



Investigating factors on the intention to use mobile apps against food waste

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Abstract

In the context of environmental sustainability, food waste is a major challenge. Digitalization and especially the proliferation of smartphones suggest the use of mobile apps to address food waste. One of the most important apps in Europe and the US is Too Good To Go. However, consumer intentions to use apps like Too Good To Go are largely unexplored. Based on a survey of 380 respondents in Germany, this paper uses a structural equation model to investigate the influence of sustainable consumption consciousness, price consciousness, and hedonic benefits on the intention to use apps against food waste. The results show that neither sustainable consumption consciousness nor price consciousness significantly influence the intention to use apps against food waste. Users use apps against food waste mainly for hedonic reasons. The results indicate that not only users with sustainable consumption consciousness are willing to use apps against food waste in the interest of sustainability. This research paper therefore makes an important contribution for companies in the food sector to better understand the intentions of consumers who use mobile apps to combat food waste. Furthermore, the paper provides important insights for developers of such apps for future development.

Keywords

sustainability – sustainable consumption consciousness – price consciousness – hedonic benefits – too good to go

1 Introduction

1.1 Background

Every year, around 930 million tons of food are thrown away in households, retail, and the food service industry worldwide (United Nations Environment Programme, 2021). In the European Union, around 60 million tons of food waste is generated annually (European Commission, 2023). Due to the significant environmental impact, the Federal Ministry of Food and Agriculture in Germany, for example, has set a target to halve food waste by 2030 (Abeliotis et al., 2015; Bundesministerium für Ernährung und Landwirtschaft, 2019). To address the environmental, but also social and economic consequences of food waste, new technologies, and especially mobile apps, have been increasingly used recently

(Grüger et al., 2023; Hanson and Ahmadi, 2022; Sestino et al., 2023). Environmental sustainability is also becoming increasingly relevant from a consumer perspective (Gonçalves et al., 2016; Susitha, 2023). At the same time, however, rising food prices, especially due to inflation, present many people with economic challenges and reduce their already low willingness to pay even higher prices for sustainable products (Mu et al., 2019; Padel and Foster, 2005; Rödiger and Hamm, 2015). This tension between sustainable consumption awareness on the one hand and price expectations on the other hand – taking into account the importance of smartphones – opens up an interesting perspective on mobile apps such as Too Good To Go, which aim to counteract food waste by making leftover products accessible at reduced prices (Too Good To Go, 2023a).

1.2 Research gap

The sharing economy phenomenon and collaborative consumption have led to the growth of food-sharing platforms, but there is still insufficient knowledge about the consumers' intention to use these platforms (Mazzucchelli et al., 2021). So far, the intention to use mobile apps in general and in the context of sustainability in particular has usually been explained using the Technology Acceptance Model (TAM) by Davis (1985) or further developments such as the TAM2 or the Unified Theory of Acceptance and Use of Technology model (UTAUT) (Al Afa et al., 2020; Puriwat and Tripopsakul, 2021; Wang et al., 2022). Previous research links the intention to use an app to a perceived benefit of use and utilitarian benefits. In the case of an app such as Too Good To Go, the utilitarian benefit can essentially be explained by the fact that users receive food at a significantly reduced price (Mu et al., 2019). The fact that users actively contribute to avoiding food waste by using apps such as Too Good To Go and thus contribute to environmental sustainability is not usually depicted as a utilitarian benefit. At the same time, however, it is obvious that, in addition to the reduced price, the contribution to environmental sustainability is an essential component of the value proposition (Nair and Bhattacharyya, 2018; Wang et al., 2022).

Overall, there are still too few empirical studies on apps against food waste (Harvey et al., 2020). Previous research shows that more studies on consumer behavior in using apps against food waste are needed (Filimonau and De Coteau, 2019). For example, a study by Du et al. (2024) examines the use of a mobile app to avoid food waste in a university canteen. However, there is little background on the intention to use apps against food waste (Fraccascia and Nastasi, 2023). Some studies are already available that focus on the origins and causes of food waste, rather than the prevention or redistribution of it (Midgley, 2014). For the app Too Good To Go, which is popular in Europe and America, there are hardly any German or international studies so far, but this app is used a lot. The app now has more than 75 million registered users in 17 different countries. The number of registered users has increased by 50% compared to the previous year. In Germany alone, 10 million people have installed the app (Too Good To Go, 2023a), which is an indication of the app's popularity. Apostolidis et al. (2021) call for further studies on such apps.

1.3 Research question and methodology

Previous research on the use of mobile apps has focused primarily on the individual benefit. The question of the

contribution to sustainability as an antecedent of the intention to use has not yet been considered. Against this background, the central research question in this paper is:

What motivates consumers to use food waste reduction apps like Too Good To Go?

In addition to the central research question, this paper aims to answer two other questions:

1. Is saving food and thus sustainable consumption awareness a central motivator or just a positive side effect?
2. To what extent does the reduced price of food play a role?

1.4 Contribution of the paper

The results of this work make an important contribution to better understanding the use of mobile apps in the context of sustainability and avoiding food waste. Sustainable consumption consciousness as an influencing factor on usage intention has not yet played a role in research. This paper embeds sustainable consumption consciousness in the context of the use of mobile apps for the first time and thus also contributes to future research projects that investigate the use of technologies with sustainability promises, for example, in the context of the TAM or the UTAUT.

2 Literature review and hypothesis

2.1 Food waste

Food waste can occur at any point of contact in the food chain (Aschemann-Witzel et al., 2017; Williams et al., 2015). In contrast to food losses, food waste tends to occur in the final stages of the supply chain (HLPE, 2014; Parfitt et al., 2010). Food losses occur at the harvesting and processing stages, while food waste occurs primarily at the distribution or consumer stages (Parfitt et al., 2010). Food waste is a current and relevant problem in ecological sustainability (Harika et al., 2021). Approximately 65 kilograms of food is wasted annually per person worldwide (Chen et al., 2020). Chen et al. (2020) studied the nutrient composition of these leftovers and found that a person could eat a balanced diet for 18 days. High-income countries are six times more likely to waste food than lower-income countries (Chen et al., 2020). However, consumers often do not consciously dispose of food (Van Geffen et al., 2016). There are several behaviors that can increase the likelihood of food waste, including values, motivation, habits, and social norms (Quested et al., 2013; Tóth and Zachár, 2021).

On the food processing side, Heikkilä et al. (2016) identified eight factors that contribute to food waste. One factor is society, which provides the framework for food handling. According to Heikkilä et al. (2016), the amount of wasted food is reflected in a company's business model. Product development and procurement, and thus also product quality and packaging sizes have an impact on food waste. Management can also influence food waste, as they decide on the amount of food prepared. In addition, there is the professional ability of the staff and the behavior of customers. Competing businesses can encourage food waste by making businesses feel pressured to expand their offerings. The last influencing factor is the lack of communication between employees and between employees and customers. Due to lack of communication, there may be confusion about stock levels, missed opportunities to save leftover food, or improper food preparation (Heikkilä et al., 2016).

On the consumer side, the issue of avoiding food waste has several dimensions. Cassia and Magno (2024) mention moral norms and external rewards. They thus distinguish between intrinsic and extrinsic motivation. Vo-Thanh et al. (2021) make a similar distinction, identifying social, functional, and emotional values as motivation to avoid food waste. Research by Attiq et al. (2021) suggests that consumers are more likely to feel committed to reducing food waste if they are educated about the consequences and feel pressure from society. When consumers are educated about the economic consequences of food waste, it can lead to behavior change (Thyberg and Tonjes, 2016). Saving money has been found to drive change in behavior toward food waste (Graham-Rowe et al., 2015; Quested et al., 2013). Consumers care more about the financial consequences of food waste and less about the impact on the environment (Quested et al., 2013). Nevertheless, it can generally be assumed that environmental awareness is associated with less food waste (Tsalis et al., 2024).

Digital transformation can promote new digital solutions and ensure more sustainable development (Schanes and Stagl, 2019). In the food industry, the business model of food-sharing platforms or apps to reduce food waste is one of the most innovative (Harvey et al., 2020). These apps are crucial for sustainability-oriented issues such as waste reduction, social inclusion, and community engagement (Schanes and Stagl, 2019). Food-sharing platforms are thus an essential tool in the fight against food waste (Cane and Parra, 2020). These digital platforms connect individuals and organizations to pass on leftover, unsold food to other individuals or organizations (de Almeida Oroski and da Silva, 2023).

Different models have been developed for this purpose. Most platforms focus on the donation or resale of surplus or unsightly food (Harvey et al., 2020).

In the study by van Der Haar and Zeinstra (2019), 22% of respondents take initiatives against food waste by using the app. Participants indicate that after using TGTG, they are more mindful of reducing food waste, shopping less, and cooking more creatively with food. Participants also embrace more thoughtful shopping. However, the app does not seem to have significantly changed the behavior or motivation to act against food waste, as most users already claim to have an ecological awareness. In advance, 35% of the participants stated that their motivation for downloading the app was to save food. Saving money on groceries was initially mentioned by 20%. Next, the usage intentions were categorized into four different outline principles. This revealed that 45% of respondents use the app to save money. The second most common reason was the surprise factor of the so-called "magic bags" (van der Haar and Zeinstra, 2019). Ranjbari et al. (2024) suggest that TGTG's marketing, which is geared towards reduced prices, should be supplemented by knowledge-enhancing activities.

In addition to Too Good To Go, there are numerous other apps that offer surplus food at a lower price. This allows people from low-income households to get high-quality food at low prices (de Almeida Oroski and da Silva, 2023). However, there are some concerns on the consumers' side about the quality of the leftover food (Apostolidis et al., 2021).

In addition to apps for selling surplus food, there are apps for household management to avoid food waste (Hanson and Ahmadi, 2022). The German Federal Ministry of Food and Agriculture (Bundesministerium für Ernährung und Landwirtschaft, 2023), for example, has developed the app "Too good for the garbage can".

2.2 *Awareness for sustainable consumption*

Consumer behavior has changed in recent years. The topic of sustainability is becoming increasingly important for consumers (Ciasullo et al., 2017; Rausch et al., 2021). Individuals are trying to significantly reduce their impact on the environment (Cherian and Jacob, 2012). As a result, sustainability is also increasingly influencing consumers' purchasing decisions (Abdul-Muhmin, 2007). Thus, purchasing decisions are no longer guided only by individual needs (Kuckertz and Wagner, 2010), but also take into account community environmental protection (Cherian and Jacob, 2012). Also, in a mobile environment, sustainability is named an important factor to buy via a mobile app (Nair and Bhattacharyya,

2018). Furthermore, sustainability is an important part of the communication to promote mobile apps tackling food waste (Sestino et al., 2023).

Consumers with positive attitudes toward environmentally friendly products are more likely to purchase these products (Sony and Ferguson, 2017, p. 201; Sun and Wang, 2019). Environmental and social values motivate consumers and increase commitment in purchasing situations (Joshi and Rahman, 2015). However, sustainable purchases can also be made quite independently of consumers' sustainability concerns (Balderjahn et al., 2018). When buying organic food, trust and the perception of nutritional benefits seem to be the main factors influencing purchases (Lazaroiu et al., 2019).

Minton and Rose (1997) show in their study that consumers' environmentally conscious attitudes have a significant impact on product choices. Sun and Wang (2019) in their study, find that consumers' sustainable attitudes have a positive impact on purchase intentions for environmentally friendly products. These effects were greater in the male subgroup, high-income households, and the Generation Y subgroup (Sun and Wang, 2019). Young consumers have more positive attitudes toward purchasing environmentally friendly products than older consumers (Sun and Wang, 2019). Rausch et al. (2021) find out that female individuals rank sustainable attributes as more important than male individuals.

Thus, in general, sustainable attitudes may have a positive influence on consumption behavior of sustainable products (Dabija et al., 2018; Ogiemwonyi and Harun, 2020). Consumers who have a sustainable consumption awareness are generally also better informed about the consequences of their behavior (Ohtomo and Hirose, 2007).

Consumers' attitudes have a positive influence on the purchase intention of food products offered online (Loketkrawee and Bhatiasavi, 2018; Quevedo-Silva et al., 2016). Young et al. (2009) have shown that there is a strong positive correlation between the perceived ethical importance of sustainable practices and consumer behavior. Consumers' attitude or awareness of sustainability is a key predictor of intention to use sustainable products (Han and Kim, 2010). Mu et al. (2019) point out that mobile apps offer relevant types of interventions to influence users to behave sustainably. However, they find that some users are not interested in sustainability when it comes to food purchasing decisions. Studies have shown that individuals with high sustainable consumption awareness waste less food (Principato et al., 2021; H. Williams et al., 2012). Other researchers find that combining mobile apps and approaches for

gamification can further enhance sustainable consumption (Boncu et al., 2022; Grüger et al., 2023). Too Good To Go users report using the app to waste less food (van der Haar and Zeinstra, 2019).

Therefore, the following hypothesis is formulated:

H1: Sustainable consumption awareness has a positive effect on the intention to use Too Good To Go.

2.3 Price as a factor for purchase decisions

The price of a product is the monetary cost of purchasing that product (Keller, 1993). The price is present in all purchasing situations and represents the money that is given up with a transaction (Lichtenstein et al., 1993). However, price perception is a subjective assessment by consumers (Calvo Porral and Lévy-Mangin, 2015). Price awareness is understood as the willingness of consumers to buy products as cheaply as possible (Lichtenstein et al., 1993). According to Sinha and Batra (1999) price awareness is the most important factor determining the intention to buy product – an evaluation of the price takes place. Thus, high prices have a negative impact on purchase intention (Sinha and Batra, 1999).

Generally, households with less income usually have an increased price awareness. The brand plays an important role in purchasing food products. There is a connection between brand loyalty and trust (Majerova et al., 2020). The more familiar people are with a brand, the lower the perceived risk. This can also influence price consciousness. For example, shopping behavior has an influence on when consumers buy many products at once and are then more sensitive to individual prices (Sethuraman and Gielens, 2014).

Thus, price is an essential influencing factor on consumer buying behavior (Adler and Wohllebe, 2020; Kim et al., 2012; Zhao et al., 2021). In the study of Büyükdag et al. (2020), a significant difference in purchase intention is found for a fixed price and a discounted price. Reduced prices have a significant effect on perceived price attractiveness and purchase intention (Büyükdag et al., 2020). In contrast, a price that is perceived as high lowers the utility of a transaction (Kim et al., 2012). Here, utility is composed of the difference between the price and the reference price (Kim et al., 2012). Thus, perceived price attractiveness depends on how the internal reference price compares to the market price (Janiszewski and Lichtenstein, 1999).

Price awareness can have a negative impact on the purchase of environmentally friendly products (Sun and Wang, 2019; Van Doorn and Verhoef, 2015). Studies have shown that price outweighs ethical concerns when

it comes to purchasing sustainable products (Connell, 2010; Gleim et al., 2013). Often, a higher price for green products is what prevents individuals from purchasing them (Padel and Foster, 2005; Rödiger and Hamm, 2015). According to Neff et al. (2015) saving money is a stronger driver for buying products than ecological concerns, probably because it has more personal consequences (Ribbers et al., 2022). Mu et al. (2019) outline a tension between price and sustainability, especially when good offers tempt consumers to buy more than they actually need.

In the study by Aschemann-Witzel et al. (2018), price-conscious consumers are more likely to buy foods that are suboptimal and therefore can no longer be sold on a regular basis. The prices of Too Good To Go surprise bags are about one third of the original price (Too Good To Go, 2023b). In van der Haar and Zeinstra's (2019) study with users of the app, saving money is one of the main reasons for use. This supports the findings of several qualitative and quantitative studies indicating that food waste avoidance is primarily motivated by financial reasons (Aschemann-Witzel et al., 2018; Neff et al., 2015; Visschers et al., 2016). Consumers are motivated to change their food waste behavior mainly by financial aspects (Graham-Rowe et al., 2015; Quested et al., 2013). The study by Hamari et al. (2016) also identified economic benefits as a motivational reason for participating in sharing economy business models. Berri and Toma (2023) in their study investigated the usage intention of social supermarkets where consumers can get leftover food at significantly lower prices. In their study, price awareness has a significant impact on usage intention (Berri and Toma, 2023). McCarthy et al. (2020) also concluded in their study, that price-conscious consumers are more likely to purchase leftover food. Price-conscious consumers might therefore be more motivated to use the app.

This results in the following hypothesis:

H2: Price awareness has a positive effect on the intention to use Too Good To Go.

2.4 Hedonic motivation to use mobile apps

According to Davis (1989) the intention to use is the best predictor for the actual use of a system. For investigating the usage intention of apps, the Technology Acceptance Model (TAM) has been proven in several studies (Briz-Ponce and García-Peñalvo, 2015; Muñoz-Leiva et al., 2017; Ross et al., 2022; Shukla and Nigam, 2018). According to Gefen et al. (2003) the TAM model can also be used for purchase intention in e-commerce. Many

studies also use the further development of the TAM, the Unified Theory of Acceptance and Use of Technology Model (UTAUT) as a predictor of mobile app usage intention (Katheeri, 2020; J.-C. Lee and Chen, 2019; Puriwat and Tripopsakul, 2021). As it evolved into the UTAUT2 model, the factors of habit, price value, and hedonic motivation were added (Venkatesh et al., 2012). However, the entire UTAUT2 model is too complex for predicting usage intention (Bagozzi, 2007). In addition, the use of moderators (age, gender, and experience) is criticized to achieve a high R² value (van Raaij and Schepers, 2008).

According to Cho et al. (2019), there are five attributes that influence the usage intention of food delivery apps. These include convenience of use, app design, trustworthiness, price, and product variety (Cho et al., 2019). In an exploratory consumer study by van de Haar and Zeinstra (2019) in collaboration with TGTG, three motivations for app use were cited. The first reason was the desire to waste less food (van der Haar and Zeinstra, 2019). Other reasons were saving money and having a surprising experience through the surprise bags (van der Haar and Zeinstra, 2019).

Hedonic motivation is the fun or pleasure derived from using a technology (Al-Gahtani et al., 2007; Brown and Venkatesh, 2005). Thus, hedonic motivation describes the intrinsic benefits of using a technology (Venkatesh et al., 2012). It is especially relevant at the beginning of the market introduction of a technology and decreases with increasing experience. After that, other reasons, such as effectiveness and efficiency become more relevant for the intention to use (Venkatesh et al., 2012).

The purchase of food online is influenced by hedonic motives (Nejati and Parakhodi Moghaddam, 2013). Purchase motivation may arise from enjoyment (Alavi et al., 2016).

According to Brown and Venkatesh (2005) hedonic motivation is an important determinant of technology adoption and use. Consumers with high sustainability awareness have a higher effect of hedonic motivation on usage intention than individuals with low sustainability awareness (Rezvani et al., 2018). The pleasure of picking up the surprise bags was one of the main reasons for use given by the respondents of van de Haar and Zeinstra (2019). Hamari et al. (2016) studied the motives for participating in sharing economy business models and found pleasure in use as one of the main motives. Fadzil (2017) identified hedonic motivation as the strongest influencing factor on mobile app usage intention in a study.

From these theoretical implications, the following hypothesis is proposed:

H3: Hedonic motivation has a positive influence on the *usage intention of Too Good To Go*.

3 Conceptual model

Based on the three hypotheses derived from the literature, a conceptual model is created (Figure 1). To test the conceptual model empirically, the four concepts of sustainable consumption consciousness, price consciousness, hedonic motivation and intention to use are operationalized based on existing research, as they are latent variables that cannot be measured directly.

The independent variables are sustainable consumption awareness, price awareness, and hedonic motivation. Since the variables in this study are latent variables, multi-item scales from established studies are used to measure the constructs. The items were slightly adapted to the content of the study.

Sustainable consumption awareness is not the same as environmental awareness (Ziesemer et al., 2016). To cover sustainability, social factors, economic factors, and environmental factors must be considered (Ziesemer et al., 2016). Balderjahn et al. (2013) then developed the Consciousness for Sustainable Consumption Scale (CSC scale) to apply the triple bottom line concept developed by Elkington (2018) to consumption behavior. The scale has already been used in several studies and shows high reliability and validity (Balderjahn et al., 2013; Suárez et al., 2020). The construct of sustainable consumption awareness is measured with the shortened scale of Ziesemer et al. (2016). Measuring 46 items for one construct would be too extensive in the context of this study. The shortened scale of Ziesemer et al. (2016) shows a further high validity, with only 12 items. The items Sus1 to Sus3 measure the ecological dimension or environmental awareness, 4 to 6 measure social awareness, and 7 to 12 measure the economic dimension (Ziesemer et al., 2016). Here, the economic dimension includes both collaborative awareness and awareness of moderate consumption (Ziesemer et al., 2016).

In addition, the variable hedonic motivation was added to predict the intention to use the app. The hedonic motivation items are adapted from the UTAUT2 model developed by Venkatesh et al. (2012). The dependent variable intention to use is measured using the items developed by Venkatesh et al. (2003). Thus, they are based on the behavioral intention variable from the UTAUT model.

The measurement of price consciousness was adopted from the study of Ailawadi et al. (2008), Sun and Wang (2019) and van Doorn and Verhoef (2015), measured with three items. The price awareness factor is composed of a total of four items.

In the study of Fraccascia and Nastasi (2023) the variables related to individual consumer factors such as perceived risk, fear of unfamiliar food, and food storage knowledge were not significant, so they are not collected again in this study. Van der Haar and Zeinstra (2019) say that the app is user-friendly and easy to use. Therefore, the variables ease of use and perceived usability (TAM) were also not surveyed.

Figure 2 provides an overview of the constructs and the underlying items for measuring the constructs. From Table A1 in the Appendix the items and their constructs can be obtained. The conceptual model will be tested using a linear structural equation model. In this way, the theoretically derived effect relationships between several variables can be analyzed (Sedlmeier and Renkewitz, 2013).

4 Research methodology

To investigate the model postulated in Figure 2, empirical-analytical research is conducted. Figure 2 is used to operationalize the conceptual model presented in Figure 1 by translating each of the concepts into measurable items for use in a questionnaire. The theoretical model and its postulated causal relationships are tested using data from an online survey.

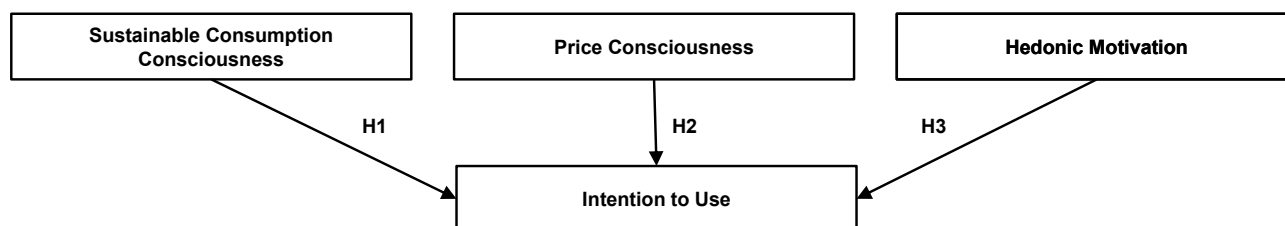


FIGURE 1 Conceptual model derived from the literature

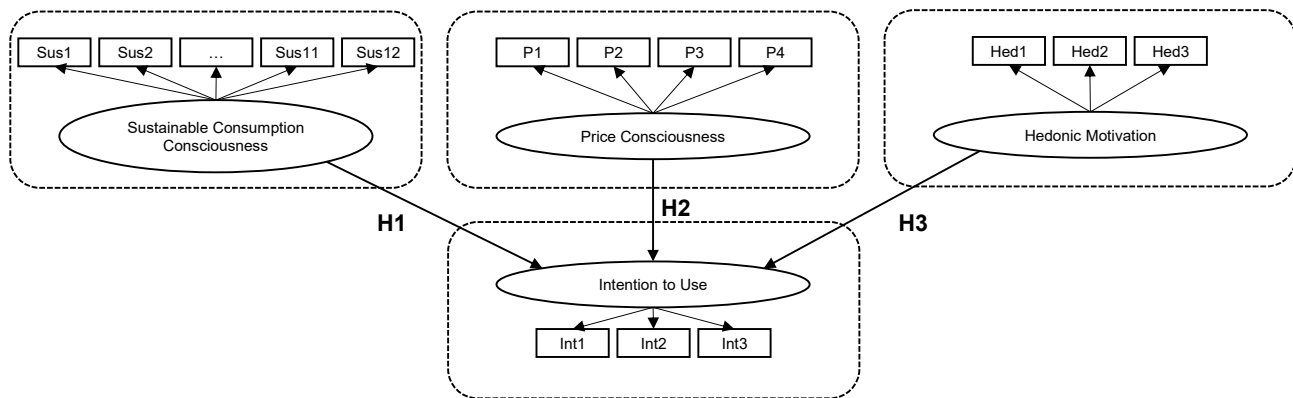


FIGURE 2 Measurement model including latent variables and items

The free tool “Google Forms” was used to design the survey. The standardized questionnaire was designed based on research questions and hypotheses and was controlled with a pretest a few days before the start of the survey. A total of five test subjects reviewed the online survey in advance. The pretest resulted in a need for a supplementary explanation of the scales, i.e., the reference to the scales was added again in each section. It turned out that the subjects noticed a similarity or duplication in the items. However, this was deliberately included in the questionnaire because of the complexity of the constructions.

Such multi-item scales measure the theoretical construct as accurately as possible to make the measurement content-valid (Sedlmeier and Renkewitz, 2013). One person found it difficult to answer the items on sustainability, as the tendency is always towards “I fully agree”. This is a known problem in consumer research, as consumers often pretend to have a conscious, sustainable attitude but behave in opposite ways (Prothero et al., 2011).

The data collection and analysis were carried out in compliance with the Declaration of Helsinki, the ethical rules of the authors’ institutions, and the applicable legal standards.

In the descriptive text of the survey, all participants were informed about the purpose of the collection, storage, and evaluation of the collected data and gave their written, informed consent. The time required to complete the survey was included. The participants were incentivized to increase the response rates by the raffle of 5 × 50 euros Amazon vouchers. Consumers from German-speaking countries were able to freely select their end device for participation, i.e. via computer, tablet and smartphone.

The first part of the survey is made up of latent variables. In addition to sustainable consumption awareness,

price awareness, hedonic motivation, and intention to use Too Good To Go are measured on a Likert scale ranging from 1 (“I strongly disagree”) to 5 (“I strongly agree”). Each variable is measured with three to twelve items.

The section of TGTG starts with a description of the app and an example picture of what a surprise bag might look like. The participants were then first asked whether they knew the app. This is followed by a question about the frequency of use and the assessment of effort, also in the form of a 5-point Likert scale. The assessment of the price attractiveness and the sustainability rating of the app were included in the questionnaire as control questions. This serves to capture the measured aspects of sustainable consumption awareness and price awareness in a context that directly relates to the app and its offering. For example, it could be that individuals have sustainable consumption awareness but do not rate the app as sustainable, so they do not use the app.

At the end of the questionnaire are the sociodemographic characteristics. To control for possible side effects, location of residence and dietary preferences were asked in addition to gender, age, educational attainment, and net household income. In smaller towns, the supply via TGTG is correspondingly lower, which could influence intention to use. The response options on place of residence are based on the classification of the German Federal Office for Building and Regional Planning (Bundesamt für Bauwesen und Raumordnung, 2023). The question about incompatibility serves as a control variable, since the app does not always allow a choice on this, which could limit the intention to use. In the study by van der Haar and Zeinstra (2019) TGTG users indicated that they would welcome vegetarian or dietary cues.

Finally, participants were asked how much money they spend on food per month and how many people live in their household.

The survey participants are generated online. The survey will be shared via the German-language online platform SurveyCircle and via the private social media profiles of German-speaking authors. As an incentive to participate, five Amazon vouchers of 50 euros each will be raffled off among all participants. The survey will run for a total of around three weeks.

5 Results

5.1 Descriptive statistics

In the period from June 9th, 2023, to July 2nd, 2023, a total of 383 people participated in the online survey. Three participants had to be removed due to missing data or inattentive responses. For example, one person indicated an age of three, and this record was excluded from the results as a precaution. Of the remaining 380 individuals, 64.5% are female, and 35.3% are male. One person identifies as diverse.

Figure 3 shows the age distribution of respondents. Fifty-two percent of respondents ($n = 198$) are between the ages of 21 and 30. This is followed by 31- to 40-year olds with a total of 20.7%. At just under 4.7%, the fewest participants are under 20 years old.

Most of the participants have a technical or university degree (64.2%). 30.1% of the respondents have a high school diploma and two of the participants have a secondary school diploma as their highest level of education.

Figure 4 shows the distribution of net monthly household income. The number of participants earning between 4000 and 5000 euros is 9.8%; 17.8% of

respondents earn more than 5000 euros per month and the majority has a monthly income of 1000 to 2000 euros, while 14.9% have a monthly net household income of less than 1000 euros.

Most respondents spend between 200 and 300 euros a month on groceries, while 8.2% spend over 600 euros. 44 people reported spending under 200 euros a month on groceries and 77 people spend between 300 and 400 euros a month. As shown in Figure 5, 55 people spend between 400 and 500 euros a month on groceries.

A total of 22.5% of participants have a food intolerance or allergy and 28.4% follow a vegetarian or vegan diet. About 22% said they were unaware of the Too Good To Go app prior to the survey. Of those who are aware of the app, only 34 people use the app, meaning about 92% of participants do not use the app. A small number of participants (7%) say they use the app regularly or very regularly for purchases. 54 people use the app sometimes.

Some respondents use alternatives to TGTG; the most mentioned alternative to Too Good To Go is food-sharing. In addition to the platform, reduced bags from supermarkets or bakeries, the boxes with exceeded best-before dates from Motatos or Sirplus, and eBay classifieds were also mentioned.

Most respondents rate the prices of TGTG as attractive to very attractive (74%). Only 5% of the respondents stated that they did not rate the prices as attractive or not at all attractive (see Figure 6). 21% could not decide. The assessment of the sustainability of the app is shown in Figure 7.

Table 1 presents the data for the means (M) and standard deviations (SD) for each item of sustainable

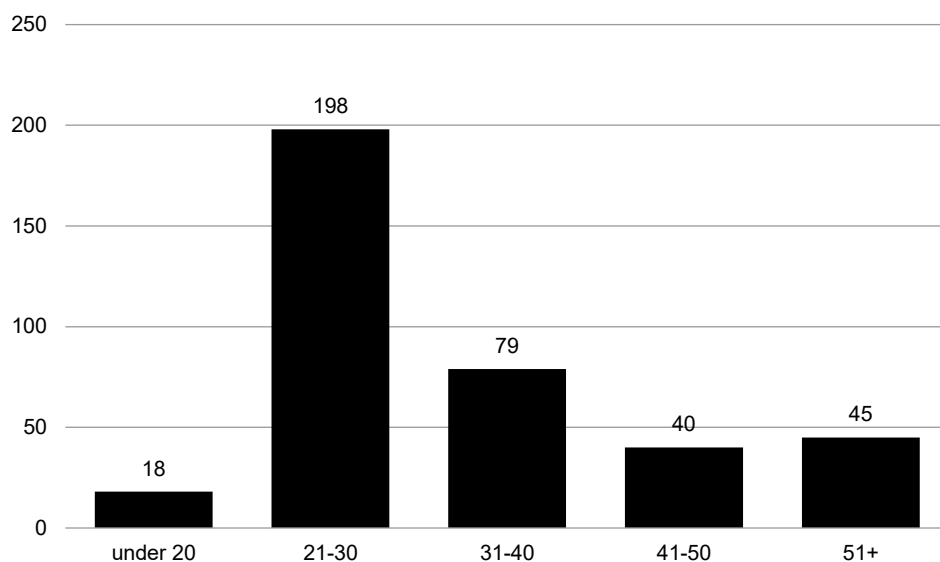


FIGURE 3 Age distribution of respondents ($n = 380$)

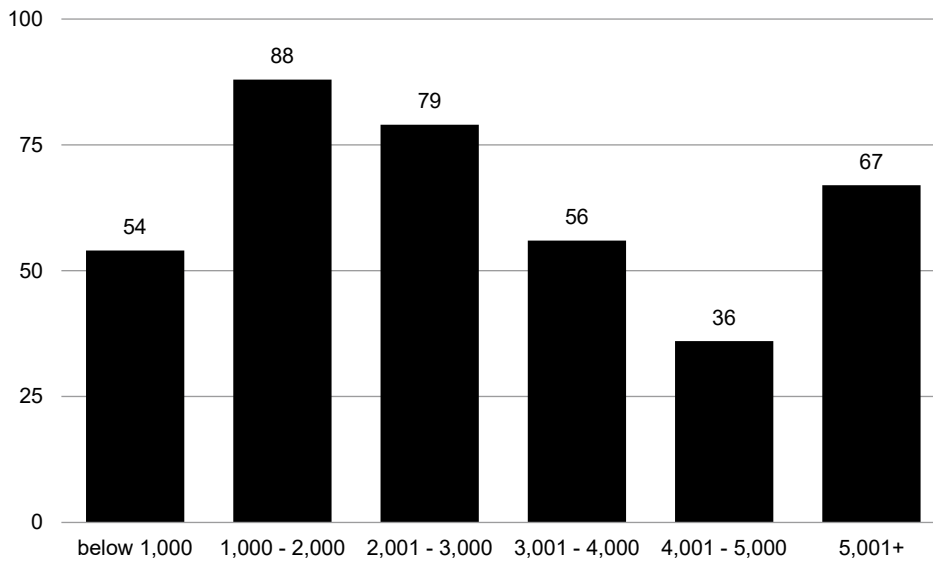


FIGURE 4 Net income distribution of respondents in EUR ($n = 380$)

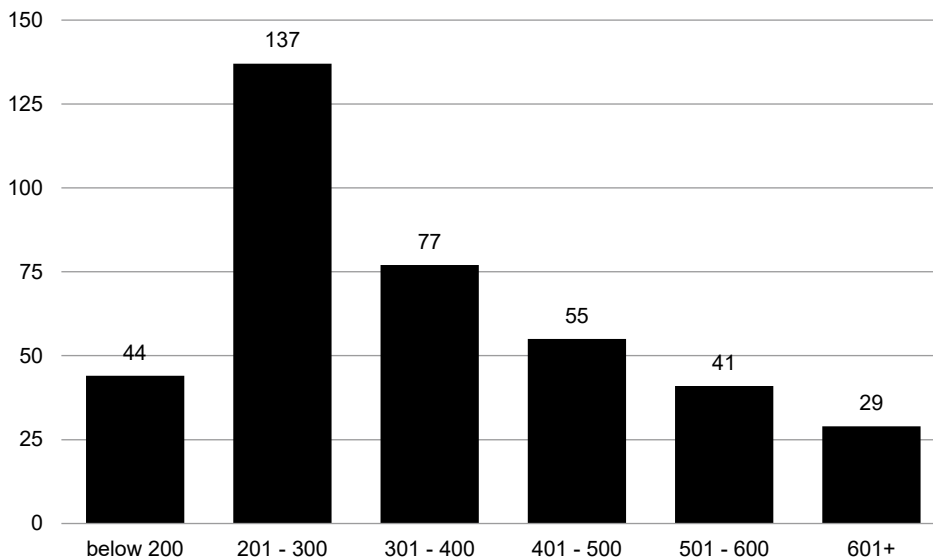


FIGURE 5 Distribution of monthly spendings for food of respondents ($n = 380$)

consumption awareness, price awareness, hedonic motivation, and intention to use variables.

On average, participants pay attention to prices, as the mean values (M) of the items range from 3.32 to 4.12. In general, then, respondents tend to be price conscious. Item P2 ("Price is important to me when I decide to buy products") shows the highest level of agreement on average ($M = 4.12$; $SD = 0.84$).

For the variable hedonic motivation, the mean values range from 3.24 to 3.44 and the standard deviations range from 1 to 1.07. The intention to use was answered on average with 3 ("I neither agree nor disagree"), but the values for these items scatter more around the mean values ($SD = 1.4$; $SD = 1.37$; $SD = 1.42$). This speaks for very different answers from the respondents.

5.2 Confirmatory factor analysis (CFA)

A confirmatory factor analysis (CFA) is carried out to check whether the data collected fits the conceptual model postulated (shown in Figure 1) and the measurement model based on it (as shown in Figure 2). Initially, all variables postulated in the measurement model are included. The CFA is carried out using the statistical programming language R version 4.3.1 and the associated R package lavaan in version 0.6.17. Table 2 shows the fit indices for the CFA with all items. Based on Kline (2015) and Hu and Bentler (1999) the statistical quality of this model is not acceptable ($\chi^2 = 1312.164$; $df = 203$; $p = 0.000$; $CFI = 0.759$; $TLI = 0.725$; $RMSEA = 0.120$; $SRMR = 0.103$).

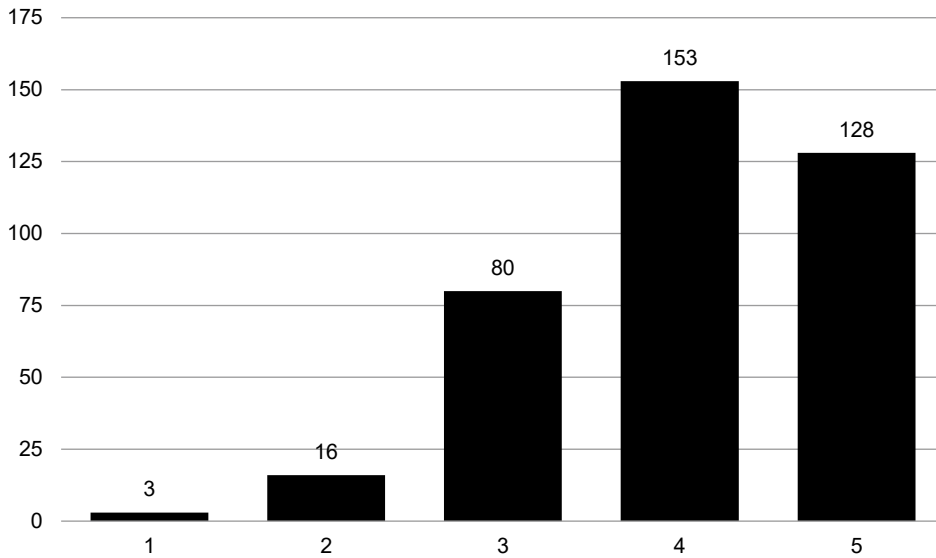


FIGURE 6 Perceived price attractiveness of food offered at TGTG ($n = 380$)

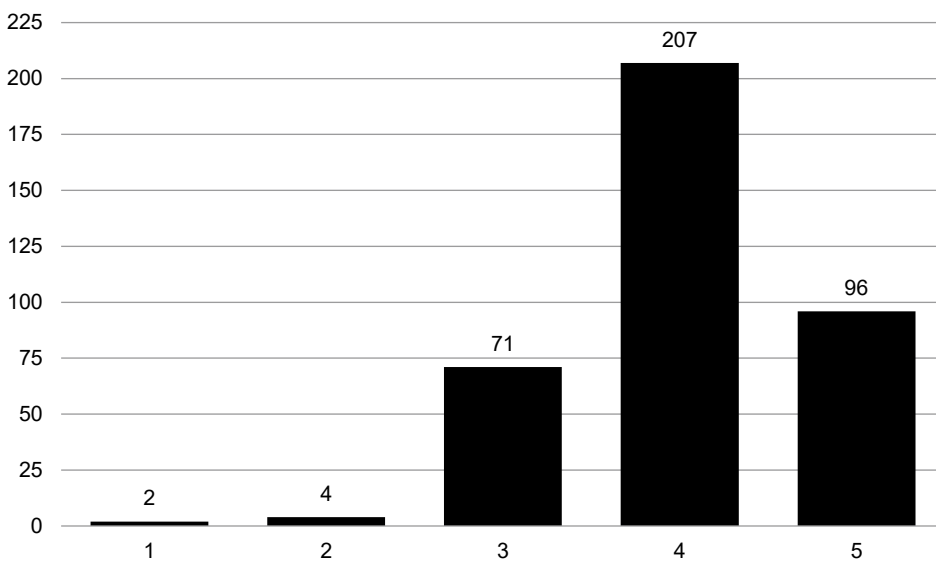


FIGURE 7 Perceived sustainability of TGTG ($n = 380$)

The examination of the latent variables in Table A2 in the Appendix shows that reliability, measured using Cronbach's alpha, is given in all cases (Schmitt, 1996). Convergent validity is assessed using the AVE. For Sustainable Consumption Consciousness (AVE = 0.306) and Price Consciousness (AVE = 0.408), these values are well below the value of 0.500 defined by Fornell and Larcker (1981).

Based on the results of the CFA with all variables, a second CFA is carried out with an adjusted model. For Sustainable Consumption Consciousness and Price Consciousness, the items with the lowest factor loadings are removed so that an AVE > 0.500 is achieved for both latent variables. This also improves the overall model, as fit indices for the adjusted model in Table 3 show. While

the RMSEA is still above the threshold value, values in the acceptable range can be achieved for CFI and SRMR in particular (Hu and Bentler, 1999).

With regard to convergent validity, the AVE in the adjusted model is above the value of .500 defined by Fornell and Larcker (1981) for all latent variables. The factor loadings are also well above the limit values recommended by Cheung et al. (2023) with reference to Stevens (2012) and Hair (2009). The reliability of Sustainable Consumption Consciousness and Price Consciousness, measured with Cronbach's alpha, could also be further increased with the adapted model. The results for the adapted model are shown in Table 4.

Regarding discriminant validity, two criteria were tested. For the criterion of Fornell and Larcker (1981),

TABLE 1 Descriptive statistics of items

ID	<i>M</i>	SD
Sus1	3.44	01.08
Sus2	3.71	01.07
Sus3	3.73	01.07
Sus4	4.43	0.84
Sus5	4.28	0.91
Sus6	4.41	0.84
Sus7	2.47	01.08
Sus8	3.21	1.15
Sus9	3.72	01.06
Sus10	3.89	0.99
Sus11	4.27	0.89
Sus12	4.16	0.95
P1	3.48	0.94
P2	04.12	0.84
P3	3.48	1.17
P4	3.32	01.08
Hed1	3.24	01.07
Hed2	3.34	01.06
Hed3	3.44	1.00
Int1	3.07	1.40
Int2	2.85	1.37
Int3	2.94	1.42

TABLE 2 Fit indices for the CFA with all items

<i>n</i>	380
Chi-square	1312.164
df	203
<i>p</i> (Chi-Square)	0.000
CFI	0.759
TLI	0.725
RMSEA	0.120
SRMR	0.103

according to which the square root of average variance extracted for each latent variable must be higher than the correlation between this latent variable and any other latent variable, a correlation matrix is calculated for the adjusted latent variables (Table A3). The correlations are then compared with the square root of AVE in Table A4. Based on the Fornell-Larcker criterion, the discriminant validity can be shown.

Furthermore, the heterotrait-monotrait ratio of correlations according to Henseler et al. (2015) is calculated

TABLE 3 CFA with adjusted latent variables: model overview

<i>n</i>	380
Chi-square	613.789
df	71
<i>p</i> (Chi-Square)	0.000
CFI	0.857
TLI	0.817
RMSEA	0.142
SRMR	0.084

to test the discriminant validity (Table A5). All HTMT values are significantly below the maximum values of 0.900 and 0.850 recommended by Henseler et al. (2015) and Voorhees et al. (2016). Accordingly, discriminant validity can be assumed for all four latent variables.

Overall, the chi-squared difference test shows that the adjusted model fits the observed data significantly better than the originally proposed model (χ^2 diff = 1055.6; df diff = 61; *p* = 0.000).

All prerequisites for a structural equation model were checked, and appropriate corrections were made. With the revised model, the relationships of the factors derived from the literature can be analyzed with a structural equation model.

5.3 Structural equation model

The linear structural equation model will be used to test the hypotheses previously derived. To calculate the model, R and the package lavaan are used. With the help of the confirmatory factor analysis, the adjusted measurement model was created as the basis for the structural equation model.

First, it is checked whether the assumption of multivariate normal distribution is fulfilled. For this purpose, the data set is tested for multivariate normal distribution using the Henze–Zirkler test (Henze and Zirkler, 1990). Because the assumption of multivariate normal distribution is violated (HZ = 1.2506; *p* = 0.000), the maximum likelihood estimator with Satorra–Bentler correction is used to calculate the structural equation model (Satorra and Bentler, 1994), as recommended by Steinmetz et al. (2015) and others. Furthermore, the assumption that there is no multicollinearity is checked. The variance inflation factor (VIF) is calculated for this purpose. Table 5 summarizes the results.

None of the VIF values is above the critical value of 10 or the questionable value of 5 (O'Brien, 2007). It can be assumed that there is no multicollinearity, so the model

TABLE 4 CFA with adjusted latent variables: factor loadings, AVE and Cronbach's Alpha

Latent variable	ID	Std. factor loading	Sq. std. factor loading	Sum sq. std. factor loading	AVE	Cronbach's Alpha
Sustainable consumption consciousness	Sus1	0.572	0.327	3.391	0.565	0.89
	Sus2	0.589	0.346			
	Sus3	0.608	0.369			
	Sus4	0.872	0.760			
	Sus5	0.869	0.755			
	Sus6	0.912	0.831			
Price consciousness	P1	10.405	10.974	2.133	10.067	0.72
	P2	0.399	0.159			
Hedonic motivation	Hed1	0.848	0.719	1.777	0.592	0.81
	Hed2	0.694	0.481			
	Hed3	0.759	0.576			
Intention to use	Int1	0.945	0.893	2.685	0.895	0.96
	Int2	0.937	0.877			
	Int3	0.956	0.913			

TABLE 5 Variance inflation factor (VIF)

Variable	VIF
Sus1	3.28
Sus2	3.10
Sus3	2.95
Sus4	3.39
Sus5	3.43
Sus6	4.14
P1	1.57
P2	1.49
Hed1	2.11
Hed2	1.76
Hed3	1.76

influence on intention to use, so Hypothesis 1 cannot be confirmed ($\beta = -0.047$, $p = 0.647$). Price awareness also has no positive influence on the intention to use, so that Hypothesis 2 cannot be confirmed ($\beta = -0.022$; $p = 0.521$). In the case of usage intention, the positive path coefficient indicates that a higher expression of hedonic motivation also results in a higher usage intention. Thus, the results support Hypothesis 3, according to which hedonic motivation has a positive influence on the intention to use Too Good To Go ($\beta = 0.906$; $p = 0.000$).

Table 6 shows the R^2 values for the variables of the model. The R^2 value for the intention to use (Int) is $R^2 = 0.384$, meaning that the model explains 38.4% of the variance.

does not need to be adjusted because of multicollinearity issues.

Figure 8 shows the results of the structural equation model calculation. It also presents the final structural equation model, indicating the direction of effects (positive or negative) as well as their significance levels (denoted by asterisks).

The negative path coefficient from sustainable consumption awareness to intention to use indicates that higher sustainable consumption awareness is associated with lower levels of intention to use. However, sustainable consumption consciousness has no significant

6 Discussion

6.1 Discussion of research results

This paper deals with the question of what motivates consumers to use apps against food waste. For this purpose, the hypotheses in Table 7 were derived from theory. The results of the structural equation model show that Hypothesis 1 cannot be confirmed. The hypothesis states that sustainable consumption awareness has a positive effect on the intention to use TGTG. Thus, sustainable consumption awareness does not lead to a higher intention to use the app. Similarly, Hypothesis 2,

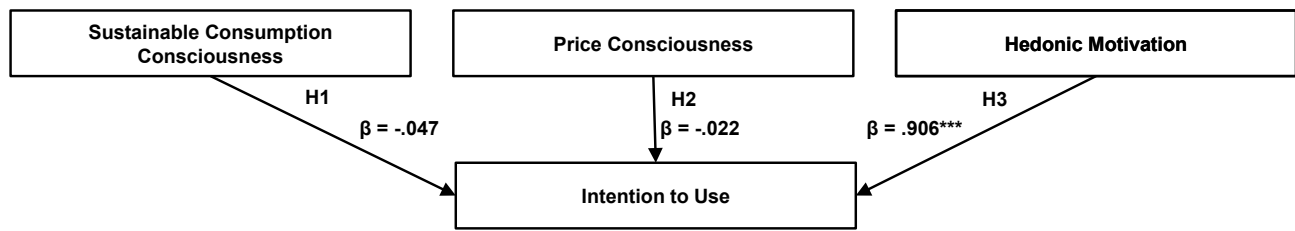


FIGURE 8 Structural equation model results with standardized coefficients (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$)

TABLE 6 R^2 values

Variable	R^2
Sus1	0.327
Sus2	0.347
Sus3	0.370
Sus4	0.760
Sus5	0.754
Sus6	0.831
P1	N/A
P2	0.162
Hed1	0.719
Hed2	0.481
Hed3	0.576
Int1	0.892
Int2	0.879
Int3	0.914
Int	0.384

which assumed a positive relationship between price awareness and usage intention, could not be confirmed. Hypothesis 3, which postulated a positive link between hedonic motivation and usage intention, could be confirmed. The results show that a pronounced hedonic motivation, i.e., the fun of the surprise bags, increases the intention to use the app. Table 7 summarizes the results for the three hypotheses.

The pleasure of the surprise effect of magic bags, motivates people to use the app. This supports the findings of Fadzil (2017), whose study identified hedonic motivation as the strongest factor influencing the intention to use mobile apps. In this respect, our results also partially support Vo-Thanh et al. (2021), who identified emotional value as a factor for the use of anti-food waste apps in addition to social and functional value. Studies considering the variable of perceived pleasure as equivalent to hedonic motivation obtain comparable results. In the study of Nejati and Moghaddam (2013) hedonic motives influenced the purchase motivation of

groceries online. Thus, purchase motivation may arise from pleasure (Alavi et al., 2016).

The relevance of hedonic motivation is further supported by the research of Boncu et al. (2022) and Gröger et al. (2023), who emphasize the role of gamification in mobile food apps to promote sustainable behavior. The app Too Good To Go or other apps against food waste should emphasize the fun that comes with using it. For example, testimonials from other users could be shared via the app showcasing their surprise bag contents. Indeed, participation in sharing economy business models is motivated in part by social interaction (Hamari et al., 2016). An alternative option is to collaborate with influencers to highlight the fun of picking up and unwrapping the bags. There are already several videos on YouTube of influencers unwrapping their surprise bags from Too Good To Go (Inken Rott, 2023; MAX, 2022; Pocket Hazel, 2022). Pocket Hazel (2022) has approximately 350 000 views on her video (as of August 2023), which could indicate potential interest from potential users. Currently, Too Good To Go is not aware of any collaborations with influencers.

Sustainable consumption awareness has no significant influence on the intention to use TGTG, as previously assumed. This supports the results from the study by Hamm et al. (2012) where environmentally conscious people are not willing to buy suboptimal foods, despite a positive attitude towards these foods. Weber's (2021) finding that mobile apps can help to promote sustainable consumption cannot therefore be transferred to sustainable consumption awareness as a factor influencing the intention to use the app. The finding by Tsalis et al. (2024) that environmental awareness would lead to less food waste cannot be confirmed, at least not for the use of an app to avoid food waste. Nair and Bhattacharyya's (2018) finding that sustainability is an important motivation for shopping via a mobile app cannot be confirmed for saving food to avoid food waste. Even if Sestino et al. (2023) point out the importance of sustainability in communication to promote food waste apps, this does not equally mean that sustainability is

TABLE 7 Summary of results based on hypotheses

No.	Hypothesis	β	p	Result
H1	Sustainable consumption awareness has a positive effect on the intention to use Too Good To Go.	-0.047	0.647	Rejected
H2	Price awareness has a positive effect on the intention to use Too Good To Go.	-0.022	0.521	Rejected
H3	Hedonic motivation has a positive influence on the usage intention of Too Good To Go.	0.906	0.000	Accepted

also a factor in the intention to use, as our results show. Lazaroiu et al. (2019) found that trust and the perception of nutritional benefits also influence the purchase of organic food. This perspective on the extent to which an app for avoiding food waste is also trusted represents an important starting point for future research in food waste apps.

In their studies, de Hooge et al. (2017) and Loebnitz and Grunert (2015) obtained different results where individuals with strong environmental awareness showed higher intentions to purchase organic foods. The variables do not seem to be independent of each other, but in which mode of action is still unclear. Sustainable consumption awareness correlates with intention to use, i.e., it would be advisable to conduct follow-up studies on this relationship. According to Loebnitz and Grunert (2015), policymakers as well as providers of such apps should emphasize the purchase of suboptimal food as an environmentally conscious alternative. On the other hand, the results of Mu et al. (2019) show that users' requirements in terms of food quality are sometimes very high, meaning that the purchase of suboptimal food could be rejected for quality reasons. Furthermore, it is advisable if consumers are more educated about the consequences of wasting food (Loebnitz and Grunert, 2015). According to Loebnitz and Grunert (2015), awareness about the problems of food waste has a significant positive influence on the purchase intention of suboptimal food. Suruliraj et al. (2020) point out that mobile apps can also be used to educate people about sustainability.

Many of the respondents are aware of the app (52%), but do not buy surprise bags. Accordingly, the intention to use is low. This could indicate that while interest in the app is high, there are barriers to using it. Possible reasons for this could be, for example, too far away from possible surprise bags, too short or inappropriate pick-up times, or lack of clarity about the function of the app. In the study by van der Haar and Zeinstra (2019), consumers of TGTG mention some suggestions to reduce the effort, such as extending the pick-up times

or allowing another person to pick up the order for the person. This means further exploratory research needs to follow to analyze the barriers to using the app. In this context, it would also be interesting to conduct a long-term study that analyzes the intention to use the app over a certain period and maps potential changes in behavior. Furthermore, it could be beneficial if future long-term studies quantify the actual importance of such apps in the fight against food waste.

Hypothesis 2 also cannot be accepted in this thesis. Although prices play an important role in consumer-decision making (Kim et al., 2012; Zhao et al., 2021), the results suggest that usage is not primarily motivated by monetary factors. Majerova et al. (2020) show that the brand and trust in a brand play an important role in the purchase of food. For food waste apps that bundle the offerings of several food producers, this raises the interesting question of what role the brand of the food waste app plays in relation to the brand of the respective food producer. The results also contradict in part the study by Mu et al. (2019), in which respondents point out the high relevance of a low price when buying food. In the studies by Williams et al. (2012) and Visschers et al. (2016) it is clear that price-conscious consumers waste less food. These results are supported by Rihn et al. (2018), as consumers' price consciousness reduces the likelihood of purchase and, consequently, the use of the app in general. However, these results contrast with the findings of Berri and Toma (2023) and McCarthy et al. (2020), who identified price awareness as a significant factor influencing intention to use reduced food waste offers. It is possible that consumers expect reduced prices in return for food that is no longer as fresh (Helmert et al., 2017). This is because the willingness to purchase suboptimal foods increases with reduced prices (Aschemann-Witzel et al., 2018; Helmert et al., 2017). In an eye-tracking study by Helmert et al. (2017), participants favored a normal product when the price was the same; when the price was reduced, it was decisive for selecting the suboptimal product. In addition to emphasizing the reduced price, the positive ecological benefits should also be

communicated more strongly. This could lead to the fact that even those individuals who are not convinced by the low price alone nevertheless tend to purchase food scraps (de Hooge et al., 2017). This would also fit in with the findings of Cassia and Magno (2024), who, in addition to external rewards as a form of extrinsic motivation, also mention intrinsic motivation as a dimension of dealing with food waste.

In terms of possible alternatives to TGTG, respondents indicated being frugal and placing importance on not being wasteful. They indicated consuming everything they buy and processing leftover food. This could indicate that respondents already consider themselves sustainable or believe that they are already contributing to reducing food waste through their behavior. The majority of TGTG users interviewed by van der Haar und Zeinstra (2019) indicate that they are ecologically aware.

Overall, the results show that consumer behavior can have a variety of motivational reasons. Consumers' intention to use TGTG is more complex than the theoretically derived model. In the future, additional influencing factors regarding the intention to use apps against food waste should be identified and empirically tested. Future studies could additionally include variables such as perceived risk in food quality perceptions or awareness of food waste issues in a model. Perceived risk is a significant influencing factor in Berri and Toma (2023), while Fraccascia and Nastasi (2023) come to opposite conclusions. Awareness of the impact of food waste can promote the intention to use such apps (Loebnitz and Grunert, 2015). Ease of use from the TAM model is a significant influencing factor on attitude, and this in turn on technology use intention (Li et al., 2020; Muñoz-Leiva et al., 2017). However, this variable is not significant in Fraccascia and Nastasi (2023) in relation to apps against food waste. In addition, respondents from van der Haar and Zeinstra's study (2019) indicate that Too Good To Go is easy to use. Therefore, the variable was not originally included in the model. It is possible that people feel insecure about the surprise bag pickup process. Therefore, in upcoming studies, ease of use could be considered as an additional variable. In the study by Cho et al. (2019), this was found to be a significant factor in the use of grocery apps.

6.2 Limitations

Like any research, this study has limitations, so it is recommended that the results be interpreted with caution. The chi-square test of the model is significant, and the data are not multivariate normally distributed. Thus, important prerequisites for the calculation of a linear structural equation model are not given. However, the

chi-square model tests often become significant because a large sample is desired for structural equation models, which can lead to high test power (Sedlmeier and Renkewitz, 2013). Thus, even small discrepancies are significant (Sedlmeier and Renkewitz, 2013). However, the robust computation of the model allows for reportable results even when the data are not normally distributed (Steinmetz et al., 2015).

In general, the empirical results of this study are based on the app Too Good To Go. Follow-up studies should investigate whether the results are comparable to other apps or food-sharing platforms.

Furthermore, intention to use was collected as a subjective assessment, which may lead to measurement error (Collopy, 1996; Lee et al., 2003). In the TAM model, intention to use is inferred from actual use (Davis, 1989). Actual use is rarely collected in studies, possibly due to more complicated data collection. Future research could consider alternative measurement methods, such as Ambulatory Assessment (AA), to simulate real-life situations of purchase behavior (Trull and Ebner-Priemer, 2013).

In this paper, only the consumers' side is considered. However, it is also necessary to understand the producers' side in order to better address food waste (Cane and Parra, 2020). Therefore, more studies are also needed regarding the motivation of companies to use such apps as an additional sales platform (Mu et al., 2019). In this regard, limited scientific literature currently exists. For example, Gollnhofer (Gollnhofer, 2015) conducted qualitative interviews with partner companies of food-sharing to find out motivational reasons for cooperation. The partner companies cited the monetary benefits resulting from waste prevention as the primary reason. In addition, the companies also referred to ethical motivations for their participation in food-sharing.

A well-known problem with consumer surveys on sustainability is social desirability (Prothero et al., 2011). An online survey ensured respondent anonymity, so socially desirable responses are lower than in traditional questionnaire studies (Krantz and Dalal, 2000). Adding qualitative surveys to quantitative approaches will provide more comprehensive insights into consumer behavior in the future (Prothero et al., 2011). Consumers can also overestimate or underestimate their behavior, because sometimes behavioral changes occur subconsciously (Cohen and Babey, 2012).

Studies have shown that consumers are willing to pay more for organic food. Since the questions on sustainable consumption were asked first, the items on price awareness may be affected by the priming effect. Respondents may have assumed that the question was

about sustainable products and therefore subsequently answered the items on price awareness differently (Gomes et al., 2023; Hao et al., 2019). A possible countermeasure would be to randomize the items in a subsequent study or to conduct an experiment that examines the priming effect by ordering the items differently.

By using a raffle of five vouchers, participants may be motivated to complete the questionnaire as quickly as possible. Such incentives may have the disadvantage that the quality of the data suffers (Brosius et al., 2016).

Despite the limitations, these findings may help to develop targeted measures to promote the use of mobile apps against food waste like Too Good To Go and contribute to reducing food waste.

7 Conclusion

7.1 Summary

The aim of this work was to investigate the intention to use apps against food waste. The findings obtained from the study and the theoretical foundations are intended to provide a basis for recommendations for action for food companies and providers of apps against food waste.

The theoretical part of this thesis has shown that there are more and more solutions against the problem of food waste, because the consequences are immense. Too Good To Go is one of the best-known platforms. Due to its commitment against food waste, the app has a sustainable reputation. Sustainable awareness is becoming more and more important to consumers and can influence their decision to buy environmentally friendly products. However, prices and the fun of using such apps can also stimulate purchasing behavior.

After collecting 380 complete online questionnaires and calculating a structural equation model, the results indicate that the intention to use TGTG is positively influenced by hedonic motivation. For this reason, the surprise effect of the bags should be advertised more. For example, in the form of collaborations with influencers or sharing the contents of the surprise bags with other users via the platform. This could also lead to the promotion of a sense of community, which could increase positive emotions.

While sustainability features prominently in both Too Good To Go's own communication and users' perceptions of the app, the actual intention to use it is ultimately not driven by sustainability concerns but by hedonic benefits. Sustainability may serve as an initial incentive to install the app, but it appears to play

little role in motivating continued use. Contrary to the assumptions from literature, a sustainable consumption consciousness or a high price consciousness does not influence the intention to use the app. Most consumers have a sustainable consumption awareness, but this does not seem to be the decisive factor for the intention to use the app. For future studies, other factors such as the convenience of use or the perceived risk should be included in an investigation. Qualitative studies can reveal patterns of consumer behavior that can be tested in quantitative studies.

The question of usage intention may be broader in the future, as it may result in studies that provide more specific results. It cannot be said with certainty what motivates consumers to use apps against food waste. However, the fun of surprise bags should not be underestimated. Factors such as perceived risk or ease of use could play a crucial role when considering intention to use. Sustainable consumption awareness is not a decisive motivational aspect for the use of TGTG in this work. Prices do play a role in the purchase decision, but the use of the app is not primarily monetarily motivated. The reduced price does not play a major role in that people who pay attention to prices are not more likely to use the app.

Despite limitations in the calculation of the structural equation model, the results of this work make a contribution to reducing food waste. In the use of digital possibilities, for example in the form of apps, lies an opportunity to advance the fight against food waste and thus come closer to the goal of halving food waste by 2030.

7.2 Theoretical implications

To explain the intention to use technologies, most studies are based on TAM or UTAUT, for example. The key factor here is usually the personal added value that a user assumes they can achieve by using technology. With sustainable consumption consciousness, this paper examines for the first time in the context of mobile apps for avoiding food waste how an altruistic benefit also affects the intention to use the technology. The results cannot confirm the relevance of sustainable consumption consciousness in the intention to use. Nevertheless, this paper makes an important theoretical contribution because it places the question of personal attitudes towards sustainability in the context of technology use. As the present results show that only the hedonic benefit significantly influences the intention to use, this paper shows that the results complement existing research, which, for example, establishes the relevance of the joy

of use in technology use. At the same time, the results raise the question of whether sustainability in itself a sufficient reason can be to use a technology or service.

7.3 Managerial implications

Regarding managerial implications, the paper provides important insights in the narrower sense for managers of mobile apps against food waste and in the broader sense for managers of products and services who see and communicate sustainability as an essential part of their value proposition. From a practical point of view, it must be emphasized that sustainable consumption consciousness is not enough for consumers to use an app that promises sustainable consumption. Rather, app developers and technology providers must ensure that its use also offers hedonic added value. Regarding Too Good To Go in particular, the surprise effect of the bags should be advertised more. For example, in the form of collaborations with influencers or sharing the contents of the surprise bags with other users via the platform. This could also lead to the promotion of a sense of community, which could increase positive emotions.

7.4 Future research perspectives

The future research perspectives essentially result from the limitations and theoretical implications of this work. This work adds the factor of sustainability to previous research on the intention to use technologies. Future research projects should examine the extent to which sustainable consumption consciousness can be integrated into existing theory, and models such as TAM or UTAUT, for example in the case of mobile apps for avoiding food waste. In addition, an important contribution to research could be to repeat the study based on actual user behavior – to be distinguished from the intention to use in the setting of a survey – to better understand the actual motivation for use. Finally, the perspective of the participating food retailers would also be interesting to investigate what role sustainability plays here as a factor in participating in mobile apps to avoid food waste.

Author contributions

Conceptualization, Louisa Boecker; Methodology, Louisa Boecker; Software, Louisa Boecker and Atilla Wohllebe; Validation, Uwe Radtke, Dirk-Siegfried Hübner and Gergely Tóth; Formal Analysis, Louisa Boecker and Dirk-Siegfried Hübner; Investigation, Louisa Boecker; Resources, Louisa Boecker and Dirk-Siegfried Hübner; Data Curation, Louisa Boecker and Atilla Wohllebe;

Writing – Original Draft Preparation, Louisa Boecker, Dirk-Siegfried Hübner and Atilla Wohllebe; Writing – Review and Editing, Uwe Radtke, Dirk-Siegfried Hübner and Gergely Tóth; Visualization, Louisa Boecker; Supervision, Gergely Tóth and Atilla Wohllebe; Project Administration, Dirk-Siegfried Hübner and Atilla Wohllebe; Funding Acquisition, Gergely Tóth and Atilla Wohllebe.

Conflict of interest

No potential competing interest was reported by the authors.

Data availability statement

The data used from the survey will be made available on request by the author Atilla Wohllebe. Please send your request to atilla.wohllebe@gmail.com

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Appendix

TABLE A1 Latent variables and items

Latent variable	ID	Item	Reference(s)
Sustainable consumption consciousness	Sus1	I prefer to buy a product when I am convinced that it is made of recyclable materials?	Balderjahn et al. (2013); Ziesemer et al. (2016)
	Sus2	I prefer to buy a product when I am convinced that it is packaged in an environmentally friendly way?	
	Sus3	I would prefer to buy a product if I am convinced that it is manufactured in a climate-friendly way?	
	Sus4	I would prefer to buy a product if I was convinced that the human rights of workers were respected during production?	
	Sus5	I would prefer to buy a product if I was convinced that workers are not discriminated against?	
	Sus6	I would prefer to buy a product if I was convinced that workers are paid fairly and equitably?	
	Sus7	Even with products that I can afford financially, I always consider whether I can share the product with others instead of owning it myself.	
	Sus8	Even with products that I can afford financially, I always consider whether I can borrow the product from friends or acquaintances.	
	Sus9	Even if I could afford a product financially, I only buy it if I really need the product.	
	Sus10	Even if I could afford a product financially, I only buy it if it is a useful product for me.	
	Sus11	Even if I could afford a product financially, I only buy it if the expenditure for it does not put an excessive financial burden on me.	
	Sus12	Even if I could afford a product financially, I will only buy it if it will not limit me in the future.	

TABLE A1 Latent variables and items (*cont.*)

Latent variable	ID	Item	Reference(s)
Price consciousness	P1	For me, the price is the decisive factor when I buy products.	Ailawadi et al. (2008); Ma and Wang (2019); Van Doorn and Verhoef (2015)
	P2	Price is important to me when I decide to buy products.	
	P3	I usually try to buy products at the lowest price.	
	P4	I must pay attention to the price when I buy products.	
Hedonic motivation	Hed1	Picking up the surprise bags is fun.	Venkatesh et al. (2012)
	Hed2	Getting surprise bags is very entertaining.	
	Hed3	Using Too Good To Go is enjoyable.	
Intention to use	Int1	I intend to use the Too Good To Go app in the next 3 months to buy leftover groceries.	Venkatesh et al. (2003)
	Int2	I plan to use the app Too Good To Go to buy leftover food in the next 3 months.	
	Int3	I plan to use TGTG in the next 3 months for buying leftover food.	

TABLE A2 CFA with complete dataset: factor loadings, AVE, and Cronbach's Alpha

Latent variable	ID	Std. factor loading	Sq. std. factor loading	Sum sq. std. factor loading	AVE	Cronbach's Alpha
Sustainable consumption consciousness	Sus1	0.582	0.339	3.678	0.306	0.82
	Sus2	0.599	0.358			
	Sus3	0.618	0.381			
	Sus4	0.87	0.756			
	Sus5	0.862	0.743			
	Sus6	0.906	0.820			
	Sus7	0.279	0.077			
	Sus8	0.300	0.090			
	Sus9	0.191	0.036			
	Sus10	0.144	0.020			
	Sus11	0.155	0.024			
	Sus12	0.169	0.028			
Price consciousness	P1	0.817	0.667	1.633	0.408	0.70
	P2	0.684	0.467			
	P3	0.578	0.334			
	P4	0.405	0.164			
Hedonic motivation	Hed1	0.846	0.715	1.775	0.592	0.81
	Hed2	0.693	0.480			
	Hed3	0.761	0.579			
Intention to use	Int1	0.945	0.893	2.685	0.895	0.96
	Int2	0.937	0.877			
	Int3	0.956	0.913			

TABLE A3 Correlation matrix for adjusted latent variables

	Sustainable consumption consciousness	Price consciousness	Hedonic motivation	Intention to use
Sustainable consumption consciousness	1.000			
Price consciousness	0.023	1.000		
Hedonic motivation	0.046	0.001	1.000	
Intention to use	0.013	0.000	0.383	1.000

TABLE A4 Correlation matrix for adjusted latent variables to assess discriminant validity according to Fornell and Larcker (1981)

	Sustainable consumption consciousness	Price consciousness	Hedonic motivation	Intention to use
Sustainable consumption consciousness	1.000			
Price consciousness	0.023	1.000		
Hedonic motivation	0.046	0.001	0.770	
Intention to use	0.013	0.000	0.383	0.946

TABLE A5 HTMT to assess discriminant validity according to Henseler, Ringle and Sarstedt (2015)

	Sustainable consumption consciousness	Price consciousness	Hedonic motivation
Price consciousness	–0.221		
Hedonic motivation	0.194	0.075	
Intention to use	0.153	–0.003	0.616