Exploring the User Experience of Self-Checkout Systems through Design

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Abstract

This thesis explores user experiences and expectations of self-checkout (SC) systems in grocery stores, focusing on both usability and socio-technical aspects. Using a mixed-method approach, including heuristic evaluation, thematic media analysis, design prototyping, a user study and an online survey, I investigated how users perceive current SC systems and what design improvements they might desire. The findings show that while users appreciate the efficiency of SC systems, they frequently encounter issues such as cramped layouts, inconsistent features, usability errors, and limited accessibility. Emotional and social factors, including past negative experiences, feelings of being watched, and a desire for human interaction, also influence their perceptions. Based on these insights, I propose design improvements that emphasise clearer user interfaces, better spatial design, enhanced accessibility, and a stronger human presence in SC areas. These recommendations aim to support designers, developers, and store owners in creating more inclusive, user-friendly, and socially aware self-service technologies.

Tiivistelmä

Tässä Pro gradu tutkielmassa tarkastellaan käyttäjien kokemuksia itsepalvelukassojen käytöstä päivittäistavarakaupoissa, keskittyen käytettävyyteen ja sosiaalisuuteen. Yhdistellen metodeja, kuten heuristista arviointia, temaattista media-analyysiä, prototypointia, käyttäjätutkimusta ja kyselyä, tutkin millaisia kokemuksia käyttäjillä on itsepalvelukassojen kanssa, ja mitä muutoksia he toivovat niihin. Tulokseni osoittavat, että käyttäjät arvostavat itsepalvelukassojen tehokkuutta, mutta kohtaavat usein ongelmia tilojen ahtauden, epäjohdonmukaisten ominaisuuksien, sekä käytettävyyden että saavutettavuuden suhteen. Emotionaaliset ja sosiaaliset tekijät, kuten aiemmat negatiiviset kokemukset, halu sosiaalisesta vuorovaikutuksesta tai tunne siitä että sinua tarkkaillaan, voivat vaikuttavaa käyttäjien odotuksiin. Tulosteni perusteella ehdotan parannuksia itsepalvelukassojen muotoiluun, korostaen selkeämpiä käyttöliittymiä, parempaa tilasuunnittelua, parannettua saavutettavuutta ja vahvempaa ihmisen läsnäoloa itsepalvelukassoilla. Näiden suositusten tarkoituksena on tukea muotoilijoita, tuotekehittäjiä ja yrittäjiä luomaan käyttäjäystävällisempiä ja sosiaalisesti tietoisempia itsepalvelukokemuksia.

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1 INTRODUCTION

1.1 Background

The user experience (UX) and usability of self-checkout (SC) systems are a current topic, as can be seen by the amount of negative media around them, for example, as seen in Figure 1. Consumers and companies question their design, usability, and economic benefit, and I echo those sentiments. When shopping for groceries, I often use SC systems, as I find them more convenient and suitable for my needs. However, even as someone who has extensive experience using these systems, I sometimes face issues when using them, which made me wonder if many other people feel the same way and whether these systems could be improved. There are SCs in use worldwide, so finding out how to improve their design could help create better experiences for customers and keep these systems in stores as an option for those who, like me, prefer using them in comparison to staffed tills.

As a diverse group of users uses grocery retail environments, it can be a challenge to find a design solution that caters to everyone. Previous research has found that especially older adults may have pre-existing biases against SC systems (Seifert & Charness, 2022) that should be considered in the design process.

SCs have become popular in retail stores worldwide as an economic way to reduce checkout queueing times. These systems aim to increase retail efficiency and improve user satisfaction by enabling customers to independently complete transactions without assistance from an employee. In an SC lane, customers usually scan their items, bag them, and pay using a payment terminal, typically with a payment card. However, SC processes and systems can differ from one store to another.

Technological advancements have made SC systems increasingly sophisticated, with features like touch screens, various scanning and payment methods, automation, and anti-theft systems. New technologies for SCs have been studied to find better interaction modalities, e.g., (Obermeier, Klingersberger, & Auinger, 2022; Bocanegra

et al., 2020; Aquilina & Saliba, 2019).

The driving force behind the implementation of SC systems is the desire of retailers to enhance the customer experience by reducing queue times, as long lines have been linked to negative reviews, poor service perception, and lower user satisfaction (Kokkinou & Cranage, 2013). Despite this, some consumers remain hesitant about SC systems, with studies indicating that preferences are often swayed by factors such as usability, sense of control, privacy concerns (Dabholkar, Bobbitt, & Lee, 2003) and whether they perceived SCs as more efficient than checkouts with employees (Kousi & Naselli, 2022). Poor functionality of UX of these services can lead to negative customer emotions and potentially result in aggressive behaviour (Surachartkumtonkun, Patterson, & McColl-Kennedy, 2013). Evaluation models for self-service and self-checkout systems have been suggested, e.g., (Parasuraman, Zeithaml, & Berry, 1988; Lin & Hsieh, 2011).

Figure 1: Media headlines highlighting that problems or negative experiences with SC are common.

1.2 Research Objectives And Questions

This thesis aims to identify usability challenges and uncover opportunities for improved UX in SC systems. The insights gained from this thesis could enhance user satisfaction, streamline retail operations, and inform future design standards for SC systems, ensuring that they better align with both customers' and retailers' needs and expectations in diverse retail environments.

This thesis seeks to address the following research questions:

1. How do users perceive the overall experience of SC systems in grocery stores?

2. What design features or improvements would users like to see in SC systems?

The primary objective of this thesis is to explore these research questions by evaluating currently deployed designs and gathering and analysing users' perceptions and experiences through design concepts, a user study, a thematic media analysis and an online survey. These methods are designed to provide insights into the UX of SC systems and offer insights for future systems from a human-centered design perspective.

1.3 Structure And Content

The structure of this thesis and my work are presented below.

Chapter 1: Introduction. Chapter 1 of this thesis describes the general context of the topic, my motivations and the structure of the thesis.

Chapter 2: Related Work. Chapter 2 presents related work in the area of SC design and UX.

Chapter 3: User Experience Design. Chapter 3 presents core characteristics of UX design, the methods used in this thesis and the structure of the two research phases.

Chapter 4: Phase I: Background Research. Chapter 5 presents the heuristic evaluation of two deployed SC systems, following Nielsen (1994)'s heuristics, and a thematic media analysis of 22 articles.

Chapter 5: Phase II: Design and Evaluation. Chapter 6 presents the design of the prototype and evaluation of said prototype using a user study, as well as the online survey held to gain further insight on the topic.

Chapter 6-7: Discussion and Conclusion. These chapters interpret my results

and compare them with related work, answer my research questions, discuss the practical and theoretical implications, as well as the limitations of my thesis.

2 RELATED WORK

2.1 Method

This related work section reviews literature on studies combining service quality models or UX research with SCs, as well as the digital divide. It was completed by searching online on Google Scholar for studies using the keywords: 'self-service,' 'self-checkout,' 'customer satisfaction,' 'customer experience,' 'UX,' 'user satisfaction,' 'efficiency,' 'user interface,' and 'digital divide.' The keywords were identified iteratively, by starting with key themes from the research questions ('self-checkout,' and 'UX,'), and finding keywords from these studies to search for next. In this review, the terms 'customer' and 'user' will be used interchangeably.

2.2 Self-checkouts, Experience and Evaluation

Various models for evaluating services have been proposed. Parasuraman et al. (1988) offers a 22-item instrument for ascertaining customers' perception of service quality in services and organisations called SERVQUAL. They propose that 'perceived service quality' differs from customer satisfaction, with perceived service quality viewing the service more globally, while customer satisfaction views specific service encounters. The SERVQUAL (Parasuraman et al., 1988) model suggests the best predictor for optimal service quality is viewing the service from five dimensions: tangibility, assurance, empathy, responsiveness, and reliability (Jonkisz, Karniej, & Krasowska, 2022). This instrument has been used in many different service fields, e.g., health care (Jonkisz et al., 2022); web design (Van Iwaarden, Van der Wiele, Ball, & Millen, 2003); hospitality (Saleh & Ryan, 1991); education (Udo, Bagchi, & Kirs, 2011). However, SERVQUAL (Parasuraman et al., 1988) has faced resistance; e.g., Smith (1995) concludes that SERVQUAL's value for academics and professionals is arguable as there is room for participants' confusion and misinterpretation of questions and answers.

Lin and Hsieh (2011) propose a similar 20-item seven-dimension scale for evaluating self-service terminals called SSTQUAL. The SSTQUAL (Lin & Hsieh, 2011) scale includes functionality, enjoyment, security, assurance, design, convenience, and customisation as topics of interest. It is reported as having sound psychometric properties and is applicable across multiple industries.

For example, Orel and Kara (2014) focus on the service quality of SCs in supermarkets and their impact on customer satisfaction and loyalty. The study focused mainly on supermarkets in Turkey and collected data from 275 shoppers who had used the SCs at a major supermarket chain. The researchers utilised the SSTQUAL scale (Lin & Hsieh, 2011) to gauge the service quality of SCs. The study found that the quality of service provided by SCs significantly impacts customer satisfaction and loyalty. The study results suggest that supermarkets must focus more on providing high-quality service through SC facilities to enhance customer satisfaction and loyalty (Orel & Kara, 2014).

To gain insights on UX, Turner and Szymkowiak (2019) explored how novice users of SCs in two locations in Scotland felt about them. The study followed a diary method among 31 participants who were relatively unfamiliar with this technology. Their perceptions were captured before, during, and after using SCs. The study found that although users were initially motivated by the promise of time savings and convenience, their actual experiences often contradicted these expectations. Technical problems, a lack of staff assistance, and impersonal interaction resulted in SCs being less efficient than staffed checkouts (Turner & Szymkowiak, 2019). As a result, users' perceptions post-use remained unchanged or negative, with many participants preferring not to use the technology again due to its impersonal and sometimes stressful nature (Turner & Szymkowiak, 2019).

Research by Bitner, Ostrom, and Meuter (2002) aimed to identify key factors for implementing self-service technologies in customer service contexts. While implementing these technologies may seem straightforward, it requires careful planning and focusing on the customer experience (Bitner et al., 2002). Effective self-service technologies should be customer-centric, well-integrated into the company's service strategy, and backed by clear customer communication and training (Bitner et al., 2002).

Companies must navigate the complexities of technology implementation to ensure reliability, ease of use, and strong support systems to effectively address failures. Therefore, understanding customer interactions with self-service technologies is essential for enhancing service delivery and boosting customer satisfaction. Bitner et al. (2002) provides strategic insights that stress the importance of aligning self-service technologies with organisational goals, designing solutions with the customer in mind, and continuously adapting to technological advancements and shifting customer expectations.

Schultz and Paetz (2025) conducted a multi-phase study to explore what drives customer satisfaction and willingness to adopt cashierless shopping systems, such as self-checkouts. Their research integrated the Unified Theory of Acceptance and Use of Technology (UTAUT) with perceived customer benefit. They found that performance expectancy, empowerment, customer experience and effort expectancy were positive drivers for satisfaction and intention to use. On the other hand, data privacy concerns were a negative driver, while convenience, social anxiety and technology affinity had no significant effect. Participants perceived convenience, privacy concerns, technical usability, and stress as factors. Participants also thought social concerns like the fear of self-service reducing jobs, a decrease in social interaction and concern for users, like elders, who are less skilled in using technology, affected the adaptability of these systems (Schultz & Paetz, 2025).

2.3 Self-checkout Technology

How self-checkout systems work can differ from store to store. Some self-checkouts can include advanced technology, while others opt for the simpler, tried and tested methods. In a laboratory study, Obermeier et al. (2022) investigated the factors influencing usage intentions of a self-service kiosk with biometric authentication in retail. They found that convenience and relative advantage significantly impacted usage intentions, indicating that customer acceptance of new technologies depends on convenience and perceived advantages. Security concerns and functionality may not be as influential in controlled settings (Obermeier et al., 2022).

Bocanegra et al. (2020) introduced RFGo, an SC system that automates the checkout process using passive Radio Frequency Identification (RFID) technology tags, impacting the customer experience. The custom-built RFID reader can decode multiple tags simultaneously, reducing checkout time to approximately two seconds per transaction. The system uses a neural network to identify products, ensuring high accuracy and privacy preservation. According to the authors Bocanegra et al. (2020), this solution streamlines the checkout process in apparel stores, eliminating queues and manual scanning and improving operational efficiency and customer satisfaction (Bocanegra et al., 2020).

Robotics solutions have also been applied in the SC domain, e.g., Aquilina and Saliba (2019) developed and presented a prototype of an automated supermarket checkout system that employs a Selective Compliance Assembly Robot Arm (SCARA) to recognise, transfer, and pack items and calculate the total bill, automating the checkout process. The study notes that potential enhancements, such as better machine vision, optimised conveyor operation, and improved system communication, could improve efficiency and customer experience. According to the authors' research, using a SCARA robot shows promise in reducing labour costs and enhancing customer interaction in retail settings (Aquilina & Saliba, 2019).

2.4 Digital Divide

SCs are used by diverse users of different ages, backgrounds and technical capabilities. According to Warschauer (2010), the digital divide refers to the gap between individuals with access to modern technology and those without it, which can exist between countries and within communities. Initially viewed as a simple divide between having internet access or technology and not having it, this perspective was found to be too simplistic, as it overlooks varying access levels and technology usage (Warschauer, 2010), for example, the technical skills of grocery store users. Bridging the digital divide requires a comprehensive strategy that considers educational, social, and economic factors to foster social inclusion and equality.

More recently, Aissaoui (2022) discusses how the COVID-19 pandemic has further

exposed the gap between those with and without access to technology. The research identifies three levels of the digital divide: access to technology, which pertains to who can obtain devices and internet connections; digital skills and usage, focusing on how effectively people can use technology; and outcomes from using technology, which examines the differences in what individuals can achieve, especially regarding education and economic opportunities. Aissaoui (2022) emphasises the need for more research to understand these disparities better and highlights the importance of developing strategies that not only ensure access to technology but also help individuals gain the necessary skills to use it effectively, ultimately aiming to reduce social and economic inequalities.

Seifert and Charness (2022) discusses the digital divide as it affects older adults in Switzerland, particularly their use and views on digital consumer services such as cash machines and ticketing systems. It highlights the challenges of age and socioeconomic status that influence how these services are adopted. While older adults often use some digital services, they tend to avoid newer ones like self-checkout systems. The reasons for this include how easy they find the services to use, their actual experience with them, and their willingness to try new technology (Seifert & Charness, 2022). It shows the need to consider age, health, income, and interest in technology when looking at how digital services are accessed and used.

2.4.1 Summary and Implications for this Thesis

The related work explores frameworks and studies evaluating SC systems, emphasising UX and user satisfaction. Models like SERVQUAL (Parasuraman et al., 1988) and SSTQUAL (Lin & Hsieh, 2011) provide dimensions for assessing SC service quality. However, critics argue that these frameworks do not fully capture the situational, emotional, and contextual complexities users experience during real-world SC use (Smith, 1995; Turner & Szymkowiak, 2019). Research indicates SCs significantly impact customer satisfaction and loyalty (Orel & Kara, 2014), though UXs vary widely, users are often negatively affected by technical issues or lack of support from staff (Bitner et al., 2002; Turner & Szymkowiak, 2019). Generally, studies point out a mismatch between the promised convenience of SC systems and users' actual

experiences, especially when usability issues, lack of assistance, or impersonal interfaces disrupt their usage (Bitner et al., 2002; Turner & Szymkowiak, 2019; Schultz & Paetz, 2025).

Technological innovations such as biometric authentication (Obermeier et al., 2022), RFID automation (Bocanegra et al., 2020), and robotic checkout systems (Aquilina & Saliba, 2019) show promise in improving efficiency and satisfaction, but mainly focus on technical performance and acceptance rather than broader UX or inclusivity (Obermeier et al., 2022; Bocanegra et al., 2020; Aquilina & Saliba, 2019). Research on the digital divide highlights that actors such as age, digital skills, and socioeconomic background not only affect access but also can influence users' confidence and success in using SC systems (Warschauer, 2010; Aissaoui, 2022; Seifert & Charness, 2022). Positive UXs, influenced by usability, aesthetics, and emotions, strongly affect SC systems' user satisfaction and adoption intentions (Schultz & Paetz, 2025).

The related work highlights the need for additional research that delves into users' experiences with SC systems, extending beyond usability, and taking into account, for example, social interaction and feelings of privacy (Turner & Szymkowiak, 2019; Seifert & Charness, 2022).

3 METHODOLOGY

The primary methodologies used in this thesis are UX design methodologies. In this section, I present the core characteristics of UX and details of the methods. Finally, I highlight the methods applied in the studies contained in this thesis.

3.1 User Experience

UX is defined as how individuals perceive and react to using or anticipating a product, system, or service (Law, Roto, Hassenzahl, Vermeeren, & Kort, 2009). It is not just about how something works, but also how it makes the user feel and how it meets their

needs. According to Thuring and Mahlke (2007), UX comprises instrumental qualities like usability, non-instrumental qualities like aesthetics, and users' emotions.

Expanding this understanding, UX can be defined as the momentary, primarily evaluative feeling that users experience while interacting with a product or service, which could be positive or negative (Hassenzahl, 2008). Instead of focusing solely on functionality or usability, UX emphasises the dynamic, subjective emotional states that users go through over time. According to Hassenzahl (2008), good UX arises when a product meets users' pragmatic goals, such as accomplishing a task, while also satisfying their deeper psychological needs, including autonomy, competence, relatedness, stimulation, and a sense of influence.

3.2 Metrics and Methods

UX design involves both qualitative and quantitative methods to understand and improve users' experiences with technology. The following describes commonly used metrics and methods.

3.2.1 User Study

User studies aim to assess products, systems, theories, or methods, using approaches such as surveys, usability testing and field studies (Kjeldskov & Graham, 2003). According to Dillon and Watson (1996), user studies aim to gather information about user needs and behaviours, which can help improve the usability and effectiveness of a system. User studies are a versatile tool that can provide helpful insights in both the early and later stages of the design process.

3.2.2 Usability Testing

A usability test is a type of user study that focuses on identifying usability issues. According to Hornbæk (2006), usability can be split into three metrics: effectiveness, efficiency and satisfaction, and each of these can be measured using different methods.

Usability is crucial to user-centered design practices and impacts every aspect of a user's engagement with a product, including its interface, functionality, and performance (Lewis, 2014).

Several different types of metrics can be used to measure usability, most commonly: completing a transaction, comparing products, evaluating frequent use of the same product, evaluating navigation and/or information architecture, problem discovery, maximizing usability for critical products, creating an overall positive UX, evaluating the impact of subtle changes, and comparing alternative designs (Albert & Tullis, 2013).

Usability testing can be applied differently at different stages of the design process. Before the product is finalised, it can be used to identify usability issues to inform iterative design improvements (Hornbæk, 2006). This is achieved through qualitative methods, such as analysing user behaviour, identifying inefficiencies or obstacles that prevent users from achieving their goals, and determining what works well and what does not.

For example, heuristic evaluation is typically conducted early, often before user testing begins, and sometimes on early prototypes, wireframes, or even design mockups. Heuristic evaluation is an approach to detecting design flaws in UIs, based on evaluators' expert experiences (Nielsen, 1994). The evaluators rely on a pre-selected checklist that includes elements related to usability, which can be created by the evaluator or chosen from a ready-made list. Typically, 3-5 evaluators independently assess the product using the checklist, and by comparing the ratings, the most significant usability issues can be identified. Nielsen (1994)'s usability heuristics are a popular framework used by designers and evaluators to assess the usability of a product or system. The framework consists of ten points, each of which plays a role in ensuring that users can interact with a product or system efficiently and satisfyingly (Figure 2).

In the later stages of product development or post-launch, usability testing tends to be more quantitative, focusing on metrics such as efficiency, effectiveness, and satisfaction (Hornbæk, 2006). Kaikkonen, Kekäläinen, Cankar, Kallio, and Kankainen (2005), for example, test a finished mobile product, analysing time-on-task, task success rates,

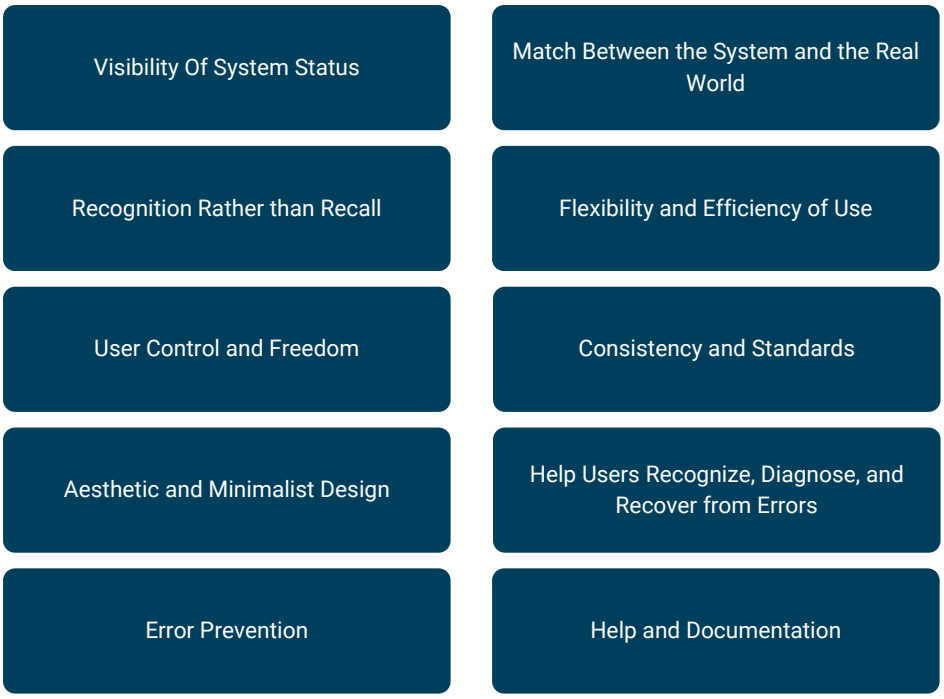

Figure 2: Nielsen (1994) 10 usability heuristics

error types, and user satisfaction in their usability study. However, these metrics could also be used for usability testing iterations in earlier stages of the design process. By evaluating the most common user errors, designers can make informed decisions about how to improve the product in subsequent iterations and anticipate potential usability challenges in the future.

The After-Scenario Questionnaire (ASQ) (Lewis, 1991) is a three-statement rating scale with a seven-point rating system ranging from 'Strongly Disagree' to 'Strongly Agree', that can be used to measure the usability of products in later stages of the design process. The three statements pertain to three essential aspects of usability. The first statement assesses the user's satisfaction with the ease of completing tasks in the given scenario, which directly impacts their effectiveness and satisfaction. The second statement evaluates the user's satisfaction with the time taken to complete the tasks, which is a measure of efficiency and satisfaction. Lastly, the third statement gauges the user's satisfaction with the support information provided, such as help online, messages, and documentation, which contributes to their overall satisfaction (Albert & Tullis, 2013).

3.2.3 User Satisfaction

User satisfaction is a metric used to collect information about the UX, as it encompasses users' perceptions and responses from their interaction with a product, system or service, whether during or after its use (Borsci, Federici, Bacci, Gnaldi, & Bartolucci, 2015). The quality of the UX directly impacts user satisfaction, and users who find an interface easy to navigate and visually appealing are more likely to report satisfaction (Borsci et al., 2015).

User satisfaction could play a role in determining the success of SC systems. According to Anderson, Fornell, and Lehmann (1994), user satisfaction impacts a company's economic success. Satisfied customers are more inclined to remain loyal to the company, even if competitors try to lure them with lower prices, which provides the company with a steady source of revenue from repeat customers. Satisfied customers are also less sensitive to price variations, meaning the company can maintain its prices without losing customers. These customers are also more likely to recommend the company to others, helping reduce the costs of attracting new customers. All these factors contribute to a company's economic performance and ensure its long-term success (Anderson et al., 1994). User satisfaction can be measured by using the ASQ (Lewis, 1991), for example.

3.2.4 Hedonic Experience

Hassenzahl (2008) defines hedonic quality as a product's ability to fulfill fundamental human needs, such as autonomy, competence, stimulation, relatedness, and popularity. When users' needs are met through their interactions with a product, they perceive it as hedonic, which directly enhances their positive UX (Hassenzahl, 2008). Benedek and Miner (2002) introduced Microsoft's Product Reaction Cards (PRC): a set of 118 items that help evaluate users' emotional and subjective responses to a product. After interacting with a system, users select items that best describe their experience, choosing from positive and negative adjectives. This method captures functional reactions and hedonic qualities, highlighting how enjoyable, exciting, or meaningful the

experience was. By focusing on users' feelings rather than task performance, designers can analyse the patterns in the selected adjectives to gain insights into how well the system meets users' emotional and psychological needs (Benedek & Miner, 2002). Merčun (2014), for example, used a modified version of the PRC with 29 items for a user study to gather subjective UX feedback on prototypes.

There are various other methods that could be used to measure users' hedonic experience. For example, the AttrakDiff (Burmester, Hassenzahl, & Koller, n.d.) questionnaire is a tool for evaluating pragmatic and hedonic qualities. It helps to understand how people feel about a product based on three main qualities: how practical it is, how enjoyable it is, and its overall appeal. Users rate the product using pairs of opposite words on a scale from 1 to 7.

The AttrakDiff (Burmester et al., n.d.) focuses on four dimensions. The first dimension, pragmatic quality, looks at how usable and functional the product is. The Hedonic quality (stimulation) dimension measures how exciting and stimulating the product feels, while the Hedonic quality (identification) dimension checks how well the product helps users express themselves or connect with others. The Attractiveness dimension reflects how appealing the user finds the product overall (Burmester et al., n.d.). Colley, Inget, Rantala, and Häkkilä (2018), for example, used AttrakDiff at the end of a user study to measure the overall UX and acceptance of their interactive ring concept. Using this approach can help designers better understand what users think, find areas for improvement, and create products that are both engaging and functional (Burmester et al., n.d.).

3.3 Applied methodology

This study uses a Research through Design (RtD) (Zimmerman, Forlizzi, & Evenson, 2007) approach in two phases. The first phase gathers insight on current SC systems, combining heuristic evaluation and a thematic media analysis based on 22 articles. In the second phase, a prototype SC system was created based on the results of the first phase and evaluated through a user study (N = 12). The findings were then used to make iterative improvements to the prototype. To conclude the work, an online survey (N = 41) was organised to help generalise the findings. The two-phase structure is illustrated in Figure 3.

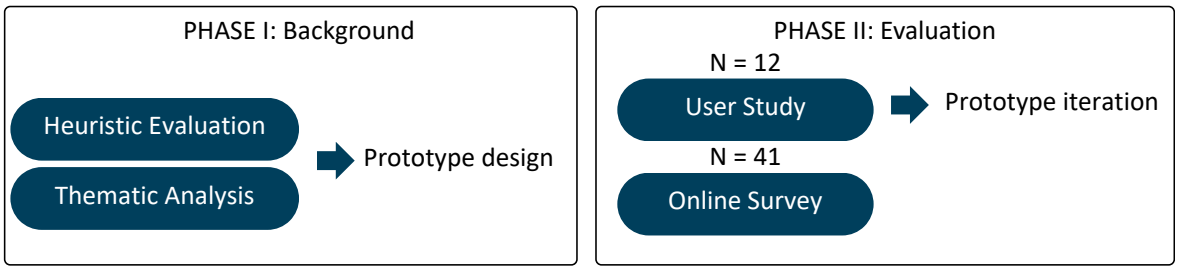

Figure 3: Study Structure

Zimmerman et al. (2007) suggests that an RtD approach helps designers in Human-Computer Interaction (HCI) tackle complex problems by creating practical design solutions, supporting teamwork across different fields, encouraging creativity, and making research findings easier to use in real-world situations. This approach is broadly used, e.g., (Markum, Wolf, Claisse, & Hoefer, 2024; Leichtmann, Nitsch, & Mara, 2022; Paananen, Kiianmies, & Häkkilä, 2024). In practice, designers identify complex problems. These problems generally do not have a clear solution and must be considered from different stakeholders' viewpoints, like self-checkout systems. After identifying and exploring the problem, the designer creates one or more prototypes that hold a possible solution. The prototypes are then tested with users for evaluation and feedback. The results are then used to refine the prototype and shared with peers to be built upon (Zimmerman et al., 2007). This RtD process is illustrated in Figure 4.

Figure 4: RtD approach (Zimmerman et al., 2007)

4 PHASE I: BACKGROUND RESEARCH

4.1 Heuristic Evaluation

4.1.1 Method

For this study, a modified version of a heuristic evaluation was used, as the author served as the sole evaluator, and the evaluation considers the SC's physical design in addition to the UI. Two grocery store chains' SC systems were observed and photographed. The two SC systems were selected because their respective stores are of similar sizes, are in the same area, sell similar products, and have established SC systems. Evaluating and comparing these two systems could highlight the differences and opportunities in their UIs and overall designs. The SC systems, referred to as SCO1 and SCO2 from here on out, used in the heuristic evaluation can be seen in Figure 5 and Figure 6. Nielsen (1994) usability heuristics were used in this evaluation.

4.1.2 Findings

Findings related to each of Nielsen (1994)'s 10 heuristics are presented in the following.

Visibility of System Status. SCO2 requires users to press a "No loyalty card" button after pressing the "Pay" button if they do not wish to use a loyalty card. This can be overlooked by users who have shifted their focus to the payment terminal. SCO1, by contrast, integrates loyalty cards into the payment process. SCO2 uses indicator lights (green, yellow, red) above the checkout to show register availability and the need for staff assistance.

Figure 5: SCO1 in Heuristic Evaluation

Match Between System and Real World. Starting the interaction with SCO2 differs from the process at checkouts with employees in the supermarket, potentially confusing users, as it requires users to start the interaction by pressing a button. SCO1 also offers a "Start Scanning" button. Still, it allows the user to begin the interaction by scanning, which aligns with standard cashier practices where users start the interaction by placing an item in front of the checkout employee. SCO1 also requires users to keep a receipt to exit the store, which is unnecessary when using an employee-operated checkout.

User Control and Freedom. Neither SCO1 nor SCO2 allows users to cancel individual scans; however, SCO2 provides an option to cancel all purchases during scanning and start again. Both SCs allow the user to scan the items in an order of their choosing and pack their shopping at their own pace.

Consistency and Standards. Some key differences can be found when comparing the two SC systems. For example, SCO2 requires the user to initiate the interaction by pressing a button, whereas SCO1 does not. Additionally, SCO1 requires a receipt to exit the store, whereas SCO2 does not. Based on this, it is unclear whether SC systems have a standard process.

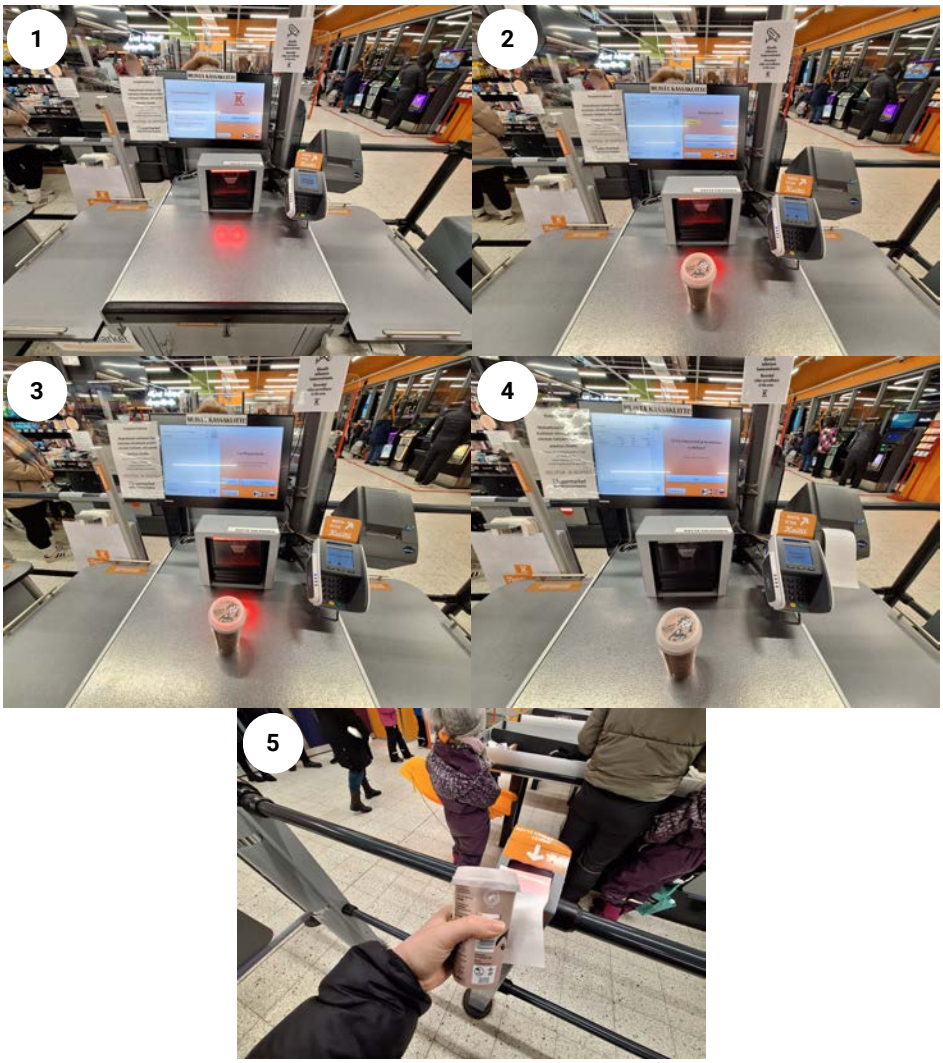

Figure 6: SCO2 in Heuristic Evaluation

Error Prevention. SCO2 requires users to start the interaction by pressing a button, but does not alert users if they start scanning items without doing so. If the process is not standard, this could lead to failed interactions.

Recognition Rather Than Recall. Both SCO1 and SCO2 display process status on-screen, minimising memory load.

Flexibility and Efficiency of Use. SCO2 requires users to confirm the absence of a loyalty card each time, whereas SCO1 integrates this step into the payment process. Neither system supports scanning multiple identical items in a single step, which may hinder efficiency.

Aesthetic and Minimalist Design. Both systems use small fonts, negatively

affecting readability. SCO2 highlights the most recent item in yellow, which could be misinterpreted as a warning.

Error Recognition and Recovery. If either SCO1 or SCO2 encounters an error requiring assistance, users are unaware of its cause and can not solve it themselves, increasing the employees' workload.

Help and Documentation. SCO2 provides extensive written instructions on the left side of the screen, which may be difficult to read due to their low placement. SCO1 includes multiple indicators or textual reminders that remind users to keep receipts to scan when exiting the store.

4.1.3 Summary of Heuristic Evaluation

Two grocery store chains implemented their self-checkout (SCO) systems, which I observed, photographed, and evaluated using Nielsen (1994)'s ten usability principles. I found notable differences in usability between SCO1 and SCO2. SCO1 generally aligned more closely with familiar employee-operated checkout processes, facilitating a smoother user experience by integrating loyalty card handling and allowing direct scanning to initiate interaction. In contrast, SCO2 introduced additional steps, such as requiring users to press a start button and explicitly decline loyalty card use, which interrupted user flow and caused confusion.

Both systems allowed flexibility in scanning and packing, but they lacked features for correcting individual items or bulk scanning, limiting user control and efficiency. When it came to feedback and error handling, neither system provided sufficient information during issues, resulting in increased reliance on staff for assistance. Visual design choices, such as small text and ambiguous color cues, hindered readability and clarity.

Help and documentation remained minimal in both systems, with SCO2 offering poorly placed signage while SCO1 also relied on signage for guidance. Overall, my evaluation highlighted inconsistencies between the systems and several areas where user expectations went unmet, suggesting a need for standardisation and improved error prevention and recovery mechanisms.

4.2 Thematic Media Analysis

4.2.1 Method

Thematic analysis is a frequently used qualitative research methodology in which researchers identify, analyse, and report patterns within data (Bowman, Nadal, Morrissey, Thieme, & Doherty, 2023). A reflexive thematic analysis was conducted with online media articles on SC systems in grocery stores to gain insights into public opinion on SCs. 22 articles were selected based on suitability to the topic, trustworthiness, and recency: 13 articles were from 2024, 4 from 2023, and 4 from between 2017 and 2022 (Figure 7). This approach allowed me to group key extracts from the data into themes and subthemes that emerged during the process. Articles in English and Finnish were used and found using a search engine with the keywords: 'self-checkout' and 'itsepalvelukassa'. See Appendix A for the full table of coded media excerpts.

4.2.2 Key Themes

The key extracts from the data were divided into three themes that emerged: usability, experience and economy, as seen in Figure 8.

Usability. The usability of SCs was a theme that appeared at the forefront. Online articles highlight the accessibility challenges of SC systems for users with disabilities (A1, A2). They noted that these systems can be particularly difficult for hearing-impaired and deaf users, noting issues such as the lack of visual feedback when scanning items and the reliance on audio instructions. Suggestions for improving accessibility include incorporating more visual cues and on-screen instructions to accommodate these users.

Similarly, the usability of SCs for low vision or blind users is another concern. Both articles comment that SCs are often unusable for individuals with severe vision impairments if the systems depend on visual interaction and feedback (A1, A2).

Num.	Article Name, Source (Year)
A1	Have supermarkets reached peak self-scan?, BBC (2024)
A2	Self-scan supermarket tills and the rows over their use, BBC (2022)
A3	Major retailers are backtracking on self-checkout, NBC News (2024)
A4	The end of self-checkouts?, Newsweek (2024)
A5	More stores are ditching self-checkout amid theft and customer complaints, CBC (2024)
A6	Einesleipiä katosi mystisesti hyllyltä – sitten kauppias keksi, miten varkaan sai nalkkiin, Yle (2024)
A7	Kyläkauppojen määrä romahti tuhansilla 1980-luvulta – itsepalvelukaupat herättävät toivoa paremmasta, Yle (2024)
A8	Imajoelle aukeaa yksi harvoista itsepalvelukaupoista pääkaupunkiseudun ulkopuolella – sisään pankkitunnuksilla, maksu sekunneissa, Yle (2022)
A9	Shop closures and self-checkouts cost tens of thousands of women's jobs, The Guardian (2019)
A10	Walmart, Costco and other companies rethink self-checkout, CNN (2023)
A11	Maksoitko itsepalvelukassalla vahingossa ostoksesi kahdesti? Kysyimme kaupoilta, korvataanko virheet jälkikäteen, Yle (2023)
A12	'It hasn't delivered': The spectacular failure of self-checkout technology, BBC (2024)
A13	Why several big-box stores have ditched their self-checkouts, CBC (2023)
A14	Self-checkout users think it makes stealing easier, LendingTree (2023)
A15	Sam's club eliminates checkout option as CEO praises move for 'faster' exit, The US Sun (2024)
A16	Itsepalvelukassat yleistyvät eikä niistä oikeastaan kenelläkään ole pahaa sanottavaa – kaupan työntekijätkin kiittävät, Kun rankkaan kassatyöhön tulee vaihtelua, Yle (2021)
A17	Itsepalvelukassa nopea reitti pikkuostosten tekijälle, MTV Uutiset (2017)
A18	Näin sijoittelet itsepalvelukassan apteekissa – kassajonot katosivat Kaaren apteekissa itsepalvelukassojen myötä, Receptum (2024)
A19	Näin karjalanpiirakka mahdollisti rikoksen ruokakaupassa – kamerat auttoivat tapauksen ratkaisemisessa, Yle (2024)
A20	Tomi poisti kaupastaan itsepalvelukassat, Kun karut faktat valkenivat, MTV Uutiset (2024)
A21	Lidl investoi isosti myymälöihin – pikakassat lähes kaikkiin Lidleihin kautta Suomen, STT Info (2024)
A22	Another major supermarket makes big change to self-checkouts, The Scottish Sun (2024)

Figure 7: Articles used in Thematic Media Analysis

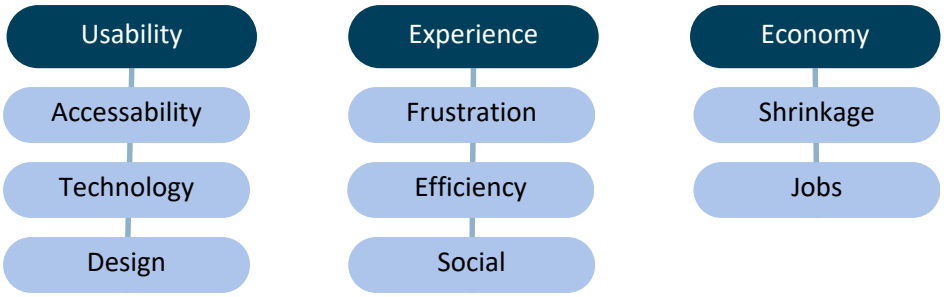

Figure 8: Themes identified through thematic analysis of online articles. See section 5.2.

SC systems may, however, offer certain advantages for, for example, autistic users. According to feedback, these systems can provide a more comfortable and independent shopping experience by reducing the need for social interaction, such as eye contact or small talk (A1).

Some stores might not be compatible with SC systems. On the one hand, loose items like bakery items without barcodes can be challenging to scan at an SC because they require knowing the product code (A12). However, some systems' UIs have considered this by including catalogues with images of the bakery produce for users to pick from (A20).

The reviewed articles discuss various technologies employed in SCs. Two articles (A2, A16) mention systems enabling users to scan items as they shop, eliminating the need to unload and reload items at checkout. These systems are noted to be convenient and efficient for customers.

Integrating artificial intelligence (AI) into SC systems is also explored. One article describes the use of AI to verify receipts at store exits, streamlining the checkout process and improving security (A15). Additionally, new fully automated self-service grocery stores have been opening across Finland, with particular success in rural areas, where customers value the convenience these stores provide, and they are more economically viable than staffed stores (A7, A6). Ordering groceries online is also possible for customers who prefer not to physically visit the store (A2).

Heavy or large items that are difficult to manoeuvre could be challenging to scan at SCs (A12). However, larger SC tills might be becoming more commonplace (A22).

Many customers avoid SCs when they have more than a few items or a shopping trolley (A21, A17).

When planning the location of SCs, it is suggested that the customer flow of the store be considered at its busiest so that customers can quickly locate them at the end of their visit (A18). A Finnish pharmacy found that implementing a tailored SC design reduced queues during rush hours (A18).

User Experience. Users' experiences with SCs and technology affect their attitude when facing SC systems. Many customers dislike SCs, perhaps due to previous malfunctions or other personal reasons (A2, A4, A5, A10, A13). Others hope to see an SC when entering a store (A21, A17, A1). This theme is divided into three subthemes: difficulty, efficiency and social.

Users' mistakes or SC malfunctions lead to negative experiences. A common grievance with SC systems that weigh items after scanning them to verify their scanning is when they recognise an unexpected item on the scale, resulting in an error (A1, A10, A13). Malfunctions like this require employee assistance to resolve and may leave the user frustrated, as the employees are not nearby (A1, A10, A13). The frustration with malfunctioning technology may overpower the customers' desire to check out as fast as possible and lead them to prefer a traditional, staffed checkout (A2).

Users can also encounter issues with SCs that require the scanning of a barcode. Some items may have multiple difficult-to-scan barcodes or product codes that need to be manually entered into the system (A10). Users might also scan items several times by mistake (A11) or be unsure if the scan was successful if they can not hear the verification signal (A10).

Many customers who use SCs find them efficient when only buying small amounts of items (A21, A17, A1). From the store's perspective, SCs can help manage large numbers of customers and reduce queues during rush hours (A17, A18). They can also allow employees to work more efficiently and with less pressure from queues (A16).

Many customers, especially senior ones, enjoy the social aspect of interacting with or speaking to an employee at the checkout till (A1, A2, A5, A13). These customers

might find it beneficial to their mental health and an important part of their day (A1). Other customers aim specifically to avoid these social interactions (A1). Customers find it more efficient and enjoyable to resolve possible issues with an employee than with the SC systems (A1, A2, A5, A13).

Economy. Customers and business owners alike wonder about the economic effects of SCs. This theme is divided into two subthemes: shrinkage and jobs.

Businesses have found they lose inventory through SCs (A3, A4, A5, A6, A7, A10, A12, A13, A14, A19, A20). This loss of inventory, or shrinkage, can significantly affect a company's baseline and refers to the loss of inventory or money due to theft.

Customers have found new ways to steal from stores using SC systems, such as only scanning some of their items or replacing the barcodes of expensive items with those of cheaper items (A10, A6). The most effective deterrent for theft is the presence of an employee (A5, A10, A13). However, employing more employees to oversee SCs also increases staffing costs for the business (A12). An alternative method for monitoring customers is the use of camera-based surveillance. Customers may, however, find this to violate their privacy (A1).

Customers may also forget to scan all their items at an SC or not realise that they have failed to scan an item correctly, leading to shrinkage (A10).

It is unclear whether the increase in SCs results in a decrease in jobs in the field. Customers are concerned that using an SC instead of a staffed checkout may result in someone being left without a job (A2, A4). However, a representative from the Finnish Service Union United PAM comments that they have not received any indication that an increase in SCs has cost someone their job (A16).

5 PHASE II: DESIGN AND EVALUATION

5.1 Prototype Design

A prototype was designed to simulate an SC system, based on the results of the heuristic evaluation and thematic media analysis. To create a representative service context, the prototype was situated in the Service Innovation Corner (SINCO) (Miettinen, Rontti, Kuure, & Lindström, 2012). SINCO (Miettinen et al., 2012) is a service design laboratory designed for service prototyping and interaction design. The laboratory enables teams to create and test service experiences by combining elements of a showroom, a theatre, a craft workshop, and a modern meeting room, allowing for a versatile environment where various design activities can occur (Miettinen et al., 2012). The prototype consisted of an SC UI concept wireframe made on Google Slides displayed on a monitor (Figure 10). A payment terminal UI, made on Marvell App, was shown on a smartphone to the right of the monitor (Figure 11). An Arduino-powered red LED light was positioned beneath the centre of the monitor to simulate the scanner. The monitor was placed on a high table, and benches were placed in front of it. The five items the participants were required to scan were placed on a bench to the left of the prototype. The prototype can be seen in as seen in 9.

The prototype functionality followed wizard-of-Oz approach (Dahlbäck, Jönsson, & Ahrenberg, 1993), with the test moderator providing the system functionality. According to Maulsby, Greenberg, and Mander (1993), the wizard-of-Oz method is often used in UI design. It involves a human, called the ‘wizard, ’ creating a simulation of a system or part of a system that has not yet been fully developed. By doing so, designers can observe how users interact with the proposed system and gather valuable feedback on its functionality and usability without needing to build a complete working model. The ‘wizard, ’ who remains hidden from the user, manually performs functions that the system is expected to do automatically, creating the impression that the system is operating as intended. This enables the design team to test hypotheses about user behaviour and system design early in the development process, making it

Figure 9: User study prototype.

easier to adjust designs based on user needs and preferences (Maulsby et al., 1993).

At first, the UI displays a welcoming view, and the user can begin the checkout process by scanning the first item or bringing the item up to the red LED light, after which the moderator plays the audio effect and changes the slide. The following slide displays the item's information, quantity and price, the sum of the scanned items, and a 'Pay' button. The participants are asked to scan all of the items. When scanning multiple items, the item's quantity will increase. Each time the participant scans an item, the moderator plays the audio effect and proceeds to the next slide on the adjacent computer.

After pressing the 'Pay' button on the monitor, participants were presented with the second smartphone displaying the payment terminal UI. The moderator pressed the screen on the smartphone to advance to the 'Finished Payment' view when the participant placed their payment card near the smartphone. Excessive support information can overwhelm users and lead to cognitive strain. Information overload, as described by Mulder, de Poot, Verwij, Janssen, and Bijlsma (2006), creates stress due to excess information, resulting in frustration and wasted time. To improve user

satisfaction and efficiency, it is essential to minimise unnecessary support information.

For audio feedback, the moderator played a beeping sound from a separate smartphone every time the participant presented an item to the red LED light. Ambient grocery store sounds were played quietly in the background from speakers. An AI-generated grocery store image was projected onto two screens that formed a corner. Benches and tables were placed to simulate the packing area in an SC, and a monitor was placed on a table behind them to act as the tangible UI typically found in SCs. The setup for the user study was based on the setups of the two evaluated SCs.

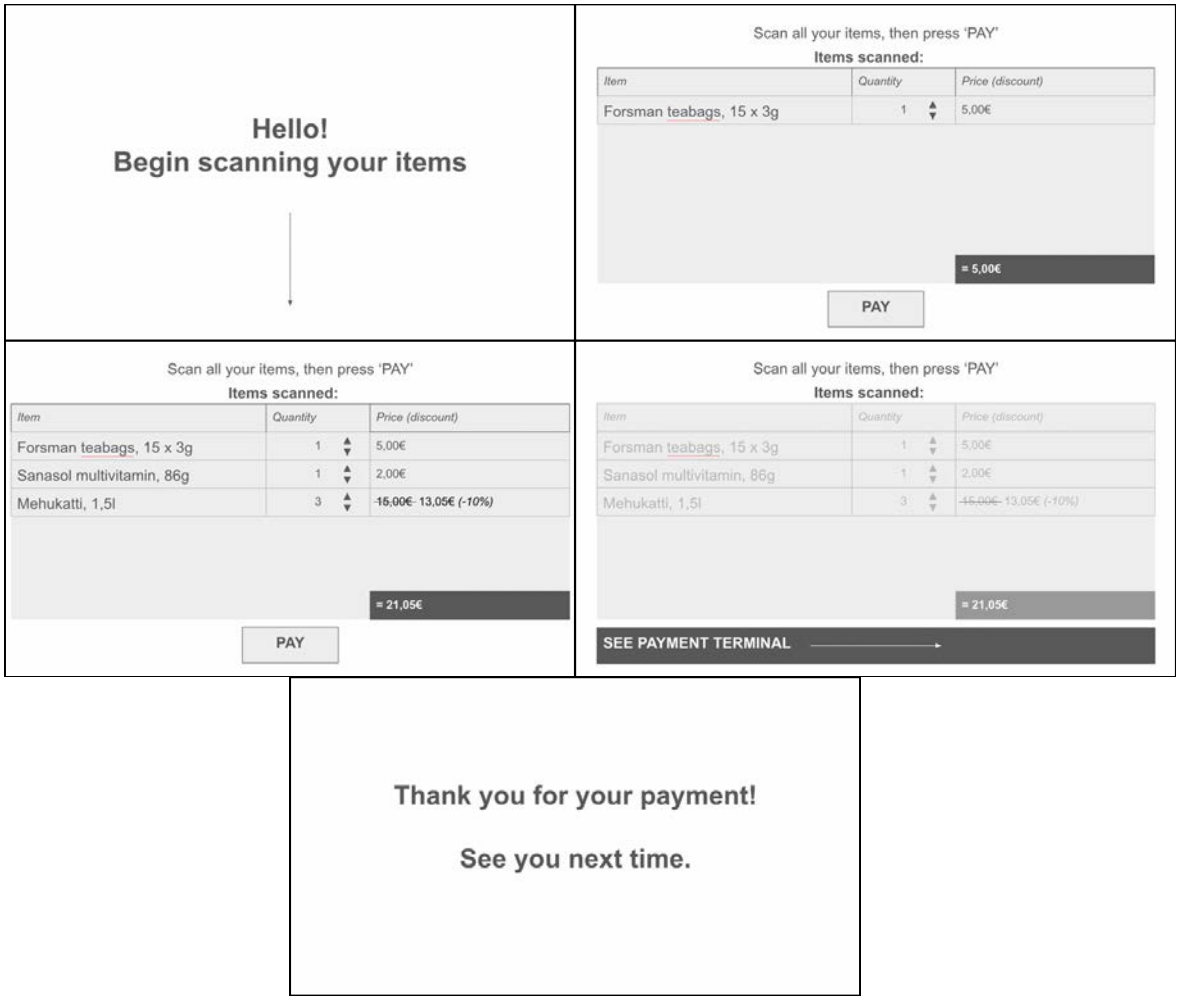

Figure 10: Prototype UI.

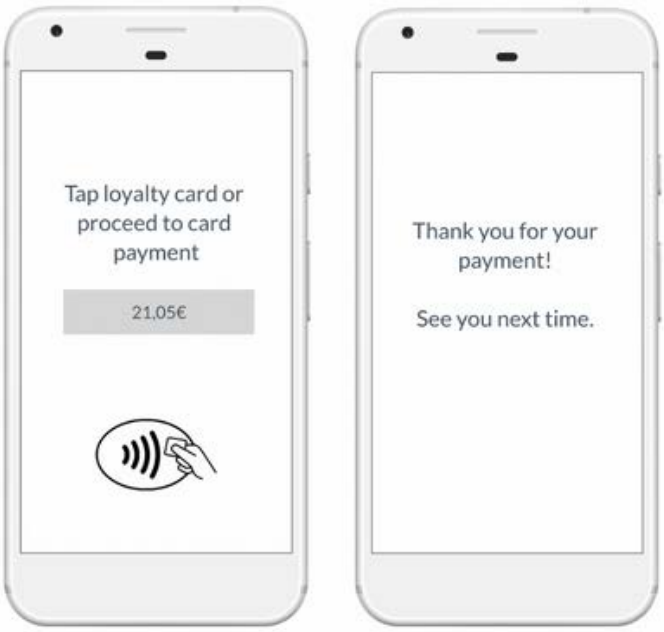

Figure 11: Payment terminal UI for SC prototype.

5.2 Prototype Evaluation

5.2.1 Method

A user study was conducted to ascertain users' experiences with self-checkouts and the prototype through a usability test and a two-part survey. The study was conducted one participant at a time in a service design laboratory to identify which features of SC systems affect UX and usability.

Structure. To begin the user study, each participant completed a consent form and the first part of the survey that collected background information and established a baseline for their typical experiences with SCs. After this, the participants were led to another laboratory area to conduct the usability test. Once the usability test was finished, the participants filled out the second part of the survey based on their experience using the prototype.

Participants. 12 participants participated in the user study. The participants were selected from the local university; all had previous experience using SCs. Of the 12 participants, one was under 18 years old, one was 18-25 years old, eight were 26-35

years old, and two were 36-45 years old. Nine participants identified themselves as women, and three identified themselves as men.

Six participants reported shopping at a grocery store 1-3 times a week, five reported going 4-6 times a week, and one reported going once a month or less. However, only one participant reported using the SC almost every day if it were an option, one reported using them 4-6 times a week, four reported using them 1-3 times a week, and six reported using them once a month or less.

Usability Testing. The participants were given a payment card and shopping bag and instructed to purchase five given items using the SC prototype in whatever way they felt was most intuitive. The first two were distinctive items, and the last three were all the same item to see how the participants approached scanning both singular and repeated items. The participants were required to start the checkout process, scan all the items into the system, pay and leave the store. The participants were timed after the fact to calculate the number of tasks completed per minute. The task success rate was also determined.

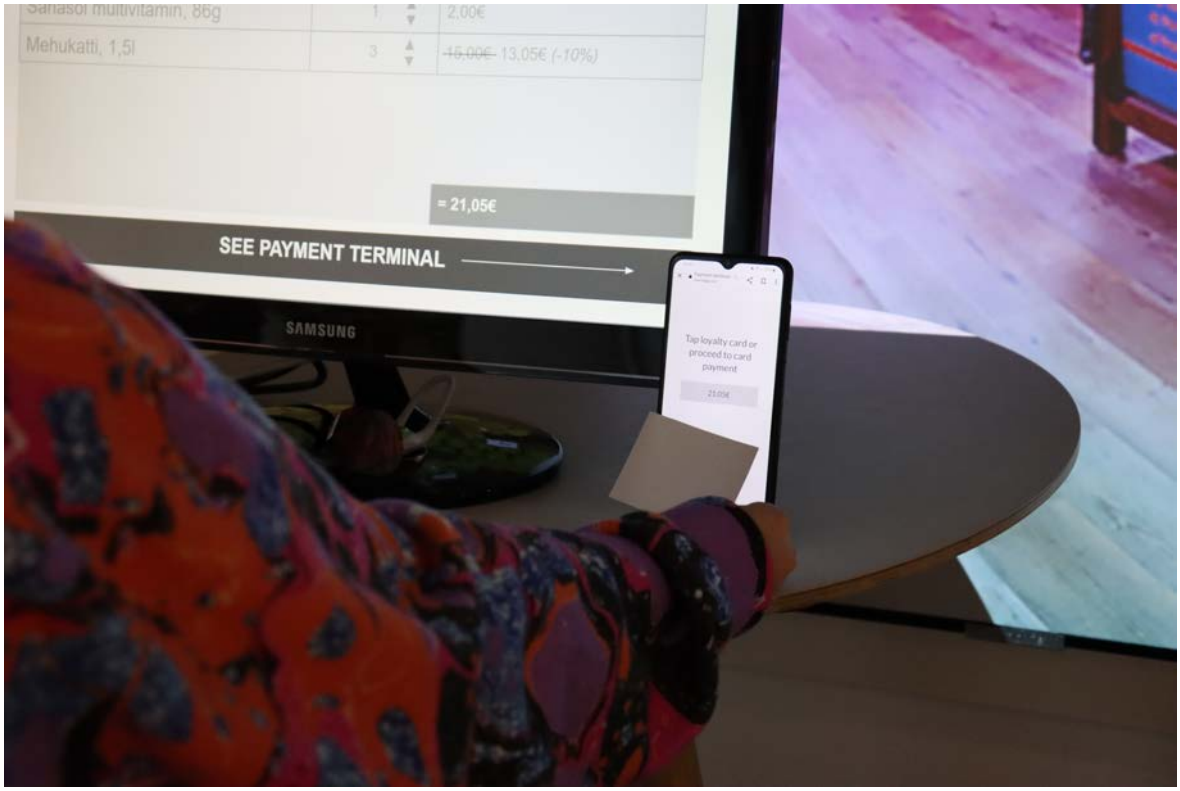

Figure 12: Participant using the payment card and terminal.

Survey Design. The participants were asked to fill out a two-part survey, with one

part before the usability test and the other after. After using the prototype, the participants were asked to fill out a survey about their experience. This survey allowed them to compare their experience with the prototype to their baseline experience with SCs from the background survey before the usability test. The open-ended questions in the surveys were analysed thematically, grouping the data by theme into the most common thoughts and issues.

The user study measures task satisfaction by using the After-Scenario Questionnaire (ASQ) (Lewis, 1991) and an adapted version of the PRC (Benedek & Miner, 2002). For this user study, this tool was modified, and 30 items were used: 15 positive items and 15 negative items. The items can be seen in Table 1.

Table 1: Positive (15) and Negative (15) PRC Used in the User Study

Positive		**Negative**	
Accessible	Advanced	Unapproachable	Dated
Appealing	Calm	Annoying	Overwhelming
Convenient	Clear	Time-Consuming	Confusing
Efficient	Familiar	Slow	Impersonable
Fast	Fun	Busy	Stressful
Helpful	Intuitive	Frustrating	Too Technical
Reliable	Time-Saving	Inconsistent	Complex
Valuable	—	Not Secure	—

Pilot Study. A pilot test was run for one participant (P1). Overall, the pilot test was successful in terms of the prototype working, but it was not possible to time the tasks or write observations with just one moderator in the pilot test. Hence, the method was adjusted to use video and audio recording of the test, which would be later analysed. Some language in the survey was revised for clarity based on questions that arose from the pilot test participant while filling them out.

5.2.2 Results

The data from the user study were analysed to determine participants' thoughts about SC systems, the task success rate, efficiency, and overall UX of the SC concept's first iteration, and any problems that need to be fixed for the second iteration. From here on out, the participants will be referred to as P1 (Participant 1), P2 (Participant 2), and so forth. See Appendix B for the full table of coded excerpts from the user study.

Task Success The following table (Table 1) showcases the task success rate of the following tasks in the user study: Starting the SC process by scanning the first item (Task 1), Scanning the second item (Task 2), Scanning the multiple (3) items (Task 3), Starting the payment process by pressing the 'Pay' button (Task 4), Using the Tap-To-Pay function (Task 5), and Packing the items into the shopping bag (Task 6).

Table 2: Task Success In User Study

Participant	**Task 1**	**Task 2**	**Task 3**	**Task 4**	**Task 5**	**Task 6**
P1	S	S	S	S	S	S
P2	S	S	S	S	S	S
P3	S	S	S	F	S	S
P4	S	S	S	S	S	S
P5	S	S	S	S	S	S
P6	S	S	S	S	S	S
P7	F	S	S	S	S	S
P8	S	S	S	S	S	S
P9	S	S	S	S	S	S
P10	S	S	S	S	S	S
P11	S	S	S	S	S	S
P12	S	S	S	F	S	S
Success (%)	92	100	100	83	100	100
S = Complete success, F = Failure						

The overall task success rate of the prototype in the user study was 96%. The task's success was evaluated on a scale of complete success and failure. If the participant required assistance to complete the task, it was classified as a failure. The task with the most failures was Starting the payment process by pressing 'Pay' (Task 4), as seen in Figure 13, with two failures. Starting the SC process by scanning the first item (Task 1) also had one failure. All other tasks had a success rate of 100% and all participants were able to complete all the tasks in the end, whether with some assistance or without. Based on this, the adjusted Wald method (Agresti & Coull, 1998) was applied using a 95% confidence interval to calculate the expected success rate in the general population. As 75% of the user study participants succeeded with no errors, the expected success rate of this prototype in the general population is between 88% and 99%. As 25% of the usability participants had one or more failures in completing the tasks, the expected failure rate in the general population is between 1% and 12% Table 3.

Figure 13: Participant initiating the payment by pressing 'Pay'.

Efficiency When discussing SCs overall, the most common comments on the topic from participants were positive, stating that they find SCs faster than the regular checkout if they only have a few items. The participants stated that they use SCs to avoid long queues at regular checkouts. *"If I do not have a lot of items, it is fast and easy. If the regular checkouts have long queues, I always wonder whether the SC would be a faster option"* (P7). On the other hand, one participant commented that if they encounter an error at the SC, using the SC is no longer efficient: *"When encountering an issue, like discounted items or age-restricted items, it is slower"* (P3).

When assessing the SC concept, participants were happy with its efficiency: *"I could use it quite fast. I have used SCs before, so it felt familiar"* (P7) and *"The scenario was clear and fast. Exactly how I would behave at a similar checkout."* (P12).

Based on the ASQ, participants were pleased with both the ease of completing the tasks ('I am satisfied with the ease of completing the tasks in this scenario'), with the mean result being 5.8 out of 7, and the amount of time it took to complete all the tasks ('I am satisfied with the amount of time it took to complete the tasks in this scenario'), with the mean result being 6.2 out of 7, as seen in Figure 16.

Table 3: Task Success Among Participants and Projections

Level of Success	**Users (out of 12)**	**Details**
Complete success	9	75% succeeded with no errors. The expected success rate in the general population is 88% to 99% (*).
One or more failures	3	25% failed at least one task. The expected failure rate in the general population is 1% to 12% (*).
(*) In this table, the ranges represent 95% confidence intervals calculated using the adjusted Wald method.		

The SC concept was evaluated using the following Product Reaction Cards: Convenient, Efficient, and Fast, but so were SC systems in general, as seen in Figure 15.

The average efficiency of the concept was determined by calculating the number of tasks successfully completed per minute during the user study. The average number of tasks completed was 4,7 tasks per minute. Participants who spent less time on the tasks were more efficient, as seen in Figure 14.

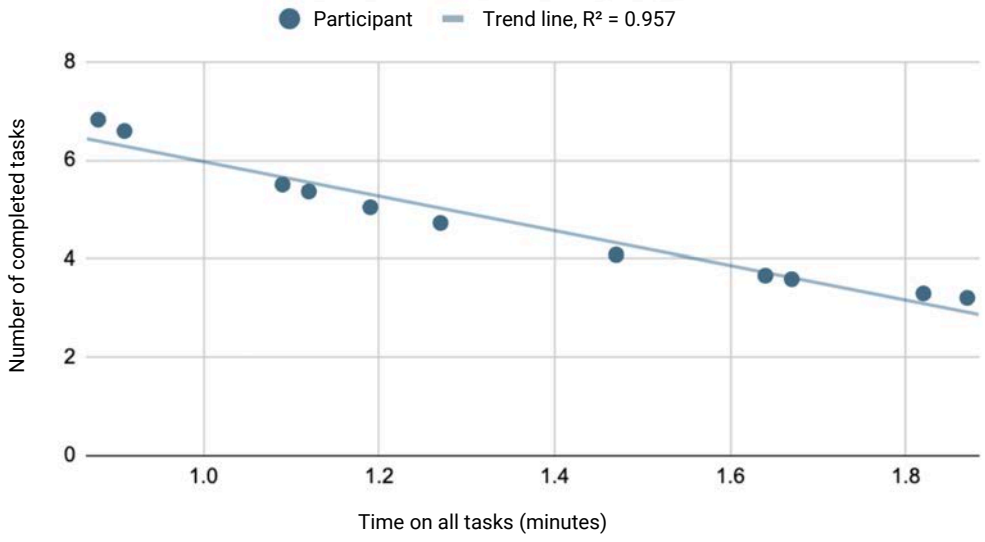

Figure 14: Task Efficiency in Relation to Completion Time

User Experience Upon reviewing the results of the PRC, it was found that the participants found the SC concept clearer than the SCs they had used previously, as the concept was described as 'Clear' by eight participants (67%). The positive PRCs used to describe the SC concept included: Accessible, Advanced, Calm, Convenient, Clear,

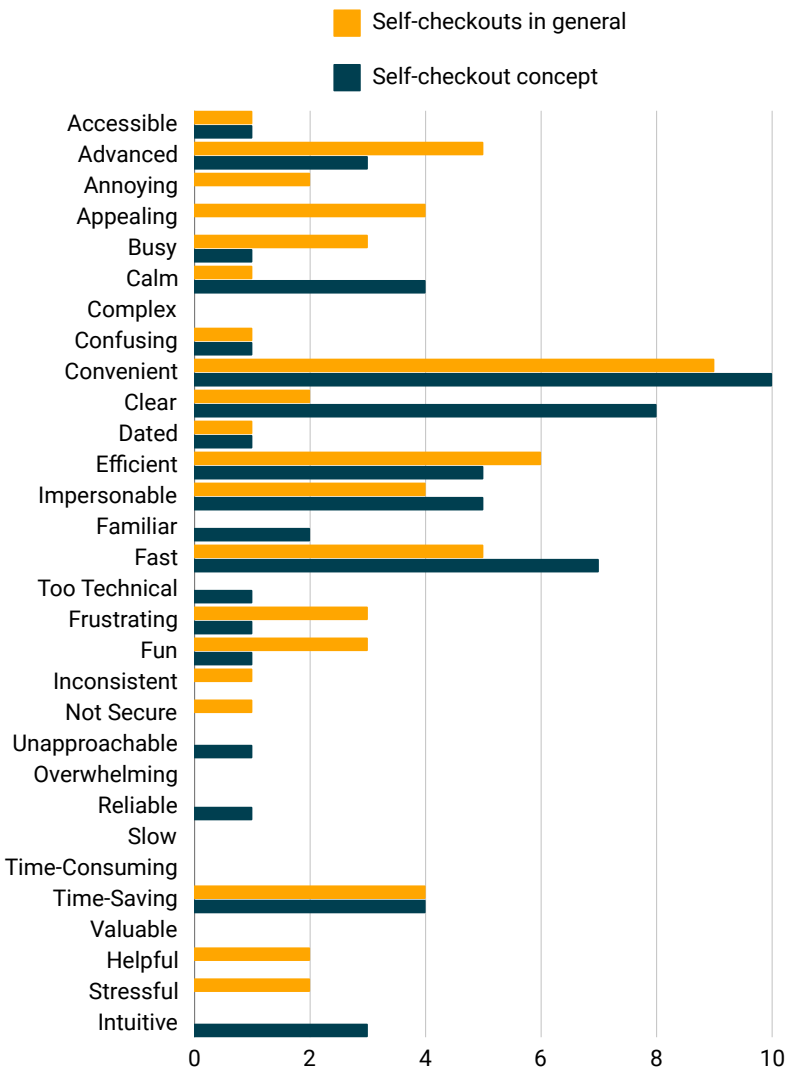

Figure 15: PRC Results: Number of participants selecting each term to describe their prior experiences with SCs and their experience of the concept prototype.

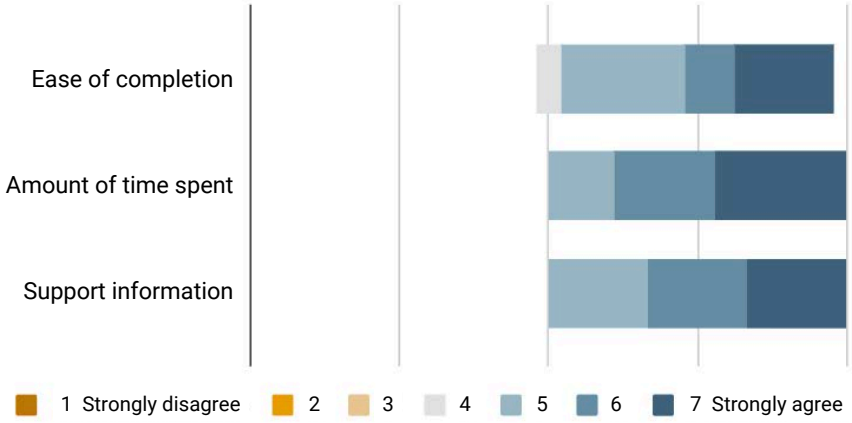

Figure 16: The ASQ Results from the user study.

Efficient, Familiar, Fast, Fun, Intuitive, Reliable, and Time-Saving. The negative Product Reaction Cards used to describe the SC were Busy, Confusing, Dated, Frustrating, Impersonable, Too Technical, and Unapproachable, as seen in Figure 15.

User Interface Design The interface got positive feedback for not demanding a loyalty card separately: *"It did not demand anything in the middle of the service"* (P5). The participants felt the SC concept was familiar, with two participants describing it using the Familiar reaction card and another participant commenting: *"Felt like a normal shopping experience"* (P8). Several participants during the user study asked whether they needed a receipt to exit the store and were positively surprised when they did not: *"I did not need a receipt, compared to real shopping, which is environmentally friendly"* (P4). One participant questioned there not being an option to reset the system manually: *"I was missing a 'next customer' button, so I could not 'zero' it, which would have made me feel like my information was more protected* (P9).

To simplify scanning multiple items of the same kind, a multiplying feature was included, in which users could scan one item and change the item amount by pressing arrows on the UI. However, no participant used this function. All participants but one scanned each of the multiple (three) items individually, while one participant scanned a singular item three times. Two participants commented they noticed the possibility of changing the number of items by pressing the arrows but felt like they might look untrustworthy if they did so: *"The social aspect of using the SC when there is an employee there, makes me feel like they might think I am not scanning everything or stealing something"* (P10).

Problem Discovery An unexpected issue that arose from the user study was the physical design of the SC and the area for packing items: *"SCs are not suitable for when you are buying a lot of items. Packing the items is annoying"* (P7) and *"There could have been some information on if I could pack the items directly into my bag"* (P3). A common sentiment about SCs was that they are only efficient when you have a small amount of items, possibly due to a lack of space. Another participant commented that they felt the experience of using SCs is *"Annoyingly cramped if there are too many SC tills next to each other, it feels like a paddock"* (P2).

5.3 Online Survey

5.3.1 Method

Based on the user study results, an online survey (n = 41) was created and circulated via Prolific participant recruitment service (Prolific, 2024) to gain further insight from a diverse group of participants. See Appendix C for the full tables of results.

Participants The online survey included 41 randomly selected participants from the United Kingdom and Ireland, aged 26 to 65 years old. One participant was 18-25 years old, 15 were 26-35 years old, 12 were 36-45 years old, eight were 46-55 years old, and six were 55-65 years old. 24 of the participants were women, 17 were men, and one identified as non-binary.

When shopping at a grocery store, 20 participants (49%) reported always using a self-checkout when it is an option, 15 participants (37%) reported using them often, four participants (9.8%) reported using them sometimes, and three (7.3%) reported using them rarely.

Survey Design The survey aimed to validate the UX themes that arose in the heuristic evaluation, thematic media analysis and user study, as well as identify further design preferences. The survey begins with background questions on the participants' age and gender, then moves on to identify how often the participants use self-checkouts (When shopping at a grocery store, how often do you use the self-checkout when it is an option?). As a lack of space was a general issue that emerged in previous parts of this study, the participants were asked what amount of purchases they found a self-checkout best for. Common issues that had arisen were compiled into a list, and participants were asked to select all that they agreed with (What makes you avoid using a self-checkout?), as well as how often they encountered issues with SC systems. Common improvement suggestions were compiled, and participants were asked to rank them by importance (Which improvements would make self-checkouts better for you?). The survey ended with an optional, open question for participants to give any further comments on their experience with SCs (Any other thoughts about your experiences

with self-checkouts?).

5.3.2 Results

Participants will be referred to as SP1, SP2 and so on from here on out for ease of reading. When asked about what amount of purchases the participants found self-checkouts best for, eight participants thought they were best for when you have 1-3 items, 23 participants (56%) thought they were best for when you have 4-8 items, and 10 participants (24%) thought they were best for when you have over 10 items.

When asked to select all the reasons they might avoid SCs, 20 participants (49%) reported never avoiding SCs. 17 participants (41%) selected not having enough space for their items at the SC as an issue. Five participants (12%) thought SCs are stressful. Five participants (12%) thought SCs are slow. Three participants (7%) selected the lack of social interaction as a deterrent for use. Two participants had privacy concerns. In the open section, two participants mentioned they avoid SCs if they want to pay in cash. The most common reasons for avoiding SCs are shown in Figure 18.

When asked about their most common issues with SC systems, 11 participants (27%) commented that they had issues with SCS not being able to recognise items in the bagging area, and four had issues with weighing items. 23 participants (56%) had issues scanning items, such as items not scanning, accidental scans, incorrect prices when scanning and issues scanning vouchers or loyalty cards. 12 participants (29%) had issues with age-restricted items, mainly with requiring confirmation from a staff member and having to wait for them. One participant disliked seeing the live camera feed of themselves using the SC. Another participant commented that sometimes the SC area can be difficult to locate in the store. The most common issues can be seen illustrated in Figure 17.

When asked to rank possible improvements to SCs based on personal preference, having faster staff assistance when needed was the most popular option with the average rank of 2,5 out of 8. The second and third most popular options were having more packing space at the SCs as well as having more space in general at the SC areas. The rankings are presented in Table 4.

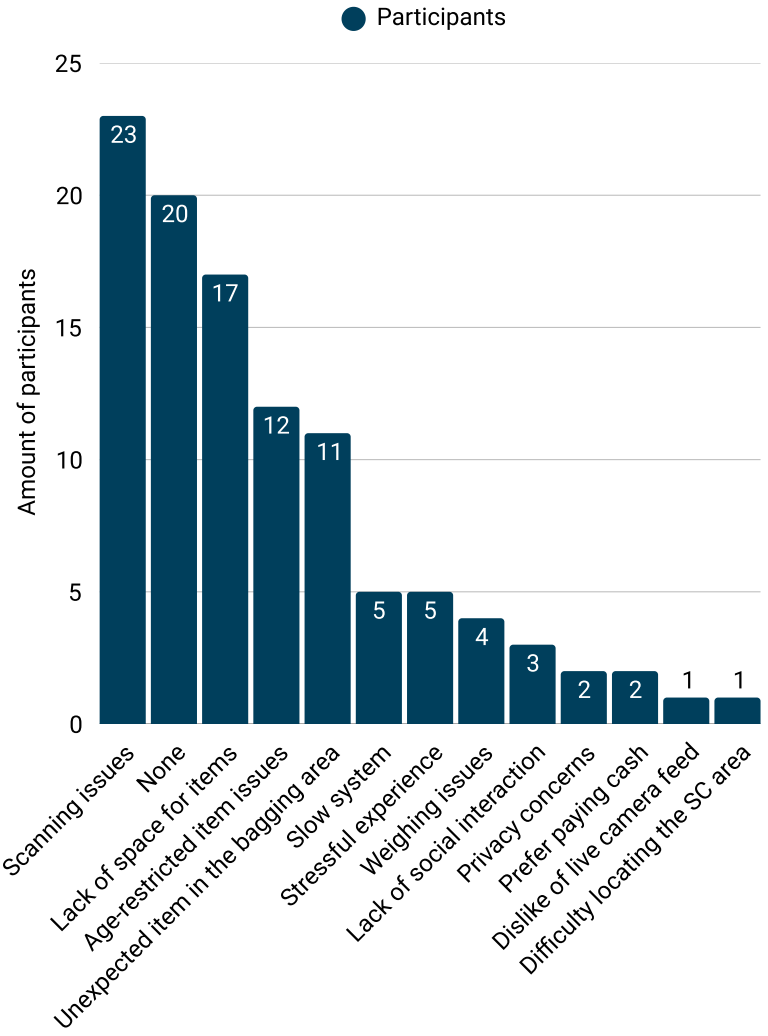

Figure 17: Online survey participants' issues with SCs

Seven participants commented that they generally enjoy using SCs, e.g. *"I think they are beneficial and when they work, they are very fast,"* (SP1) and *"I love the quickness of SCs,"* (SP10). One participant commented that SCs are easier to use for wheelchair users: *"I am disabled and use a wheelchair and find it easier to use a SC than a manned till as using a manned till means I have to lift my shopping on to the conveyor twice as high as when using a SC,"* (SP34). Another participant commented they feel less self-conscious of their purchases when using a SC: *"In some shops I have felt less self-conscious about trying new products for personal use, such as haircare or fragrances, as I know that I can avoid judgmental looks from shop assistants or other customers queuing more closely behind at a conveyor belt,"* (SP41).

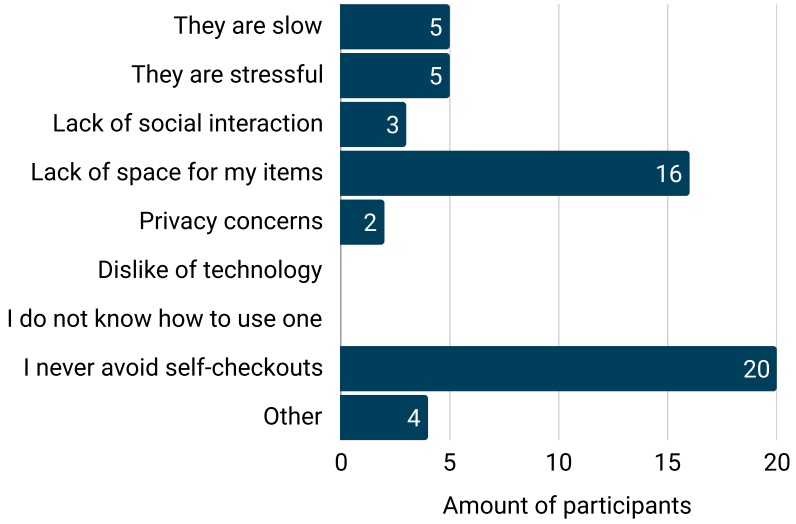

Figure 18: Online survey results for: What makes you avoid using a self-checkout?

Improvement Option	Average Rank
Faster staff assistance when needed	2.5
More packing space	3.0
More space overall in self-checkout areas	3.5
Easier barcode scanning	4.0
Simpler instructions	4.5
Not requesting a loyalty card	5.0
Added accessibility options (e.g., audio/visual feedback)	6.0
No need for printed receipts	7.0

Table 4: Average rank of desired self-checkout improvements from online survey participants. A lower average rank indicates a higher priority.

5.4 Prototype Iteration

Based on the study's results, a second iteration of the prototype UI was made (Figure 19). The UI follows the layout and style of the previous iteration, as it did well in terms of efficiency and clarity in the user study. To begin, the UI greets the user and guides them in scanning their objects. There are options for changing the language and a help button that gives additional information. Once the first item is scanned, the SC displays the scanned items and guides the user to scan the rest of their items. The user can call for assistance or quit the transaction at the top right of the screen. The item multiplying option was removed as it was not used. Once the user is ready to pay, they can press the 'Pay' button, after which the SC prompts the user to turn their attention to the payment terminal. The user can offer any loyalty cards at the payment terminal.

The user can return to the item scanning screen after pressing 'Pay,' if needed. Once the payment is finalised, the SC thanks the user and wishes them goodbye. A countdown alerts the user that the system will restart soon.

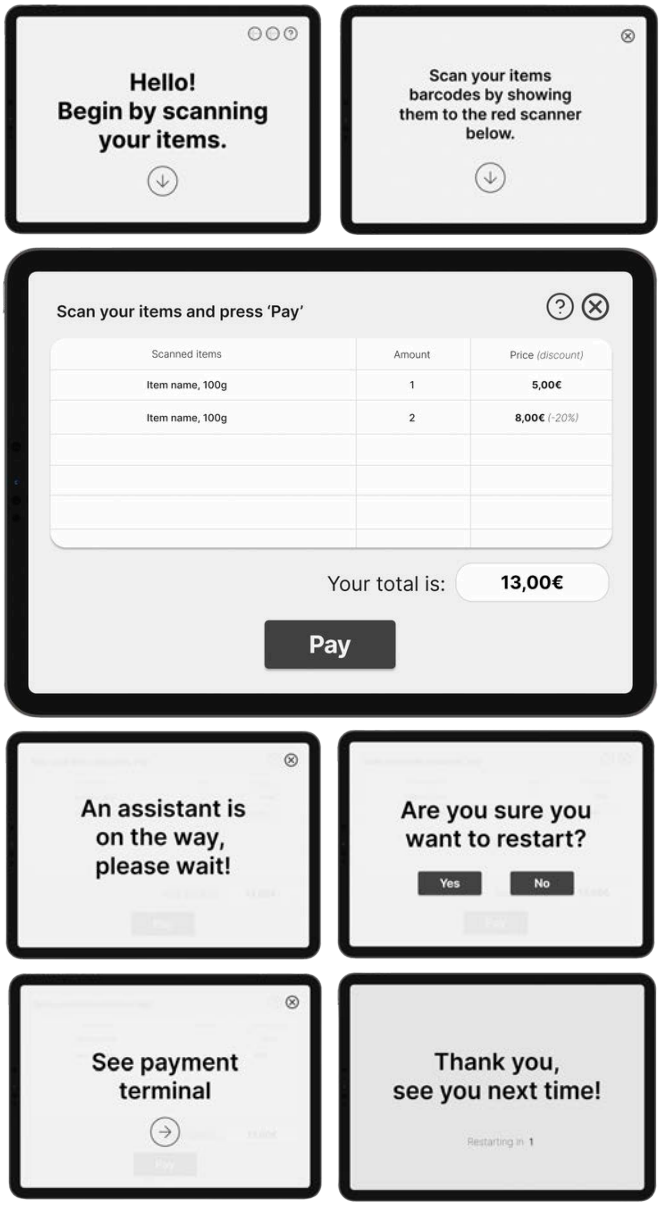

Figure 19: Second iteration of the prototype UI

6 DISCUSSION

In this section, I will interpret my results, compare them with results from related work, answer my research questions, and discuss the practical and theoretical implications and limitations of my thesis.

6.1 Interpretation of Results

The findings of my thesis show that while users generally find SC systems functional and convenient, their experience depends on more than just the interface design. Participants successfully completed tasks using the lo-fi prototype, appreciating its clarity and ease of use. However, the broader findings reveal that current SC systems often face challenges from inconsistent features, physical limitations, and a lack of accessibility. Participants reported feeling cramped in SC areas, encountering difficulties with scanning and weighing items, and requiring more staff assistance in stores. Furthermore, many users valued staff presence not only for practical support but also for social interaction.

These practical issues become more significant when coupled with emotional and social factors. Past negative experiences with technology can shape users' expectations and attitudes, and past frustrations with SC systems related to, for example, usability, could cause users not to want to use them again. This is in line with findings by Turner and Szymkowiak (2019), that users who struggled once are less likely to try again and might avoid SC systems, and with findings by Bitner et al. (2002), highlighting that errors cause frustration with users.

Some participants felt pressured by long queues or had privacy concerns. Implementing more technology could ease queues, but in some cases, it could increase privacy concerns. This is echoed by Bocanegra et al. (2020) and Aquilina and Saliba (2019), who found that using alternative technologies like RFID and robotics can reduce checkout time but bring privacy/security concerns.

These insights highlight the need for a more holistic approach to SC design. Designers should consider usability, spatial design, accessibility, and the emotional aspects of shopping. By addressing these issues, the user satisfaction and inclusivity of SCs could be improved, ultimately leading to greater adoption of self-service technologies in retail environments, findings in line with those by Schultz and Paetz (2025).

6.2 Answering Research Questions

The following questions guided this research. These questions aimed to uncover usability issues, understand users' perceptions of SC experiences, and identify user-centered improvements to enhance UX.

How do users perceive the overall experience of SC systems in grocery stores? I found that users' perceptions of SC systems in grocery stores vary based on their previous experiences and the usability of the SC system in use. Users generally find SCs efficient and convenient when they work, but even minor usability issues can affect their perception. Users with previous experience with usability issues when using SCs may be less likely to want to use them in the future.

Users also have issues with the social aspects of using SCs. In particular, senior users tend to prefer human interaction, highlighting the importance of grocery stores offering both self-checkout and staffed checkout options to cater to diverse user preferences, which aligns with research on the digital divide, e.g., Seifert and Charness (2022). Theft from SCs being more commonplace could make users more conscious about not looking like they could be stealing or about staff monitoring them in the store.

What design features or improvements would users like to see in SC systems? Based on my findings, users struggle most with system errors and insufficient space at SCS. As stores may employ SC systems with different features from one another, the usability issues of SC systems cannot be generalised. However, based on my results, some common features that users struggle with could be avoided. As users appreciate efficiency at SCS, anything that delays or interrupts their interaction should be avoided to improve the system's UX, such as errors when

scanning barcodes or with the weighing features, as well as requests for additional information, like loyalty cards or identification for age verification. Improving the technology of these systems to prevent these common errors would be a desirable improvement. Still, a more plausible improvement would be increasing the number of staff available to facilitate faster recovery from these errors. This could also benefit users who appreciate social interaction with employees and those concerned that self-service technology will decrease the number of jobs available. Additionally, it could be beneficial for companies that want to reduce theft.

Users find SCs and SC areas cramped, and require more space for their items at SCs. Modifying the physical design of these systems could positively impact UX. Additional space could also make these areas more accessible for users with mobility aids.

6.3 Theoretical And Practical Implications

This study contributes insights to UX design and human-computer interaction (HCI) by examining how spatial design, socio-technical interactions, and prior technological experiences influence SC usage in grocery stores. The study emphasises the need to view SC systems not just as tools but as socially situated interfaces. Participants report feeling watched or rushed, highlighting the significance of social presence and in future theoretical frameworks for self-service technologies. My findings assert that accessibility in UX must extend beyond visual and physical aspects to include users' emotional and social needs, particularly for those who are socially inclined or face accessibility challenges.

The findings present several actionable insights for enhancing the design and implementation of SC systems in grocery stores. Designers should closely examine the spatial layout of SC areas, as participants expressed discomfort due to cramped checkout areas, which impacts both UX and usability. By improving ergonomics and accessibility for individuals using mobility aids or those with visual or auditory impairments, designers can create a more inclusive shopping experience. Developers should aim for consistency in core interactions, as inconsistencies can make it difficult for users to know what to do. While custom features for different stores are often

necessary, maintaining standard functions can reduce users' frustration.

The UI of the tested prototype received positive feedback, indicating that clarity and simplicity are crucial for user satisfaction and task success. Designers should prioritise these aspects in the future. Regarding accessibility, this thesis highlights the importance of catering to a broader range of needs, like emotional and social needs. Some participants expressed a desire for more interaction with staff, whether for assistance or human contact. Therefore, store managers should consider assigning staff to SC areas not only to address technical issues or ID checks but also to provide a reassuring social presence, which can enhance the overall user experience and deter theft. Improved queue design or visual cues could help reduce the sense of surveillance and privacy concerns, and enhance the overall experience of SCs.

6.4 Limitations

This study has limitations, such as the small sample size of 12 participants in the user study and 41 participants in the online survey, making it difficult to generalise the findings for the broader user population. Also, using participants in the user study who are already used to SCs, makes it less likely for them to make errors compared to inexperienced users. Task success and error rates can be surface-level performance metrics that do not account for cognitive differences between participants or other reasons behind the results. Considering this and other accessible design approaches when planning could make for a more inclusive study.

The prototypes in this thesis are based on SC systems and grocery stores in Finland. However, their design does not consider cultural differences that might be seen in stores, users, and shopping customs of different areas and peoples, which could affect the usability, UX, and design of SC systems.

The study's controlled environment may also fail to reflect real-world contexts, including varying store layouts and UX during peak-time rushes. Future research could include larger samples and longitudinal studies to understand long-term user behaviour and experiences better.

7 CONCLUSION

This thesis investigated how users perceive SC systems in grocery stores and their desired design improvements. Through a multi-method approach, including heuristic evaluations, media analysis, prototyping, user testing and an online survey, I identified both technical and social challenges in current SC designs. User study participants valued efficiency and appreciated the clear, simple UI of the tested prototype. Generally, participants struggled with usability issues, cramped layouts, and limited accessibility. Emotional and social factors, such as the desire for human interaction and discomfort under surveillance, also significantly shaped their experiences.

Based on these insights, I aimed to highlight that enhancing both the user interface and the physical and social environment of SC areas can improve usability, inclusivity, and user satisfaction. Designers, developers, and store owners might value these findings to create future SC systems that are not only more functional but also more empathetic to users' diverse needs.

8 REFERENCES

Agresti, A., & Coull, B. A. (1998). Approximate is better than "exact" for interval estimation of binomial proportions. *The American Statistician*, *52*(2), 119–126. doi: 10.1080/00031305.1998.10480550

Aissaoui, N. (2022). The digital divide: a literature review and some directions for future research in light of covid-19. *Global Knowledge, Memory and Communication*, *71*(8/9), 686–708.

Albert, B., & Tullis, T. (2013). *Measuring the user experience: collecting, analyzing, and presenting usability metrics*. Newnes.

Anderson, E. W., Fornell, C., & Lehmann, D. R. (1994). Customer satisfaction, market share, and profitability: Findings from sweden. *Journal of marketing*, *58*(3), 53–66.

Aquilina, Y., & Saliba, M. A. (2019). An automated supermarket checkout system utilizing a scara robot: preliminary prototype development. *Procedia Manufacturing*, *38*, 1558–1565.

Benedek, J., & Miner, T. (2002, July 8-12). Measuring desirability: New methods for evaluating desirability in a usability lab setting. In *Usability professionals association 2002 conference.* Orlando, FL.

Bitner, M. J., Ostrom, A. L., & Meuter, M. L. (2002). Implementing successful self-service technologies. *Academy of management perspectives*, *16*(4), 96–108.

Bocanegra, C., Khojastepour, M. A., Arslan, M. Y., Chai, E., Rangarajan, S., & Chowdhury, K. R. (2020). Rfgo: a seamless self-checkout system for apparel stores using rfid. In *Proceedings of the 26th annual international conference on*

mobile computing and networking (pp. 1–14).

Borsci, S., Federici, S., Bacci, S., Gnaldi, M., & Bartolucci, F. (2015). Assessing user satisfaction in the era of user experience: Comparison of the sus, umux, and umux-lite as a function of product experience. *Intl. Journal of Human–Computer Interaction*, *31*, 484—495.

Bowman, R., Nadal, C., Morrissey, K., Thieme, A., & Doherty, G. (2023). Using thematic analysis in healthcare hci at chi: A scoping review. In *Proceedings of the 2023 chi conference on human factors in computing systems* (pp. 1–18).

Burmester, M., Hassenzahl, M., & Koller, F. (n.d.). *Attrakdiff: Questionnaire.* `https://www.attrakdiff.de/index-en.html`. (Retrieved: 29.10.2024)

Colley, A., Inget, H., Rantala, J., & Häkkilä, J. (2018). Investigating interaction with a ring form factor. In *Proceedings of the 20th international conference on human-computer interaction with mobile devices and services (mobilehci '18)* (pp. 1–8). ACM. doi: 10.1145/3229434.3229439

Dabholkar, P. A., Bobbitt, L. M., & Lee, E.-J. (2003). Understanding consumer motivation and behavior related to self-scanning in retailing: Implications for strategy and research on technology-based self-service. *International Journal of Service Industry Management*, *14*(1), 59–95.

Dahlbäck, N., Jönsson, A., & Ahrenberg, L. (1993). Wizard of oz studies: Why and how. *Knowledge-Based Systems*, *6*(4), 258–266. doi: 10.1016/0950-7051(93)90017-N

Dillon, A., & Watson, C. (1996). User analysis in hci—the historical lessons from individual differences research. *International journal of human-computer studies*, *45*(6), 619–637.

Hassenzahl, M. (2008). User experience (ux): Towards an experiential perspective on product quality. In *Proceedings of the 20th french-speaking conference on human-computer interaction* (pp. 11–15).

Hornbæk, K. (2006). Current practice in measuring usability: Challenges to usability studies and research. *International Journal of Human-Computer Studies*, *64*(2), 79–102. doi: 10.1016/j.ijhcs.2005.06.002

Jonkisz, A., Karniej, P., & Krasowska, D. (2022). The servqual method as an assessment tool of the quality of medical services in selected asian countries. *International journal of environmental research and public health*, *19*(13), 7831.

Kaikkonen, A., Kekäläinen, A., Cankar, M., Kallio, T., & Kankainen, A. (2005). Usability testing of mobile applications: A comparison between laboratory and field testing. *Journal of Usability Studies*, *1*(1), 4–16.

Kjeldskov, J., & Graham, C. (2003). A review of mobile hci research methods. In *International conference on mobile human-computer interaction* (pp. 317–335).

Kokkinou, A., & Cranage, D. A. (2013). Using self-service technology to reduce customer waiting times. *International Journal of Hospitality Management*, *33*, 435–445.

Kousi, S., & Naselli, G. (2022). Cashier-free supermarkets and consumer emotions. *Extending Boundaries*, 47.

Law, E. L.-C., Roto, V., Hassenzahl, M., Vermeeren, A. P., & Kort, J. (2009). Understanding, scoping and defining user experience: a survey approach. In *Proceedings of the sigchi conference on human factors in computing systems* (pp. 719–728).

Leichtmann, B., Nitsch, V., & Mara, M. (2022). Crisis ahead? why human-robot

interaction user studies may have replicability problems and directions for improvement. *Frontiers in Robotics and AI*, *9*, 838116.

Lewis, J. R. (1991). Psychometric evaluation of an after-scenario questionnaire for computer usability studies: the asq. *ACM Sigchi Bulletin*, *23*(1), 78–81.

Lewis, J. R. (2014). Usability: lessons learned... and yet to be learned. *International Journal of Human-Computer Interaction*, *30*(9), 663–684.

Lin, J.-S. C., & Hsieh, P.-L. (2011). Assessing the self-service technology encounters: development and validation of sstqual scale. *Journal of retailing*, *87*(2), 194–206.

Markum, R. B., Wolf, S., Claisse, C., & Hoefer, M. (2024). Mediating the sacred: Configuring a design space for religious and spiritual tangible interactive artifacts. In *Proceedings of the eighteenth international conference on tangible, embedded, and embodied interaction* (pp. 1–22).

Maulsby, D., Greenberg, S., & Mander, R. (1993). Prototyping an intelligent agent through wizard of oz. In *Proceedings of the interact'93 and chi'93 conference on human factors in computing systems* (pp. 277–284).

Merčun, T. (2014). Evaluation of information visualization techniques: Analysing user experience with reaction cards. In *Proceedings of the fifth workshop on beyond time and errors: Novel evaluation methods for visualization* (pp. 103–109).

Miettinen, S., Rontti, S., Kuure, E., & Lindström, A. (2012). Realizing design thinking through a service design process and an innovative prototyping laboratory: Introducing service innovation corner (sinco).

Mulder, I., de Poot, H., Verwij, C., Janssen, R., & Bijlsma, M. (2006). An information overload study: using design methods for understanding. In *Proceedings of the 18th australia conference on computer-human interaction: design: activities,*

artefacts and environments (pp. 245–252).

Nielsen, J. (1994, 11 15). 10 usability heuristics for user interface design. *Nielsen Norman Group*. Retrieved from https://www.nngroup.com/articles/ten-usability-heuristics/ (Original publication date: April 24, 1994)

Obermeier, G., Klingersberger, J., & Auinger, A. (2022). Factors influencing usage intentions towards a self-service kiosk with biometric authentication.

Orel, F. D., & Kara, A. (2014). Supermarket self-checkout service quality, customer satisfaction, and loyalty: Empirical evidence from an emerging market. *Journal of Retailing and Consumer services*, *21*(2), 118–129.

Paananen, S., Kiianmies, T., & Häkkilä, J. (2024). Crossing the virtuality border: Immersive narratives of local culture and histories with design students. In *Relate north: New genre arctic art education beyond borders* (pp. 136–155). InSEA Publications.

Parasuraman, A., Zeithaml, V. A., & Berry, L. L. (1988). Servqual: A multiple-item scale for measuring consumer perceptions of service quality. *1988*, *64*(1), 12–40.

Prolific. (2024). *Prolific.* https://www.prolific.com. (Accessed: 2024-10-29)

Saleh, F., & Ryan, C. (1991). Analysing service quality in the hospitality industry using the servqual model. *Service Industries Journal*, *11*(3), 324–345.

Schultz, C. D., & Paetz, F. (2025). The way out–customer benefits and self-service satisfaction in cashierless shopping systems. *Journal of Retailing and Consumer Services*, *85*, 104280.

Seifert, A., & Charness, N. (2022). Digital transformation of everyday lives of older swiss adults: use of and attitudes toward current and future digital services.

European journal of ageing, *19*(3), 729–739.

Smith, A. M. (1995). Measuring service quality: is servqual now redundant? *Journal of marketing management*, *11*(1-3), 257–276.

Surachartkumtonkun, J., Patterson, P. G., & McColl-Kennedy, J. R. (2013). Customer rage back-story: Linking needs-based cognitive appraisal to service failure type. *Journal of Retailing*, *89*(1), 72–87.

Thuring, M., & Mahlke, S. (2007). Usability, aesthetics and emotions in human–technology interaction. *International Journal of Psychology*, *42*(4), 253–264.

Turner, J. J., & Szymkowiak, A. (2019). An analysis into early customer experiences of self-service checkouts: Lessons for improved usability. *Engineering Management in Production and Services*, *11*(1), 36–50.

Udo, G. J., Bagchi, K. K., & Kirs, P. J. (2011). Using servqual to assess the quality of e-learning experience. *Computers in Human Behavior*, *27*(3), 1272–1283.

Van Iwaarden, J., Van der Wiele, T., Ball, L., & Millen, R. (2003). Applying servqual to web sites: An exploratory study. *International Journal of Quality & Reliability Management*, *20*(8), 919–935.

Warschauer, M. (2010). Digital divide. *Encyclopedia of library and information sciences*, *1*(1), 1551–1556.

Zimmerman, J., Forlizzi, J., & Evenson, S. (2007). Research through design as a method for interaction design research in hci. In *Proceedings of the sigchi conference on human factors in computing systems* (pp. 493–502).

9 APPENDICES

This section includes supplementary materials that support my findings. These include raw survey responses, forms, and supporting figures.

Article ID	Author / Affiliation	Title	Year	Country	Theme	Subtheme(s)	Excerpt
A1	Moreau, E. / BBC	Have supermarkets reached peak self-scan?	2025	United Kingdom	Usability	Accessability	Julie Yates has two adult sons who have autism and said self-checkouts allow them some independence. "They don't have to interact with anyone, they can be in and out and gone," she said. "They don't have to make eye contact or small talk."
A1	Moreau, E. / BBC	Have supermarkets reached peak self-scan?	2025	United Kingdom	Usability	Accessability	"As a deaf person, I can't hear the beep when I scan items so I'm always getting in a tangle with them as they don't always scan correctly," said Anna Kenyon from Manchester.
A1	Moreau, E. / BBC	Have supermarkets reached peak self-scan?	2025	United Kingdom	Usability	Technology	The dreaded "unexpected item in the bagging area" announcement.
A1	Moreau, E. / BBC	Have supermarkets reached peak self-scan?	2025	United Kingdom	Usability	Design	Some shoppers dislike it (SC), mainly when they have a full trolley.
A1	Moreau, E. / BBC	Have supermarkets reached peak self-scan?	2025	United Kingdom	User Experience	Efficiency	Shoppers told the BBC they're happy to skip the queues and the chit chat if it speeds up their shop.
A1	Moreau, E. / BBC	Have supermarkets reached peak self-scan?	2025	United Kingdom	User Experience	Social	Mental health benefits to speaking to someone when grocery shopping. "Especially if you're living on your own. Doesn't matter if it's about the weather or the news or whatever, it's just good to chat."
A1	Moreau, E. / BBC	Have supermarkets reached peak self-scan?	2025	United Kingdom	User Experience	Social	"My mum and I, we go to a [staffed] checkout," Ms Yates said. "It's a little social interaction, it can be a nice part of the day."
A1	Moreau, E. / BBC	Have supermarkets reached peak self-scan?	2025	United Kingdom	Economy	Shrinkage	She is particularly turned off by the cameras on some of these tills that capture live footage of the user. "You see an image of yourself moving about and I don't like it," the 62-year-old said. "I'd rather get in a queue."
A2	Meierhans, J. / BBC	Self-scan supermarket tills and the rows over their use.	2025	United Kingdom	Usability	Accessability	"I am severely sight impaired - registered blind - so, self service tills are a non-starter," Pennie Orger says. "My guide dog is clever, but not that clever."
A2	Meierhans, J. / BBC	Self-scan supermarket tills and the rows over their use.	2025	United Kingdom	Usability	Accessability	And John Stonier asks: "What about deaf shoppers? We cannot hear any instructions from self checkout tills. Why not use a screen to give us visual instructions?"
A2	Meierhans, J. / BBC	Self-scan supermarket tills and the rows over their use.	2025	United Kingdom	Usability	Design	"Self-service tills are brilliant, even better when you can use the portable scanner and checkout without unloading and reloading your trolley," he says with enthusiasm. "I wouldn't dream of going back to cash and all the faff at the checkout."
A2	Meierhans, J. / BBC	Self-scan supermarket tills and the rows over their use.	2025	United Kingdom	Usability	Technology	While Donna Marie tells us she is convinced she has too much static electricity in her body as self-scans never work properly for her. She would rather stand in line for the tills than go through the "torture" of self-checkout.
A2	Meierhans, J. / BBC	Self-scan supermarket tills and the rows over their use.	2025	United Kingdom	User Experience	Efficiency, Social	She argues that far from being effortless, her experience can be slow and confusing and she really misses a friendly chat with a cashier.
A2	Meierhans, J. / BBC	Self-scan supermarket tills and the rows over their use.	2025	United Kingdom	Economy	Jobs	The row over self-scan versus cashier bubbled to the surface this week, after 69-year-old Pat McCarthy started a petition calling for Tesco to "stop replacing people with machines", swiftly gaining more than 100,000 signature
A2	Meierhans, J. / BBC	Self-scan supermarket tills and the rows over their use.	2025	United Kingdom	Other		There are, however, other ways to shop, points out Mr Przedrzymirski, who switched to home delivery during the pandemic and now uses click and collect.
A3	Giangiulio, D. & Cheung, B. / NB	Major retailers are backtracking on self-checkout	2024	United States of America	Economy	Shrinkage	Some of the companies shifting gears on self-checkout have blamed theft for their moves.
A4	Higham, A. / Newsweek	The End of Self-Checkouts?	2024	United States of America	Economy	Shrinkage	"In particular, self-checkout causes a dramatic increase in partial shrink, where a shopper pays for some of their purchase, but not the full amount," he explained. "By eliminating partial shrink, checkout-free systems more than double bottom-line grocery profits, a win-win for retailers and shoppers."
A4	Higham, A. / Newsweek	The End of Self-Checkouts?	2024	United States of America	Economy	Jobs, Social	The survey, conducted between June 28 and 29 among 2,500 eligible voters in the U.S., also found that the main reason why people don't like self-checkout technology is because it takes away another person's job (62 percent). Some respondents also said they disliked self-checkouts because they prefer to speak to a person (40 percent), and because some machines don't take cash (27 percent).
A4	Higham, A. / Newsweek	The End of Self-Checkouts?	2024	United States of America	Other		Exclusive polling for Newsweek conducted by Redfield & Wilton Strategies has found that 43 percent of Americans supported the removal of self-checkouts from retail stores; 23 percent said they strongly support the technology's removal; and 20 percent replied they generally support such a move.
A5	Harris, S. / CBC News	More stores are ditching self-checkout amid theft and customer complaints	2024	United States of America	User Experience	Social	He says, rather than theft, he made the change because many of his customers are seniors who dislike using the machines. "The biggest complaint you have from everybody is, 'You don't pay me to work here,'" said Savage. "They would line up at my regular registers, and they would just prefer that service."
A5	Harris, S. / CBC News	More stores are ditching self-checkout amid theft and customer complaints	2024	United States of America	User Experience	Social	We believe there is truly no substitute for an employee presence.
A5	Harris, S. / CBC News	More stores are ditching self-checkout amid theft and customer complaints	2024	United States of America	Economy	Shrinkage	But in an interview with ABC's Good Morning America last week, U.S. Walmart's CEO admitted that the retailer removed the machines from locations with the highest rates of disappearing merchandise (known as "shrink" in the industry).
A5	Harris, S. / CBC News	More stores are ditching self-checkout amid theft and customer complaints	2024	United States of America	Economy	Shrinkage	"What they found was that actually they couldn't eliminate a lot of the cashiers, because they needed the cashiers there, in part, to deter shoplifting," said Andrews, an associate professor at Drew University in Madison, N.J.
A6	Karhu, O. / Yle	Einesleipiä katosi mystisesti hytiyltä – sitten kauppias keksi, miten varkaan sai nalkkiin	2024	Finland	Usability	Technology	Ahtoniemen mukaan valvonnan tulevaisuus on tekoälyssä.
A6	Karhu, O. / Yle	Einesleipiä katosi mystisesti hytiyltä – sitten kauppias keksi, miten varkaan sai nalkkiin	2024	Finland	Economy	Shrinkage	Aktiivinen asiakaspalvelu on Ahtoniemen mukaan paras tapa ehkäistä varkauksia.
A6	Karhu, O. / Yle	Einesleipiä katosi mystisesti hytiyltä – sitten kauppias keksi, miten varkaan sai nalkkiin	2024	Finland	Economy	Shrinkage	Kauppiaan mukaan itsepalvelukassat ovat lisänneet myymälävarkauksia. Näpistelyyn jaetaan jopa vinkkejä internetissä.
A6	Karhu, O. / Yle	Einesleipiä katosi mystisesti hytiyltä – sitten kauppias keksi, miten varkaan sai nalkkiin	2024	Finland	Economy	Shrinkage	Itsepalvelukassat ovat Ruissalon mukaan lisänneet varkauksia. Hän muistelee tilannetta, jossa asiakas toi itsepalvelukassalle kasan ruokaa ja piippaiti niitä normaalisti. – Hän piti halpaa suklaapatukkaa jokaisen tuotteen edessä. Onneksi myyjä huomasi, että koneeseen oli lyöty 10 patukkaa, vaikka ostokset olivat vaikka mitä.
A6	Karhu, O. / Yle	Einesleipiä katosi mystisesti hytiyltä – sitten kauppias keksi, miten varkaan sai nalkkiin	2024	Finland	Economy	Shrinkage	Syinä näpistelyn kasvuun ovat Ruissalon mukaan ihmisten talousvaikeudet ja ruoan hinnan nousu.– Näpistäjät myös tietävät, että seuraukset varkaudesta ovat nykyään olemattomat. Se on huolestuttava piirre, johon toivottavasti saadaan lainsäädännöllä muuto
A7	Lindroos, J. / Yle	Kyläkauppojen määrä romahti tuhansilla 1980-luvulta – itsepalvelukaupat herättävät toivoa paremmasta	2024	Finland	Other		Vesangan Kyläkaupan ensimmäinen vuosi on ollut niin myönteinen, että seuraava kauppa on tekeillä.
A8	Aho, E. / Yle	Ilmajoelle aukeaa yksi harvoista itsepalvelukaupoista pääkaupunkiseudun ulkopuolella – sisään pankkitunnuksilla, maksu sekunneissa	2022	Finland	Other		Ilmajoen Ahonkylään on elokuussa aukeamassa itsepalvelukauppa. Mini Smart -nimellä toimiva kauppa on Etelä-Pohjanmaan ensimmäinen elintarvikkeita myyvä itsepalvelukauppa. Idea sen perustamiseen syntyi kauppias Petri Jaakkolalle, kun kylälle kaivattiin lähikauppaa.
A9	Booth, R. / The Guardian	Shop closures and self-checkouts cost tens of thousands of women's jobs	2019	United Kingdom	Economy	Jobs	A surge in shop closures and the growth of automated retail are forcing tens of thousands of women out of work, according to a study of the economic pain caused by high street decline.
A10	Meyersohn, N. / CNN	Walmart, Costco and other companies rethink self-checkout	2023	United States of America	Usability	Technology, Efficiency	Customers at Booths also frequently misidentified which fruits and vegetables they were buying when prompted by self-checkout machines. Alcohol purchases also were not smooth transactions through self-checkout because employees had to verify customers' ages.
A10	Meyersohn, N. / CNN	Walmart, Costco and other companies rethink self-checkout	2023	United States of America	Usability	Technology, Accessability	Some products have multiple barcodes or barcodes that don't scan properly with self-checkout technology. Produce, including fruit and meat, typically needs to be weighed and manually entered into the system using a code. Customers may type in the wrong code by accident. Other times shoppers won't hear the "beep" confirming an item has been scanned properly.
A10	Meyersohn, N. / CNN	Walmart, Costco and other companies rethink self-checkout	2023	United States of America	Usability	Efficiency	"Our customers have told us this over time — that the self-scan machines that we've got in our stores ... can be slow, they can be unreliable (and) they're obviously impersonal," Booths managing director Nigel Murray told the BBC.
A10	Meyersohn, N. / CNN	Walmart, Costco and other companies rethink self-checkout	2023	United States of America	Usability	Errors	But additional anti-theft measures also lead to more frustrating "unexpected item in the bagging area" errors, requiring employees to intervene.
A10	Meyersohn, N. / CNN	Walmart, Costco and other companies rethink self-checkout	2023	United States of America	Economy	Shrinkage	But now, retailers are rethinking self-checkout. They have found that self-checkout leads to higher merchandise losses from customer errors and intentional shoplifting — known as "shrink" — than human cashiers ringing up customers.
A10	Meyersohn, N. / CNN	Walmart, Costco and other companies rethink self-checkout	2023	United States of America	Economy	Shrinkage	Other customers take advantage of the lax oversight at self-checkout aisles and have developed techniques for stealing. Common tactics include not scanning an item, swapping a cheaper item (bananas) for a more expensive one (steak), scanning counterfeit barcodes attached to their wrists or properly scanning everything and then walking out without paying. Stores have tried to limit losses by tightening self-checkout security features, such as adding weight sensors.
A11	Salovaara, M. / Yle	Maksoitko itsepalvelukassalla vahingossa ostoksesi kahdesti? Kysyimme kaupoilta, korvataanko virheet jälkikäteen	2023	Finland	Usability	Technology, Design	Yleen yhteyttä ottanut ihminen kertoo, että hän skannasi vahingossa yhden ostoksistaan kahdesti ja huomasi virheen vasta kotona. Mitä siinä tilanteessa pitää tehdä?
A12	Becker, S. / BBC	It hasn't delivered': The spectacular failure of self-checkout technology	2024	United Kingdom	Usability	Efficiency	"It's not that self-checkout technology is good or bad, per se... [but] if we try self-checkout and realise we're not benefitting from it, we might switch back to not using it," says Amit Kumar, an assistant professor of marketing and psychology at the University of Texas, who studies consumer behaviour and decision-making.
A12	Becker, S. / BBC	It hasn't delivered': The spectacular failure of self-checkout technology	2024	United Kingdom	User Experience	Frustration	It's a common sight at many retail stores: a queue of people, waiting to use a self-checkout kiosk, doing their best to remain patient as a lone store worker attends to multiple malfunctioning machines. The frustration mounts while a dozen darkened, roped-off and cashier-less tills sit in the background.
A12	Becker, S. / BBC	It hasn't delivered': The spectacular failure of self-checkout technology	2024	United Kingdom	Economy	Shrinkage	Some retailers cite theft as a motivator for ditching the unstaffed tills.
A12	Becker, S. / BBC	It hasn't delivered': The spectacular failure of self-checkout technology	2024	United Kingdom	Economy	Jobs	It simply doesn't lead to the cost savings businesses hoped for. Just as Dollar General appears poised to add more employees to its check-out areas, presumably increasing staffing costs.
A13	Harris, S. / CBC	Why several big-box stores have ditched their self-checkouts	2022	United States of America	Usability	Design	He said the main reason was to make way for a new system where all shoppers wait in the same line for the next cashier. "The flow is a lot better," he said. "Canadian Tires carry so many big products, whether it's snowblowers, gazebos, generators that don't really lend themselves to self-checkouts."
A13	Harris, S. / CBC	Why several big-box stores have ditched their self-checkouts	2022	United States of America	User Experience	Frustration	That friction includes technical hurdles, like when the machine freezes due to an "unexpected item in the bagging area." There's also growing customer anger over feeling forced to use self-checkout.
A13	Harris, S. / CBC	Why several big-box stores have ditched their self-checkouts	2022	United States of America	Economy	Shrinkage	"Theft is a big, big issue," said Gray with Vancouver-based DIG360 Consulting. "At the self-checkout area ... you don't have the eyes on you like you would with the cashier."
A13	Harris, S. / CBC	Why several big-box stores have ditched their self-checkouts	2022	United States of America	Economy	Jobs	I'm not comfortable using them and I don't think some of my customers are comfortable [either]," said Ouelette, who removed the machines in July and replaced them with cashiers. "I'd rather my customers see my cashiers and if there's any questions or concerns, at least there's somebody they can talk to."
A13	Harris, S. / CBC	Why several big-box stores have ditched their self-checkouts	2022	United States of America	Other		"We have lots of loose produce, lots of loose bakery items. It slows the whole thing down. It makes it really complicated," he said.
A14	Davis, M., Shepard, D. & Della Costa, C. / LendingTree	Self-checkout users think it makes stealing easier	2024	United States of America	Economy	Shrinkage	According to the latest LendingTree survey of 2,000 U.S. consumers, 15% of self-checkout users have purposely stolen an item — and 44% of self-checkout thieves plan to do it again.
A15	Willeford, J. / The Sun	Sam's Club eliminates checkout option as CEO praises 'bold' move to make customers 'exit faster'	2024	United States of America	Usability	Technology	The Sam's Club location could do this in part because of an AI tech update that automatically verifies receipts when shoppers exit.
A16	Kaakinen, E. & Kuikka, P. / Yle	Itsepalvelukassat yleistyvät eikä niistä oikeastaan kenelläkään ole pahaa sanottavaa – kaupan työntekijätkin kiittävät, kun rankkaan kassatyöhön tulee vaihtelua	2021	Finland	Usability	Technology	Uusiakin itsepalvelutapoja kehitetään. Esimerkiksi Prisma- ja S-market ketjuissa on vuoden verran kokeiltu palvelumallia, jossa ostokset skannataan käsiskannerilla ja pakataan omiin ostoskasseihin jo myymälää kierrettäessä.
A16	Kaakinen, E. & Kuikka, P. / Yle	Itsepalvelukassat yleistyvät eikä niistä oikeastaan kenelläkään ole pahaa sanottavaa – kaupan työntekijätkin kiittävät, kun rankkaan kassatyöhön tulee vaihtelua	2021	Finland	Usability	Efficiency	Kaupan näkökulmasta katsottuna itsepalvelukassat tasaavat sopivasti ruuhkahuippuja.
A16	Kaakinen, E. & Kuikka, P. / Yle	Itsepalvelukassat yleistyvät eikä niistä oikeastaan kenelläkään ole pahaa sanottavaa – kaupan työntekijätkin kiittävät, kun rankkaan kassatyöhön tulee vaihtelua	2021	Finland	Usability	Design	– Jos olen viikko-ostoksilla, pitää mennä toiselle kassalle, koska tässä itsepalvelukassalla ei ole laskutilaa niin isoille ostoksille.
A16	Kaakinen, E. & Kuikka, P. / Yle	Itsepalvelukassat yleistyvät eikä niistä oikeastaan kenelläkään ole pahaa sanottavaa – kaupan työntekijätkin kiittävät, kun rankkaan kassatyöhön tulee vaihtelua	2021	Finland	Economy	Jobs	– Sellaista palautetta ei ole tullut, että ihmiset olisivat itsepalvelukassojen takia töitänsä menettäneet, toteaa PAMin työympäristöasiantuntija Erika Kähärä.
A16	Kaakinen, E. & Kuikka, P. / Yle	Itsepalvelukassat yleistyvät eikä niistä oikeastaan kenelläkään ole pahaa sanottavaa – kaupan työntekijätkin kiittävät, kun rankkaan kassatyöhön tulee vaihtelua	2021	Finland	Economy	Jobs	– Kassatyö aiheuttaa työntekijöille tuki- ja liikuntaelinvaivoja. Se on raskaimpia töitä mitä kaupassa on. Myös seisominen itsepalvelukassalla voi kuormittaa. Kähärä näkisikin mielellään, että työntekijöillä olisi mahdollisuus pikakassavuoroissakin välillä istua. Hänestä on tärkeää, että työtä itsepalvelukassallakaan ei tehtäisi yhtäjaksoisesti kovin pitkään.
A17	MTV Uutiset	Itsepalvelukassa nopea reitti pikkuostosten tekijälle	2017	Finland	Usability	Efficiency	– Asiakkaat ovat toivoneet mahdollisuutta kassatapahtuman hoitamiseen itsepalveluna, jolloin erityisesti pienten ostosten teko on nopeaa ja sujuvaa myös suosituimpien ostostuntien aikana, kertoo S-ryhmän vähittäiskaupan myymälätoiminnosta vastaava johtaja Sanna Timola.
A17	MTV Uutiset	Itsepalvelukassa nopea reitti pikkuostosten tekijälle	2017	Finland	Usability	Efficiency	– Monet ajattelevat, että itsepalvelukassa on kuin pikakassa. Jos on pienet ostokset, sitä kautta on helppoa mennä ulos, vastaa Keskon palvelujohtaja Teemu Naumanen.
A17	MTV Uutiset	Itsepalvelukassa nopea reitti pikkuostosten tekijälle	2017	Finland	Usability	Design	– Jos ostoskärry on täynnä ostoksia, niin sitten on helpompi asioida perinteisellä kassalla, hän kertoo.
A17	MTV Uutiset	Itsepalvelukassa nopea reitti pikkuostosten tekijälle	2017	Finland	Economy	Jobs	Palvelualojen ammattiliitto PAM kertoo, ettei itsepalvelukassojen yleistymisessä ole ollut suurempia ongelmia. PAM on kysellyt asiaa luottamusmiehiltään.
A18	Receptum	Näin sijoittelet itsepalvelukassan apteekissa – kassajonot katosivat Kaaren apteekissa itsepalvelukassojen myötä	2024	Finland	Usability	Design, Efficiency	Apteekin kassapisteiden suunnittelu on hyvin suuresti kalustusasia. Itsepalvelukassa kannattaa kyttiltää ja sen lisäksi kassapisteen laitteiston sijoittelu kannattaa miettiä apteekin kiireisten tuntien mukaan: mitä asiakas näkee, kun kassajonossa onkin useampi asiakas?
A18	Receptum	Näin sijoittelet itsepalvelukassan apteekissa – kassajonot katosivat Kaaren apteekissa itsepalvelukassojen myötä	2024	Finland	Usability	Design	Hybridikassa on pelkkänä laitteena hyvinkin kompaktin kokoinen. Jotta sen käyttö on luontevaa, se täytyy sijoittaa oikealle korkeudelle, mieluiten 70 – 80 senttimetriä korkealle tiskitasolle.
A19	Kymäläinen, S. / Yle	Näin karjalanpiirakka mahdollisti rikoksen ruokakaupassa – kamerat auttoivat tapauksen ratkaisemisessa	2024	Finland	Economy	Shrinkage	Itsepalvelukassojen yleistyminen on johtanut siihen, että kärsäjoikeuksissa jaetaan myymälävarkaille tuomioita lievistä petoksista.
A20	Tuominen, P. / MTV Uutiset	Tomi poisti kaupastaan itsepalvelukassat, kun karut faktat vaikenivat	2024	Finland	Usability	Efficiency	Kauppiaan mukaan itsepalvelukassat helpottaisivat ihmisten arkea.
A20	Tuominen, P. / MTV Uutiset	Tomi poisti kaupastaan itsepalvelukassat, kun karut faktat vaikenivat	2024	Finland	Economy	Shrinkage	mutta ne perustuvat rehellisyyteen.
A21	Lidl Suomi / STT Info	Lidl investoi isosti myymälöihin – pikakassat lähes kaikkiin Lidleihin kautta Suomen	2024	Finland	Usability	Efficiency	– Asiakkaat ovat toivoneet kovasti pikakassoja omaan lähimyymäläänsä, joten uudistus tulee varmasti olemaan mieluisa. Monet asiakkaista ovat tänä päivänä tottuneet käyttämään pikakassoja, ja ostosten skannailu sujuu ketterästi.
A21	Lidl Suomi / STT Info	Lidl investoi isosti myymälöihin – pikakassat lähes kaikkiin Lidleihin kautta Suomen	2024	Finland	Usability	Efficiency, Design	Pikakassat palvelevat erityisesti niitä asiakkaita, joilla on vähemmän ostoksia, mutta niiden kautta onnistuu hyvin piipata suuremmatkin viikko-ostokset. Pikakassat tuovat monen myymälän kassa-alueelle väljyyttä, joten siinäkin mielessä myymälässä asiointi helpottuu, kertoo Lidl Suomen myynnin ja tavaranhallinnan johtaja Akseli Mäkisalo.
A21	Lidl Suomi / STT Info	Lidl investoi isosti myymälöihin – pikakassat lähes kaikkiin Lidleihin kautta Suomen	2024	Finland	Other		Pikakassalla voi maksaa myös ale-laputetut tuotteet ja palauttaa pullopanttikuitin. Sen sijaan alkoholia tai alkoholittomia oluita, siidereitä ja viinejä pikakassalla ei voi maksaa. Lidl Plus -kortin skannaaminen onnistuu pikakassalla yhtä helposti kuin perinteiselläkin kassalla. Myymälähenkilökunta myös auttaa ja valvoo pikakassoilla.
A22	Cruz Lima, J. / The Sun	Another major supermarket makes big change to self-checkouts – shoppers will be divided	2024	United Kingdom	Usability	Efficiency	For some, the convenience of larger self-checkouts is undeniable. Customers who are comfortable with scanning and packing their own groceries may find the process faster and more efficient, especially if it eliminates the need to wait in line at a staffed checkout.

Consent form

Welcome to participate in an user study! The research investigates the user experience of self-checkout systems. The research in conducted by Jemina Colley and used for her Master's thesis. (contact: jemina.colley@ulapland.fi).

By signing this form,

I understand the nature of this study, and I agree to participate.
I understood that I can withdraw from this study at any time.
I allow the study to be recorded (audio, video and photos) for research purposes. All materials will be anonymised.

Participant _____ Date _____

Researcher _____ Date _____

A. Käyttäjätutkimus / *User Study*

Itsepalvelukassajärjestelmien käyttäjäkokemus / User experience of self-checkout systems, Jemina Colley
Osallistujanumero / *Participant number:*____

Päivämäärä / *Date:*_____

Ikä / *Age:*

- ☐ *<18*
- ☐ *18-25*
- ☐ *26-35*
- ☐ *36-45*
- ☐ *46-55*
- ☐ *55-65*
- ☐ *66+*

Sukupuoli / *Gender:*

- ☐ Nainen / *Female*
- ☐ Mies / *Male*
- ☐ Joku muu / *Other*
- ☐ En halua vastata / *I'd rather not answer*

Ammatti / *Occupation:*

_____

Kuinka usein arvioisit käyväsi ruokakaupassa ostoksilla? / *How often do you shop at a grocery store on average?*

- ☐ Kerran kuussa tai vähemmän*/ Once a month or less*
- ☐ 1-3 kertaa viikossa / *2-3 times a week*
- ☐ 4-6 kertaa viikossa / *4-6 times a day*
- ☐ Melkein joka päivä / *Almost everyday*

Käydessäsi ruokakaupassa, kuinka usein käytät itsepalvelukassaa sen ollessa vaihtoehto? / *When shopping at a grocery store, how often do you use the self-checkout when it is an option?*

- ☐ Kerran kuussa tai vähemmän*/ Once a month or less*
- ☐ 1-3 kertaa viikossa / *2-3 times a week*
- ☐ 4-6 kertaa viikossa / *4-6 times a day*
- ☐ Melkein joka päivä / *Almost everyday*

Esteetön / Accessible	Vanha / Dated	Luotaantyöntävä / Unapproachable
Edistynyt / Advanced	Tehokas / Efficient	Musertava / Overwhelming
Ärsyttävä / Annoying	Persoonaton / Impersonable	Luotettava / Reliable
Houkutteleva / Appealing	Tuttu / Familiar	Hidas / Slow
Kiireinen / Busy	Nopea / Fast	Aikaa vievä / Time-Consuming
Rauhallinen / Calm	Liian tekninen / Too Technical	Aikaa säästävä / Time-Saving
Selkeä / Clear	Turhauttava / Frustrating	Arvokas / Valuable
Monimutkainen / Complex	Hauska / Fun	Avulias / Helpful
Hämmentävä / Confusing	Epäjohdonmukainen / Inconsistent	Stressaava / Stressful
Kätevä / Convenient	Turvaton / Not Secure	Intuitiivinen / Intuitive

Kuvaile viidellä taulukon sanalla kokemustasi tämän itsepalvelukassajärjestelmän kanssa. / *Describe your experience with this self-checkout system using the given words.*

*1.*_____
*2.*_____
*3.*_____
*4.*_____
*5.*_____

Mikä on positiivista itsepalvelukassoissa? / *What is positive about self-checkouts?*

_____
_____
_____

Mikä on negatiivista itsepalvelukassoissa? / *What was negative about self-checkouts?*

_____
_____
_____

Onko sinulla muuta kommentoitavaa itsepalvelukassoista? / *Do you have any other comments about self-checkouts?*

_____
_____
_____
_____
_____

B. Käyttäjätutkimus / *User Study*

Itsepalvelukassajärjestelmien käyttäjäkokemus / User experience of self-checkout systems, Jemina Colley
Osallistujanumero / *Participant number:____*

Olen tyytyväinen tämän skenaarion tehtävien suorittamisen helppouteen. / *I am satisfied with the ease of completing the tasks in this scenario.*

Täysin eri mieltä / Strongly disagree	***1***	***2***	***3***	***4***	***5***	***6***	***7***	Täysin samaa mieltä / Strongly agree

Oliko joku osuus skenaarion tehtävistä erityisen helppo tai vaikea suorittaa? / *Was some part of the tasks given in this scenario especially easy or difficult to complete?*

_____
_____
_____

Olen tyytyväinen siihen, kuinka paljon aikaa tehtävien suorittamiseen kului tässä skenaariossa. / *I am satisfied with the amount of time it took to complete the tasks in this scenario.*

Täysin eri mieltä / Strongly disagree	***1***	***2***	***3***	***4***	***5***	***6***	***7***	Täysin samaa mieltä / Strongly agree

Kuluiko johonkin osuuteen skenaarion tehtävistä erityisen paljon tai vähän aikaa? / *Did some part of the tasks given in this scenario take a especially little amount or a lot of time?*

_____
_____
_____

Olen tyytyväinen tukitietoihin mitä sain tehtävän suorittamisen aikana. / *I am satisfied with the support information when completing the tasks..*

Täysin eri mieltä / Strongly disagree	***1***	***2***	***3***	***4***	***5***	***6***	***7***	Täysin samaa mieltä / Strongly agree

Oliko joku tukitieto erityisen hyödyllinen tai jäitkö kaipaamaan jotain? / *Was some of the support information especially useful or was something missing?*

_____
_____
_____

Esteetön / Accessible	Vanha / Dated	Luotaantyöntävä / Unapproachable
Edistynyt / Advanced	Tehokas / Efficient	Musertava / Overwhelming
Ärsyttävä / Annoying	Persoonaton / Impersonable	Luotettava / Reliable
Houkutteleva / Appealing	Tuttu / Familiar	Hidas / Slow
Kiireinen / Busy	Nopea / Fast	Aikaa vievä / Time-Consuming
Rauhallinen / Calm	Liian tekninen / Too Technical	Aikaa säästävä / Time-Saving
Selkeä / Clear	Turhauttava / Frustrating	Arvokas / Valuable
Monimutkainen / Complex	Hauska / Fun	Avulias / Helpful
Hämmentävä / Confusing	Epäjohdonmukainen / Inconsistent	Stressaava / Stressful
Kätevä / Convenient	Turvaton / Not Secure	Intuitiivinen / Intuitive

Kuvaile viidellä ylläolevalla sanalla tätä itsepalvelukassakokemustasi. / *Describe your experience of this self-checkout using the given words above.*

*1.*_____
*2.*_____
*3.*_____
*4.*_____
*5.*_____

Mikä oli positiivista tässä itsepalvelukokemussa? / *What was positive about this self-checkout experience?*

_____
_____
_____

Mikä oli negatiivista tässä itsepalvelukokemussa? / *What was negative about this self-checkout experience?*

_____
_____
_____

Onko sinulla muuta kommentoitavaa tästä itsepalvelukassakokemuksesta? / Do you have any other comments about this self-checkout experience?

_____
_____
_____
_____
_____
_____

Kiitos! / *Thank you!*

Date	Participant number	Age	Gender	Occupation	How often do you shop at a grocery store on average?	When shopping at a grocery store, how often do you use the self-checkout when it is an option?	Describe your experience of self-checkouts in grocery stores using the given words above.	What is positive about self-checkouts?	What is negative about self-checkouts?	Do you have any other comments about self-checkouts?
7.3.2024	1 (pilot)	26-35	Woman	Researcher	4-6 times a week	Once a month or less	Stressful, Annoying, Inconsistent, Advanced, Impersonable	If I have to buy something, I can pay quickly and leave the shop. Usually I don't have to speak to anyone.	If I have a lot of shopping, I'm too lazy to scan each item and pile them onto the checkout, using a conveyor belt is more useful. I can trust that the cashier does the job right, and there aren't as many opportunities for mistakes as when using a self-checkout.	They always yell, eg. about using a loyalty card. I like them when I can use them as a 'quick checkout' when I have eg. less than a basket-full of items. IKEA's self-checkouts annoyed me, because there was no option to use a checkout with a cashier, instead you had to do it yourself. I don't like forced self-service culture, eg. get the meal yourself and through away the trash yourself.
26.4.2024	2	26-35	Woman	University student	1-3 times a week	1-3 times a week	Convenient, Efficient, Impersonable, Frustrating, Time-Saving	Usually I can get to the self-checkout quickly and it is convenient if I only have a few items.	You can not buy alcohol, accidental scans require employee help, the volume is super loud. Annoyingly cramped if there are too many self-checkout tills next to each other, feels like a paddock.	It is okay. It is nice they exist. Usually I will still however use the regular checkouts.
26.4.2024	3	18-25	Woman	University student	1-3 times a week	1-3 times a week	Convenient, Efficient, Fun, Appealing, Advanced	No need for human contact, it is not as busy and it is fast.	When encountering an issue, like discounted items or age-restricted items, it is slower.	Overall it is good and convenient.
26.4.2024	4	36-45	Woman	Postdoctoral researcher	1-3 times a week	Almost every day	Efficient, Fast, Helpful, Accessible, Convenient	Do not need to wait when there is a lot of people.	Usually when there is a discount after 7pm, I can not get the discount when using the self-checkout (K-Kauppa).	I want to get the 'after 7pm' discount for items.
26.4.2024	5	36-45	Woman	Project manager	4-6 times a week	Once a month or less	Annoying, Frustrating, Impersonable, Busy, Dated	If I only have one item in my shopping basket it is faster than queueing for a regular checkout.	There is a red light everytime I try and use the loyalty card (K-Kauppa). If I have a lot of items there is not enough space and the next customers are anxiously waiting for their turn.	On one hand it is a good concept and works for example in Ikea, but in a local grocery store it always demands the loyalty card and this ends up taking more time than the regular checkout.
26.4.2024	6	26-35	Woman	Project manager	Once a month or less	Once a month or less	Busy, Confusing, Frustrating, Time-Saving, Stressful	If I only have a few items and the regular checkouts have long queues they can help me get out of the shop faster. I do not need to encounter an employee.	Sometimes there are issues or it lags and does not work as intended. Sometimes I press the wrong button. They call over the employee automatically even if it is not necessary.	I would like it if you could also pay by cash and not just card. They could be developed to be more convenient, for example when buying a larger amount of items. The area to place your shopping bag could be better. They should have clearer instructions for the user.
26.4.2024	7	26-35	Man	Industrial designer	1-3 times a week	Once a month or less	Fast, Time-Saving, Convenient, Efficient, Appealing	If I do not have a lot of items it is fast and easy. If the regular checkouts have long queues, I always wonder whether the self-checkout would be a faster option.	They are not suitable for when you are buying a lot of items. Packing the items is annoying.	-
26.4.2024	8	<18	Woman	Middle school student	1-3 times a week	Once a month or less	Calm, Clear, Convenient, Fun, Appealing	Self-checkouts are easy and fast.	The volume.	No.
26.4.2024	9	26-35	Woman	Research assistant	4-6 times a week	1-3 times a week	Convenient, Impersonable, Not Secure, Appealing, Advanced	When I am in a hurry the self-checkouts are faster than queueing frustratingly for the regular checkouts. No awkward interaction (with an employee) when buying hygiene products.	The UI in Minimani looks like a back-end service. The self-checkouts in Sale speak aloud in the language you pick, which makes me stand out as I speak a minority language and in some areas of Finland that could be distressing. Also, it is annoying that I can not, for example, scan my driving license to buy energy drinks, but instead I need to call an empoyee over.	1. The appearance should serve the customer, not the shop. 2. It is not always clear where to place the shopping basket and where to pack the items, for example does it matter on which side I do what. 3. Often the shopping basket needs to be returned to the beginning of the checkout area, which is annoying.
26.4.2024	10	26-35	Man	Researcher	4-6 times a week	4-6 times a week	Efficient, Convenient, Fast, Advanced, Frustrating	If I do not have a lot of items it is faster to use the self-checkout.	If I have items with a discount tag or alcohol the self-checkout is more of an ordeal, as I need to get the attention of a employee.	I would have comments about labor rights and about the relationship between technology and humans, but overall the experience is good.
26.4.2024	11	26-35	Woman	Researcher	4-6 times a week	1-3 times a week	Fast, Time-Saving, Convenient, Clear, Helpful	The self-checkout saves me time and is clear. There are now often employees to help me at the self-checkout, if I encounter an issue.	There is less space for packing the items and the next customer might try and push to come use my self-checkout while I am still packing my items.	Packing the items could be more efficient, otherwise it is a working concept. As I am aware, you can also not buy alcohol or tobacco items from the self-checkouts.
26.4.2024	12	26-35	Man	Research assistant	1-3 times a week	Once a month or less	Efficient, Convenient, Advanced, Busy, Fast	I can get through the cash register faster during rush hours.	I wonder if the employees trust that I have scanned all my items. Getting discounts is a real ordeal. I can not buy alcohol products and end up having to awkwardly cancel the transaction.	No.

Participant number	I am satisfied with the ease of completing the tasks in this scenario	Was some part of the tasks given in this scenario especially easy or difficult to complete?	I am satisfied with the amount of time it took to complete the tasks in this scenario?	Did some part of the tasks given in this scenario take an especially little amount or a lot of time?	I am satisfied with the support information given when completing the tasks.	Was some of the support information especially useful or was something missing?	Describe your experience of this self-checkout using the given words above.	What was positive about this self-checkout experience?	What was negative about this self-checkout experience?	Do you have any other comments about this self-checkout experience?
1 (pilot)	4	It would have been good to have been given the payment card beforehand. It was difficult when the big screen didn't tell you that the payment had gone through. The scanning and using the payment card was easy.	5	Quite an adequate amount of time. I would have liked instructions on how I can leave.	5	When can I leave, can I pack my shopping directly into my bag, and did I already purchase the bag.	Convenient, Calm, Impersonable, Time-Saving, Intuitive	The clear user-interface.	The surrounding tasks, like when can I leave. The benches in front of the screen disturbed me.	On one hand it was good that there wasn't any audio useless audio instructions, but on the other hand it could be more accessible with audio feedback.
2	6	No.	6	No.	6	No.	Clear, Confusing, Convenient, Efficient, Intuitive	I did not have any mis-scans.	It was difficult to know where it was scanning from.	It went nicely.
3	7	Paying was more difficult than the other tasks.	7	There was no difference between different sections.	6	The 'payment terminal' would have been good to be visible all the time.	Advanced, Convenient, Efficient, Calm, Clear	It was a clear and easy user interface.	The location of the payment terminal confused me.	There could have been some information on if I could pack the items directly into my bag.
4	7	All parts were easy.	7		6	I did not know I was going to get a discount.	Advanced, Efficient, Fast, Convenient, Time-Saving	I did not need receipt, compared to real shopping, which is environmentally friendly.	None.	No.
5	7	The discount made me wonder at first, but in the end I took a guess at how it works and just tried it out.	7	Scanning the items was easy and clear, the audio feedback added to making it understandable. Fast and clear in my opinion.	5	Clear instructions and the information on the screen was enough. For the discount it could have been visible immediately after scanning one juice container, after which I could have still picked the 3-for-1 option.	Fast, Clear, Impersonable, Familiar, Calm	It did not work how I expected it to work. It did not demand anything in the middle of the service.	The discount confused me to begin with, mutta also that worked how I expected it to in the end.	The atmosphere was good, and the soundscape and the experience felt like a shop's would. The lack of other customers and the stress that comes from them was missing, which was positive compared to the real experience.
6	5	It was intuitive to beep the items at the red light and it made a beep sound to signal it and you could check the items from the screen. It was a bit awkward to do while holding the bag, I could have been instructed to place it onto the packing surface before scanning and buying the items, so I could have packed them straight into it.	7	It was efficient.	5	Nice and simple, there were not anything unessecary distractions, but there could have been some introduction, like "put your bag over there and beep your items here".	Clear, Fast, Impersonable, Intuitive, Convenient	It was clear and simple, everything extra had been left out.	It was pretty good, but maybe I missed some cheerfulness.	It was very nice. Maybe some more reactions or positive feedback, or a welcome screen with information about where to place the bag could be good.
7	7	It was a bit difficult finding the bar code on the items. I am not quite sure if it was even necessary to find the bar codes, I do not know how this scanner is reading them.	5	Finding the bar codes on the items, otherwise it was easy.	5	Maybe showing the scanners area for scanning could make it easier and faster.	Fast, Frustrating, Convenient, Calm, Impersonable	I could use it quite fast. I have used self-checkouts before so it felt familiar.	-	-
8	7	Normal	7	Normal	7	Everything was useful	Accessible, Convenient, Clear, Fun, Efficient	Felt like a normal shopping experience.	Nothing.	No.
9	6	The products would actually be in my arms or in a basket when approaching the self-checkout. It felt unatural to get them all individually from the shelf.	6	Collecting the items. Really the shopping basket would be on the left side of the payment terminal.	5	It was clear, but too industrial. There was no fun. I crave gamification like in the Wolt app or Kotipizza online service's animations. Less Minimani payment terminal, more simple Sale.	Clear, Unapproachable, Impersonable, Dated, Too Technical	It was clear, being able to add more in amount was interesting. Accessible, though I am not sure if shades of grey are.	It's clarity made in boring and because there is security cameras, I would rather scan each product individually.	Self-checkouts are accessible, but impersonable. I would rather go converse with the cash register employee, as this created a cold and boring experience. In addition, the ending screen was missing a 'next customer' button, so I could not 'zero' it, which would have made me feel like my information is more protected.
10	7	Usually easy, standard.	6	It could be more efficient to scan the same product three times to get the discount.	7	The UI was clear and standard, I was already used to it.	Efficient, Time-Saving, Clear, Convenient, Fast	There was no audio talking.	The screen could have colour coding for the discounts to make it clearer.	The social aspect of using the self-checkout when there is an employee there, makes me feel like they might think I am not scanning everything or stealing something.
11	7	Everything was easy and logical.	7	Everything was fast.	7	I did not need more information. The instructions were logical.	Fast, Time-Saving, Familiar, Convenient, Reliable	Everything was clear and the discount came automatically.	First I was apprehensive about how the discount would work, but it came automatically.	Clear and consistent.
12	7	All the tasks in this scenario went smoothly.	7	It only took a little time. Almost like simulating my actual behaviour at a self-checkout.	7	I am satisfied with the support information and I understood where we were at.	Advanced, Convenient, Fast, Clear, Busy	The scenario was clear and fast. Exactly how I would behave at a similar checkout.	Maybe that I needed to scan the discount items in order.	No.

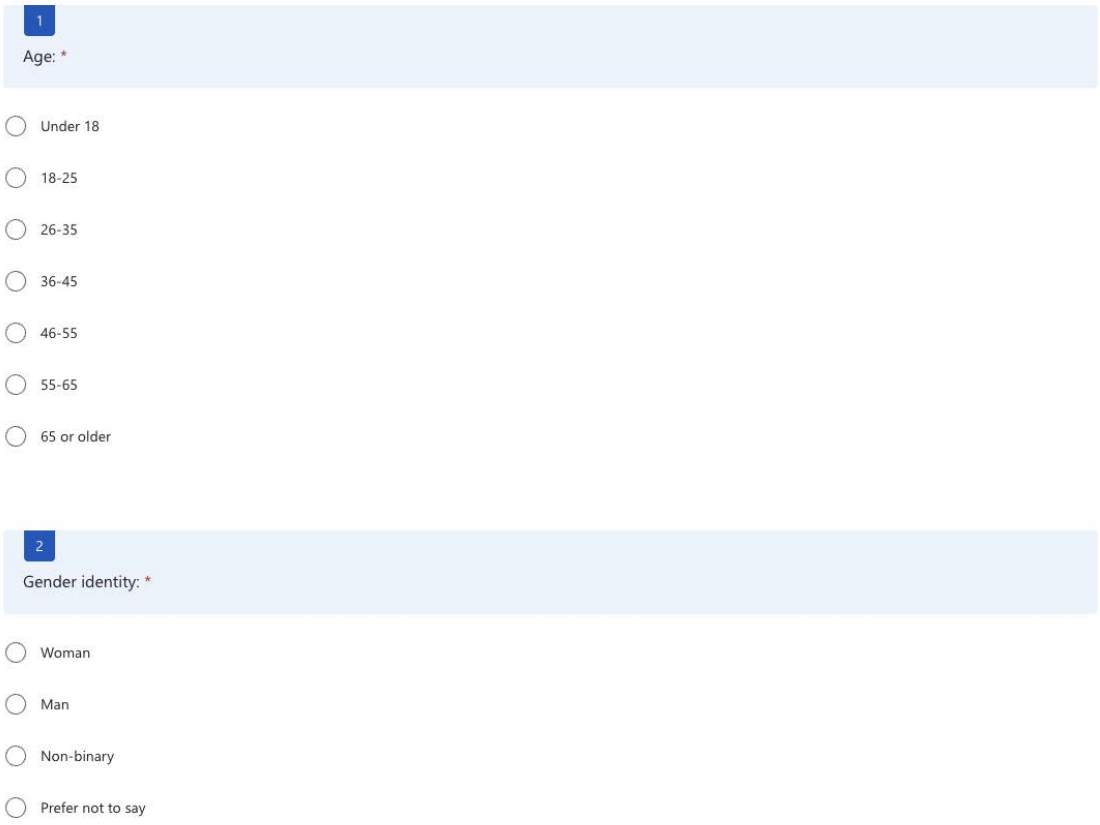

Figure 20: Online Survey: background questions

P.number	Date	Age	Gender	When shopping at a grocery store, how often do you use the self-checkout when it is an option?	What amount of purchases do you find a self-checkout best for?	What makes you avoid using a self-checkout?	How often do you encounter issues (e.g., errors, scanning problems) at self-checkouts?	What kinds of issues do you encounter at self-checkouts?	Which improvements would make self-checkouts better for you? Rank.	Any other thoughts about your experiences with self-checkouts?
1	27.4.2025	26-35	Woman	Always	4-8 items	Lack of space for my items;	Sometimes	Unexpected item in bagging area	Faster staff assistance when needed;More space overall in self-checkout areas;More packing space;Simpler instructions;Not requesting a loyalty card;No need for printed receipts;Easier barcode scanning;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);	
2	27.4.2025	46-55	Woman	Often	4-8 items	Lack of space for my items;	Often	Unexpected item in bagging area	Faster staff assistance when needed;More packing space;Easier barcode scanning;More space overall in self-checkout areas;Not requesting a loyalty card;Simpler instructions;No need for printed receipts;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);	No
3	27.4.2025	36-45	Woman	Often	4-8 items	I never avoid self-checkouts;	Sometimes	Permission needed for alcohol etc, double scanning or not putting in bagging area	Faster staff assistance when needed;Easier barcode scanning;More packing space;More space overall in self-checkout areas;Simpler instructions;Not requesting a loyalty card;No need for printed receipts;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);	
4	27.4.2025	26-35	Woman	Always	4-8 items	They are stressful;Lack of space for my items;They don't work well;	Often	Not registering items in bagging area	Faster staff assistance when needed;More packing space;More space overall in self-checkout areas;Easier barcode scanning;Simpler instructions;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);No need for printed receipts;Not requesting a loyalty card;	No
5	27.4.2025	36-45	Woman	Always	1-3 items	They are slow;I never avoid self-checkouts;	Sometimes	The item isn't recognised, too heavy items	Easier barcode scanning;Faster staff assistance when needed;More space overall in self-checkout areas;More packing space;Simpler instructions;Not requesting a loyalty card;No need for printed receipts;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);	I think they are very useful and when they work properly they are easy to use
6	27.4.2025	26-35	Man	Always	1-3 items	I never avoid self-checkouts;	Sometimes	Not scanning, weighing issues or ID checks.	Faster staff assistance when needed;Easier barcode scanning;More packing space;More space overall in self-checkout areas;Simpler instructions;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);Not requesting a loyalty card;No need for printed receipts;	

7	27.4.2025	46-55	Woman	Always	9 or more items	I never avoid self-checkouts;	Rarely	Waiting for age verification. Scales not recognising bags or items.	Faster staff assistance when needed;More packing space;No need for printed receipts;Easier barcode scanning;Simpler instructions;More space overall in self-checkout areas;Not requesting a loyalty card;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);	
8	27.4.2025	26-35	Woman	Always	9 or more items	I never avoid self-checkouts;	Sometimes	Light items not showing up on the scales	Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);More packing space;Faster staff assistance when needed;Easier barcode scanning;More space overall in self-checkout areas;No need for printed receipts;Simpler instructions;Not requesting a loyalty card;	Quick but only if the attendant can help. And more room required for packing
9	27.4.2025	26-35	Woman	Sometimes	1-3 items	They are slow;They are stressful;Lack of space for my items;	Sometimes	Unexpected items in bagging area, items that won't scan	Easier barcode scanning;Faster staff assistance when needed;More space overall in self-checkout areas;More packing space;Simpler instructions;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);Not requesting a loyalty card;No need for printed receipts;	I prefer to use a normal till
10	27.4.2025	36-45	Woman	Always	9 or more items	They are slow;	Rarely	Item needs approval	More space overall in self-checkout areas;More packing space;Simpler instructions;Not requesting a loyalty card;Faster staff assistance when needed;Easier barcode scanning;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);No need for printed receipts;	no
11	27.4.2025	46-55	Man	Often	4-8 items	I never avoid self-checkouts;	Sometimes	Unable to scan products	Faster staff assistance when needed;Easier barcode scanning;Simpler instructions;More space overall in self-checkout areas;More packing space;No need for printed receipts;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);Not requesting a loyalty card;	Get better year on year
12	27.4.2025	36-45	Man	Often	9 or more items	Lack of space for my items;	Rarely	Struggling to get some items to scan	More space overall in self-checkout areas;More packing space;Easier barcode scanning;Faster staff assistance when needed;Not requesting a loyalty card;No need for printed receipts;Simpler instructions;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);	N/a

13	27.4.2025	55-65	Woman	Often	4-8 items	Lack of social interaction;Lack of space for my items;	Often	unexpected item in baggage area products not scanning	Faster staff assistance when needed;More space overall in self-checkout areas;More packing space;Easier barcode scanning;No need for printed receipts;Simpler instructions;Not requesting a loyalty card;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);	
14	27.4.2025	26-35	Man	Always	4-8 items	I never avoid self-checkouts;	Rarely	Sometimes a barcode wont scan or it will scan twice but for the most part i don't get many issues at self checkouts	More space overall in self-checkout areas;Faster staff assistance when needed;More packing space;Not requesting a loyalty card;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);Simpler instructions;No need for printed receipts;Easier barcode scanning;	I wish there was a way to just scan your ID when you are buying something that requires ID rather than a member of staff having to come over and approve the item
15	27.4.2025	46-55	Man	Always	9 or more items	I never avoid self-checkouts;	Rarely	sometimes the discounts barcodes can't be scanned so I have to input them manually	Easier barcode scanning;More space overall in self-checkout areas;More packing space;Faster staff assistance when needed;Simpler instructions;Not requesting a loyalty card;No need for printed receipts;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);	It's the fastest options.
16	27.4.2025	36-45	Woman	Often	1-3 items	Lack of space for my items;	Rarely	The only issue I can remember is when I had an item that was marked as reduced, but it scanned through at full price on the self-checkout.	More packing space;Faster staff assistance when needed;More space overall in self-checkout areas;Easier barcode scanning;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);Simpler instructions;Not requesting a loyalty card;No need for printed receipts;	I find them convenient to use overall. Sometimes I think the entrance to them isn't marked clearly in supermarkets, so it's not obvious where to go.
17	27.4.2025	36-45	Woman	Rarely	1-3 items	They are stressful;Lack of space for my items;	Often	Item not placed properly on the bagging area	Faster staff assistance when needed;Easier barcode scanning;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);More packing space;More space overall in self-checkout areas;Not requesting a loyalty card;No need for printed receipts;Simpler instructions;	
18	27.4.2025	36-45	Woman	Often	4-8 items	Lack of space for my items;They are slow;does not accept cash (if I only have cash at the moment);	Rarely	not often, but sometimes slow	Faster staff assistance when needed;Easier barcode scanning;More packing space;More space overall in self-checkout areas;Simpler instructions;Not requesting a loyalty card;No need for printed receipts;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);	

19	27.4.2025	36-45	Man	Often	4-8 items	Lack of space for my items;They are slow;	Sometimes	Sometimes they don't read the barcodes of products	Easier barcode scanning;More space overall in self-checkout areas;Faster staff assistance when needed;Simpler instructions;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);Not requesting a loyalty card;No need for printed receipts;More packing space;	No
20	27.4.2025	26-35	Woman	Always	9 or more items	I never avoid self-checkouts;	Sometimes	Item not scanning correctly, updated discount price not registering, accidentally scanning an item twice and not being able to cancel it	Easier barcode scanning;More packing space;More space overall in self-checkout areas;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);Faster staff assistance when needed;No need for printed receipts;Not requesting a loyalty card;Simpler instructions;	They are very convenient for me but I 100% see the value in having normal checkouts so I don't particularly like when some stores have all of the tills closed and everyone has to go to self-checkout
21	27.4.2025	46-55	Man	Often	4-8 items	Lack of space for my items;	Rarely	Sometimes things will not scan	More space overall in self-checkout areas;More packing space;Faster staff assistance when needed;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);Easier barcode scanning;Not requesting a loyalty card;No need for printed receipts;Simpler instructions;	They are extremely convenient, especially when I only have a few items
22	27.4.2025	36-45	Woman	Rarely	4-8 items	Lack of social interaction;Lack of space for my items;	Sometimes	things won't scan	More packing space;Faster staff assistance when needed;More space overall in self-checkout areas;Simpler instructions;Not requesting a loyalty card;No need for printed receipts;Easier barcode scanning;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);	none
23	27.4.2025	36-45	Man	Always	4-8 items	I never avoid self-checkouts;	Sometimes	Bagging alerts	Faster staff assistance when needed;More packing space;More space overall in self-checkout areas;Simpler instructions;Not requesting a loyalty card;No need for printed receipts;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);Easier barcode scanning;	None
24	27.4.2025	26-35	Man	Rarely	1-3 items	Privacy concerns;	Never		Simpler instructions;Easier barcode scanning;Faster staff assistance when needed;Not requesting a loyalty card;More packing space;No need for printed receipts;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);More space overall in self-checkout areas;	

25	27.4.2025	26-35	Woman	Often	1-3 items	Lack of space for my items;	Sometimes	Issues with scanning items, issues with the bagging area, age restricted items, issues scanning a loyalty card	More packing space;More space overall in self-checkout areas;Easier barcode scanning;Faster staff assistance when needed;No need for printed receipts;Not requesting a loyalty card;Simpler instructions;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);	I would very much prefer to not see myself when I'm scanning. For some reason, it seems to have become normal for cameras to be directed at your face at these self-service check-outs, and for the shopper to be shown what the camera is seeing. I would rather not see myself as I am doing my shopping. Having cameras on people is normal, we are very used to that, but seeing the feed for it is really weird.
26	27.4.2025	36-45	Man	Always	4-8 items	I never avoid self-checkouts;	Rarely	Accidentally scanning something twice Items that don't scan Items that are incorrectly priced	Faster staff assistance when needed;More packing space;Not requesting a loyalty card;More space overall in self-checkout areas;Easier barcode scanning;Simpler instructions;No need for printed receipts;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);	
27	27.4.2025	55-65	Woman	Often	9 or more items	I never avoid self-checkouts;	Sometimes	scanner not working approval of 18 plus goods	Faster staff assistance when needed;More packing space;Easier barcode scanning;More space overall in self-checkout areas;Simpler instructions;Not requesting a loyalty card;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);No need for printed receipts;	They are difficult for older people to use so more staff availabity would be good.
28	27.4.2025	36-45	Man	Always	1-3 items	I never avoid self-checkouts;	Rarely	Sometimes self-checkouts do not work and I ask the staff members to help me with the issue.	Easier barcode scanning;More packing space;Faster staff assistance when needed;Simpler instructions;More space overall in self-checkout areas;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);Not requesting a loyalty card;No need for printed receipts;	My experience is mostly smooth and I find it quick and user friendly.
29	27.4.2025	26-35	Woman	Always	4-8 items	I never avoid self-checkouts;	Sometimes	Item weight	Faster staff assistance when needed;More packing space;Not requesting a loyalty card;No need for printed receipts;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);More space overall in self-checkout areas;Simpler instructions;Easier barcode scanning;	No
30	27.4.2025	55-65	Woman	Sometimes	4-8 items	I never avoid self-checkouts;	Rarely	Sometimes I can't find the grocery item. Sometimes an item doesn't scan correctly.	Faster staff assistance when needed;More packing space;More space overall in self-checkout areas;Easier barcode scanning;Not requesting a loyalty card;No need for printed receipts;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);Simpler instructions;	I like them, especially when they're not crowded.
31	27.4.2025	46-55	Woman	Often	4-8 items	Lack of space for my items;If there's an action that can only be done at manned checkout, also if the machine doesn't accept cash;	Sometimes	Reduced items can't be scanned, need for the approval for certain items, not enough cash payment machines	Faster staff assistance when needed;More space overall in self-checkout areas;More packing space;Easier barcode scanning;Not requesting a loyalty card;Simpler instructions;No need for printed receipts;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);	Should be accepting cash on all of the machines or at least have equal amount of the machines of both kind. Also fix any broken ones fast.

32	27.4.2025	55-65	Man	Always	4-8 items	Lack of space for my items;	Sometimes	Items not being recognised as having been placed on the packing surface. Barcodes not able to be read on awkward shaped packaging.	More packing space;More space overall in self-checkout areas;Easier barcode scanning;Faster staff assistance when needed;Not requesting a loyalty card;No need for printed receipts;Simpler instructions;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);	At busy periods self checkouts can take just as long as manned checkouts. Too long a wait for assistance when encountering problems or when buying age restricted items.
33	27.4.2025	55-65	Man	Often	4-8 items	Lack of social interaction;Privacy concerns;	Rarely	Scanning problems	Simpler instructions;More packing space;Easier barcode scanning;More space overall in self-checkout areas;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);Faster staff assistance when needed;Not requesting a loyalty card;No need for printed receipts;	It is easy to operate.
34	27.4.2025	46-55	Man	Always	9 or more items	I never avoid self-checkouts;	Sometimes	Security checks, items not scanning, need authorization for coupons	More space overall in self-checkout areas;More packing space;Easier barcode scanning;Faster staff assistance when needed;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);Simpler instructions;Not requesting a loyalty card;No need for printed receipts;	IM disabled and use a wheelchair and find it easier to use a self checkout than a manned till as using a manned till means i have to lift my shopping on to the conveyer higher and twice as much than when using self checkout. I prefer using a price gun which even easier and quicker as not need at all to repack. but i still have to have security check and the same issues with coupons ect
35	27.4.2025	55-65	Man	Always	4-8 items	I never avoid self-checkouts;	Sometimes	Barcode faulty or some error the store employee has to log in and fix. Incorrect price after I scan the odd time.	Faster staff assistance when needed;More packing space;More space overall in self-checkout areas;Easier barcode scanning;Not requesting a loyalty card;No need for printed receipts;Simpler instructions;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);	They are good but need to have an employee there at all times in case of issues. Most stores have this but sometimes you have to wait for someone to come.
36	27.4.2025	26-35	Woman	Sometimes	4-8 items	They are stressful;	Often	error messages	Not requesting a loyalty card;More packing space;No need for printed receipts;Simpler instructions;Easier barcode scanning;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);Faster staff assistance when needed;More space overall in self-checkout areas;	no
37	27.4.2025	26-35	Man	Often	4-8 items	Lack of space for my items;When purchasing age restricted items;	Rarely	It is mostly the delay to get age verified. When purchasing alcohol items I tend to go to a service desk unless I can see that their is someone at the self service and there are not many people also using them.	Faster staff assistance when needed;Easier barcode scanning;More packing space;More space overall in self-checkout areas;Simpler instructions;Not requesting a loyalty card;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);No need for printed receipts;	

38	27.4.2025	26-35	Woman	Always	9 or more items	I never avoid self-checkouts;	Rarely	Problems scanning items	Easier barcode scanning;Faster staff assistance when needed;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);Simpler instructions;Not requesting a loyalty card;No need for printed receipts;More packing space;More space overall in self-checkout areas;	None
39	27.4.2025	26-35	Man	Always	4-8 items	I never avoid self-checkouts;	Sometimes	Weight issues	More packing space;Faster staff assistance when needed;More space overall in self-checkout areas;Simpler instructions;Not requesting a loyalty card;No need for printed receipts;Easier barcode scanning;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);	No
40	27.4.2025	26-35	Woman	Sometimes	4-8 items	They are stressful;	Sometimes	Item in the bagging area is not validated and a staff member has to verify it, staff have to verify your own bag weight	Easier barcode scanning;Faster staff assistance when needed;More space overall in self-checkout areas;More packing space;Simpler instructions;Not requesting a loyalty card;No need for printed receipts;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);	
41	27.4.2025	46-55	Non-binary	Always	9 or more items	I never avoid self-checkouts	Sometimes	Items not being in the system and needing an assistant to enter the price. Items such as pieces of fruit whose weight varies sometimes give an error.	More space overall in self-checkout areas;More packing space;Faster staff assistance when needed;Added accessibility options in technology features (e.g. possibilities for audio or visual feedback);Easier barcode scanning;Simpler instructions;Not requesting a loyalty card;No need for printed receipts	I prefer them as I experienced judgemental looks at things like vegetarian food options and I find they are always faster, especially for small numbers of items. In some shops I have felt less self-conscious about trying new products for personal use such as haircare or fragrances as I know that I can avoid judgemental looks from shop assistants or other customers queuing more closely behind at a conveyor belt.

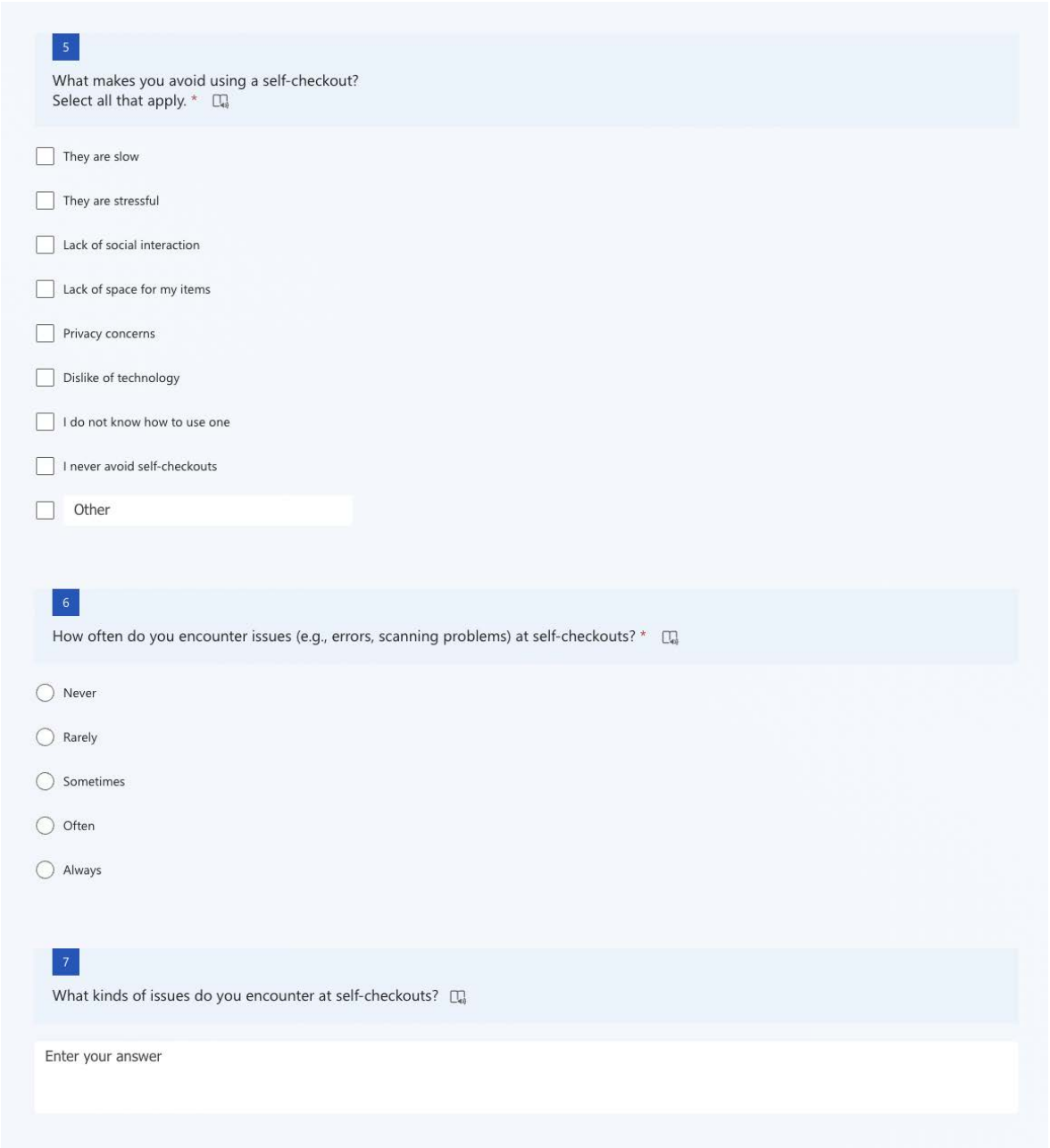

Figure 21: Online Survey: tasks (1)

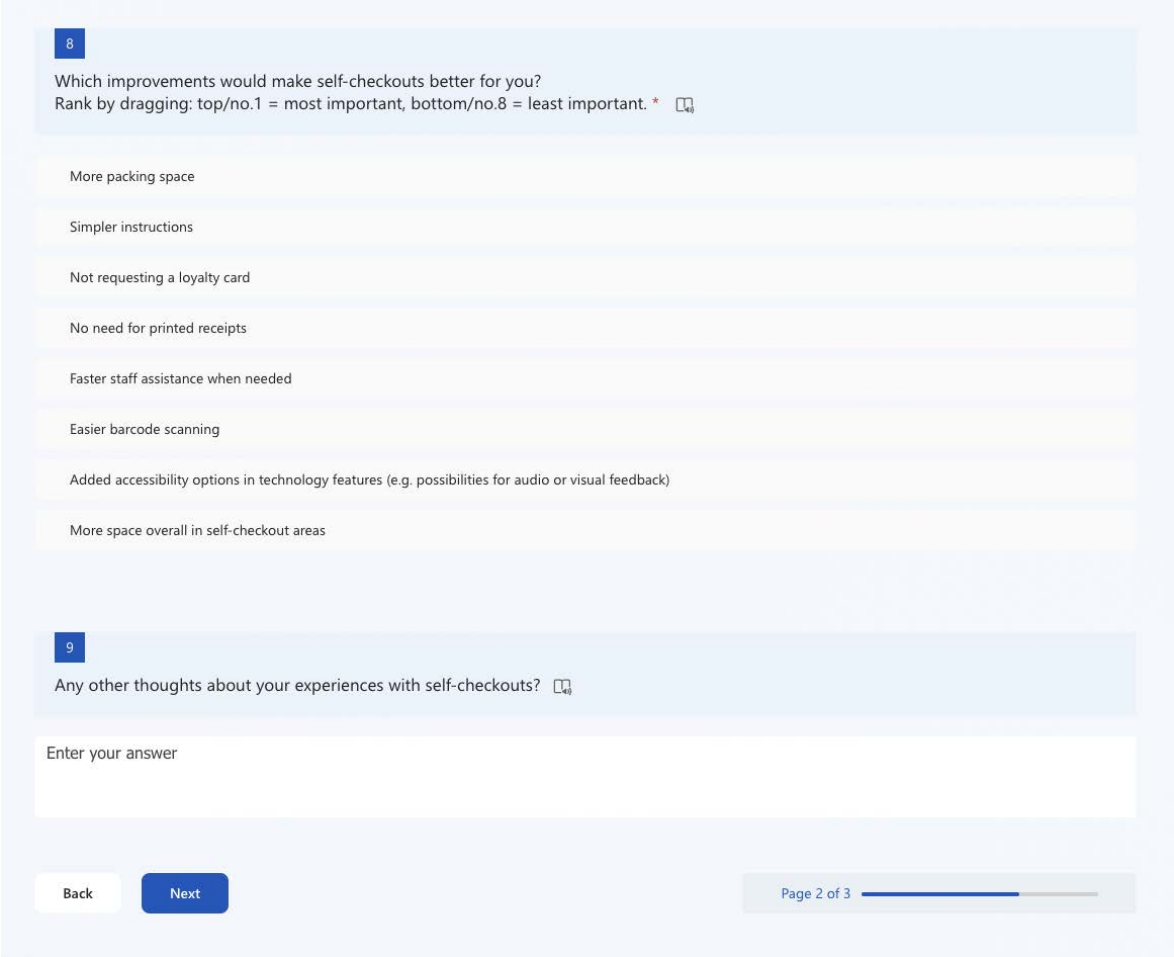

Figure 22: Online Survey: tasks (2)

Rank	Item	First choice ● ● ● ● ● ● ● ● Last choice
1	Faster staff assistance when needed	
2	More packing space	
3	More space overall in self-checkout areas	
4	Easier barcode scanning	
5	Simpler instructions	
6	Not requesting a loyalty card	
7	Added accessibility options in technology features	
8	No need for printed receipts	

Figure 23: Online Survey: Ranking results