The impact of self-service technology on sustainable consumption of supermarket customers

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Abstract

Despite the increased interest towards self-service technology and demand for organic and sustainable products, little is known about how customers use these systems during grocery shopping and how this affects their choice of sustainable products. The main goal of this research is to provide insights between modern and conventional supermarket customers on sustainability. In doing so, this research aims to explore and evaluate the use of self-service systems in relation to sustainable consumption as well as the role of green purchase intentions of supermarket customers. Furthermore, we want to investigate the influence of socio-demographic characteristics on self-service technology and sustainable consumption. The following research question has been formulated: "*To what extent do online shopping and self-scanning, as forms of self-service technology, and green purchase intentions affect sustainable consumption of Dutch supermarket customers living in Twente*?".

To answer the research question, a survey was conducted for which online questionnaires were distributed among Dutch respondents. The data is analyzed to test the impact of self-service technology on sustainable consumption using SPSS. Regression analysis, multiple regression, t-test, and ANOVA were used to test the associated hypotheses. A Sample of 505 respondents was obtained of which 45 questionnaires were excluded from the analysis (N=460).

Results show that there is no relationship between self-service technology and sustainable consumption and that green purchase intentions are strongly related to sustainable consumption but does not act as a moderator. In addition, we found that all socio-demographic characteristics have in influence on self-service technology and sustainable consumption except for gender on sustainable consumption and Income on self-service technology.

The limitations of the study are that the variables were noted through self-reports measured with a one-time questionnaire. Secondly, the measurements of self-service technology and sustainable consumption are more likely to reflect consumers' intent rather than their actual behavior. Lastly, the measurement scale of self-service technology has not been used in this type of research in relation to sustainable consumption before, which could mean that there may be more suitable alternative scales.

follow-up research could focus on a different type of research method or setting to observe the actual shopping behavior of customers. Other possibilities are to investigate the underlying motives to use self-scan and other determinants that predict the sustainable consumption of supermarket customers.

1. Introduction

Over the last few decades, supermarket customers have become more exposed to digital applications such as self-service technology and aware of their impact on the environment as well as how they can contribute to a sustainable future (Chang, Chen, Chen, & Li, 2020). According to Söderholm et al. (2019), technological developments contribute to sustainable solutions and are essential for environmental challenges. Thus, understanding customers' shopping behavior can provide valuable insights that can help to stimulate the use of self-service technology and increase sustainable consumption.

Self-service technology (SST) is defined as "technological interfaces that enable customers to produce a service independent of direct service employee involvement" (Meuter M. L., Ostrom, Roundtree, & Bitner, 2000, p. 50). Whereas, sustainable consumption aims to reduce the impact of products and services on the environment by reducing the environmental impact of consumption (Kumara & Yadav, 2021). According to the World Green Economy Organization, green economies require a high degree of technological innovation to achieve sustainability (Chang et al., 2020). Past studies have shown that there is evidence of SST in the food industry that can reduce environmental impact (Richards & Hamilton, 2018; Rai, 2021; Harvey, Smith, Goulding, & Illodo, 2020). Furthermore, consumers are turning toward green products (Chang et al., 2020), which increases the global demand for organic food (Jensen, Denver, & Zanoli, 2011).

Most of the literature has covered consumers' behavior, motivation, intentions towards self-service technology and sustainable consumption, and other determinants that explain their influence on both topics separately. However, despite a large number of studies on the causes of on sustainable consumption (Vermeir & Verbeke, 2008; Kumara & Yadav, 2021) and self-service technology (Meuter et al., 2000; Curran & Meuter, 2005; Dabholkar, Bobbitt, & Lee, 2003) little empirical research has been done on self-service systems - in particular, online shopping and self-scanning - as determinants of consumers' decision to buy groceries that contribute to sustainable consumption in comparison to the conventional way of grocery shopping. Furthermore, the existing literature investigating the relationship between self-service technology and sustainable consumption found limited or conflicting results (Cervellon, Sylvie, & Ngobo, 2015; Verain, Sijtsema, & Antonides, 2016; Giesen & Leenheer, 2019). This makes it difficult to determine whether customers' behavior toward using self-service technology affects their choice of sustainable products. Therefore, this study aims to explore and evaluate the use of self-service systems (online shopping & self-scan) in relation to the sustainable consumption of supermarket customers.

This study extends prior research on sustainable shopping orientation by Cervellon et al. (2015) by taking a more narrowed and in-depth approach. It excludes multiple shopping channel choices and only includes online shopping and self-scan as SST – measured using the technology acceptance model by Davis (1989) – and the conventional way of grocery shopping. Furthermore, Cervellon et al. (2015) emphasize that their research's mixed results depend on the sustainability component. Thus, including the component of sustainability, this study uses the constructs of green purchase behavior – as the actual behavior of buying green products – and green purchase intentions as a moderator effect used in previous studies (Jaiswal & Singh, 2018; Yarimoglu & Binboga, 2018). Moreover, this study uses socio-demographic characteristics to investigate differences between supermarket customers. Furthermore, it examines three factors that can determine sustainable consumption, namely: self-service technology, green purchase intentions, and socio-demographic characteristics. This leads to the following research question:

"*To what extent does online shopping and self-scanning, as forms of self-service technology, and green purchase intentions affect sustainable consumption of Dutch supermarket customers living in Twente*?".

To answer the research question, four sub-questions are formed:

1. *To what extent is self-service technology related to sustainable consumption?*

2. *To what extent are green purchase intentions related to sustainable consumption?*

3. *To what extent do self-service technology, green purchase intentions, and the interaction between self-service technology and green purchase intentions explain sustainable consumption?*

4. *To what extent are socio-demographic characteristics related to self-service technology and sustainable consumption?*

To answer the sub-questions and subsequently the main research question, chapter 2 begins with an overview of the literature with the corresponding hypotheses, and the conceptual model. Next, in chapter 3 the methodology is described, containing information about the research population, measuring instruments, and data analysis. Subsequently, the results are presented in Chapter 4. Finally, chapter 5 discusses the results of the research and are compared with the results of previous studies. This chapter ends by presenting the limitations of this thesis and its conclusion.

2. Theoretical framework

This chapter introduces the variables SST as the independent variable and sustainable consumption as the dependent variable by providing theoretical background using previous studies. Hypotheses are formulated and substantiated using the results of past research. A conceptual model is developed which presents the relationship between SST and sustainable consumption. Green purchase intentions and socio-demographic are added to the model since both variables are often used in previous research and present statistical evidence. These variables can help to provide further insights between SST and sustainable consumption.

2.1 Self-Service Technology

Organizations use digital technologies for establishing new products and services, implementing new business processes, or to operate new business models (Wiesböck & Hess, 2019). The current retailing industry is transforming due to many innovations driven by digitalization. The rise of online- and digital channels such as mobile apps and social media have changed retail business models, the retail mix, and the shopping behavior of consumers (Verhoef, Kannan, & JeffreyInman, 2015). This kind of development is a transition from multichannel to omnichannel retailing. Omni-channel can be seen as the evolved version of the multi- and cross channel that takes a broader perspective on how consumers influence and shopping experience (Verhoef et al., 2015). This kind of retailing characterizes itself with a greater engagement of consumers by the use of SST.

The introduction of SST to the delivery of service removes the provider's personnel from the transaction and places additional responsibilities on the customer to transact the service (Curran & Meuter, 2005). In this way, customers are becoming involved in the service delivery process as productive resources. SST helps retailers to handle demand fluctuations and enables a standardized technological interface that leads to more consistent service without being interfered by employees' personalities and moods (Weijters, Rangarajan, Falk, & Schillewaert, 2007). Like any investment, SST has to attract a large enough group of customers to cover the implementation costs and become a viable asset. To do so, Curran and Meuter (2005) emphasize that service providers need to understand which aspects may affect consumers' decision to use SST.

The adoption of SST by customers originates from different reasons such as customer's attitudes toward SST (Curran & Meuter, 2005), customer satisfaction (Meuter et al., 2000), consumer differences (Dabholkar, Bobbitt, & Lee, 2003), and weighing up the pros and cons of SST (Curran, Meuter, & Surprenant, 2003). Customers may find SST easy to use, more convenient than the alternatives, or allows them to purposely avoid contact with the provider's personnel (Meuter et al. 2000). Other potential benefits are the convenience of location, and fun or enjoyment of using the technology, time and cost savings, greater control over the service delivery, reduced waiting time, and a higher perceived level of customization (Curran & Meuter, 2005). Retailers are increasingly turning

toward self-service technologies aimed at improving productivity and service quality while cutting costs (Weijters et al., 2007).

2.1.2 Self-service technology in supermarkets

One of the latest innovations that supermarkets introduced is the digitalization of self-service. These innovations are being applied by stores to make grocery shopping more convenient as well as gain economic benefits such as higher turnovers, lower (operational) costs, and increased efficiency. Examples of SST in the food retail industry are self-service checkouts, online shopping, and self-scanning (Dabholkar & Bagozzi, 2002). Other digital applications related to self-service are roadmaps for shopping lists, interactive digital displays, digital loyalty cards, and mobile payments. Nearly are Dutch supermarket franchise formulas are equipped with self-service applications such as online websites, self-scan devices, self-checkout systems, or using a self-scan app using your mobile phone (De Ondernemerspers Nederland BV, 2020). Of which the rise of E-commerce has been the most noticeable.

Due to the Covid-19 pandemic, the sales of online grocery shopping (OGS) increased by 50% in 2020 and increased its market share of online supermarket sales by 1.8% in the Netherlands (Brink, 2021). The rapid growth of online grocery shopping has made retailing more complex and competitive which has led grocery retail groups to introduce digital applications and channels to seize new opportunities (Mkansi, Eresia-Eke, & Emmanuel-Ebikake, 2018). According to Mkansi et al. (2018), the value of online grocery shopping varies between retailers and consumers. For retailers, the value lies in unlimited trading hours, extending geographical reach, reducing product cycles, and faster transactions. The value of online grocery shopping for consumers is providing economic value, increased offer of products and retailers, convenience, and time savings. However, Mkansi et al. (2018) also address concerns about the potential of the online sector due to different challenges in the supply and distribution of online groceries. Another challenge that can withhold the growth of online grocery shopping is the increase of a different kind of SST, which is the use of self-scan systems in physical stores.

Self-scan "represents a form of customer participation in service creation, a form of self-service and a technology-based service delivery device" (Marzocchi & Zammit, 2007, p. 651). Consumers that want to utilize this type of service need to be willing to be part of the service as a co-creator. They participate by using a self-scanning device that enables them to perform a service that was before fulfilled by service employees of the grocery stores. This handheld device is a terminal that scans product bar codes via an integrated optical reader and displays product information such as price, quantity, and type (Marzocchi & Zammit, 2007). According to Marzocchi and Zammit (2007), the greatest advantage is that customers don't have to wait in line which reduces the waiting time because they already scanned their products. However, research has shown that the use of self-scans does not reduce the overall time spend on shopping (Weijters et al., 2007). One of the reasons is that consumers spend more time scanning their products than service employees.

2.2 Sustainable consumption

Most current definitions of sustainability are strongly connected with sustainable development which stresses the necessity of meeting the needs of current generations without compromising the needs of future generations (Schaefer & Crane, 2005). Generally, sustainability is defined as a combination of social-ecological and economic aspects (Vermeir & Verbeke, 2008), also known as people, planet, profit and stems from the triple bottom line concept (Kuhlman & Farrington, 2010). The social aspect is about what is socially acceptable by society and support from the society and government for the primary production sector. The ecological aspect involves care for the natural environment, living environment, and quality of life, whereas the economic aspect focuses on a fair price for agricultural entrepreneurs and consumers (Vermeir & Verbeke, 2008).

Consumption by consumers plays an important role when it comes to impact on the environment as well as the well-being of consumers. The growing world population and rising levels of

material consumption are two important contributors that are responsible for the high level of overall consumption (Schaefer & Crane, 2005). Sustainable consumption aims to reduce the impact of products and services on the environment by reducing the environmental impact of consumption (Kumara & Yadav, 2021). Others define sustainable consumption as "The use of goods and services that respond to basic needs and bring a better quality of life, while minimizing the use of natural resources, toxic materials and emissions of waste and pollutants over the lifecycle, so as not to jeopardize the needs of future generations" (Jackson 2004, as cited Ofstad, 1994, p. 1029). An effective way to achieve this is by increasing the consumption of green products (Kumara & Yadav, 2021). Green products, also known as ecologically and environmentally friendly products, contain recycled materials, reduce waste, conserve energy or water, use less packaging, and reduce the amount of toxics disposed or consumed (Nimse, Vijayan, Kumar, & Varadarajan, 2007). These products are less harmful to consumers and the environment than traditional products and are more usable in the long run from a triple bottom line point of view (Nimseet al., 2007). The large majority of green products are food-related.

Food consumption is a major issue in the politics of sustainable consumption and production because of its impact on the social, ecological, and economic components (Reisch, Eberle, & Lorek, 2013). For instance, the consumption of food and agricultural goods constitutes an important part of household-based GHG emissions, and the demand for food products also plays an important part in the carbon footprint of households due to the use of energy, materials, and other resources that are required within the entire food chain (Panzone, Perino, Swanson, & Leung, 2011). Verain, Dagevos and Antonides (2015) suggest that consumers can improve their food consumption by consuming organic food such as fish, along with vegetables, fruit, legumes, whole grain, and nuts (Sigurdsson, et al., 2020), and by reducing their meat consumption. Another option to improve sustainable consumption is the curtailment of consumption within food categories that have a high environmental burden (Verain et al., 2015), or reducing the availability of packaging (Panzone et al., 2011), as well as improving the quality of packing for recycling and reuse.

2.3 The relationship between self-service technology and sustainable consumption

So far, SST such as online shopping and self-scanning have not been investigated as determinants of consumers' decision to buy groceries that contribute to sustainable consumption in comparison to conventional grocery shopping. Prior studies - which investigated the influence of other forms of SST on sustainable consumption and sustainable consumption in (online) retail settings - are presented in Table 1. The results of these studies show contradicting results. For instance, the use of interactive digital displays that provides sustainability information increased innovative shopping and awareness for environmental concerns (Giesen & Leenheer, 2019), and the symbolic presentation of products in online stores leads to relatively fewer unhealthy food choices by online consumers than conventional consumers (Verain, Sijtsema, & Antonides, 2016).

However, Giesen and Leenheer (2019) did not find empirical evidence that this also translated into sustainable consumer choices. And although sustainability and healthy food products correlate, it is not always the case that healthy products are the most sustainable choices (Verain et al., 2016). Other forms of SSTs that have been studied concerning sustainable consumption in an online setting are food-waste reduction apps (Lazell, 2016; Lim, Funk, Marcenaro, Regazzoni, & Rauterberg, 2017), quick-response codes (Atkinson, 2013), and social media content (Strähle & Gräff, 2016; Young, Russell, Robinson, & Barkemeyer, 2017). Although the majority of these studies reported results as being effective, the actual impact is limited or remains unclear.

Table 1

Other forms of SST on sustainable consumption

SST	Empirical evidence	References
Realtime spending feedback (RSF)	Mixed	(Lembcke, Engelbrecht, Willnat, & Lichtenberg, 2020)
Interactive digital displays	Partial	(Giesen & Leenheer, 2019)
Symbolic presentation	Partial	(Verain, Sijtsema, & Antonides, 2016)
Food waste reduction apps	Limited	(Lazell, 2016) (Lim, Funk, Marcenaro, Regazzoni, & Rauterberg, 2017)
Quick-response (QR) codes	Mixed	(Atkinson, 2013)
Social media content	Partial	(Strähle & Gräff, 2016) (Young, Russell, Robinson, & Barkemeyer, 2017)
Digital meal box schemes	None	(Heidenstrøm & Hebrok, 2021)
Descriptive norms	Partial	(Demarque, Charalambides, Hilton, & Waroquier, 2015)

Online grocery shopping is to a larger extent mirroring in-store shopping, implying that online shopping has the same sustainable potential as conventional shopping (Heidenstrøm & Hebrok, 2021), and is increasingly replacing in-store shopping in certain categories (Guillen-Royo, 2019). However, it doesn't show the real effects of an increase in sustainable consumption. For example, online stores are more attractive to customers with a sustainable store orientation than conventional stores (Cervellon et al., 2015). However, they also observed a negative association between sustainable product orientation and the attractiveness of online stores and conventional stores.

Also, Reisch (2001) argues that the ease of online shopping fosters green consumption and therefore can be seen as a beneficiary effect. While the evidence is found that online shopping does make consumption more efficient and easier (Frick & Matthies, 2020), and that the internet mitigates the constraints of time and space and encourages online shopping, no direct relationship between sustainable consumption and internet penetration was found (Wang & Hao, 2018). Moreover, there is a risk of overconsumption since the internet offers endless online shopping opportunities (Reisch, 2001). And while digital food provisioning platforms, such as meal box schemes and online grocery stores could reduce transport emissions, reduce food waste and increase the use of organic products, no evidence was found that this also leads to these potential sustainable effects (Heidenstrøm & Hebrok, 2021).

Nevertheless, online technology does offer increased access to information on sustainability and sustainable goods (Frick & Matthies, 2020). For example, research showed that descriptive norms lead to a positive effect on eco-product purchasing as well as an increase in spending (Demarque, Charalambides, Hilton, & Waroquier, 2015). Other than that, there is a lack of empirical research to be found on the relationship between online shopping and sustainable consumption. Even though a partial relationship between SST and sustainable consumption can be found, the overall results are inconclusive since multiple studies show mixed results or found no empirical evidence at all. Therefore, it is expected to find no difference between self-service customers and conventional customers and their sustainable consumption. The hypothesis is as follows:

H1: Self-service technology is not related to the sustainable consumption of supermarket customers.

2.4 Green purchase intentions

Consumers have been self-acknowledging the importance of sustainable consumption as well as giving more attention to changing their behavior into ecological consciousness to protect the environment (Yarimoglu & Binboga, 2018). Moreover, consumers have begun to consider ecological and environmental protection as the standard measurement of value when making a purchase (Chang, et al., 2020). Young, Hwang, McDonald, and Oates (2009) emphasize this by stating that there is the potential to contribute to a sustainable pattern of consumption whenever a consumer is making a purchase decision.

Consumer intention is a fundamental predictor of green purchase behavior and green purchase behavior is mainly about the consumers' purchase decision for ecologically friendly products (Jaiswal & Singh, 2018). Yarimoglu and Binboga (2018) refer to green purchase behavior as the actual behavior of buying green products. They also argue that intentions are needed to predict the action that performs the behavior. This so-called intention-behavior gap has been widely researched within the literature on sustainable consumption.

2.5 The relationship between green purchase intentions and sustainable consumption

The study by Jaiswal & Singh (2018) showed that green purchase behavior is significantly determined by green purchase intentions, which in turn is significantly and positively influenced by the attitude towards green products. This is also confirmed by Yarimoglu and Binboga (2018) and Jain, Dahiya, Tyagi, and Dube (2021) who found empirical evidence that green purchase intentions positively affect green purchase behavior. Green labeling, economic incentives, and environmental attitude are direct antecedents of green purchase intentions (Lim, Perumal, & Ahmad, 2019). On the contrary, high prices of green food, unavailability issues, and limited knowledge are factors triggering the gap between green food purchase intentions and green purchase behavior (Qi, Yu, & Ploeger, 2020).

Other researchers have studied the interrelationships between constructs regarding environmental concerns, consumer environmental knowledge, and behavioral intentions and found a positive association between constructs (Pagiaslis & Krystallis, 2014). Tanner and Kast (2003) showed that green food purchases are facilitated by positive attitudes of consumers toward environmental protection, fair trade & local products, and availability of knowledge. However, they also found that green behavior is negatively associated with perceived time barriers and the frequency of in-store shopping in supermarkets. One could argue that the latter can be diminished due to the beneficial effects of SST such as online shopping, as this is perceived as more efficient (Verhoef & Langerak, 2001) and store visit does not take place. Based on the prior research results the hypothesis is as follows:

H2: Green purchase intentions is positively related to sustainable consumption of supermarket customers.

2.6 The interaction between self-service technology and green purchase intentions and sustainable consumption

Although the literature about the relationship between green purchase intentions and SST is lacking, there are indications that there is an association between the two. Prior research showed that the intention to use SST is driven by various antecedents such as hierarchical attitudes (Curran, Meuter, & Surprenant, 2003) personal values (Lee & Lyu, 2016), perceived consequences, technological and personal innovativeness (Lee, Cho, Xu, & Fairhurst, 2010; Limayem, Khalifa, & Frini, 2000). These factors could be substantiated by environmental or sustainability reasons but have not yet provided sufficient evidence regarding green purchase intentions and the use of SST. Moreover, customers with low purchase intentions for organic items who usually buy fewer organic products, purchased significantly more organic food items online when receiving real-time spending feedback (Lembcke et al., 2020). Furthermore, internet penetration encourages people with higher environmental efficacy

and who perceive stronger environmental impact to consume sustainably and greenly (Wang & Hao, 2018). Furthermore, consumers intend to behave more sustainably in the future and act more sustainably outside the food domain when using digital displays that present sustainability information (Giesen & Leenheer, 2019). Thus, strong evidence that the increased environmental concern translates into more sustainable consumer choices in the supermarket itself is lacking.

This indicates that consumers with green purchase intentions are more likely to use technology to provide for their sustainable needs. Based on the available literature, it can be expected to find an interaction effect of green purchase intentions on the relationship between SST and sustainable consumption. Hence the following hypothesis:

H3: Green purchase intentions positively moderate the relationship between self-service technology and sustainable consumption of supermarket customers.

2.7 The influence of socio-demographic characteristics

Understanding and explaining consumers' shopping behavior is an important aspect of the theoretical framework of this research. Another important aspect to consider is the heterogeneity of consumers when studying sustainable behavior, since customers may differ in their sustainable behavior. For instance, customers can differ in the importance they attach to sustainability, the frequency in which they perform sustainable behaviors, and the type of sustainable behaviors they perform (Verain et al., 2015). To determine whether there are distinct differences between online and in-store shoppers and their sustainable consumption, socio-demographic characteristics will be used.

Prior research on individual characteristics showed that gender, age, and education have an impact on consumers' buying behavior (D'Amico, Vita, & Monaco, 2016), as well as predicting purchase intentions and frequency of purchasing organic items (Magnusson, Arvola, Hursti, Åberg, & Sjödén, 2003). Consumers who are older and female tend to behave more sustainably (Gilg, Barr, & Ford, 2005). While males have significantly lower pro-environmental attitudes. Moreover, age is positively related to green environmental action, and education is partly correlated with pro-environmental behavior (Panzone, Hilton, Sale, & Cohen, 2016). However, others found that education is unrelated to environmental behavior as well as occupational level, employment status, and income (Tanner & Kast, 2003). These mixed results between socio-demographic characteristics and sustainable consumption are due to self-reported measures and small sample sizes (Panzone et al., 2016).

Research on socio-demographic characteristics and SST show similar results. For instance, males show greater usage of online shopping (Meuter et al., 2003), while others found little to no difference between gender in online shopping (Lee, Sener, & Handy, 2015; Lee, Sener, Mokhtarian, & Handy, 2017). Income and age are associated with a greater likelihood of shopping online (Lee et al., 2015), as consumers tend to be younger, higher educated, and have a higher income (Lee et al., 2017; Farag, Schwanen, Dijst, & Faber, 2007). As for the influence of sociodemographic characteristics on self-checkouts and self-scan, researchers found no significant results on the intention to use retail self-checkouts (Lee, Cho, Xu, & Fairhurst, 2010), or demographic differences between consumers on use, preference, or avoidance of self-scanning (Dabholkar et al., 2003).

H4. Socio-demographic characteristics including (a) gender, (b) age, (c) education, and (d) income are related to self-service technology and sustainable consumption.

2.8 The conceptual model

A conceptual model has been drawn up based on the theoretical framework as shown in Figure 1. It is assumed that online shopping and self-scanning, as forms of SST, are not related to the sustainable consumption of supermarket customers. However, it is expected that the interaction of green purchase intentions affects the relationship between SST and sustainable consumption, which leads to an increase in sustainable consumption.

Figure 1

The conceptual model
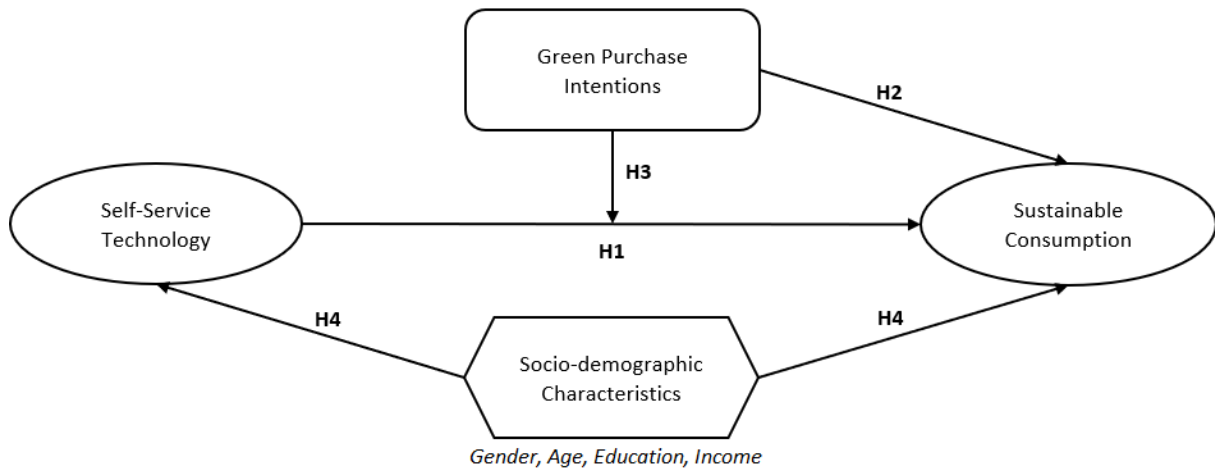
3. Methodology

The first section describes the study population and setting. This is followed by a description of the data collection procedure and survey. Subsequently, the research design and measuring instruments are explained. The last section describes the data analysis.

3.1 Research population and setting

For this research, a quantitative cross-sectional study among supermarket customers is adopted. The target group is customers older than eighteen years old, that buy groceries at a supermarket or online, and who are living in Twente. Twente is a region in the east of the province of Overijssel, which is one of the twelve provinces of the Netherlands. The region includes the current municipalities of Almelo, Borne, Dinkelland, Enschede, Hof van Twente, Haaksbergen, Hellendoorn, Hengelo, Losser, Oldenzaal, Rijssen-Holten, Tubbergen, Twenterand and Wierden. A sample of 505 respondents was collected, of which 7 respondents do not buy groceries and 38 respondents did not complete their questionnaires. Therefore, 45 questionnaires were excluded from the sample so that the total number of completed and valid questionnaires consists of 460 respondents (n=460).

3.2 Procedure data collection

The data is collected from primary and secondary sources to answer the research question. Secondary data was retrieved using existing theories and prior research conducted by researchers. This data contains in-depth knowledge such as theories, measurement instruments, and empirical evidence on the research topics. Primary data was collected by survey research. A self-administered web-based survey using Qualtrics was conducted among participants by filling in a questionnaire that contains closed-ended questions where respondents need to select answers by choosing from a limited predetermined set of responses. Respondents were collected via social media channels using a staggered procedure.

Over the course of 4 weeks, the survey was published online at a certain moment in time on a specific platform individually instead of simultaneously at once. The online survey method has several advantages since online channels have a greater range, and are accessible from any device, which makes it more convenient as well as easy to share. Moreover, online surveys are easily re-distributed so that participants who forgot to fill them in the first time are reminded again to participate. The questionnaire was distributed via multiple social media channels which increased the overall sample size. The social media channels included WhatsApp communities, e-mail, LinkedIn, Facebook, and web

applications of companies and organizations – for example, the municipality of Hengelo – known through personal and business-related networks of the researcher. A pretest of the survey was performed to see if the items that need to be collected corresponded with the variables, we expected it to do and to test the overall survey procedure to avoid sampling errors during data collection.

3.3 The survey

The purpose of the survey was to determine the "sustainable" shopping behavior of supermarket customers. The information obtained from the survey also provides insights into shopping channel preferences and customers' perceptions of sustainable intentions. In addition, the survey included questions on personal information such as gender, age, educational level, and income. An overview of the questions is presented in Appendix 1. The survey began with a brief introduction and some general questions so that respondents understood the concepts that were represented by the questions.

Before the questions were asked, the question *"do you buy groceries at a supermarket?"* was asked to obtain valid data. If the respondents answered "yes", then the data was utilized in the analysis. Any respondent who answered "no" was not able to proceed with the survey, and their questionnaire was excluded from the analysis. By doing so, the data retrieved from the survey is more valid and of greater value to the success of this study. Unfinished surveys and respondents that are under the age limit are also excluded. The minimum number of observations is targeted at 384 respondents which will result in more reliable conclusions and ensures that we can generalize our findings from the research sample. This is based on the population size with a margin error of 5% at a 95% confidence level (Bartlett, Kotrlik, & Higgens, 2001). Every participant was made aware of the confidential usage of the data, that it will not be used for other purposes and that the survey was anonymous.

3.4 Research Design

The survey contained questions and statements, of which the latter are sentences that provide an opinion about a topic. Statements were taken from previous research to guarantee that items that capture the core of the variables indicated in the literature review section were used (Lewis, 2019; Jaiswal & Singh, 2018; Zhang, et al., 2018; Verain et al., 2015; Farag et al., 2007). Figure 2 presents an overview of the variables, items, and references. The survey measured multiple variables, beginning with questions concerning general shopping behavior. This was followed by SST, sustainable consumption, green purchase intentions, and socio-demographic characteristics. All variables – except for socio-demographic characteristics - were measured on a 7-point Likert scale, which implies that each statement has seven responses, each with its own numerical value, ranging from one to seven, with one being "strongly disagree" and seven being "strongly agree". This simplified the analysis of this study as the higher the mean score, the higher the respondents' rating of a variable. Socio-demographic characteristics are measured using nominal scales. Gender, age, education, and income were assessed by a single question. Figure 2 presents which part of the questionnaire is used to answer the previously stated sub-questions and main research question.

Figure 2

Questionnaire distribution

Sub-questions	Variables	Questionnaire items
To what extent is self-service technology related to sustainable consumption?	**Perceived usefullness & Perceived usability** (Lewis, 2019)	* Using online shopping for groceries enables me to accomplish my grocery shopping more quickly. * Using online shopping makes buying groceries easier. * I would find online shopping useful when buying groceries. * Learning to buy groceries online would be easy for me. * It would be easy for me to become skillful at using online shopping for groceries * I would find online shopping easy to use when buying groceries.
	Sustainable consumption (Jaiswal & Singh, 2018)	* When I want to buy a product, I look at the ingredients label to see if it contains environmentally damaging things. * I prefer green products over non-green products when their product qualities are similar. * I choose to buy environmentally friendly products. * I buy green products even if they are more expensive than non-green ones.
To what extent are green purchase intentions related to sustainable consumption?	**Green purchase intentions** (Jaiswal & Singh, 2018)	* I would consider buying products because they are less polluting. * I would consider switching to other brands for ecological reasons. * I intend to switch to a green version of a product.
	Sustainable consumption	* Same questions as previously mentioned
To what extent do self-service technology, green purchase intentions, and the interaction between self-service technology and green purchase intentions explain sustainable consumption?	**Perceived usefullness & Perceived usability** **Green Purchase Intentions** **Sustainable consumption**	* Same questions as previously mentioned
To what extent are socio-demographic characteristics related to self-service technology and sustainable consumption?	**Socio-demographic characteristics** (Zhang, et al., 2018; Verain et al., 2015; Farag et al., 2007)	* Which gender do you identify yourself with? * What is your age? * What is the highest level of education you have completed? * What is your annual income?

The measurement items for the questionnaire are generated from previous literature. Standardized validated scales are utilized with some modifications to assess the relationship between SST and sustainable consumption among supermarket customers.

3.4.1 Measurements

To our knowledge, no validated scales exist to exactly measure the use of SST. Therefore, this study refers to the SST scale as a combination between perceived usefulness and perceived usability based on the Technology Acceptance Model (TAM) by Davis (1989) and later modified in more a recent study by Lewis (2019). A higher score indicates a higher level of SST acceptance. This scale comprises six items (α = .919). For the variable sustainable consumption, the scale developed by Lee (2008) and adopted in a recent study by Jaiswal and Singh (2018), is used. A higher score indicates a higher level of sustainable consumption. This scale comprises four items (α = .908). The scale developed by Chan and Lau (2000), and later modified by Mostafa (2006), and Jaiswal and Singh (2018), is used to measure the green purchase intentions of consumers. A higher score indicates a higher-level green purchase intentions. The scale contains three items (α = .929). The socio-demographic characteristics scale in this study contained nominal items which measured the different characteristics of the consumers.

These items are gender, age, education, and income as used in previous related studies (Zhang, et al., 2018; Verain et al., 2015; Farag et al., 2007).

3.5 Data analysis

Data analysis is performed using Statistical Package for Social Sciences (SPSS) version 26. Via descriptive statistics, the central tendency and measures of variability of the variables (percentages, means, standard deviations) are calculated. Reliability analysis is performed using Cronbach's Alpha to test and determine the reliability of the variables SST, sustainable consumption, and green purchase intentions. Values are classified and interpreted as follows: value <. 50 = low, value between .50 and .70 = moderate, and value > .70 = high (Hinton, Mcmurray, & Brownlow, 2014). Correlations between the variables are measured using Pearson's R. Values are classified and interpreted as follows: value <. 50 = weak, value between .50 and .70 = moderate, and value > .70 = strong.

Regression analysis is performed to analyze the relationships between the variables SST and green purchase intentions on sustainable consumption separately. Also, multiple regression analysis is used to test the moderation interaction effect of green purchase intentions on the relationship between SST and sustainable consumption. Furthermore, the one-way analysis of variance (ANOVA) and independent sample T-test are performed to analyze and describe the differences between groups based on their socio-demographic characteristics in relation to SST and sustainable consumption. The results of these analyses are described and interpreted by their variances, betas, t-statistics, and p-values.

4. Results

Chapter 4 begins by providing descriptive statistics of the research population. Subsequently, the values and interpretation of the reliability and correlation analysis of the variables will be provided. The last part will describe and explain the results of the regression analysis and ANOVA tests.

4.1. Description of the research population

This section gives a description of the socio-demographic characteristics of the research population and some insights into their shopping behavior. Furthermore, the average scores of the variables SST, sustainable consumption, and green purchase intentions are presented.

Table 2

Socio-demographic characteristics of supermarket customers (N=460)

Gender:		N	%
	Male	185	(40,2)
	Female	275	(59,8)
Age:			
	18-25 years	39	(8,5)
	26-35 years	90	(19,5)
	36-45 years	97	(21,09)
	46-55 years	117	(25,4)
	56-65 years	99	(21,5)
	65 years or older	18	(3,9)
Education:			
	Secondary education (VMBO, HAVO, VWO)	37	(8,0)
	Middle-level applied Education (MBO)	120	(26,09)
	Higher Professional education (HBO)	217	(47,2)

		(18,7)
University (WO)	86	(18,7)
Income:		
less than € 1.000	20	(4,4)
€ 1.000 - € 1.999	90	(19,6)
€ 2.000 - € 2.999	222	(48,3)
€ 3.000 - € 3.999	100	(21,7)
€ 4.000 - € 4.999	14	(3,0)
€ 5.000 or more	14	(3,0)

N=number of respondents

Table 2 shows that the majority of respondents (59,8%) are female and that the average age of the research population is 45 years. Almost half of them (47,2%) have achieved a degree or participated in higher professional education. The majority earn a monthly income between €2.000 - €3.000 (48,3%). Other statistics as presented in Appendix 2, show that 47% of the participants are married, that the majority of the sample buys groceries 2 to 3 times a week (58,7%), and that they spend on average between €250 and €500 on groceries (51,3%). They also prefer to use self-scan (45,7%) over the traditional way of grocery shopping (31,3%).

In Table 3 the means, range, standard deviations, and reliability scores of SST, sustainable consumption, and green purchase intentions are presented.

Table 3

Mean, standard deviation, range, and Cronbach's Alpha (N=460)

	M	Range	SD	Variance	Cronbach's Alpha
Self-service technology (SST):	5,28	6	1,25	1,57	0,917
Sustainable consumption (SC):	3,49	6	1,44	2,06	0,885
Green purchase intentions (GPI):	4,36	6	1,45	2,10	0,919

N = number of respondents, M= average score of all the respondents, SD= standard deviation.

The mean score of the SST is 5.28. This means that customers have a high degree of perceived usefulness and usability towards online shopping and self-scanning. Sustainable consumption has a lower mean than SST, nonetheless on average customers show a positive attitude towards sustainable consumption. This is even more noticeable in the mean (4.36) for green purchase intentions. Cronbach's alpha, which measures how closely a set of items is related, shows that all three variables score high alphas. This indicates that all scales are strongly reliable.

4.2. The relationship between self-service technology and sustainable consumption

Table 4 presents an overview of the hypotheses, betas, p-value, and the decision of each hypothesis. The following paragraphs provide further explanations of each hypothesis.

Table 4

Overview of hypotheses

Hypotheses	Beta coeff.	P-value (P<0.05)	Decision	Justification
H1: Self-service technology is not related to the sustainable consumption of supermarket customers.	-.009	.862	Accepted	The p-value is not significant at a 95% confidence level.
H2: Green purchase intentions (GPI) is positively related to sustainable consumption (SC) of supermarket customers.	.724	< .001	Accepted	The p-value is significant and GPI has a 72,4% positive impact on SC.
H3: Green purchase intentions positively moderate the relationship between self-service technology and sustainable consumption of supermarket customers.	-.028	.252	Rejected	The p-value is not significant at a 95% confidence level.

To investigate to what extent SST is related to sustainable consumption a simple linear regression analysis was conducted. Table 5 presents the statistical results on the relationship between SST and sustainable consumption. The SPSS output is presented in Appendix 3.

Table 5

Regression statistics SST in relation to sustainable consumption

	R	R^2	df	F	β	T	Sig.
Correlation	.008	.000	460				0.431
F-test			458	.030			0.862
Regression					-.009	-.174	0.862

The first statistical measure is the correlation that expresses the extent to which two variables are linearly related. In other words, it indicates that as one variable changes in value, the other variable tends to change in a specific direction. Based on the statistical analysis, there is no correlation found between the two variables SST and sustainable consumption (R = -.008, df = 460, p = .431) which is expressed by the Pearson's R. This means, that a higher score in SST does not mean a higher score in sustainable consumption.

The second measurement is the R-square, which is a goodness-of-fit measure for linear regression models and measures the strength of the relationship. This statistic indicates the percentage of the variance in the dependent variable that is being explained by the independent variables. Similar to Pearson's R, the R^2 (.00) also shows no significant result since there is no explained variance between the variables which indicates that the variance in sustainable consumption is not being explained by SST.

The F-Test of overall significance in regression is a test of whether or not the linear regression model provides a better fit to a dataset than a model that contains no predictor (independent) variables. In line with the previous results, we observe the model of the main effect (F (1,458) = 0.30, p = .862) is not significant. This means that the model with no predictor variables - also known as an intercept-only model - fits the data as well as the regression model.

The linear regression model represents the response variable as a function of one or more predictor variables. The beta coefficient (β) is the degree of change in the outcome variable for every 1-unit of change in the predictor variable. In our model, we find that the regression equation is not statically

significant (β .008, T (458) = -.174, p = .862) since the p-value is not less than .05. The Beta coefficient shows that a change in the SST-score has only a -.009 change in the score of sustainable consumption.

Based on the results, we can determine that the null hypothesis is not rejected. This indicates that there is no relationship between SST and the sustainable consumption of supermarket customers. Hypothesis 1 - *self-service technology is not related to the sustainable consumption of supermarket customers -* is accepted.

4.3. The relationship between green purchase intentions and sustainable consumption

A simple linear regression was also analyzed to predict participants' sustainable consumption based on their green purchase intentions. The results on the relationship between green purchase intentions and sustainable consumption are presented in Table 6. Appendix 4 shows the SPSS output of the analysis.

Table 6

Regression statistics green purchase intentions in relation to sustainable consumption

	R	R^2	df	F	β	T	Sig.
Correlation	.731	.535	460				<.001
F-test			458	526.705			<.001
Regression					.724	22.950	<.001

We expected to find a positive relationship between green purchase intentions and sustainable consumption. As predicted, the Pearson's R shows that there is a strong correlation between the two variables (R = .731, df = 460, p = < .001). Furthermore, the magnitude (R^2) of the regression model is .535. This means that 54% of the variation in sustainable consumption can be explained (predicted) by the green purchase intentions of supermarket customers.

The model for the main effect is significant (F (1, 458) = 526.705, p = < .001). Since the F-value is high and the p-value is less than the significance level (<.05), the sample data provide sufficient evidence to conclude that the overall regression model fits the data better than the model with no independent variables (intercept-only model).

The results of the regression analysis shows that the regression model is statically significant (β .724, T (458) = 22.950, p = < .001). Green purchase intentions is the predictor variable in this regression model. Based on the beta coefficient it can be stated that every level of increase in green purchase intentions results in an increase of .724 in sustainable consumption. In other words, customers who have greater green purchase intentions are more willing the consume sustainably. There is a significant positive relationship between green purchase intentions and sustainable consumption. Therefore, the null hypothesis is rejected. Hypothesis 2 – *green purchase intentions is positively related to sustainable consumption of supermarket customers –* is accepted.

4.4. The interaction effect of green purchase intentions on self-service technology and sustainable consumption

Multiple linear regression was performed to predict customers' sustainable consumption based on their use of SST and green purchase intentions. In this regression model, green purchase intentions act as a moderator to predict the interaction effect on the relationship between SST and sustainable consumption. Table 7 presents the statistical results on the interaction effect of green purchase intentions on SST and sustainable consumption. The SPSS output is presented in Appendix 5.

Table 7

*Regression statistics SST*green purchase intentions (GPI) in relation to sustainable consumption*

	R	R^2	df	F	β	T	Sig.
Correlation	.734	.562					<.001
F-test			456	177.405			<.001
Regression SST					.063	.574	.567
Regression GPI					.874	6.632	<.001
Regression SST*GPI					-0.28	-1.146	.252

In line with the previous analysis, a similar Pearson's R is found (.734) indicating a strong correlation between the variables within the overall model (R = .734, df = 460, p = < .001). The R^2 of the model is .562 which means that 56% of the variation in sustainable consumption can be explained (predicted) by the variables green purchase intentions and SST. We also observe a significant effect of the main model (F (1, 456) = 177,405, p = < .001). However, upon further investigation, we can conclude that this is mainly due to the inclusion of green purchase intentions (β .874, T (456) = 6,632, p =< .001) which is statistically significant.

When looking at the other regression coefficients we observe that SST remains not significant (p =.567). We also observe that the interaction effect of SST*GPI is not significant (p = .252). The difference in statistical significance between the main model and regression models is because the F-test of the main model tests the overall significance whether all of the predictor variables are jointly significant while the t-test merely tests whether each predictor variable is individually significant. Although there is partial evidence found we did not find statistical evidence on the interaction effect. This means that green purchase intentions does not have an interaction effect on the relationship between SST and sustainable consumption. Therefore, hypothesis 3 - *green purchase intentions positively moderate the relationship between self-service technology and sustainable consumption of supermarket customers* - is rejected.

4.5. The influence of socio-demographic characteristics on self-service technology and sustainable consumption

To analyze the socio-demographic differences between supermarket customers and the influence of these characteristics on SST and sustainable consumption (SC), independent sample T-tests as well as ANOVA analysis were conducted. Preliminary analyses were performed to ensure there was no violation of the assumptions of normality and linearity.

Significant difference found

	SST	SC
Gender	√	-
Age	√	√
Education	√	√
Income	-	√

Gender

An independent sample T-test was performed to compare the means of males and females, and to determine whether there is statistical evidence that the means are significantly different. Table 8, Appendix 6 shows that the mean difference for females towards using SST with a mean of 5.39 (n=275) is on average 0.27 higher than males. The result of the T-test (T = -2.217, df=458, p = .027) indicates that there is a statistical difference in the means. Based on the sample, females are more attracted to SST than males.

Table 8

Socio-demographic characteristic: Gender on SST and sustainable consumption (SC)

Gender	N	SST Mean	SC Mean
Male	185	5,1153	3,3946
Female	275	5,3855	3,5536

	Levene's test for equality of variances					
	F	Sig.	T	df	Sig.	
SST	6.717	0.10	-2.217	458	.027	Equal variance not assumed
SC	2.414	.121	-1.166	458	.244	Equal variance assumed

As for the influence of gender on sustainable consumption, there was no statistical evidence found. Although the mean difference for females (3.55) is on average 0.16 higher than males, the T-test (T = -1.166, df = 458, p = .244) does not substantiate that the difference is statically significant. Therefore, gender does not influence the sustainable consumption of supermarket customers.

Age

For the influence of age on SST, an ANOVA test is performed. The one-way analysis of variance (ANOVA) is used to determine whether there are any statistically significant differences between the means of three or more independent groups. Table 9, Appendix 7 shows that according to the F-test there is a statically difference (F (5, 454) = 6.186, p = < .001). The age group 18-25 with a mean of 5.64 is on average 1.32 higher than the age group 65 years and older. The Eta = .253 indicates that the strength of the relationship is weak. R^2 in only 6,5%, which means that 6,5% of the variation in SST can be explained by age. Younger customers are more attracted to SST than older customers.

Table 9

Socio-demographic characteristic: Age on SST and sustainable consumption (SC)

Age	N	SST Mean	SC Mean
18-25	39	5,64	2,88
26-35	90	5,40	3,21
36-45	97	5,46	3,46
46-55	117	5,41	3,51
56-65	99	4,86	3,93
65 or older	18	4,31	3,75
Total	460	5,28	3,49

	df	F	Sig.	Eta	Eta²
SST	5	6.186	<.001	.253	.064
SC	5	4.179	.001	.210	.044

This seems to be the other way around based on the ANOVA test between age and sustainable consumption. The F-test reveals that there is a significant difference in means between age groups (F (5, 454) = 4.179, p = .001). The age group 18-25 with a mean of 2.88 is on average 1.04 lower than the age group 56-65. Similar to the previous result, the strength of the relation is also weak (Eta = .210), and there is an explained variance of 4,4%. Older customers are more inclined towards sustainable consumption than younger customers.

Education

An ANOVA test is also conducted to analyze the influence of education on SST and sustainable consumption. Table 10. Appendix 8 provides evidence on SST (F (3, 456) = 4.616, p = .003) that there is a significant difference in the means between educational levels. The result shows that the mean for customers with a higher educational background (WO) is on average .71 higher than the mean of lower educational level customers. The strength of the relationship is (Eta = .172), with an explained variance of only 3%.

Table 10

Socio-demographic characteristic: Education on SST and sustainable consumption (SC)

		SST	SC
Education	**N**	**Mean**	**Mean**
Secondary education (VMBO, HAVO, VWO)	37	4,84	3,19
Middle-level applied Education (MBO)	120	5,05	3,15
Higher Professional education (HBO)	217	5,37	3,51
University (WO)	86	5,55	4,03
Total	460	5,28	3,49

	df	F	Sig.	Eta	Eta²
SST	3	4.616	.003	.172	.029
SC	3	7.018	<.001	.210	.044

Significant evidence is also found for the influence of education on sustainable consumption (F (3, 456) = 7.018, p = <.001). The mean of high educational level customers (WO) is on average .84 higher than costumers with a lower educational level. The strength of the relationship is (Eta = .210), and an explained variance of 4,5%. Customers with higher education are more attracted to SST and are more inclined towards sustainable consumption.

Income

Lastly, no statistical evidence is found on the difference in SST between the income levels of customers (F (5, 454) = 1.556, p = .171). We did found evidence for a significant difference in the mean of sustainable consumption between the income groups (F (5, 454) = 5.229, p = < .001). The strength of the relationship is (Eta = .233), with an R^2 of 5,4%. The mean for customers that earn less than €1.000 is on average 1.25 lower than the high-income group. Therefore, High-level earners are more inclined toward sustainable consumption than low-income earners. This concludes the chapter on the results from the SPSS analysis.

Table 11

Socio-demographic characteristic: Education

		SST	SC
Income	**N**	**Mean**	**Mean**
Less than €1.000	20	5,27	3,20
€1.000 - €1.999	90	4,99	3,38
€2.000 - €2.999	222	5,32	3,27
€3.000 - €3.999	100	5,35	3,98
€4.000 - €4.999	14	5,75	4,45
€5.000 or more	14	5,45	3,68
Total	460	5,28	3,49

	df	F	Sig.	Eta	Eta²
SST	5	1.556	.171	.130	.017
SC	5	5.229	<.001	.233	.054

5. Discussion and conclusion

The last chapter provides an explanation and discussion of the main findings. Subsequently, the limitations of the research are presented and implications for future research are described. Finally, this chapter ends with a conclusion. The study aimed to test whether there is a relation between the use of SST and sustainable consumption and if green purchase intentions can moderate the effect of SST on sustainable consumption. Furthermore, we wanted to investigate if socio-demographic characteristics are related to the use of SST and the sustainable consumption of supermarket customers. The objective of this research was to answer the following question: *"To what extent do online shopping and self-scanning, as forms of self-service technology, and green purchase intentions affect sustainable consumption of Dutch supermarket customers living in Twente?".* Before answering the main research question, we will first answer the sub-questions and discuss the answers.

Sub- question 1; To what extent is self-service technology related to sustainable consumption?

The regression analysis showed that SST is not related to sustainable consumption. This is in line with the study by Wang and Hao (2018) which found no direct relationship between internet penetration and sustainable consumption as well as the study by Cervellon et al. (2015) who found a negative association between sustainable product orientation and the attractiveness of online stores and therefore expected. A possible explanation could be that the use of SST leads to an increase in consumption in general as mentioned by Reisch (2001), and therefore does not act as the appropriate predictor for sustainable consumption. It also could be because other determinants are more suited to explain the sustainable consumption of customers. As for SST, Frick and Matthies (2020) indicated that online shopping does make consumption more efficient and easier. This study shows that consumers find SST useful and enables them to accomplish their grocery shopping more quickly.

Sub- question 2; To what extent are green purchase intentions related to sustainable consumption?

The study by Jaiswal and Singh (2018) showed that green purchase behavior is significantly determined by green purchase intentions, which was also confirmed by Yarimoglu & Binboga (2018) and Jain et al. (2021) who found empirical evidence that green purchase intentions positively affect green purchase behavior. As excepted, this study found a positive relationship between both variables and showed that green purchase intentions act as a predictor (54%) for the degree of sustainable consumption. Supermarket customers who have green purchase intentions are more inclined towards sustainable consumption.

Sub-question 3; To what extent do self-service technology, green purchase intentions, and the interaction between self-service technology and green purchase intentions explain sustainable consumption?

A multiple regression analysis was conducted to investigate if there was an interaction effect between green purchase intentions and SST on sustainable consumption, which was expected based on the literature. The analysis showed that this is not consistent with the results of this study in which no interaction effect has been demonstrated. Prior studies by Wang and Hao (2018), and Lembcke et al. (2020) did provide evidence that SST-related predictors positively moderate the sustainable consumption of customers which is in line with the research question. Although the overall model was significant, the results did show that the interaction effect was not significant. This is once again because SST is not related or that the use of SST has countervailing effects – the positive impact is not large enough to offset the negative impact- on the sustainable consumption of customers as mentioned by Wang & Hao (2018).

Sub-question 4; To what extent are socio-demographic characteristics related to self-service technology and sustainable consumption?

Finally, the influence of socio-demographic characteristics on SST and sustainable consumption was tested via T-test and ANOVA. The results showed that nearly all socio-demographic characteristics are related to SST and sustainable consumption, except for gender on sustainable consumption and Income on SST as presented in paragraph 4.5. Contrary to Meuter et al. (2003) who provided evidence that males show greater usage of SST, this study found that females are more attracted to SST than males. In line with Lee et al. (2015; 2017), we found evidence that customers that have a greater likelihood of SST are younger, are higher educated, and have a higher income level as well as that older customers tend to behave more sustainably (Gilg et al., 2005). While Tanner and Kast (2003) describe that education and income are unrelated to sustainable consumption, we found that customers with a high-level income and education are more inclined towards sustainable consumption.

While prior studies found mixed results or no significant results on the demographic differences between customers on SST and sustainable consumption, our research did find differences in the influence of socio-demographic characteristics. An obvious explanation is that in recent years SST experienced improvements such as technological advancements, availability, and accessibility. As for sustainable consumption, customers are becoming more self-aware about their impact on the environment and by recognizing that environmental deterioration is affecting their quality of life, consumers are turning towards green products.

To sum up, the most important findings are that SST is not related to sustainable consumption and that green purchase intentions do not act as a moderator. In addition, we found that all socio-demographic characteristics influence SST or sustainable consumption, or both.

5.1 Limitations

This study has several limitations that may affect the results and conclusion. First of all, this study is a cross-sectional study where the data was obtained through a one-time questionnaire with self-report measures which are subjected to bias and causality cannot be determined. A multi-method assessment of the data − for instance combining self-report data with an experimental design or interviews − could have reduced the information bias and improved the reliability and validity of the results. Secondly, the measurements of SST and sustainable consumption are more likely to reflect consumers' intent rather than their actual behavior to use certain types of technology and consume sustainably which was also the case in several related studies. Thirdly, the measurement scale of SST which is based on the Technology Acceptance Model by Davis (1989) and Lewis (2019) has not been used in this type of research in relation to sustainable consumption before. Although it proves to be a reliable measurement for perceived usefulness en usability, one could argue that another measurement type could be better suited to measure the attractiveness of SST.

5.2 Recommendations for future research

Based on the results and limitations, several recommendations can be made for future research.

Observation of behavior

First of all, there was no relationship found between SST and sustainable consumption based on the cross-sectional study. As mentioned before, the measurements of SST and sustainable consumption are more likely to reflect consumers' intent rather than their actual behavior to use SST and consume sustainably and data was collected at a specific point in time. However, both variables separately show on average a high score meaning that customers do perceive SST to be useful and are inclined to consume sustainable based on this study. A different type of research in a broader context could be conducted which observes the actual shopping behavior of customers. For instance, an experiment would lend itself better for this type of research since it can monitor the actual behavior but also offers the option to use treatments during the experiment to measure the responses of participants.

Underlying motives to use self-scan

Most of the participants prefer self-scanning when buying groceries. However, it remains unclear what the underlying motives are of customers for choosing self-scan over the traditional way of shopping. An important factor is that the majority of supermarkets currently offer this kind of innovative service to their customers although this is mainly to reduce personnel costs. Future research could investigate what drives customers to use self-scan during grocery shopping. Possible reasons could be that customers are technologically driven, because of the improvements, availability, and accessibility of self-scan devices, or due to the potential benefits such as fun or enjoyment from using the technology, cost savings, and reduced waiting time (Curran & Meuter, 2005).

Other determinants that predict sustainable consumption

Although no relationship was found between SST and sustainable consumption, one of the findings did show that socio-demographic characteristics can be used to describe group differences within the population. Narrowing down segments of a population is an important factor to determine target groups since customers with the same characteristics tend to value the same products or services. Considering that, it could be an interesting case to examine if there are other segments, such as psychographic segmentation, that describe customers' way of buying groceries concerning their sustainable consumption. This segment can give valuable insight into customers' motives, preferences, and needs. Personality traits – often referred to as the "Big Five" – could be a very suitable construct to examine consumers' characteristic patterns of thoughts, feelings, and behavior.

5.3 Conclusion

This study investigated the relationship between SST, sustainable consumption, green purchase intentions, and socio-demographic characteristics. By testing the impact of self-service technology on sustainable consumption among supermarket customers, this study established that the perceived usefulness & usability of SST does not have a significant effect on the sustainable consumption of supermarket customers living in Twente. As mentioned before, this could be due to the fact that overall consumption increases (Reisch, 2020). However, an important factor to consider is that the conventional way of grocery shopping is being replaced by SST. particular self-scan, since supermarkets are replacing manned registers with self-checkouts and self-scan devices. Therefore, customers are being forced to use SST instead of buying their groceries the conventional way. Furthermore, green purchase intentions positively affect sustainable consumption. However, it did not act as a moderator between SST and sustainable consumption. In addition, the socio-demographic characteristics of age and education are related to SST and sustainable consumption whereas gender is only related to SST and income only to sustainable consumption.

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Appendix

Appendix 1: Survey items

Variable	Questionnaire items
Pre-test	- "Do you buy groceries at a supermarket?" - "Do you live in or around the Twente area?"
Gender	1. Which gender do you identify yourself with?
Age	2. What is your age?
Education	3. What is the highest level of education you have completed?
Income	4. What is your annual income?
General Shopping behavior	5. What is your marital status? 6. How often do you buy groceries? 7. How much do you spend on groceries monthly? 8. I prefer to buy groceries in the following way: 9. I prefer buying groceries online over conventional shopping.
Perceived usefulness (SST) Perceived usability (SST)	10. Using online shopping for groceries enables me to accomplish my grocery shopping more quickly. 11. Using online shopping makes buying groceries easier. 12. I would find online shopping useful when buying groceries. 13. Learning to buy groceries online would be easy for me. 14. It would be easy for me to become skillful at using online shopping for groceries 15. I would find online shopping easy to use when buying groceries.
Sustainable consumption	16. When I want to buy a product, I look at the ingredients label to see if it contains environmentally damaging things. 17. I prefer green products over non-green products when their product qualities are similar. 18. I choose to buy environmentally friendly products. 19. I buy green products even if they are more expensive than non-green ones.
Green Purchase Intentions	20. I would consider buying products because they are less polluting. 21. I would consider switching to other brands for ecological reasons. 22. I intend to switch to a green version of a product.

Appendix 2: Other descriptive statistics

Marital status

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Married	216	47,0	47,0	47,0
	Legal partnership	46	10,0	10,0	57,0
	Living together	100	21,7	21,7	78,7
	Single	77	16,7	16,7	95,4
	Divorced	16	3,5	3,5	98,9
	Widow	5	1,1	1,1	100,0
	Total	460	100,0	100,0	

Purchase frequency

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	once a week	124	27,0	27,0	27,0
	2 - 3 times per week	270	58,7	58,7	85,7
	4 - 5 times per week	57	12,4	12,4	98,0
	More than 5 times per week	9	2,0	2,0	100,0
	Total	460	100,0	100,0	

Monthly average spending

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than € 100	25	5,4	5,4	5,4
	€ 100 - € 250	100	21,7	21,7	27,2
	€ 250 - € 500	236	51,3	51,3	78,5
	€ 500 - € 1.000	95	20,7	20,7	99,1
	€ 1.000 or more	4	,9	,9	100,0
	Total	460	100,0	100,0	

Purchase preference

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Online	39	8,5	8,5	8,5
	Self-scan	210	45,7	45,7	54,1
	Traditional	144	31,3	31,3	85,4
	No preference	67	14,6	14,6	100,0
	Total	460	100,0	100,0	

Appendix 3: SST v sustainable consumption (SC) statistics

Correlations

		SC	SST
Pearson Correlation	SC	1,000	-,008
	SST	-,008	1,000
Sig. (1-tailed)	SC	.	,431
	SST	,431	.
N	SC	460	460
	SST	460	460

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	SST[b]	.	Enter

a. Dependent Variable: SC

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,008[a]	,000	-,002	1,43677

a. Predictors: (Constant), SST

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	,062	1	,062	,030	,862[b]
	Residual	945,451	458	2,064		
	Total	945,513	459			

a. Dependent Variable: SC

b. Predictors: (Constant), SST

Coefficients[a]

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.	95,0% Confidence Interval for B Lower Bound	Upper Bound
1	(Constant)	3,539	,291		12,172	,000	2,967	4,110
	SST	-,009	,054	-,008	-,174	,862	-,115	,096

a. Dependent Variable: SC

Appendix 4: Green purchase intentions (GPI) v sustainable consumption (SC) statistics

Correlations

		SC	GPI
SC	Pearson Correlation	1	,731[**]
	Sig. (2-tailed)		,000
	N	460	460
GPI	Pearson Correlation	,731[**]	1
	Sig. (2-tailed)	,000	
	N	460	460

[**]. Correlation is significant at the 0.01 level (2-tailed).

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	GPI[b]	.	Enter

a. Dependent Variable: SC

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,731[a]	,535	,534	,97990

a. Predictors: (Constant), GPI

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	505,742	1	505,742	526,705	,000[b]
	Residual	439,771	458	,960		
	Total	945,513	459			

a. Dependent Variable: SC

b. Predictors: (Constant), GPI

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	,332	,145		2,287	,023	,047	,617
	GPI	,724	,032	,731	22,950	,000	,662	,786

a. Dependent Variable: SC

Appendix 5: Interaction effect

Correlations

		SC	SST	GPI	SSTxGPI
Pearson Correlation	SC	1,000	-,008	,731	,562
	SST	-,008	1,000	,055	,591
	GPI	,731	,055	1,000	,815
	SSTxGPI	,562	,591	,815	1,000
Sig. (1-tailed)	SC	.	,431	,000	,000
	SST	,431	.	,119	,000
	GPI	,000	,119	.	,000
	SSTxGPI	,000	,000	,000	.
N	SC	460	460	460	460
	SST	460	460	460	460
	GPI	460	460	460	460
	SSTxGPI	460	460	460	460

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	SSTxGPI, SST, GPI[b]	.	Enter

a. Dependent Variable: SC
b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,734[a]	,539	,536	,97816

a. Predictors: (Constant), SSTxGPI, SST, GPI

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	509,218	3	169,739	177,405	,000[b]
	Residual	436,295	456	,957		
	Total	945,513	459			

a. Dependent Variable: SC
b. Predictors: (Constant), SSTxGPI, SST, GPI

Coefficients[a]

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.	95,0% Confidence Interval for B Lower Bound	Upper Bound
1	(Constant)	-,009	,592		-,014	,989	-1,171	1,154
	SST	,063	,110	,055	,574	,567	-,153	,279
	GPI	,874	,132	,882	6,632	,000	,615	1,133
	SSTxGPI	-,028	,024	-,189	-1,146	,252	-,076	,020

a. Dependent Variable: SC

Appendix 6: Socio-demographic characteristic: Gender

Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
SST	Male	185	5,1153	1,35319	,09949
	Female	275	5,3855	1,16706	,07038

Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
SC	Male	185	3,3946	1,48442	,10914
	Female	275	3,5536	1,40030	,08444

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
SST	Equal variances assumed	6,727	,010	-2,282	458	,023	-,27014	,11840	-,50282	-,03746
	Equal variances not assumed			-2,217	354,592	,027	-,27014	,12186	-,50981	-,03047

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
SC	Equal variances assumed	2,414	,121	-1,166	458	,244	-,15904	,13642	-,42713	,10905
	Equal variances not assumed			-1,153	379,025	,250	-,15904	,13799	-,43036	,11228

Appendix 7: Socio-demographic characteristic: Age

Report

SST

Age	Mean	N	Std. Deviation
18-25	5,6368	39	,95504
26-35	5,4019	90	1,29892
36-45	5,4622	97	1,08267
46-55	5,4088	117	1,10240
56-65	4,8586	99	1,37444
65 or older	4,3148	18	1,69668
Total	5,2768	460	1,25088

Report

SC

Age	Mean	N	Std. Deviation
18-25	2,8846	39	1,11191
26-35	3,2139	90	1,38793
36-45	3,4639	97	1,56166
46-55	3,5128	117	1,38839
56-65	3,9293	99	1,39745
65 or older	3,7500	18	1,46277
Total	3,4897	460	1,43525

ANOVA

SST

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	45,807	5	9,161	6,186	,000
Within Groups	672,390	454	1,481		
Total	718,197	459			

ANOVA

SC

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	41,603	5	8,321	4,179	,001
Within Groups	903,910	454	1,991		
Total	945,513	459			

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of SST is the same across categories of Age.	Independent-Samples Kruskal-Wallis Test	,000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is ,050.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of SC is the same across categories of Age.	Independent-Samples Kruskal-Wallis Test	,001	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is ,050.

Measures of Association

	Eta	Eta Squared
SST * Age	,253	,064

Measures of Association

	Eta	Eta Squared
SC * Age	,210	,044

Appendix 8: Socio-demographic characteristic: Education

Report

SST

Education	Mean	N	Std. Deviation
Middelbare school (VMBO, HAVO, VWO etc)	4,8423	37	1,26133
Middelbaar Beroeps Onderwijs (MBO)	5,0514	120	1,32751
Hoger Beroeps Onderwijs (HBO)	5,3687	217	1,22769
Wetenschappelijk Onderwijs (Universitair)	5,5465	86	1,10869
Total	5,2768	460	1,25088

Report

SC

Education	Mean	N	Std. Deviation
Middelbare school (VMBO, HAVO, VWO etc)	3,1892	37	1,28345
Middelbaar Beroeps Onderwijs (MBO)	3,1542	120	1,36207
Hoger Beroeps Onderwijs (HBO)	3,5138	217	1,36479
Wetenschappelijk Onderwijs (Universitair)	4,0262	86	1,61383
Total	3,4897	460	1,43525

ANOVA

SST

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	21,168	3	7,056	4,616	,003
Within Groups	697,029	456	1,529		
Total	718,197	459			

ANOVA

SC

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	41,728	3	13,909	7,018	,000
Within Groups	903,786	456	1,982		
Total	945,513	459			

Measures of Association

	Eta	Eta Squared
SST * Education	,172	,029

Measures of Association

	Eta	Eta Squared
SC * Education	,210	,044

Appendix 9: Socio-demographic characteristic: Income

Report

SST

Income	Mean	N	Std. Deviation
less than € 1.000	5,2667	20	1,29710
€ 1.000 - € 2.000	4,9870	90	1,37510
€ 2.000 - € 3.000	5,3213	222	1,15920
€ 3.000 - € 4.000	5,3500	100	1,25764
€ 4.000 - € 5.000	5,7500	14	1,19606
€ 5.000 or more	5,4524	14	1,60984
Total	5,2768	460	1,25088

Report

SC

Income	Mean	N	Std. Deviation
less than € 1.000	3,2000	20	1,10799
€ 1.000 - € 2.000	3,3806	90	1,22602
€ 2.000 - € 3.000	3,2658	222	1,42469
€ 3.000 - € 4.000	3,9825	100	1,52970
€ 4.000 - € 5.000	4,4464	14	1,45503
€ 5.000 or more	3,6786	14	1,49817
Total	3,4897	460	1,43525

ANOVA

SST

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	12,101	5	2,420	1,556	,171
Within Groups	706,096	454	1,555		
Total	718,197	459			

ANOVA

SC

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	51,482	5	10,296	5,229	,000
Within Groups	894,031	454	1,969		
Total	945,513	459			

Measures of Association

	Eta	Eta Squared
SST * Income	,130	,017

Measures of Association

	Eta	Eta Squared
SC * Income	,233	,054