ donors because the government choose an *opt-in* approach. Heitmann et al. (2008)

the person forgets the components related to that task, like retrieving the card. That's why the cash machines are designed in a way that the card will only be returned before the task is completed, retrieve the cash (R. H. Thaler & Sunstein, 2021).

3.1.3 Feedback

"The best way to help Humans improve their performance is to provide feedback" (R. H. Thaler et al., 2010, p. 9) According to Thaler et al. (2010), another way of nudging is to mirror a user's behaviour to himself. There are two types of feedback. On the one hand, when the user is doing something wrong, and on the other hand, when the user is doing something. Thaler et al.(2021) give the example of a Tesla, which will alert the driver if the battery is too drained to reach the destination and navigates the driver to a charging station (R. H. Thaler & Sunstein, 2021, p. 118).

3.1.4 Mapping

Mapping is used to display complex choices in an understandable context to the decision-maker. During the climate debate, understanding how much CO_2 each individual produces can be difficult to comprehend, and the principle of mapping described later can help users with it. Weinmann et al. (2016) provide the example of "Mapping megapixels to maximum printable size instead of pointing to megapixels when advertising a digital camera" (Weinmann et al., 2016, p. 435).

3.1.5 Incentives

The *incentives* approach is important to understand the necessity of using nudging to increase a users awareness towards environmentally-friendly behaviour. Other than, for example, a sunburn, people cannot see or feel climate change. They can especially see how their own decisions can influence climate change. By raising the users' awareness of whether the product they are choosing is an environmentally-friendly option or not, the e-commerce shop could help users to act in an environmentally-friendly manner.

As Thaler and Sunstein (2021) already state in their book' Nudge: The Final Edition', if there was an easy option to guide people into environmentally-friendly behaviour, it would already have been done.

Apart from the five nudging methods Thaler and Sunstein (2021) described, there are also other aspects that can influence customers to decisions the designer wants them to make. Tietz and Sunstein (2021), for example, proposed the *decoy effect* as another way of nudging people. This principle will be explained further in the following chapter.

The five nudging strategies above are seen as the most common ones. Sunstein (2014) extended those by aspects like *simplification*, use of *social norms*[6], I*ncrease in ease and*

[6] Nudging people in a particular direction by showing them what others do for example the strategy used by amazon 'Customers who bought this product also bought…' some electric

convenience[7]*, disclosure, pre-commitment strategies, reminders, eliciting implementation intentions*[8]*,* and *informing* people of the nature and consequences of their own past choices (Sunstein, 2014).

3.2 Further aspects which can influence a users choice

Apart from the nudges provided above, there are also different biases and psychological effects which can influence users in a digital and a non-digital context. Some of the most common ones are displayed below.

3.2.1 The decoy-effect

The choice architect can influence a user's choice not only by using design methods but also by adding more options. Tietz et al. (2016) showed in their paper "The Decoy Effect in Reward-Based Crowdfunding: Preliminary Results from an Online Experiment" that by adding a *decoy,* the user was more willing to choose the more expensive option. For their study, Tietz et al. (2016) presented two basic options to choose from in a crowdfunding-based environment. On the one hand, they offered a competitor, in this case, an eBook, which the users received when they paid 10$ for a crowdfund. On the other hand, the target, when the users paid 20$, they would get an eBook and a hardcover book. Without adding the *decoy,* most subjects chose the 10$ donation option. By adding the *decoy*, when the users pay 20$ for a crowdfund, they would get a hardcover book. Most subjects chose the 20$ for a hardcover book and eBook option (Tietz et al., 2016)

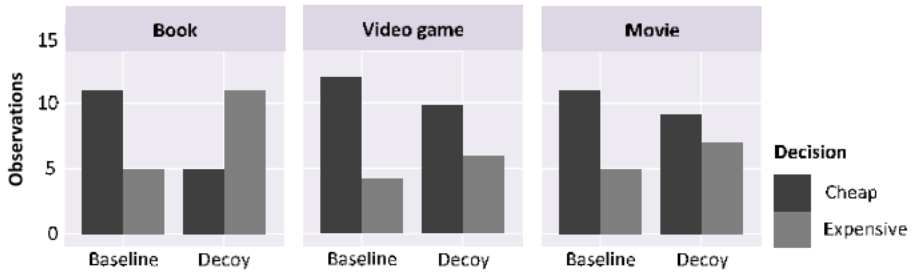

Figure 7. The decoy effect by Tietz et al. (2016)

As shown in figure 3, Tietz et al. (2016) used three cases to investigate the *decoy effect*. In each case, more consumers chose the costlier option as soon as Tietz et al. (2016) added a *decoy*.

companies also send their customers electric bills which compare their energy usage with their neighborsR. H. Thaler and Sunstein (2021).

7 Make the desired option also easy to understand.

8 Sunstein (2014) uses the example of 'do you plan to vaccinate your child? ' Sunstein (2014).

3.2.2 The scarcity-effect

The *scarcity effect* describes the need of a user to get an item which is supposedly limited or *scarce*. In the year 1993, Cialdini described it with the words, “opportunities seem more valuable to us when their availability is limited” (Cialdini, 1993, 1993, p. 179) As an example, Cialdini (1993) described how he read a newspaper article about a Mormon temple in his hometown. Even though Cialdini never was interested in going inside this Mormon temple before, the newspaper article stated that there was a section inside the temple which was only open to the public for a few days. Normally this section was open for very religious Mormons only. Triggered by the narrow time window, Cialdini suddenly was very interested in visiting the temple until he confronted himself with the fact that it was only a result of the *scarcity* (Cialdini, 1993).

3.2.3 Status quo bias

The *status quo bias* can be divided into three subcategories, according to William Samuelson and Ricard Zeckhauser (1988). These are rational decision making, cognitive misperception and psychological commitment (Samuelson & Zeckhauser, 1988).

Rational decision making includes the transition cost a decision-maker must take by deciding on an option. Samuelson and Zeckhauser (1988) stated that for the United States, for example, changing their current nonmetric measurement system to the metric system would, in the long run, have many positive aftereffects for the country. The financially and cognitive costs are too high to transition, even though the costs would only be short term disadvantages, while the actual change would have long-term benefits (Samuelson & Zeckhauser, 1988).

The second subcategory of *the status quo bias,* according to Samuelson and Zeckhauser (1988), is the *cognitive misperception*. For this subcategory, Samuelson and Zeckhauser (1988) display the loss aversion theory provided by Kahneman and Tversky[9] (1984). In general meaning, the decision-maker will always see losses from a decision as more significant than possible benefits resulting from making the decision (Samuelson & Zeckhauser, 1988, p. 569).

The last subcategory described by Samuelson and Zeckhauser (1988) is called the *psychological commitment,* which itself is divided into three subcategories. The first one is the *sunk cost* and *sunk benefits* principle (Samuelson & Zeckhauser, 1988). An example of this principle is shown in the study by Kim and Kankanhalli (2009) regarding the users’ resistance to the implementation of a new Information System. Here the authors explain the *sunk cost* principle based on the users’ concern regarding the loss of their knowledge and skills for the old information system, which will be of no use for the new Information System (Kim & Kankanhalli, 2009) Another example of the *sunk cost* principle is provided by Thaler (1980), a person who subscribed for a whole concert series would more likely

[9] All in all to acquire a certain amount of money is less tempting than losing a certain amount of money is deterrent Kahneman and Tversky (1984)

visit each concert, no matter if they want to go, because they paid for it beforehand. Would the ticket be a gift or something the person did not have to pay for, not visiting a concert would have been more likely (Richard Thaler, 1980).

Additional psychological commitment issues which lead to the *status quo bias* are the regret avoidance principle and the drive for consistency (Samuelson & Zeckhauser, 1988).

The *regret avoidance* principle describes a persons need to make decisions in a way to possibly avoid past situations which lead to negative emotions.

Samuelson and Zeckhauser described the principle with the statement, "If it was good enough for me then, it is (must be) good enough for me now" (Samuelson & Zeckhauser, 1988, p. 39), meaning decision-makers will most likely make the same decision as before, even though the other option might be better, just because they decide for this particular decision before and do not want to change their past decision, which could lead to cognitive dissonance[10] (Samuelson & Zeckhauser, 1988).

The last subcategory of what can lead to the status quo bias describes the *effort to feel in control* (Samuelson & Zeckhauser, 1988) According to Kim and Kankanhalli (2009) "can result in status quo bias because individuals do not want to lose control by switching to an unknown system or unfamiliar way of working" (Kim & Kankanhalli, 2009, p. 569) even though the unfamiliar option might be the better one for the decision-maker.

3.2.4 Anchoring bias

Tversky and Kahneman first mentioned the anchoring bias in their 1974 paper "Judgment under Uncertainty: Heuristics and Biases". This roughly describes how in some situations, people tend to make estimations regarding a decision by starting from an initial value, which then will be adjusted. The starting point from which the decision-maker starts can either be given by the choice architect or be a result of the decision makers' estimations or calculations.

To test this bias, Tversky and Kahneman (1974) asked several subjects various estimation questions. One of those questions was how high "the percentage of African countries in the United Nations "(Tversky & Kahneman, 1974, p. 185) was. Before everyone could make an estimation, a wheel of fortune was spun. After that, each subject first had to give an estimation of whether the percentage of African countries in the UN was beneath or above the number shown on the wheel of fortune. As a result, the median of people receiving the number 10 on the wheel of fortune was that 25 percent of countries in the UN were African. If the subjects received the number 65, they estimated a median of 45

[10] *Cognitive dissonance* describes the phenomenon, that occurs if an expectation about for instance what should happen is not fulfilled Festinger (1962) . Festinger describes that in the example of one decision maker having to choose one of two options. During the decision process the decision maker will most likely find both positive and negative arguments for each option. According to Festinger as soon as the decision is made the negative arguments for the picked options and the positive arguments for the rejected option are dissonances in the decision makers' eye.

percent (Tversky & Kahneman, 1974). In another example given by Tversky and Kahneman, they provided the task of estimating the product of 8 x 7 x 6 x 5 x 4 x 3 x 2 x 1. In this example, the suspects estimated the product in median being 2250. In the other group, the subjects received the task to estimate the product of 1 x 2 x 3 x 4 x 5 x 6 x 7 x 8. The median of this calculation was 512 (Tversky & Kahneman, 1974).

3.3 The design process of a nudge

After providing different ways how to influence people in a digital and non-digital context, a possible design process of a nudge is illustrated below. Later on, this cycle will also be used to design an environmentally-friendly supermarket. The designed nudges will not be tested, therefore, their effectiveness can only be estimated by having a look at similar research provided in chapter 4.

Schneider et al. (2018) introduced a possible cycle for implementing nudges in a workflow.

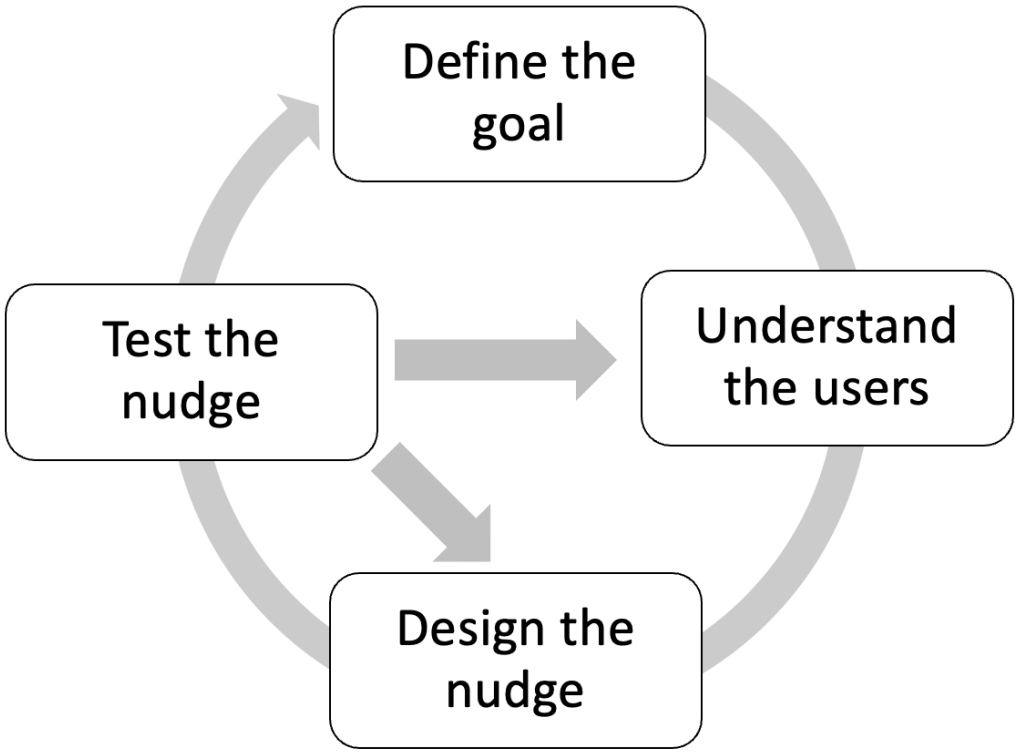

Figure 8. Lifecycle of a nudge based on Scheider et al. (2018)

Before designing the nudge, the choice architect must declare which goal the nudge shall achieve. If the digital nudge is based on a normal e-commerce shop, the goal probably would be to increase sales (Schneider et al., 2018).

The second step, according to Schneider et al. (2018), is to understand the user by defining which goals they follow and by which biases they could be influenced. Possible biases or heuristics can be the confirmation bias or the status quo bias mentioned before.

The choice architect would have to work around as many possible biases as possible to get a maximum number of users to decide the way the choice architect wants to. However, eliminating all biases is never possible because each individual is influenced by different biases in different ways (Schneider et al., 2018).

The third step in the nudge development process provided by Schneider et al. (2018) is the design of the nudge. Johnson et al. (2012) stated that even by not providing any intentional nudge by the choice architect, the developer influences the user no matter if they intend to or not (Johnson et al., 2012). The presentation order can influence a users' decision. As stated, before, the anchoring bias, for instance

Another aspect of designing a nudge is additionally how many options the choice architect presents to the user. As soon as there are too many options to choose from, the user could be overwhelmed and choose in a manner that neither the choice architect nor the user intended to. On the other hand, Johnson et al. (2012) state that the more options the choice architect provides, the more likely it is the user gets the preferred outcome (Johnson et al., 2012).

And finally, the last step is to test the nudge. For all policies, including nudges, it is exceedingly important "to rely on evidence rather than intuitions, anecdotes, wishful thinking, or dogmas" (Sunstein, 2014, p. 585). Similar to an agile development process, testing the nudge can but does not have to be the last step in the development process. As soon as the choice architect gets the feedback that the nudge might not work for their users, the nudge can step back to be designed or even back to defining the users.

According to Schneider et al. (2018), using a nudge in an online context can improve the effectiveness of a nudge. One reason is the possibility of real-time tracking and analysis of the users' behaviour and the option to completely personalise a nudge to the different users and by being able to alter nudges fast, as soon as the developer realises if the nudge is not effective.

All in all, the nudges and biases provided in this chapter are helpful to understand how many different aspects influence the design process of an application. Due to the number of different effects, a developer cannot take each of them into consideration. However, raising awareness by displaying nudges and biases can lead to better-developed applications.

4 Nudging regarding food choices

There have already been a few studies using nudging to guide users into buying healthier or environmentally-friendly food options. The study provided by Berger et al. (2020) tried to use digital nudging to guide users towards ecologically sustainable nutrition in online grocery stores.

Berger et al. (2020) designed a study to prove the possibility of nudging participants into choosing ecologically sustainable nutrition. For this purpose, the researchers designed three different nudges. First, they provided an organic (in Germany known as “Bio”) label. The second nudge included the simplification of information by adding a smiling earth smiley and the additional sentence “This product was classified as ecologically sustainable”, and the third nudge is based on the social concept of conforming to sustainable food shopping behaviour (Berger et al., 2020). The participants were asked to purchase online groceries to prepare a meal for the following evening. They were divided into four different groups. The first one is the control group without any nudges. The second group was confronted with the nudging default rules. The third group of participants faced the simplification nudge described above, while the final group had the social norms nudge as mentioned before (Berger et al., 2020).

Berger et al. (2020) concluded that an already environmentally – conscious person “score(s) highest in food choice motives regarding naturalness, environmental and animal friendliness, and fair trade” (Berger et al., 2020, p. 10). Furthermore, the environmentally-conscious participants were the most affected by the social norms nudge.

On the other hand, environmentally – unconscious participants “exhibit the lowest scores regarding the above-mentioned food choice motives […] and consume the least plant-based products […] compared to the other clusters” (Berger et al., 2020, p. 11).

Apart from the study mentioned before, Jesse, Jannach and Gula (2021) investigated how to use digital nudging for online food choices. Similar to the study provided by Berger et al. (2020), Jesse et al. (2021) asked participants to choose recipes they would like to try.

First, the participants had to choose three options from the categories “Vegetarian, Pasta, Fish, Sandwiches, and Desserts” (Jesse et al., 2021, p. 3). After selecting three categories, each participant had to choose one recipe from each category. After selecting a recipe, each participant had to answer a questionary. Jesse et al. (2021) performed two studies. In the first study, the participants were randomly assigned to being in the control group or the treatment group. The treatment group faced one nudge for each recipe category. The nudges were a “highlighted recipe in the Vegetarian category, a default recipe was set for Pasta recipes, [meaning a recipe was already chosen for the participant,] and social information was presented for Fish dishes. The category of Sandwiches used the hybrid nudge “(Jesse et al., 2021, pp. 3–4). The second study was similar to the first one described before, but here Jesse et al. (2021) wanted to elaborate on

the effectiveness of a nudge by showing it in each category. Furthermore, Jesse et al. (2021) tested if a combination of two nudges, the default, and the social nudge, would lead to better results.

Overall, the nudging options were selected more often than the same item in the control group. The combination of two nudges, in this case, the combination of a default nudge and a social nudge, provided the most selections, with about 57,6% of participants selecting the item, while only 22% selected the item in the control group (Jesse et al., 2021)

Jesse et al. (2021) also differentiated between nudging customers towards a decision and nudging customers away from an option. To test the nudging participants away, they implemented a warning. For example, if a participant chose a recipe that contained alcohol a warning appeared after being warned, 75 % of the participants changed their selection to a healthier alternative (Jesse et al., 2021).

5 Goal and requirements

Hereafter the different steps of the design process presented by Schneider et al. (2018) for a digital nudge will be applied to the environmentally-friendly supermarket. The effectiveness of a nudge can only be confirmed as soon as it is tested with different participants.

5.1 Defining the goal

The goal of the environmentally-friendly supermarket, as the name already suggests, is to influence its customers into acting in an environmentally-friendly manner. In this context, it would be to purchase the products which produce the least CO_2. The environmentally-friendly supermarket will provide environmentally-unfriendly food options but wants to highlight the environmentally-friendly options. In this context, the prototype, which will be described later, is limited to vegetables and fruits and doesn't take more complex choices like meat or other processed foods into weight.

After evaluating the different studies provided by Berger et al. (2020) and Jesse et al. (2021), the author of this thesis developed different requirements the online supermarket has to achieve.

1. **Users, no matter if environmentally – conscious or – unconscious, should get the tools to make an environmentally-friendly food purchase by:**
    a. **Providing the CO_2 Balance.**
    b. **Providing an organic label.**
2. **Developers provide a "dies könnte dir gefallen" section to optimize the users' online shopping experience and to subconsciously highlight environmentally-friendly products.**
3. **The developers implement a personalisation, to increase the users' identification with the store and products.**
4. **The developers implement a graphical representation of the users' purchases' carbon footprint. This will lead users to try to keep the purchases' CO_2 emissions in a low or medium range of the representation.**
5. **The possibility to combine two or more nudges is provided to accomplish a better nudging.**

5.2 Understanding the users

Taking a look at the study of Berger et al. (2020), it is likely for environmentally – conscious participants to be more open to being influenced by environmentally-friendly nudges than environmentally – unconscious participants (Berger et al., 2020).

"Green marketing depends on the consumer's attitude towards the environment. If there is no strong demand for such a shift in consumer attitude, businesses will not put in the

extra effort to move towards introducing green products and services" (Cherian & Jacob, 2012).

As mentioned before, in 2020, most of the people purchasing online groceries were in the age group between 25 and 55 years. Since the Paris Climate agreement in 2015, the general awareness of the environment has risen. All in all, the environmentally-friendly supermarket should be available for every age group still it cannot be guaranteed that the nudges implemented will apply to every customer.

5.3 Design the nudge

The nudges implemented are a mapping nudge, incentives nudge, a nudge considering loss aversion and a warning nudge. With these nudges, the requirements mentioned in chapter 5.1 are to be fulfilled. Taking the previous literature research into consideration, the prototype was developed and will be presented in the next chapter.

6 Prototype

Based on the previous literature research and analysis of other online supermarkets, a prototype for an environmentally-friendly supermarket was developed. However, this prototype is not intended to be exclusively environmentally-friendly but rather a standard online supermarket that uses nudges to guide customers to choose the environmentally-friendly option. For this, however, a few factors must be considered.

As noted earlier in the literature review, each person or customer is influenced by various environmental factors and biases, such as the status quo or anchoring bias. One can never eliminate every bias in the design of an application. The development of a good individual online supermarket also requires various analysis runs to determine whether users react to the supermarket the way the designer or developer wanted them to.

So, in the design and development phase of the prototype, one can only try to create the best possible nudge, but the final usefulness of this would have to be tested in a study, as previously shown in the development cycle of Schneider et al. (2018).

To create the prototype, Figma was first used to develop a wireframe. Figma is a vector-based design tool used by companies such as Twitter, Zoom, and Airbnb to develop prototypes (Kasimov, 2020)

The IDE (Integrated Development Environment) IntelliJ IDEA was used to develop and program the prototypes. IntelliJ IDEA is part of the JetBrains company. However, through various plug-ins, the IDE can also be used for other programming languages and SDKs (Software Development Kit). In the case of the development of the eco-friendly supermarket, the programming language Dart is used with the SDK Flutter.

6.1.1 Flutter and Dart

Flutter is an open-source software development kit. With the first release of Flutter 1.0 in 2018, Google introduced its SDK with which programmers are able to develop cross-platform applications, similar to react-native (Rahman, 2019) Flutter uses Dart as its programming language. Dart is an object-oriented language which has similarities to the programming language C. There are more than 350 thousand applications programmed with Flutter and Dart. Tone notable example which was created using Flutter and Dart is Google Ads. In addition, companies such as Toyota and eBay used Flutter for development (Flutter) Special features of Dart and Flutter include the ability to write code for all operating systems. Furthermore, Flutter offers the possibility of a so-called hot reload. This is used to test small changes directly to the app without having to reload the entire application.

Flutter is a widget-based SDK. This means that developers can string different widgets together to create the app they want.

6.2 Design

Figma was first used to develop a rough design of the default online supermarket. Figure 9 shows the overview page of the online supermarket without nudges.

The environmentally-friendly online supermarket was developed as a smartphone application since most existing online supermarkets like Gorillas and Picnic are realized in a smartphone application as well. Another reason to develop a mobile nudging supermarket is to provide a realistic testing environment for future subjects.

Figure 9. Figma design default screen

For this purpose, the design of the well-known and existing online supermarkets Gorillas and Flink were used. Both supermarkets use a card look for the different categories and products in the categories. The gestalt principle coming into play for an environmentally-friendly supermarket is the *principle of proximity* seen in the separation of the different subcategories and the header bar. The *principle of proximity* is used all over the prototype. Figures 9 to 11 show the product cards of Gorillas, Flink, and Get Faster. Here it can also be seen what information the various online supermarkets provide to their customers.

Figure 12. Item Card G

Figure 11. Item Card F

Figure 10. Item Card GF

This would be the name of the product, how many items were purchased, the price, and where it originates from. Apart from the country of origin, however, the leading online supermarkets, like regular supermarkets, do not provide any information about how environmentally-friendly or environmentally-harmful this product is.

On the one hand, there is a default supermarket, which tries not to apply nudging. This is followed by the presentation of the implemented supermarket, which tries to encourage users to act in an environmentally-friendly manner through nudging. The prototype description will be divided into three sections. First, the default supermarket and with that, the application itself will be described. After that, the differently implemented nudges will be explained. The last section will go more into detail about how different parts of the supermarket were implemented.

6.3 The default supermarket

At the beginning of each session, the participants must log themselves in. This allows the user's name to be saved for the personalisation of later screens. The login screen can be seen in Figure 12. Since the supermarket is a front-end-only application and has no back end, names and shopping lists can only be saved during one session and cannot be retrieved afterwards.

The login page is designed in a rather minimalistic way and resembles the normal login pages that the user probably uses daily. The first *Gestalt principle* discussed in chapter 2.2, used to separate the login box, was the *principle of common region*. The fields the user can interact with are surrounded by a frame. Furthermore, each text field (e.g.,

Name and E-Mail) is underlined, which also helps to separate both text fields from each other.

Figure 13. Prototype Login Screen

Figure 13 also shows that the login page is designed to accommodate a fold-out keyboard. Because the online supermarket is designed for a mobile application, these platform-specific details need to be taken into consideration. As soon as the users enter the columns name and e-mail, the warnings that the field must not be empty disappear. In addition, the users can only click on the login button when the name field is not empty to ensure that the name can be used for a nudge in the future. As soon as the Name field is not empty anymore, the login button gets enabled, and the user can continue to the next screen.

As soon as the users are logged in, they are redirected to the overview page of the online supermarket.

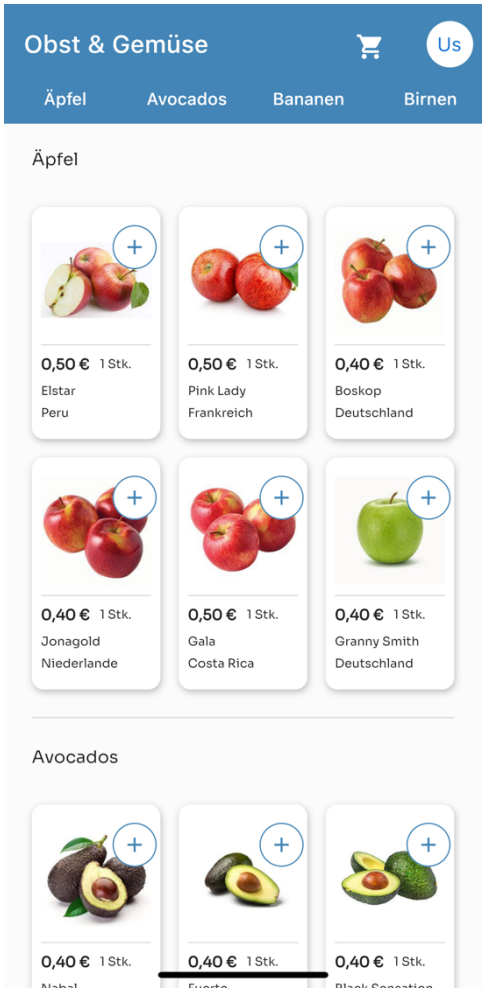

Figure 14. Prototype Home Page

The default overview page is divided into three parts. On the top, there is the `Appbar`, which displays the title of the page, in this case, “Obst & Gemüse”, followed by the shopping cart. The cart is currently empty. When a user adds an item to the shopping cart, a red box with the number of groceries which are currently inside the shopping cart can be seen in Figure 17. After the shopping cart icon, there is a profile icon with the initials of the current user displayed.

Beneath the `Appbar`, a navigation bar can be seen, which is called `HeaderBar`. `GlobalKeys`[11] allow the user to be directed to the desired category by tapping the button belonging to the category. Keys in Flutter are used to give a widget individuality.

[11] A GlobalKey is unique throughout the whole app and is used to uniquely identify elements and to provide access to other objects associated with those elements for example the BuildContext. Flutter

The `HeaderBar` is followed by the main component of the screen. There, the different fruit and vegetable categories are listed, as can be seen in figure 13. There are different biases which must be considered to receive valid results. One of them is the Anchoring bias mentioned before. To ensure that the costumers have chosen a product because of the product itself, in the best case because the item is environmentally-friendly, and not because they underly the anchoring bias, the individual subcategories are randomised. The main categories, apples, avocados, bananas, and pears, are ordered alphabetically, but the subcategories, meaning the individual item cards, are randomized. The default supermarket should be as close as possible to the existing online supermarkets so that the decision taken by the participants is as close as possible to reality.

Although the cards are randomized, the data per card is not randomised to assure that the environmentally–friendly option costs the same amount of money. Otherwise, the users could be influenced by a lower price for the environmentally-unfriendly or a higher price for the environmentally-friendly option, and vice versa. The default supermarket tries to avoid biases as much as possible. Another attempt, for instance, to make the default supermarket as bias-free as possible is to provide more than three options to avoid users choosing the middle option.

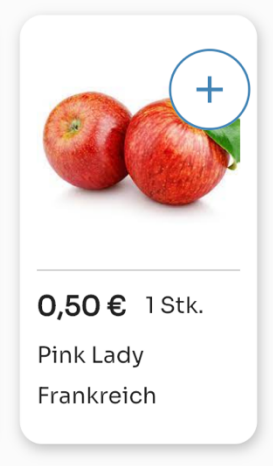

Figure 15. Prototype grocery card

Figure 15 shows a product card of the online supermarket in more detail. Each `OptionCard` provides a picture of the product, followed by the information, how much the product costs, the sales unit, the name of the product and which country it originates from. The gestalt principles used on the `OptionCards` are, on the one hand, the *principle of common region*, to separate each option card from the rest and to separate the image from the information about the product, on the other hand, the principle of similarity. In this case, the *principle of dissimilarity* highlights the price from the other information. The country from where the product originates is the only indication the users get about how environmentally-friendly a product is on the default screen. Apart from the information provided, on the top right corner is an add Button. By clicking this button, the product is added to the shopping cart, and the dialogue shown in Figure 16 appears.

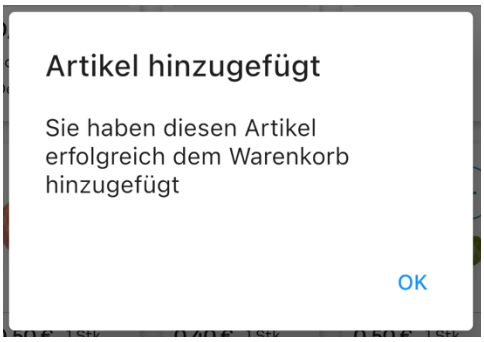

Figure 16. Prototype pop-up message

Furthermore, the user can click the `OptionCard` to be navigated to the details screen for the selected product.

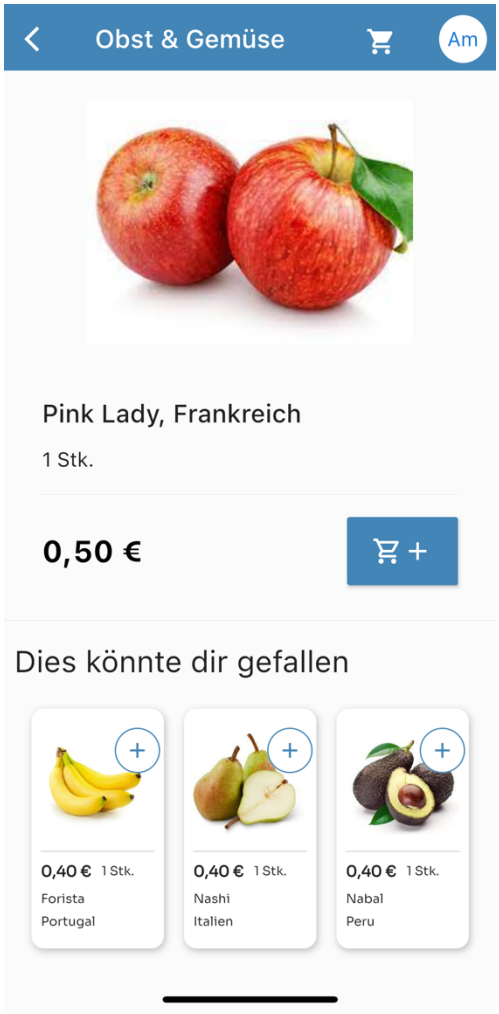

Figure 17. Prototype details screen

The details page displayed in Figure 17 provides the same information as the `OptionCard`. The title of the `HeaderBar` on top was replaced by a back button which navigates the user back to the default main screen. The participants are able to add the

product to the cart by clicking the blue add to cart button. In the lower third of the screen, the participants see more products they can purchase. As mentioned before, the items of each subcategory are randomized. In the default supermarket, the products displayed in the “Dies könnte dir gefallen” category are the first item on the category lists. If the item displayed on the details page is part of the items which are shown in the “Dies könnte dir gefallen” section, it will not be displayed. On the details screen, there are multiple gestalt principles combined to provide a structured overview page. First, the *principle of common region* is applied to separate the different categories from each other. The *principle of similarity* is used to group the different `OptionCards` in the “Dies könnte dir gefallen” section. Furthermore, the *principle of common fate* is used to include several `OptionCards` in the “Dies könnte dir gefallen” section by making it scrollable when more than three `OptionCards` are provided.

By clicking the cart icon on the `HeaderBar,` the user is directed to the cart screen, as seen in Figure 18.

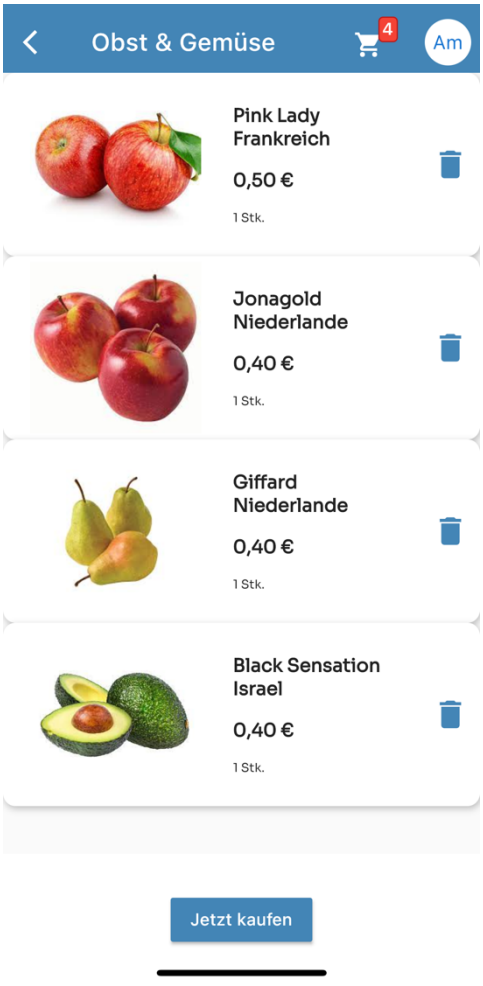

Figure 18. Prototype cart screen

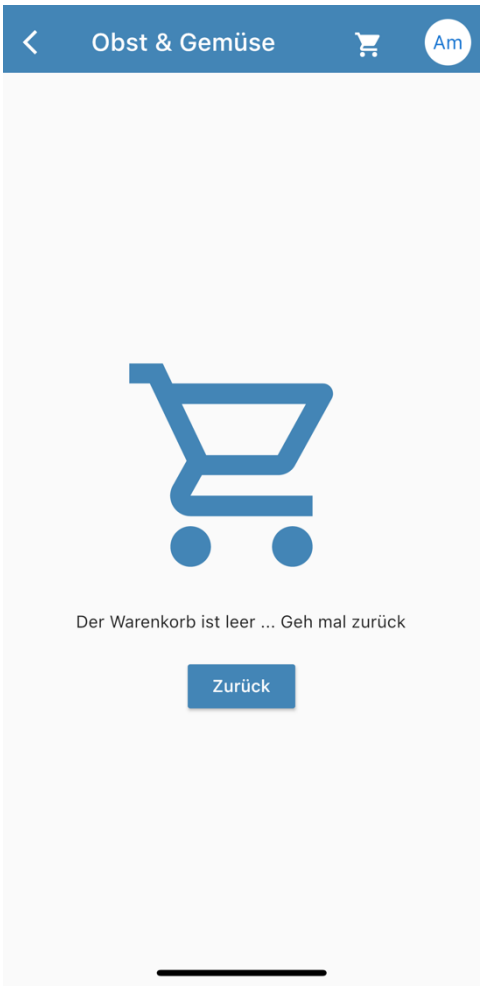

Figure 19. Prototype empty cart screen

The screen has two stats. The first one is the screen seen in Figure 18 and the second one is the screen seen in Figure 19. The first screen displays the items the user added to the cart. The selected purchases are stored in a list in the model described later. On the cart screen, the user can delete products out of the cart and finish the online shopping by clicking the “Jetzt kaufen” button. The gestalt principles implemented on this screen are the *principle of common region* to separate the different `OptionCards` from each other, as seen in Figure 18. Furthermore, the *principle of common fate* is implemented similar to the details screen. If the cart screen displays more than five groceries, the list gets scrollable. The user can still group the different OptionCards because they scroll in the same direction or have the same fate. When the user removes every item from the shopping cart, the screen displayed in Figure 19 appears. Here the user can only go back to the details screen because there are no other possible interactions with this screen. The *gestalt principle* used on this screen is the principle of conciseness. By displaying an empty shopping cart, the user can quickly comprehend that there are no possible interactions.

6.4 The Nudging Supermarket

As described beforehand in chapter 3, there are many ways to guide a user in the direction the developer or designer wants them to go in this context into an environmentally-friendly behaviour regarding purchase decisions in an online supermarket.

The nudging supermarket does not alter that much from the default supermarket only a few GUI aspects are altered to nudge users into purchasing the environmentally-friendly option. For this reason, the *gestalt principles* explained before will not be repeated, only if an additional aspect, which uses the gestalt principles, appears, a description will be provided.

To select the different nudges, there is a drawer implemented shown in Figure 20.

There are five different nudges, all of which can be switched on and off separately. The implemented nudges will be explained in more detail below.

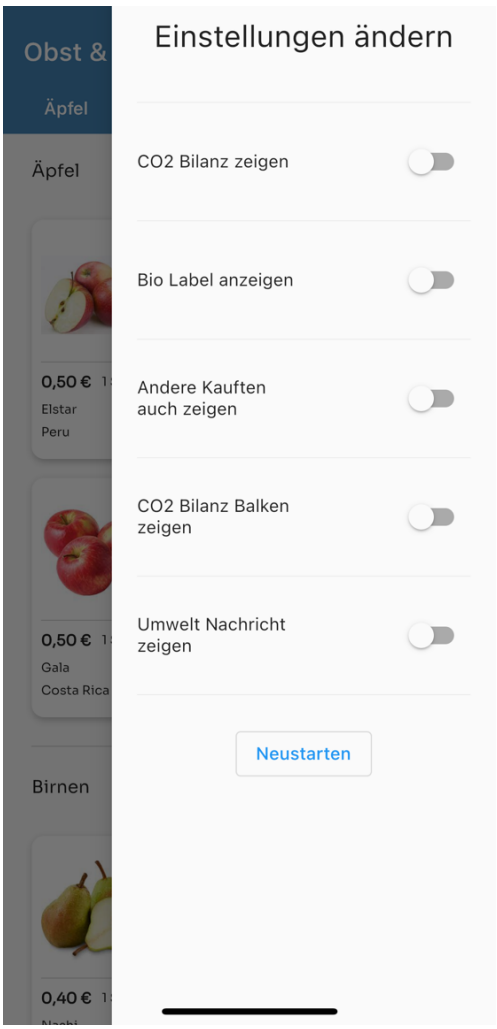

Figure 20. Prototype nudge drawer

On this screen, the *principle of common fate* is used to separate the different nudges from each other. All in all, the usage of the *principle of common fate* and the *principle of similarity* are easily implemented GUI aspects that provide a well-designed application. As mentioned before, the research provided by Adobe (2016) stated that 46 % of the participants would “not purchase from a brand if its website or mobile experience is poorly designed” (Adobe, 2016, p. 36)

6.4.1 Increasing awareness by Displaying the CO_2 balance

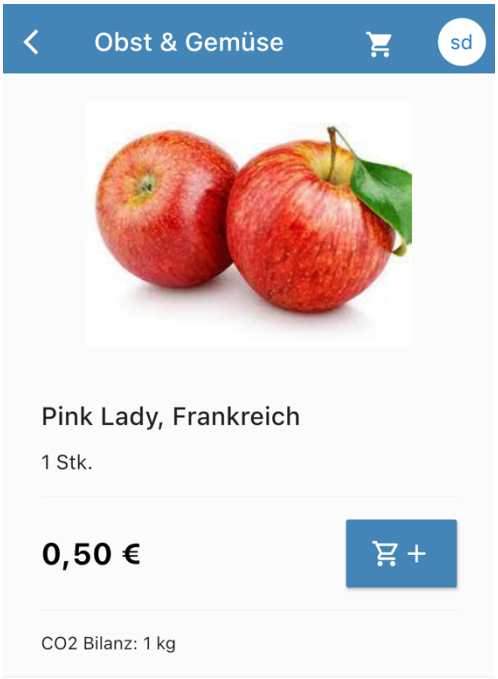

Figure 21. Details screen with CO_2 balance

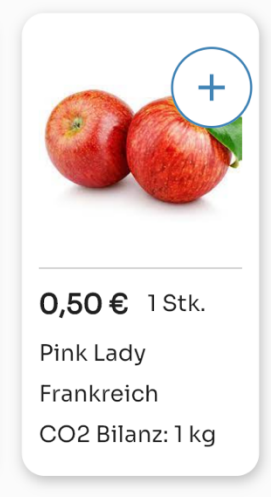

Figure 22. Grocery card with CO_2 balance

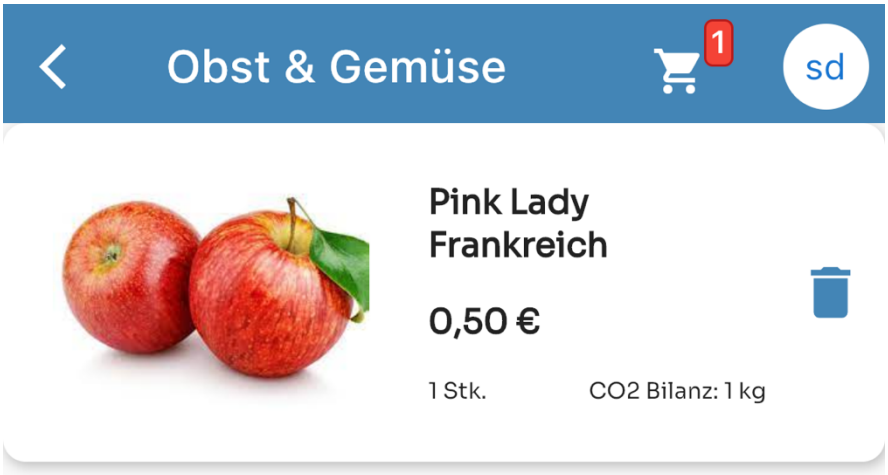

Figure 23. Shopping cart screen with CO_2 balance

As shown in Figures 21 to 23, there is the option of showing the CO_2 balance. This is displayed on all product screens. This means on the start page as seen in Figure 22, on the details screen as seen in Figure 21 and on the shopping basket screen displayed in Figure 23.

This is well described by the *incentive* and *mapping* nudge provided by Thaler et al. (2010). As described before, it is difficult for users to get a reference to how much CO_2 they consume, as the well-known online supermarkets only provide data on where the products come from, but not how much CO_2 was produced in their manufacture. Visualising how much CO_2 was produced for each product can help.

6.4.2 Nudging by displaying an organic label

Another possible form of nudging in the eco-friendly supermarket is to display an organic label. The organic label is shown similar to the CO_2 balance on each screen, the main screen, the details screen and the shopping cart screen. The Verbraucher Initiative e.V. stated that around 51 % of their 1004 participants pay attention to organic labels while purchasing groceries (Verbraucher Initiative e.V., 2016).

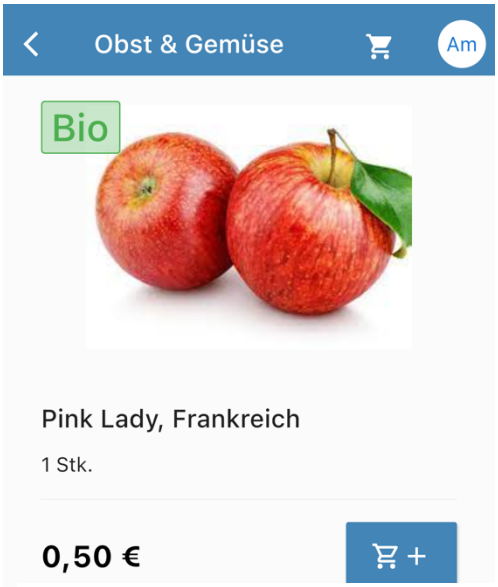

Figure 24. Details screen with organic label

Figure 25. Grocery card with organic label

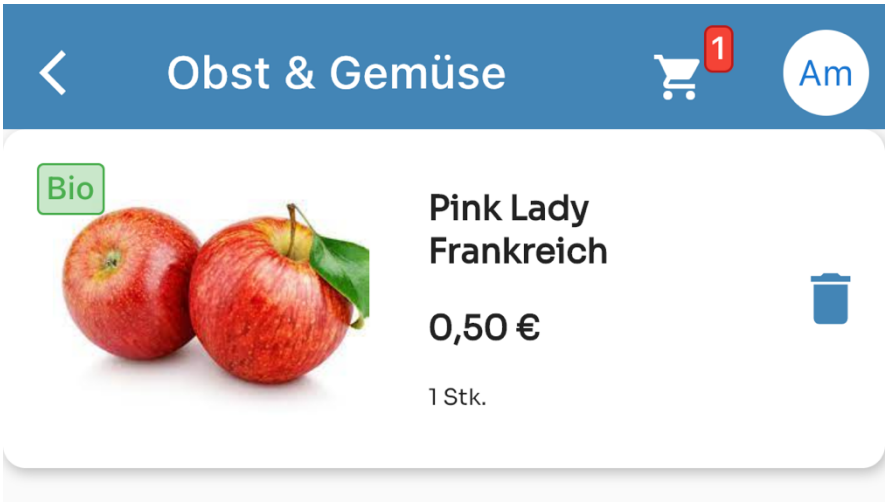

Figure 26. Shopping cart screen with organic label

6.4.3 Nudging with the „Dies könnte dir gefallen" Option.

On the detail screen, both the nudging and the default supermarket show other products with the title "Dies könnte dir gefallen". However, in the case of the nudging supermarket, only the environmentally-friendly variant of the individual product categories are displayed. As mentioned before in the description of the default supermarket, the "Dies könnte dir gefallen" category contains the first element of the randomised default data list for each main category. This nudge, furthermore, provides two different approaches. First of all, it can be tested if the customer gets nudged into buying the environmentally-friendly option because it is recommended by the Application. The second nudge provided is the personalisation of the "dies könnte dir gefallen" by adding the users' names seen in Figure 27.

Figure 27. Personalised nudge

6.4.4 Graphical representation of CO_2 emissions.

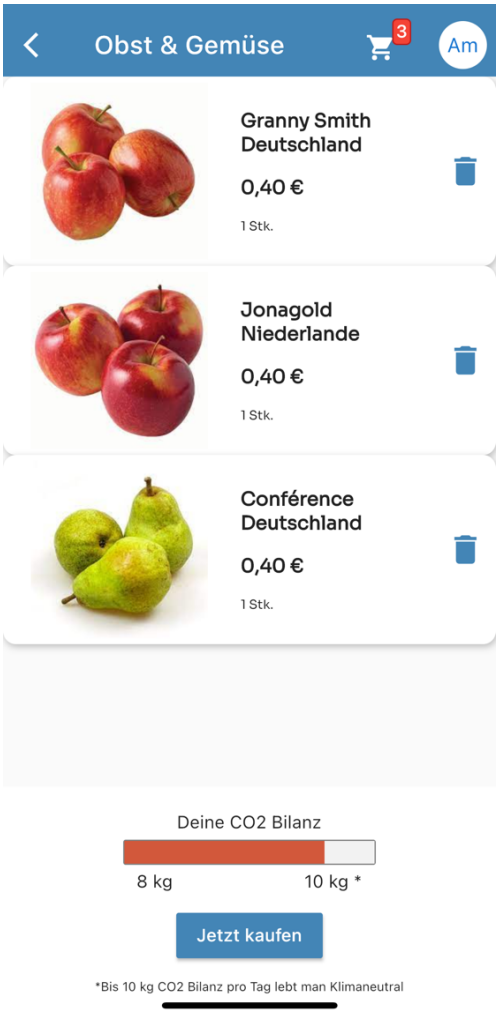

Figure 28. Graphical representation of CO_2 balance

The second to last nudge, similar to the display of the CO_2 balance of each product, is based on increasing the awareness of the user and visually displaying the current CO_2 emissions of the purchase. For each product, a CO_2 balance is stored, as mentioned before in Figure 28. These are divided into a low CO_2 emission of up to 3 products with a medium CO_2 balance and one product with a high CO_2 emission. Although users can get a rough idea of how environmentally-friendly or environmentally-harmful a product is by naming the country of origin or by the Awareness Nudge, i.e., the presentation of the CO_2 balance of a product, a visualisation helps to make this easier to understand and sustainably present.

Apart from the provided feedback nudge, the CO_2 balance bar also uses the *principle of conciseness to* influence the users' purchase decisions.

For this purpose, there is the option to display a progress bar. The status of the user's current CO_2 balance is shown there. The value ranges from 0 to 10. In the

environmentally-friendly online supermarket, 10 kg of CO_2 is set as the limit for how much CO_2 a person can consume per day in order to live in an environmentally-friendly or climate-neutral way. In reality, the value is 6.8 kg of CO_2 that can be consumed per day to live climate-neutrally. (Marina, 2021) In addition, the CO_2 balance for the individual products is made up in order to simplify the comparison of the individual subcategories.

When a test person puts a product in the shopping cart, the progress bar is updated by the respective CO_2 balance. In addition, the colour of the bar changes from green to red. When the user opens the shopping cart, a visual representation of how environmentally-friendly the purchase is is shown at the bottom of the screen.

To implement the progress bar, an animation was implemented to realise the change in the bar value as soon as the user deletes a product from the shopping cart. There are several ways to realise an animation in Flutter. These include Flutter's own animation widgets[12] and the possibility to give a widget an animation itself. In the case of the CO_2 bar, the colour of the bar is animated. This class interpolates between two given colours, in this case, green and red. Apart from the colour, the value of the bar is also animated. The total CO_2 balance is stored in the model for this purpose. This will be described more in detail in the implementation description.

6.4.5 Visualization of CO_2 emission in the confirmation dialogue

Another tool for visualising the CO_2 balance is the distinction of whether the product that the customer has placed in the shopping cart has a low, medium or high CO_2 balance.

[12] Including for instance an AnimatedController which itself returns values between 0 and 1 during a given duration. Flutter (2022)

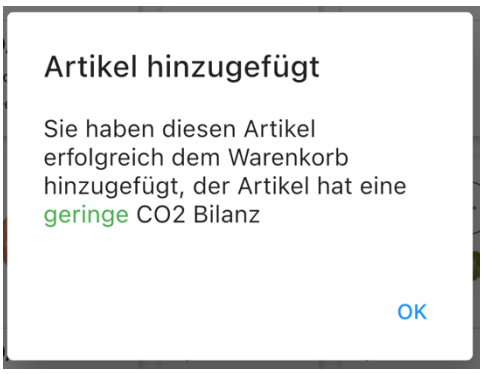

Figure 29. Pop-up message good CO2 balance

Figure 30. Pop-up message middle CO2 balance

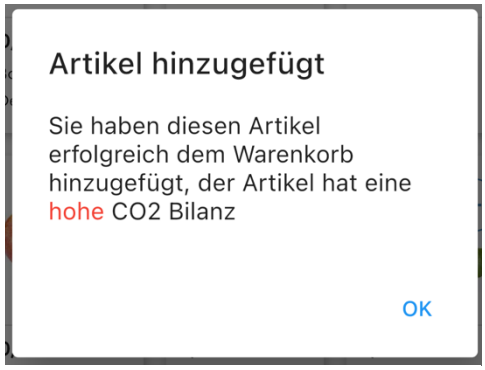

Figure 31. Pop-up message bad CO_2 balance

As soon as a product is placed in the shopping basket, the user receives a notification that the product has been placed in the shopping basket, as can be seen in Figure 30.

In order to adjust the message according to the CO_2 balance, it is first asked what the CO_2 balance of the product is, and depending on this, a colour is assigned to the product. Green means here that the product has a low CO_2 balance, the up to three medium CO_2 balances have an orange tone, and the high CO_2 balance is coloured red. The three stages can be seen in Figures 29 to 31. The gestalt principle used on the pop-up messages is the *principle of dissimilarity.* If a product, which the users put in a shopping cart, is environmentally-friendly can easily be classified according to the colour displayed on the pop-up message.

6.5 Implementation

Below we will have a closer look at some implemented widgets.

The whole code can be seen in the other file provided or on GitHub.

One important component for the implementation is the ternary operator. The statement, including the ternary operator, always contains three components. First of all, the ternary operator itself. It's a Boolean, which is implemented before, most of the time in the model.

```
Boolean ? (execute if true) : (execute if false)
```

The Boolean can either be true or false. If the Boolean is true, the first component gets executed. If the Boolean is false, the second component behind the : gets executed.

One example of the ternary operator is the login button on the login screen. The Boolean component, in this case, checks if the `nameController`, the `TextController` that safes the input from the Name text field, is Empty or not. If the `nameController` is empty, the ternary operator returns null, which leads to the button being disabled and greyed out. If the `nameController` is not empty, the `TextController` value will be saved in the model, and the user will be directed to the default screen.

```
child: MaterialButton(
  onPressed: nameController.text.isNotEmpty
      ? () {
          presenter.login(nameController.text);
          Navigator.of(context).pushReplacementNamed(
            ('/default'),
          );
        }
      : null,
```

As mentioned before, most of the data is stored in the model. First, the Booleans for turning the nudges on and off are stored there. Furthermore, the default data for each grocery category is saved inside the model. Each category (apples, avocados, bananas, and pears) has a default data List, which consists of different `ItemArguments` which provide the data shown in the code snippet below.

```
ItemArguments(
  fileName: 'assets/images/apple1.jpeg',
  price: '0,50 €',
  name: 'Pink Lady',
  amount: '1 Stk.',
  origin: 'Frankreich',
  co2Balance: lowCO2Balance,
),
```

Through the `..shuffle();` function, the list entries are randomized each time the application is restarted. As mentioned before, this randomisation is intended to ensure that the customer's decision is not influenced by which product is shown first.

While each item provides a string, the `co2Balance` provides an integer (short int), which is defined beforehand with the following values. This specification simplifies further comparisons to provide nudges based on whether the CO_2 balance is low, medium, or high.

```
final int lowCO2Balance = 1;
final int mediumCO2Balance = 2;
final int mediumCO2Balance2 = 3;
final int mediumCO2Balance3 = 4;
final int highCO2Balance = 5;
```

6.5.1 HeaderBar

As mentioned before, the `HeaderBar` on the top of the default page landing page uses keys to jump to the different categories, as seen in the code snippet below. Here the code snippet from the default screen can be seen.

```
Text(
  headerTitle[0],
  key: appleKey,
  style: TextStyle(fontFamily: 'Sora', fontWeight: FontWeight.w300),
),
```

Each title also contains a key here, for instance, the `appleKey,` which is important for jumping to each category.

The different items of the `HeaderBar` get injected through a for-loop. The `header-Title` list is declared beforehand. For each title, a new button is implemented, which has the width `MediaQuery.of(context).size.width,` which gets the current screen width divided by the length of the `headerTitle` list. In the onPressed event, the evaluation of the key is seen. If, for example, the item from the `headerTitle` list has the value of ‘Äpfel’, the function `Scrollable.ensureVisibile(apple-Key.currentContext!);` jumps to the fitting key inside the Text Widget.

```
for (final item in headerTitle)
  Container(
    color: MyColors.mainColor,
    width:
        MediaQuery.of(context).size.width / headerTitle.length + 2,
    height: 40,
    child: MaterialButton(
      height: 30,
      onPressed: () {
        if (item == 'Äpfel') {
          Scrollable.ensureVisible(appleKey.currentContext!);
        } else if (item == 'Birnen') {
          Scrollable.ensureVisible(pearKey.currentContext!);
        } else if (item == 'Bananen') {
          Scrollable.ensureVisible(bananaKey.currentContext!);
        } else if (item == 'Avocados') {
          Scrollable.ensureVisible(avocadoKey.currentContext!);
        }
      },
      color: MyColors.mainColor,
      elevation: 0,
      splashColor: MyColors.mainColor.withOpacity(0.5),
      child: Text(
        item,
        style:
            context.textTheme.button?.copyWith(color: Colors.white),
      ),
    ),
  ),
```

6.5.2 OptionCard

If a participant clicks on one of the `OptionCards`, the participant will be redirected to the details page. There, the user receives information about the selected product and the possibility of adding it to the shopping cart. The information about the product is forwarded to the new screen via navigation, as seen in the code snippet below.

```
onTap: () {
  Navigator.of(context).pushNamed('/details',
      arguments: ItemArguments(
        fileName: widget.fileName,
        price: widget.price,
        amount: widget.amount,
        origin: widget.origin,
        name: widget.name,
        co2Balance: widget.co2Balance,
      ));
},
```

As soon as an `OptionCard` is clicked to open the details page, the necessary arguments `fileName`, `price`, `amount`, `origin`, `name` and `co2Balance` will be redirected to the details page.

```
final args = ModalRoute.of(context)!.settings.arguments as ItemArguments;
```

The details page needs the code above to read and use the provided arguments.

6.5.3 ECommerceModel

The `ECommerceModel` does not only provide the Boolean arguments and the default Data for the online supermarket but also stores the `groceries` list, which holds every added grocery.

Every time the user selects add to cart, the product is added to the groceries list, and the code below is called.

```
void addToCart(ItemArguments arguments) {
  groceries.add(arguments);
  _totalCO2Balance = totalCO2Balance + arguments.co2Balance / 10;
  notifyListeners();
}
```

This list is now called on the shopping cart screen to show users their purchases. There is another function which removes the groceries from the `groceries` list, called `removeFromCart`, which looks similar to the `addToCart` function but instead of `.add` calls `groceries. remove(arguments);`.

Apart from adding or removing arguments from the `groceries` list, the `addToCart` also calculates the `totalCO2Balance,` which is used, to display the CO_2 balance in the CO_2 Balance Bar.

6.5.4 Display of the “Dies könnte dir gefallen” nudge

The code snippet below displays the selection of which product is displayed in the “Dies könnte dir gefallen” category. First, the if-statement checks if the product shown on the details page is part of the products already displayed in the “Dies könnte dir gefallen” and if the details screen already displayed the first item of the default data list.

The favourite product contains the first element from the default data list in the model, which has the lowCo2Balance.

```
final favoriteApple = presenter.defaultDataApple.firstWhere((element) =>
element.co2Balance == lowCO2Balance);
```

If the displayed item on the details screen is not part of the lower third, the Option Card will be added to the “Dies könnte dir gefallen”. After the if statement, the ternary operator will either lead to the display of the overall favourite product, which is, for instance the code snippet below

```
if (favoriteApple.name != args.name && presenter.defaultDataApple[0].name
!= args.name)
  Padding(
    padding: const EdgeInsets.all(8.0),
    child: presenter.showOthersFavorites
        ? OptionCard(
            fileName: favoriteApple.fileName,
            price: favoriteApple.price,
            name: favoriteApple.name,
            amount: favoriteApple.amount,
            origin: favoriteApple.origin,
            co2Balance: favoriteApple.co2Balance,
          )
        : OptionCard(
            fileName: presenter.defaultDataApple[0].fileName,
            price: presenter.defaultDataApple[0].price,
            name: presenter.defaultDataApple[0].name,
            amount: presenter.defaultDataApple[0].amount,
            origin: presenter.defaultDataApple[0].origin,
            co2Balance: presenter.defaultDataApple[0].co2Balance),
  ),
```

6.5.5 CO2BalanceBar

The `CO2BalanceBar` contains an animation to display a smooth transition when a user deletes an item from the cart.

The `CO2BalanceBar` mainly consist of a `LinearProgressIndicator`, as shown in the Code snippet below.

```
child: LinearProgressIndicator(
  value: value,
  color: animation!.value,
  valueColor: animation,
  backgroundColor: MyColors.lightGrey,
),
```

The values injected into the `LinearProgressIndicator` seen above are part of an animation, which will be described below.

The `animationForward` function interpolates the `AnimationCotroller` class to a fixed value, usually between zero and one, in this case, between zero and the total CO2 balance. A duration must be specified in advance for this to happen, in this case,

one second.

```
@override
void initState() {
  controller = AnimationController(duration: Duration(seconds: 1), vsync:
this)
    ..addListener(() {
      setState(() {});
    });
  animation = ColorTween(begin: Colors.green, end:
Colors.red).animate(controller!)..addListener(() {});
  super.initState();
  controller!.animateTo(context.read<ECommerceModel>().totalCO2Balance);
}

void animationForward(double value) {
  controller!.animateBack(value);
}
```

As soon as the delete button on the shopping cart page is pressed, the animationForward function is executed, and the animation controller animates to the new total CO_2 balance.

7 Discussion

The main course of this thesis was to find and display a possibility to use the growth of online supermarkets in Germany to nudge users into purchasing more environmentally-friendly. Acting environmentally-friendly in this context relates to users buying groceries with a lower CO_2 balance. The provided approach displayed five different ways of nudging based on the work of Thaler and Sunstein (2009) will be discussed more in detail.

The only sector benefiting from the ongoing Covid – 19 pandemic is the online supermarket sector. Since the start of the pandemic, the number of people purchasing groceries in an online supermarket had risen from 16 % to 26% (Burgsted & Schweikert, 2021)

Nudging in a behavioural economic context was first used by Thaler and Sunstein (2009) to describe different forms of guiding people into acting a certain way. Those forms can be translated into a digital context by using GUI aspects to guide users.

In the course of this thesis, there are five different requirements that need to be implemented to change a default supermarket into an environmentally-friendly online supermarket.

1. **Users, no matter if environmentally – conscious or – unconscious, should get the tools to make an environmentally-friendly food purchase by:**
    a. **Providing the CO_2 Balance.**
    b. **Providing an organic label.**
2. **Developers provide a "dies könnte dir gefallen" section to optimize the users' online shopping experience and to subconsciously highlight environmentally-friendly products.**
3. **The developers implement a personalisation to increase the users' identification with the store and products.**
4. **The developers implement a graphical representation of the users' purchases' carbon footprint. This will lead users to try to keep the purchases' CO_2 emissions in a low or medium range of the representation.**
5. **The possibility to combine two or more nudges is provided to accomplish a better nudging.**

The following section will go into greater detail about how the requirements were implemented.

The first nudge to be discussed is the implementation of the CO_2 balance on each `OptionCard`. This is part of the approach to fulfilling the requirement 1 to provide the user with tools to act environmentally-friendly. By raising the awareness of how environmentally- friendly or how healthy an option is, as seen in the study of Berger et al. (2020) and Jessen et al. (2021), most participants choose the environmentally-friendly option.

Still, the research provided by Venghaus, Henseleit, and Belka (2022) goes more into detail about an existing attitude–behaviour gap regarding raised awareness towards the climate crisis. Meaning that there is a positive attitude toward decreasing emissions, this

attitude does not yet show in actual behaviour and alters regarding effects on political agenda settings (Venghaus et al., 2022).

The discrepancy seen between the study provided by Berger et al.(2020), which shows a behavioural change with raising awareness and the results provided by Venghaus et al. (2022) can be explained by them being a result of the experimental environment and not being able to be translated to the real world.

The implementation of this nudge was relatively easy from a frontend developers' point of view. The difficulties lay in the collection of the actual data. The reason why default data is being displayed instead of actual CO2 balance data is that the calculation for each product is way too complex. Variables like the location of production[13], how it was transported to the supermarket, and miscellaneous surrounding factors needed to be put into consideration. To be able to display the actual CO_2 balance of a product, the provider of each product would have to provide the actual CO_2 balance, which is currently not the case. This calls for further interdisciplinary research in order to gain as well as process these kinds of data.

The next nudge that was designed to raise awareness is the display of an organic label. All in all, this nudge underlies the same problems as the display of the CO_2 balance. Even though the Verbraucher Initiative e.V. (2016) evaluated that 51 % out of 1004 participants stated that labels are important for a purchase decision, it is not exactly clear if it is organic labels they are referring to. The participants were also asked which criteria they wanted to be displayed by labels. Here only 49 % chose a label that hints at an environmentally–friendly production. 86 % wanted a label providing more information about how healthy a product is. This nudge is both on the frontend and on the backend side, easy to implement for developers. If a product has an organic label is always displayed on the product itself.

The two nudges discussed above aimed to fulfil first requirement "**1 Users, no matter if environmentally – conscious or – unconscious, should get the tools to make an environmentally-friendly food purchase".**

The implementation of the "Dies könnte dir gefallen" requirement (requirement 2) uses biases to nudge users into buying an environmentally-friendly product. Amazon, for instance, uses the "Top picks for you" section to guide users into buying recently watched items. The bias used here is the part of the status quo bias, the regret avoidance principle by Samuelson and Zeckhauser (1988) describes, "If it was good enough for me then, it is (must be) good enough for me now." (Samuelson & Zeckhauser, 1988, p. 39). Furthermore, this section implements the personalisation mentioned in the requirement "**The developers implement a personalisation, to increase the users' identification with the store and products."** Schneider et al. (2016) stated that the advantage of a digital nudge is the possibility of personalisation. When a nudge or application is personalised, users tend to be more willing to choose the nudge. Without any nudges, the "Dies könnte

[13] On a field or in a greenhouse

dir gefallen" section only displays the first product of each category[14]. The first nudge displays only the environmentally-friendly option of each product. This nudge also tries to use biases as a way of nudging. One could argue that the *regret avoidance principle* described before can fit this nudge. As described before, the regret avoidance principle The last nudge is related to personalising the nudge above. The text "Dies könnte dir gefallen" will be expanded with the customer's name. With this nudge, it can be tested whether the actual personalisation affects the user's decision. We could have also changed the default heading to "Others also bought" to emphasise even more if the customer selects a product from this section because it contains a personalised nudge by addressing the user.

The CO_2 balance bar, compared to the other implemented GUI aspects, would take the most development efforts for a frontend developer compared to the other nudges. The CO_2 balance bar sums up each CO_2 balance for each item inside the shopping cart. Additionally, it displays the current purchase sum in relation to the total CO_2 emissions a person should produce per day to live climate neutral. This nudge itself can be seen as a combined nudge. On the one hand, the nudge provides feedback to the customer on whether the CO_2 emissions are above the daily emissions[15] a person should make to live climate neutral. Apart from the feedback provided, the CO_2 production is also mapped to an understandable colour display. Green symbolises good, read bad, and orange stands in the middle, meaning it is neither good nor bad, similar to a traffic light. By simplifying the concept of CO2 emissions, this nudge uses mapping, as described by Thaler and Sunstein (2021). By providing the maximum CO_2 emissions per day, the user furthermore gets a better understanding, similar to the displaying of the CO_2 balance for each product, of how environmentally-friendly the purchase is. Even though this nudge is rather time-consuming for a frontend developer, it displays the CO2 emissions in the most detailed and understandable for the users. This GUI aspect would lead to the best nudging results. The implemeteation of the CO2 balance bar served to meet the requirement "**The developers implement a graphical representation of the users' purchases' carbon footprint. This will lead users to try to keep the purchases' CO_2 emissions in a low or medium range of the representation."**

Another nudge which fulfils the "**The developers implement a graphical representation of the users' purchases' carbon footprint. This will lead users to try to keep the purchases' CO_2 emissions in a low or medium range of the representation."** Requirement is similar to mapping the emissions of a product into understandable colours, the third nudge provided displays with a pop-up message, which is related to whether the product is environmentally friendly or not. In the default supermarket, the pop-up message also appears but misses the information if the selected item is environmentally friendly. Like the CO_2 balance bar nudge, the customer is not provided with any additional information on which product is an environmentally friendly option. This

[14] The categories being„ Äpfel, Avocados, Bananen und Birnen"

[15] When the total CO_2 balance is above 10 kg the bar is coloured red if it's still under the daily production, its colour ranges from green to orange.

information only appears when the customer puts the product into the shopping cart. This could lead to customers purchasing a product with a high CO_2 emission because removing it from the shopping cart would, in comparison, cost more for the individual. Removing it and selecting another product without knowing if this option is more environmentally friendly than purchasing the product. Here, some biases come into play. First of all, according to the loss aversion theory by Kahneman and Tversky (1984), the customer invests time by adding the product to the shopping cart and even though changing the product to an environmentally friendly alternative would be better for the environment, the cost of removing the item and selecting a new one ways heavier for the individual. As shown in a study by Jessen et al., a customer would change the selected product after a warning was shown, and 75% of their participants took the extra costs by selecting a new recipe. If this technique is also appropriate for the current setting, it would need to be investigated in a later survey.

As previously explained in the study of Jesse et al. (2021), the combination of nudges can also lead to better results (Jesse et al., 2021). The way the environmentally-friendly supermarket is developed allows each combination of nudges, because each nudge can be individually turned on and off. All in all, it is useful to combine the display of the CO_2 balance in the individual product cards with the display of the total CO_2 balance in a progress bar. This provides users with an overview of how much CO_2 the individual products emit and gives them a general overview of their total purchases. In addition, it makes sense to test the label nudge both on its own and in combination with the CO_2 balance display. This could indicate whether the test participants pay more attention to a label or the actual environmental impact, which would need to be tested in a future research.

To prove the effectiveness of the nudges displayed in the environmentally-friendly supermarket, a user test would need to take place. The setup of this possible future user test is explained in the subchapter 8.1.

Another possible approach to decrease the CO_2 emissions resulting from this study can be to promote healthy options which are also environmentally-friendly. This approach would no longer be seen as nudging since a nudge should work without the users' knowledge. By actively promoting healthy options, which are also environmentally-friendly, the users would be actively guided.

To scope of the environmentally-friendly supermarket implemented in this thesis only provides possible nudges for the category "fruits and vegetables" due to an easier testing and displaying of the CO_2 balance. In future developments of a nudging invoked online shop should cover a greater range of items, which all in all produce more CO_2 than a fruit or vegetable.

A big factor in diets regarding environmental awareness and climate-neutral behaviour is the consumption of meat. 2020 in Germany, an estimated amount of 4,4% of the German population, follows a vegetarian diet, and around 3,2% don't consume any animal products by following a vegan diet. (Brogmann, 2020) This leads to around 92,4% of the German population consuming meat regularly.

As mentioned before, the production of meat produces a great number of Greenhouse Gases compared to fruit and vegetable production. According to the *Umwelt Bundesamt* (2022), an estimated amount of 7%[16] of Greenhouse Gases were produced in the agricultural sector. One of the main sources for this amount of Greenhouse Gases is the methane produced by the digestive processes of livestock[17](Umwelt Bundesamt, 2022).

In the future, an environmentally-friendly supermarket could not only increase its' customers' awareness regarding, for instance, how much Greenhouse Gases a tomato produces but also how much Greenhouse Gases could be reduced by changing to a vegetarian or even vegan diet. Because nudging describes a way of leading or softly pushing a decision-maker into acting or choosing in the way the choice architect wants them to, without taking away any options, an environmentally-friendly supermarket would still have to provide meat options for its customers if the online supermarket would only provide vegan or vegetarian options. The number of people buying their groceries there would sink to a minimum. Another aspect that must be considered is that nudging people into reduced meat consumption, can cause a loss aversion. As soon as the customers think that they lose something, in this case the option to buy meat, they most likely will choose another online supermarket to purchase their groceries.

Keeping those arguments in mind, a possibility would be to still sell meat options but to actively put them in the "other users also bought these products" section or to highlight them with a label. This would lead to an ongoing confrontation with vegan and vegetarian alternatives and could lead to less meat consumption. However, variables like individual preferences and attitudes need to be considered when designing future online-supermarkets.

Furthermore, a nudging-based supermarket could not only lead to a more environmentally-friendly lifestyle but could also help in promoting healthier diets in general. In Germany, around 67% of men and 53% of women are overweight, and around 23% of men and 24% of women are obese. (Robert Koch Institut, 2014) An online supermarket would have the possibility to monitor the food choices and eventually support healthier alternatives or regulate possible deficits by nudging customers into healthier food options and by increasing the awareness about what and how much the individual purchased.

As this thesis primarily addressed the implementation of nudges in online supermarkets its effectiveness remains open. To verify the presented nudges and experiment with a controlled setting is needed. One common practice in software development is testing prototypes by using the A/B-testing principle. Following the procedure of an experimental setup will be described briefly:

[16] In 2021 an estimated amount of 54.80 million tons of carbon dioxide and other Greenhouse Gases.

[17] According to the Bundes Umweltamt in 2021 an estimated amount of 36 million tons of carbon dioxide and other Greenhouse Gases were directly produced by livestock farming, which is equivalent to 66% of emissions produced in. the agriculture sector and around 5% of Germanys overall emissions.

For the current case, participants would be assigned to either of two groups – one group would be presented an online supermarket without any nudges and other group a version without any nudges. Both groups would be asked to choose a set of products. Afterwards, they would fill out an questionnaire that includes the following:

The experiment would follow an A/B testing principle. The participants would be confronted with either the default supermarket, without any nudges or with a supermarket containing one nudge. In a third experimental step, two nudges would be combined to check the requirement 5.

Each participant will have to answer a questionary after choosing different fruits and vegetables from the online supermarket. The questionary will include:

- Demographic data
- Their technical affinity, to note whether the participant is keen on using new technologies like online supermarkets or if the participant may already purchase groceries in an online environment.
- How environmentally – conscious the participants are in general. Do the participants already take the CO_2 emissions into relation while they are groceries shopping?

For using the environmentally-friendly online supermarket, the participants each will get the same task to complete. Each participant will get the recipe for a fruit salad. The ingredients are an apple, a banana and a pear. This will ensure that each participant has to choose from the same categories. The task description will be as follows:

> *It's a rainy Saturday morning, and after a long night, you want to treat your health by eating a fresh fruit salad. Unfortunately, you ran out of fresh fruits. You recently discovered the HRW online shop and want to try it out for the first time. For your fruit salad, you want to purchase*
>
> - *An apple*
> - *A pear*
> - *A banana*

After the participants solved this task, they would be asked to answer the questionary mentioned before. The questionary will not be provided before the task to avoid that participants may act more environmentally-friendly than they used to. Lastly, the participants data could be used to verify if the nudges implemented in this thesis are an effective tool to guide customers purchase decisions. The limitation of this thesis includes, as stated before, that the nudges themselves were not tested. To prove if a nudge is working for a range of people, it would have needed to be tested. This leads to another limitation. The number of customers itself is limited as well. Even though the number of people using online supermarkets in Germany increased since the start of the Covid – 19 pandemic it still is not comparable to other countries. The last main limitation would be the actual CO2 balance for each item, since there are many aspects coming into play, when

calculating the total CO2 balance for a product. Furthermore, to transpose this product into a real live environment, the grocery providers would need to reveal the CO2 balance of their products, which most likely will not happen.

8 Conclusion

All in all, this thesis shows that it is possible to implement an environmentally – friendly supermarket, which influences users into acting environmentally-friendly on a technical basis. Furthermore, the question if a developer can guide users into acting environmentally – friendly without them knowing can be answered with yes. The nudges provided in the prototype can be used to influence users and are easy to implement. Some of them are easier to implement for an experienced developer, like the organic label, and some take more obvious nudging into place, like the CO_2 balance bar and are also harder to implement for an experienced developer. Developers always influence users in some way or another without even the developer knowing it. Using this power to support environmentally-friendly behaviour could help reach the climate goals recorded in the Paris climate agreement.

All in all, the research issue cannot be finally answered. For this purpose, a study and survey would have been necessary. The question if developers can guide users to act in an environmentally-friendly way without the users' knowledge is not finally answered in this paper. Still, because of the studies by Berger et al. (2020) and Jessen et al.(2021), it can be estimated that different nudges and biases can be helpful in guiding users in an environmentally-friendly direction. Accordingly, the prototype devolved in this thesis provides a starting point for further research.

In the case of the prototype provided in this thesis, confronting the user with the display of the CO_2 balance of each product combined with the CO_2 balance bar could increase environmentally-conscious and -friendly food choices from the user.

As stated in the chapter about possible future works, the environmentally-friendly online supermarket could be extended by more food categories and not only take the ecological damage into perspective but furthermore the health risks followed by unhealthy diets.

The development of purchasing groceries online can help increase the consumers' awareness of the ecological and health perspective of food.

References

Adobe (2016). State of Create.

Ahrens, S. (2021). *Kaufst du Süßwaren und Snacks häufig direkt an der Kasse?* https://de.statista.com/statistik/daten/studie/1170056/umfrage/kauf-von-suesswaren-und-snacks-an-der-kasse/

Ahrens, S. (2022). *Umsatz mit Lebensmitteln im Online-Handel in Deutschland von 2014 bis 2021 (in Millionen Euro)*. https://de.statista.com/themen/2052/lebensmittelkauf-im-internet/#topicHeader__wrapper

Arm, K., Miller, L., & Tucker, A. C. (2022). *Online Grocery Shopping During the COVID-19 Pandemic: Opportunities to support equitable access to food*. https://www.thinkglobalhealth.org/article/online-grocery-shopping-during-covid-19-pandemic#:~:text=A%20nationally%20representative%20survey%20found,online%20after%20the%20pandemic%20ends.

Berger, M., Nueske, N., & Müller, C. (2020). *Digital Nudging in Online Grocery Stores - Towards Ecologically Sustainable Nutrition.*

Britannica, T. Editors of Encyclopaedia. (2020). *greenhouse effect -- Britannica Online Encyclopedia*.

Brogmann, S. (2020). Europäischer Ernährungsreport 2020.

Bundesministerium für Wirtschaft und Klimaschutz. (2022). *Abkommen von Paris*. https://www.bmwi.de/Redaktion/DE/Artikel/Industrie/klimaschutz-abkommen-von-paris.html#:~:text=Bei%20der%20UN%20-Klimakonferenz%20in,globalen%20Treibhausgase%20emittieren%2C%20ratifiziert%20wurde.

Burgsted, L., & Schweikert, A. (2021). *Corona bewirkt dauerhafte Veränderung beim Kauf von Lebensmitteln*. https://www.bitkom.org/Presse/Presseinformation/Corona-bewirkt-dauerhafte-Veraenderung-beim-Kauf-von-Lebensmitteln

Cherian, J., & Jacob, J. (2012). Green Marketing: A Study of Consumers' Attitude towards Environment Friendly Products. *Asian Social Science*, *8*(12). https://doi.org/10.5539/ass.v8n12p117

Cialdini, R. (1993). *Influence: Science and Practice.*

Clark, M., & Tilman, D. (2017). Comparative analysis of environmental impacts of agricultural production systems, agricultural input efficiency, and food choice. *Environmental Research Letters*, *12*(6), 64016. https://doi.org/10.1088/1748-9326/aa6cd5

Eurostat. (2022, January 26). *Online purchases of goods, EU, 2021*. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Online_purchases_of_goods,_EU(1),_2021_(%25_of_individuals_who_bought_or_ordered_goods_or_services_over_the_internet_for_private_use_in_the_previous_3_months).png#filelinks

Festinger, L. (1962). Cognitive Dissonance. *Scientific American*, *207*(4), 93–106. http://www.jstor.org/stable/24936719

Flink. (2022). https://www.goflink.com/de-DE/?campaignid=15002213999&adgroupid=134315842291&creative=581548309819&utm_source=google&gclid=Cj0KCQjwl7qSBhD-ARIsACvV1X2Y6-YUMPnSH7OLut8sCMzQcX2pUXDgz-rEJ4KsR4zGw8ofsg8xsGNUaAgF3EALw_wcB

Flutter. (o.D.) *Build apps for any screen*. https://flutter.dev/?gclid=CjwKCAjw3cSSBhBGEiwAVII0Z302RSDKR0vLyYB5bpPwJnZD_os6vtbvOGrXqNEUWrXJP-z8A93w4BoCt48QAvD_BwE&gclsrc=aw.ds [Acess Date: 21.3.2022]

Flutter. (o.D.) *GlobalKey<T extends State<StatefulWidget>> class*. https://api.flutter.dev/flutter/widgets/GlobalKey-class.html [Acess Date: 25.3.2022]

Flutter. (2022, March 27). *AnimatedContainer class*. https://api.flutter.dev/flutter/widgets/AnimatedContainer-class.html [Acess Date: 28.3.2022]

Gorillas. (2022). *Gorillas Liefergebiete*. https://gorillas.io/de/liefergebiete [Acess Date: 14.02022]

Heitmann, M., Goldstein, D., Johnson, E., & Herrmann (2008). Nudge Your Customers Toward Better Choices. *Harvard Business Review*, *86*, 99–106.

Jesse, M., Jannach, D., & Gula, B. (2021). Digital Nudging for Online Food Choices. *Frontiers in Psychology*, *12*, 729589. https://doi.org/10.3389/fpsyg.2021.729589

Johnson, E. J., Shu, S. B., Dellaert, B. G. C., Fox, C., Goldstein, D. G., Häubl, G., Larrick, R. P., Payne, J. W., Peters, E., Schkade, D., Wansink, B., & Weber, E. U. (2012). Beyond nudges: Tools of a choice architecture. *Marketing Letters*, *23*(2), 487–504. https://doi.org/10.1007/s11002-012-9186-1

Kahneman, D., & Tversky, A. (1984). Choices, values, and frames. *American Psychologist*, *39*(4), 341–350. https://doi.org/10.1037/0003-066X.39.4.341

Kasimov, J. (2020, May 2). *For those 10 companies Figma was a starting point to new heights*. https://setproduct.com/blog/figma-10-tech-companies#:~:text=There%20are%20only%2010%20companies,%2C%20Volvo%2C%20and%20many%20others.

Kim, H.-W., & Kankanhalli, A. (2009). Investigating User Resistance to Information Systems Implementation: A Status Quo Bias Perspective. *MIS Quarterly*, *33*(3), 567–582. https://doi.org/10.2307/20650309

Koptyug, E. (2021). *B2C-e-commerce revenue in Germany from 1999 to 2020.* statista. https://www.statista.com/statistics/454371/e-commerce-revenue-germany/

Lübke, C. (2021, March 10). *Wahrnehmung des Klimawandels als gesellschaftliches Problem*. https://www.bpb.de/kurz-knapp/zahlen-und-fakten/datenreport-2021/umwelt-energie-und-mobilitaet/330375/wahrnehmung-des-klimawandels-als-gesellschaftliches-problem/

Marina. (2021, January 13). *Klimaneutral leben: Wie du deinen CO2-Fußabdruck zum Schrumpfen bringst*. https://www.loewenzahn.at/magazin/klimaneutral-leben/#:~:text=pro%20Kopf%20in%20Deutschland%207.75,8%20kg%20CO2%20ausgesto%C3%9Fen%20werden.

Masson-Delmotte, V., Pirani, A., Chen, Y., Matthews, J., Yelekci, O., Lonnoy, E., Leitzell, K., Connors, S. L., Goldfarb, L., Berger, S., Yu, R., Maycock, T. K., Zhai, P., Péan Clotilde, Gomis, M. I., Huang, M., Zhou, B., Waterfield, T., & Caud, N. (2021). *Climate Change 2021: The Physical Science Bias*. Summary for Policymakers.

Pereira, F. (2019). *Digital Nudge: The hidden forces behind the 35,000 decisions we make every day.*

Rabe, L. (2021). *Wie gehen Sie mit Cookie-Hinweisen grundsätzlich um?* https://de.statista.com/statistik/daten/studie/1121071/umfrage/umgang-mit-cookie-hinweisen-in-deutschland/

Rahman, S. (2019). *A simplified introduction to Dart and Flutter*. https://www.freecodecamp.org/news/https-medium-com-rahman-sameeha-whats-flutter-an-intro-to-dart-6fc42ba7c4a3/

Robert Koch Institut. (2014). *Übergewicht und Adipositas*. https://www.rki.de/DE/Content/Gesundheitsmonitoring/Themen/Uebergewicht_Adipositas/Uebergewicht_Adipositas_node.html;jsessionid=7EE8A6B6550C4D7357D5C51812CE7093.internet081

Röös, E., Carlsson, G., Ferawati, F., Hefni, M., Stephan, A., Tidåker, P., & Witthöft, C. (2020). Less meat, more legumes: prospects and challenges in the transition toward sustainable diets in Sweden. *Renewable Agriculture and Food Systems*, *35*(2), 192–205. https://doi.org/10.1017/S1742170518000443

Samuelson, W., & Zeckhauser, R. (1988). Status quo bias in decision making. *Journal of Risk and Uncertainty*, *1*(1), 7–59. https://doi.org/10.1007/BF00055564

Schneider, C., Weinmann, M., & vom Brocke, J. (2018). Digital Nudging: Guiding Online User Choices through Interface Design. *Communications of the ACM*, *61*, 67–73. https://doi.org/10.1145/3213765

Sunstein, C. R. (2014). Nudging: A Very Short Guide. *Journal of Consumer Policy*, *37*(4), 583–588. https://doi.org/10.1007/s10603-014-9273-1

Thaler, R. H., & Sunstein, C. R. (2021). *Nudge: The Final Edition*. Penguin Publishing Group. https://books.google.de/books?id=2rUsEAAAQBAJ

Thaler, R [Richard] (1980). Toward a positive theory of consumer choice. *Journal of Economic Behavior & Organization*, *1*(1), 39–60. https://doi.org/10.1016/0167-2681(80)90051-7

Thaler, R [Richard], & Sunstein, C. (2009). NUDGE: Improving Decisions About Health, Wealth, and Happiness. *Nudge: Improving Decisions About Health, Wealth, and Happiness*, *47*.

Thaler, R. H., Sunstein, C. R., & Balz, J. P. (2010). Choice Architecture.

Thedens, T., & Hachiniti, M. (2022). Ultimate Overview of Online Food Retailing in Germany in 2022 and Beyond: A study on customer buying behavior, brand perception, and the role of technology.

Tietz, M., Simons, A., Weinmann, M., & vom Brocke, J. (2016). *The Decoy Effect in Reward-Based Crowdfunding: Preliminary Results from an Online Experiment.*

Tversky, A., & Kahneman, D. (1974). Judgment under Uncertainty: Heuristics and Biases. *Science*, *185*(4157), 1124–1131. https://doi.org/10.1126/science.185.4157.1124

Umwelt Bundesamt. (2021, December 1). *Weltweite Temperaturen und Extremwetterereignisse seit 2010*. https://www.umweltbundesamt.de/themen/klima-energie/klimawandel/weltweite-temperaturen-extremwetterereignisse-seit#das-jahr-2018

Umwelt Bundesamt. (2022, March 21). *Beitrag der Landwirtschaft zu den Treibhausgas-Emissionen*. https://www.umweltbundesamt.de/daten/land-forstwirtschaft/beitrag-der-landwirtschaft-zu-den-treibhausgas#treibhausgas-emissionen-aus-der-landwirtschaft

Venghaus, S., Henseleit, M., & Belka, M. (2022). The impact of climate change awareness on behavioral changes in Germany: changing minds or changing behavior? *Energy, Sustainability and Society*, *12*(1), 8. https://doi.org/10.1186/s13705-022-00334-8

Verbraucher Initiative e.V. (2016). Wirkung von Siegeln auf das Verbraucherverhalten.

Weinmann, M., Schneider, C., & vom Brocke, J. (2016). Digital Nudging. *Business & Information Systems Engineering*, *58*(6), 433–436. https://doi.org/10.1007/s12599-016-0453-1

Wertheimer, M. (1923). Untersuchungen zur Lehre von der Gestalt. II. *Psychologische Forschung*, *4*(1), 301–350. https://doi.org/10.1007/BF00410640

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Hiermit erkläre ich, dass ich die vorliegende Bachelorarbeit selbständig angefertigt habe. Es wurden nur die in der Arbeit ausdrücklich benannten Quellen und Hilfsmittel benutzt. Wörtlich oder sinngemäß übernommenes Gedankengut habe ich als solches kenntlich gemacht. Die vorgelegte Arbeit hat weder in der gegenwärtigen noch in einer anderen Fassung schon einem anderen Fachbereich der Hochschule Ruhr West oder einer anderen wissenschaftlichen Hochschule vorgelegen.

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