Journal of Retailing and Consumer Services 61 (2021) 102498

Contents lists available at ScienceDirect

Journal of Retailing and Consumer Services

journal homepage: http://www.elsevier.com/locate/jretconser

# Customer reactions to self-checkout discontinuance

Tapani Rinta-Kahila [a,*], Esko Penttinen [b], Ashish Kumar [c], Ramkumar Janakiraman [d]

[a] UQ Business School and Australian Institute for Business and Economics, The University of Queensland, Colin Clark, 39 Blair Dr, St Lucia QLD, 4067, Australia
[b] Aalto University School of Business, Espoo, Finland
[c] RMIT University, Melbourne, Australia
[d] Business Partnership Foundation Research Fellow, Darla Moore School of Business, University of South Carolina, Columbia, SC, USA

ARTICLE INFO

*Keywords:*
Technology discontinuance
Retailing
Self-service technology
Signaling effect
Natural field experiment

ABSTRACT

Self-service technologies (SSTs) increasingly permeate retail space. Yet, sometimes retailers decide to revert to human-delivered service mode by discontinuing their incumbent SST. In this study, we examine how self-checkout (SCO) discontinuance affects customers' perceptions of SCO technology and purchase behavior. We conduct a natural field experiment by surveying two groups of customers *pre-* and *post-* SCO discontinuance: *treatment* group (who experience discontinuance) and *control* group (who do not experience discontinuance). Leveraging difference-in-differences analyses, we find that SCO discontinuance results in decreases in customers' satisfaction with technology, intentions to use technology, perceived simplicity of technology, and basket size. Our results inform managers of the potential downsides of discontinuing SST and provide corroborating evidence of the technology's benefits.

## 1. Introduction

In-store technologies have become an indispensable part of retail servicescape (Kwon et al., 2015; Lemon and Verhoef 2016). This development is embodied in the increasing emergence of retail self-service technology (SST), which has transformed the nature of service delivery by complementing and sometimes replacing the traditional customer-employee interaction in several facets of the shopping experience (Meuter et al., 2005). Besides cutting operations costs, retailers can leverage SST in building more attractive and flexible servicescapes: customers report increased convenience as one of their main reasons to use SST (Blut, Wang, and Schoefer 2016; Collier and Kimes 2012; Kimes and Collier 2015). A prominent form of SST are self-checkouts (SCOs) that have become an important part of retail customer experience (Orel and Kara 2014; Renko and Druzijanic 2014) as a growing number of retailers have introduced such services in their stores. Even unstaffed retail stores, that rely on an array of technological solutions such as mobile applications, sensors, and RFID, have emerged (Chen et al., 2020; Keyes 2017; Reuters 2018; Tsai et al., 2010).

Piloting and experimenting with novel solutions often means that not every technology gets to stay in place indefinitely, as some may end up being discontinued (i.e., decommissioned) after having been available for customers. Indeed, some retailers choose to discontinue their existing SCO services and replace them with staffed checkouts (CNBC 2011; FierceRetail 2011; Halkias 2011). Such decisions can be motivated by customer feedback (The Telegraph, 2015), low usage levels (CNBC 2011), operational reasons (Business Insider, 2013), or concerns of "shrink" or lost inventory due to factors ranging from theft to accidental failure to scan an item at SCO (Beck and Hopkins 2015; IBM 2008). This situation raises questions about the longevity of the SCO technology (IHL Consulting 2011). While reserchers' attention has been on studying the acceptance and continued use of technologies, discontinuous use has received less attention (Soliman and Rinta-Kahila 2020; Turel 2015). Moreover, while the nascent technology discontinuance literature has examined customers' decisions to stop using SST and other types of technologies (Avornyo et al., 2019; Coursaris et al., 2013; Hand et al., 2009; Huang et al., 2020; Prendergast and Marr 1995), it has given much less attention to organizations' decisions to decommission their technology services (Soliman and Rinta-Kahila 2020) and thus far no studies have been conducted on retail SST discontinuance.

SSTs are becoming ubiquitous in both private and commercial domains (Fano and Gershman 2002). Yet, service providers' actions that remove customers' access to them can have a harmful impact on the acceptance of other such innovations in the future (Shih and Venkatesh

* Corresponding author.
*E-mail addresses:* t.rintakahila@uq.edu.au (T. Rinta-Kahila), esko.penttinen@aalto.fi (E. Penttinen), ashish.kumar@rmit.edu.au (A. Kumar), janakiraman.ramkumar@gmail.com (R. Janakiraman).

https://doi.org/10.1016/j.jretconser.2021.102498
Received 11 August 2020; Received in revised form 1 February 2021; Accepted 6 February 2021
Available online 2 March 2021

2004). As managers are weighing the pros and cons of continuing or discontinuing their previously implemented SSTs, it is important to understand the signal that their termination might send to the customers and how that may shape their perceptions of the discontinued SST. Moreover, considering that retail SSTs have been found to increase the convenience of retail shopping (Collier and Kimes 2012), their discontinuance would be expected to have ramifications on customers' purchase behavior. Research on brand discontinuance has demonstrated the importance of studying customer reactions to retailers' discontinuous decisions (Shah 2020), yet, reactions to SST service discontinuance remain uncharted.

Therefore, we set out to investigate the following research question: *what are the effects of SST discontinuance on customers' technology perceptions and purchase behavior?* Replacing a technology-delivered service with a human-delivered one contradicts the general trend of increasing technological ubiquity, as traditionally the subject of downsizing has been human staff instead of IT (Céspedes-Lorente et al., 2019; Habel and Klarmann 2014). Thus, it should not go unnoticed by customers who may interpret SST discontinuance as a signal of dissatisfactory performance and adjust their perceptions accordingly. Drawing on the signaling effect (Connelly et al., 2011; Spence 1973), we study users' reactions to SST discontinuance in retailing context, where SCO discontinuance has occurred (Business Insider, 2013; CNBC 2011; FierceRetail 2011; IHL Consulting 2011; The Telegraph 2015).

This study contributes to the literature on retail SST use (Avornyo et al., 2019; Chen et al., 2020; Hand et al., 2009; Orel and Kara 2014) and customer reactions to retailers' SST decisions (Reinders et al., 2008; White et al., 2012) by uncovering the implications of SST discontinuance on customers' technology perceptions and purchase behavior. Moreover, we contribute to research on technology discontinuance (Hand et al., 2009; Soliman and Rinta-Kahila 2020; Turel 2015) by examining an organization-level discontinuance decision in the context of retail SST services.

In the next section, we set the scene for our study by discussing the relevant literature on retail SST. We then develop hypotheses based on prior literature's findings and theoretical insights. After this, we report our quasi-experimental method and empirical results. The final sections are dedicated to discussion of implications and limitations.

## 2. Related work

In this section, we provide an overview on research on technology discontinuance followed by a discussion of relevant factors in SST user behavior.

### 2.1. Technology discontinuance

At the individual level of analysis, previous research has investigated why consumers quit using technology-enabled services such as online grocery shopping (Hand et al., 2009), mobile banking (Avornyo et al., 2019), automated telling machines and telephone banking (Prendergast and Marr 1995), interactive television entertainment service (Lemon et al., 2002), and social networking systems (Coursaris et al., 2013; Ng 2020; Turel 2015), among others. However, organization-level decisions to decommission incumbent technologies have received scanter attention (Soliman and Rinta-Kahila 2020). Such studies have examined mainly business-to-business systems, such as knowledge-sharing platforms (Tully 2015), online real-time auction systems (Charki et al., 2017), and interorganizational IT standards (Power and Gruner 2015). Motivations for discontinuance have been found to relate to burden of system maintenance costs, disadvantages that the system incurs for operations, and uncontrollable changes within the organization and in its environment (Power and Gruner 2015). Also, high system complexity, poor compatibility with organizational needs (Tully 2015), and emergent legal and ethical pressures (Boukef and Charki 2014; Charki et al., 2017) have caused organizations to terminate their incumbent technologies. However, only few studies have ventured beyond the antecedents of organizational technology discontinuance to study the outcomes of such decisions, such as end-user reactions (Rinta-Kahila et al., 2018). Moreover, none of the studies examining organizational technology discontinuance have addressed the phenomenon in the consumer context, where, instead of employees of an organization, the end users of the discontinued technology are consumer customers. Although SSTs are getting increasingly common in retailing, they are also a subject of constant experimentation, and therefore discontinuation, by retailers (Laird 2013; Matthews 2018). To understand the potential effects of SST discontinuance, we next turn to the current SST literature.

### 2.2. Self-service technologies and relevant factors of usage behavior

Consumers' SST acceptance is largely determined by user perceptions (Blut et al., 2016), as is the case with technology in general (Davis 1989; Venkatesh et al., 2012). Overall, service convenience brought by SST predicts adoption (Chen et al., 2020). More specifically, use behavior is shaped by utilitarian aspects of the technology, such as its *perceived efficiency* (i.e., how well the technology performs in doing its job) and *perceived simplicity* (i.e., how easy it is to use the technology) (Dabholkar and Bagozzi 2002; Weijters et al., 2007). Then again, also hedonically oriented perceptions matter, embodied as the fun or *perceived enjoyment* of using SST (Collier and Sherrell 2010; Dabholkar and Bagozzi 2002; Weijters et al., 2007). In addition, prior research on SST use highlights the importance of *satisfaction with SST* and *intention to use SST* in shaping user behavior (Wang et al., 2013). Understanding user perceptions of technology is especially important when a new technology is introduced, as perceptions and intentions tend to drive use behavior before the usage becomes habitual (Wang et al., 2013, 2017). Finally, various situational factors, such as waiting time and crowdedness may play decisive role in the adoption, use, and discontinuance of SST (Hand et al., 2009; Renko and Druzijanic, 2014; Rinta-Kahila and Penttinen, 2021; Wang et al., 2012).

Some have looked into SST implementation's implications to retailers. For instance, SST use has been found to entail positive effects on customers' purchase behavior (Evanschitzky et al., 2015; Weijters et al., 2007), satisfaction (Orel and Kara 2014), and patronage (Lee and Yang 2013). On the contrary, *forcing* customers to use SST leads to negative attitudes toward the SST and the service provider (Reinders et al., 2008) as well as decreased spending (White et al., 2012). Yet, no research has looked into how customers react to SST discontinuance that forces customers to use human-delivered service.

Understanding this is important since the service provider may choose to reintroduce the same or similar technologies later (Abraham and Hayward 1984; Soliman and Rinta-Kahila 2020), in a similar manner that an individual user may return to use a technology the user has previously abandoned (Ng 2020). Also, since intense technology users show higher interest in similar future technologies compared to those who use the technology in a more limited manner (Shih and Venkatesh 2004), providing customers the opportunity to become intense users is important: those who have had no possibility to become intense users may be reluctant to adopt technologies in the future. While maintaining an opportunity to experiment with an SST has been found to help to keep customers engaged with the technology (Avornyo et al., 2019), removing access to the SST may alienate customers from it. This highlights the importance of understanding the potentially disruptive effects of SST discontinuance on customers' technology acceptance. We posit that discontinuing a current SST, such as SCO, sends a negative signal about the technology to its users.

## 3. Hypotheses development

Signal is information about the underlying quality of the subject of the information, whether it relates to a certain aspect of an individual,

organization, or technology (Connelly et al., 2011, p. 44). Signaling theory (Spence 1973) is typically used for studying how signalers intendedly communicate their positive attributes. Previous research has found that technology-related decisions have a signaling effect: managers may successfully promote customer perceptions of the high quality of their service by signaling their firm's affinity for technology to their customers (Fleming et al., 2018). Moreover, adopting a transparency-promoting technology can yield reputational benefits via signaling of an organization's trustworthiness (Caviggioli et al., 2020). However, negative *unintended* signaling can occur too (Sauer et al., 2010). As Connelly et al. (2011, p. 45) note, negative signals sent by insiders to outsiders are *"often an unintended consequence of the insider's action"*. While a service provider's (insider) decision to discontinue a technology, such as SST, may not be intended as signaling, it may be interpreted as such by customers (outsiders), who may not be aware of the motivations of discontinuance. Such a signal could reinforce the negative attitudes of skeptical users who have not accepted the technology as well as disrupt the positive perceptions of its intense users. In the context of banking, Fleming et al. (2018) found that "perceived firm attitudes, in this case affinity for technology, may influence consumer perceptions of service performance." (p. 240) It is thus reasonable to expect that SST-related decisions may influence consumer perceptions of the SST in question. Further, an unintended negative signaling effect can be fortified by hindsight bias (Fischhoff 1975): people may view an event (SST discontinuance) as having been predictable, even though there was little or no objective basis for predicting it to happen.

In Fig. 1, we provide our conceptual framework that outlines the effects of SST discontinuance on perceptions of the discontinued SST and purchase behavior. Next, we discuss variables in each category and present hypotheses.

### 3.1. Technology perceptions

Prior literature suggests that effective implementation of retail SST can contribute to higher customer satisfaction with the shopping process (Kimes and Collier 2015; Orel and Kara 2014). This happens mainly

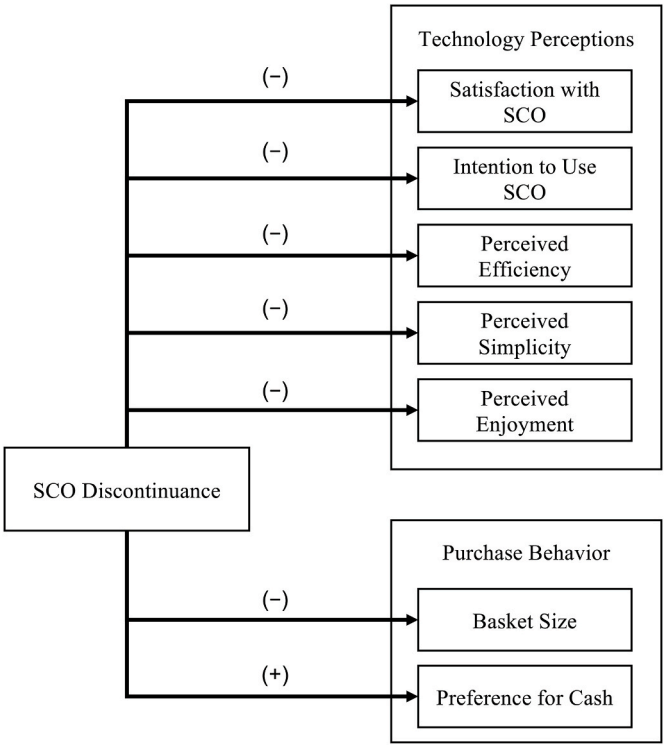


**Fig. 1.** Conceptual model.

through providing speedier checkout and shorter queues (Kimes and Collier 2015; Meuter et al., 2000; Wang et al., 2012), enabling customers to choose the service delivery method (Cranage and Sujan 2004; Kimes and Collier 2015), and giving them a high perceived control over the service process (Ba and Johansson 2008). However, dismantling previously implemented SCOs may send a contradicting signal to the customers, indicating that SCOs do not deliver such benefits. Thus, we propose that SCO discontinuance will be interpreted as a change that will negatively affect perceived satisfaction with SCO technology, leading customers' beliefs about SCOs' benefits to decrease:

$H_1$: Discontinuance of an SCO service has a negative effect on satisfaction with SCO technology.

Customers' expectation of future use is a key element in determining their service retention decision (Lemon et al., 2002). Future use of technology reflects customer's intentions or prospects toward using the technology in the future. A negative signal about SCOs, such as SCO discontinuance, could have a negative impact on these intentions, especially fortifying the skeptical attitudes of those who did not like the service or had not tried it yet. This could mean that the customers are less willing to use SCOs elsewhere or re-adopt the service if it is later brought back. In addition, users' behavioral intentions are shaped by their attitudes (Curran, Meuter, and Surprenant 2003; Wang, Harris, and Patterson 2012), and attitude toward a specific SST has been found to determine also one's global attitudes toward SST in general (Curran et al., 2003). Based on the above arguments, we propose:

$H_2$: Discontinuance of an SCO service has a negative effect on intentions to use retail SCO technology.

The main benefits of retail SCOs have been reported to arise from shorter queues and waiting times to service (Meuter et al., 2000; Wang et al., 2012). As such, the system's ability to provide such benefits by "doing its job" (Meuter et al., 2000, p. 55–57) with high "speed of delivery" (Dabholkar 1996, p. 33–34) is of essential relevance. Following Dabholkar and Bagozzi (Dabholkar and Bagozzi 2002), we define a service system's efficiency in terms of how it performs in facilitating the service process, in this case checking out from the store. A retailer's decision to discontinue SCOs can send a signal that questions the efficiency of SCOs – after all, customers should expect retailers to aim for higher efficiency in their operations. Thus, customers might interpret that the discontinuance event was an expected result of the poor efficiency of the system. Then again, even if a user did not experience any major problems with the system, the service provider's discontinuance decision may display the system in less favorable light as the negative aspects of the system may gain a higher emphasis on the user's overall perception of the system. Thus, we propose the following:

$H_3$: Discontinuance of an SCO service has a negative effect on perceived efficiency of retail SCO technology.

Also referred to as perceived ease of use (Davis 1989) or (inversely) complexity (Rogers 2003; Simon and Usunier 2007), simplicity has been identified as a strong determinant of technology's perceived usefulness (Davis 1989). Simplicity of system use generally reflects how easily a user can learn to operate the system and whether using the system is perceived effortless (Venkatesh et al., 2003). The perception of system simplicity may change due to service discontinuance as customers may interpret it as a signal of high system complexity. Moreover, since users who initially learned to use the system can no longer access it, they may lose the vivid memory of system use and thus evaluate it as more difficult to use than before. Finally, users who suffered a service failure with SST before its discontinuance might not have gotten a chance to experience a successful self-service encounter or to recover from such failure (Foubert and Gijsbrechts 2016; Zhu et al., 2013), leading to decreased perceived simplicity. Thus, we propose the following:

$H_4$: Discontinuance of an SCO service has a negative effect on perceived simplicity of retail SCO technology.

Even with strongly utilitarian SST, hedonic aspects can emerge as crucial determinants of adoption and use (Curran and Meuter 2007). Likewise, SCOs may amplify the hedonic dimension of shopping (Orel

and Kara 2014) through the active participation in self-scanning. This is supported by prior research on online shopping, where high interactivity in the shopping environment has been found to contribute to shopping enjoyment (Childers et al., 2001). SCO discontinuance, however, may signal customers that the service was not enjoyable for the majority of shoppers and this could impact their perception of SCO enjoyment. Thus, we propose:

$H_5$: Discontinuance of an SCO service has a negative effect on perceived enjoyment of retail SCO technology.

### 3.2. Purchase behavior

In the retailing context, basket size is one of the most relevant measures of shopping behavior due to its direct relation with purchase incidence (Bell and Lattin 1998, p. 68) and profitability (Liu, 2007). Basket size refers to the average number of products a customer would purchase on a normal shopping trip (Desai and Talukdar 2003, p. 910). SSTs have been found improve shopping convenience in a way that increases customers' spending (Evanschitzky et al., 2015; Grewal et al., 2020) and stimulates impulsive purchases (Farah and Ramadan 2020). With SCOs, reduced waiting time to service has been identified as an important source of convenience (Meuter et al., 2000; Wang et al., 2012) that can trigger increased purchases. Time is a resource alike money, and consumers optimize these resources jointly (Leclerc et al., 1995). This suggests that time resources can be exchangeable with financial resources. Accordingly, Weijters et al. (2007) show how SCO users translate the perceived time savings and increased control of the checkout process into a increased purchases. Moreover, the fast-food giant McDonalds has found that their self-service kiosk using customers spend 30% more than the ones who choose traditional service, most likely due to the convenience, privacy, and control provided by the SST (CBC News 2016). Conversely, lower convenience (e.g., delays and long waits) has been found to negatively influence spending (Rao et al., 2011; De Vries et al., 2018). By corollary, discontinuing SCO reduces the overall convenience of retail shopping and may thus exert a negative impact on customers' basket size:

*$H_6$: Discontinuance of an SCO service decreases customer's basket size.*

Many SCOs accept only card payments as such machines come with a lower cost, smaller size, and better efficiency than the ones accepting both card and cash (The Grocer 2014). Customers' exposure to SST and the subsequently accumulating use experience can decrease their preference of more conventional means of service (Prendergast and Marr 1995), and thus also a conventional mode of payment, while simultaneously facilitating the adoption of more advanced payment technologies (i.e., making card a more attractive mode of payment). Thus, while SCO availability is likely to cause the prominence of cash to decline, SCO discontinuance may disrupt this trajectory as the 'cards-only' service option is no longer there to induce cash-preferring customers out of their old habits:

$H_7$: Discontinuance of an SCO service increases customer's preference for cash payment.

## 4. Methods

### 4.1. Empirical setting

The data set for this study comes from two major national retail chains in Finland, which we refer to as Retailer 1, and Retailer 2.[1] Both retailers operate in grocery retailing where they hold similar market shares[2] with hundreds of stores nationwide, and their product assortments are comparable. In 2012, Retailer 1 introduced a self-checkout (SCO) service in three of its grocery retail stores. During the same year, Retailer 2 introduced a similar SCO service in one of its grocery retail stores. These stores of both retailers are comparable as they are similar in size, product assortment, and target market. After ten months of utilizing SCOs, Retailer 2 discontinued its SCO service from the store, i.e., they reverted to the original service where the only checkout option was the traditional till with service employees. However, the SCO service in Retailer 1 stores remained in operation. There were no significant changes in the market environment or market positions of the retailers during this time. Notably, Retailer 2 did not publicly comment on the motivations behind their SCO discontinuance decision. It is important to mention that prior to these implementations, SCOs had not been widely deployed in Finland's grocery retailing context, highlighting the importance of user perceptions of the newly introduced technology.

### 4.2. Research design

The objective of our study is to investigate the causal link between SCO discontinuance and customer behavior. Therefore, the dataset for our research comes from a natural field experiment described above. In line with these naturally occurring events, we conducted *three* survey rounds for this study. We conducted the *first* survey round in 2013, after both retail chains had introduced their SCO services and had them available for their customers for several months. This survey was sent to a combined sample of 19,395 customers provided by both retail chains. This sample was selected randomly for those customers who shopped with their loyalty cards in three of the stores where SCO service had been introduced (two Retailer 1 stores and one Retailer 2 store). We received 3098 responses (yielding a response rate of 16%), of which 2167 and 649 customers indicated Retailer 1 and Retailer 2 as their focal retail chain respectively (the rest indicated a focal retailer other than Retailer 1 or Retailer 2). Four months later, we conducted a *second* survey round with the 2595 respondents who had given their consent to sending follow-up surveys. This yielded 1538 responses (a response rate of 59.3%), of which 1125 and 290 responses were from the regular customers of Retailer 1 and Retailer 2, respectively. Then, after another five months we conducted a *third* survey round, post discontinuance of SCO by the Retailer 2 store. The last survey round gathered 972 responses (a response rate of 63.2%). After removing duplicate responses (some customers had loyalty memberships with both the retailers and had visited both during the sampling period, thus receiving the survey from both retailers) and respondents who exhibited random or dishonest survey response behavior (e.g., by giving the same value to each question), we ended up with a useable sample of 719 loyal customers from Retailer 1 and 173 from Retailer 2 who have responded to all three rounds of the survey.

The first survey round identified the focal stores of the sampled customers, as well as their background information. Then, these customers were naturally divided into two groups: *treatment-group* customers who experienced the intervention, i.e., SCO discontinuance (i.e., their focal store is the store operated by Retailer 2), and *control-group* customers who do not (i.e., their focal store is from Retailer 1). The second and third survey rounds captured customers' perceptions of SCO technology and purchase behavior in *pre-* and *post*-periods of SCO discontinuance for both treatment- and control-group customers. We used customers' e-mail addresses to link their responses to each wave of survey and note that the same set of questions were asked from the respondents in the second and the third waves of survey. In addition, each survey included a section wherein the respondents could write informal feedback related to SCOs, the survey, or any topic of their choosing. We summarize the timeline of these events in Fig. 2.

### 4.3. Measurement

We measured the constructs satisfaction, intention to use, perceived efficiency, perceived simplicity, and perceived enjoyment by using

[1] We do not disclose the names of these two retailers to ensure their anonymity.

[2] We do not disclose the market shares to ensure the retailers' anonymity.

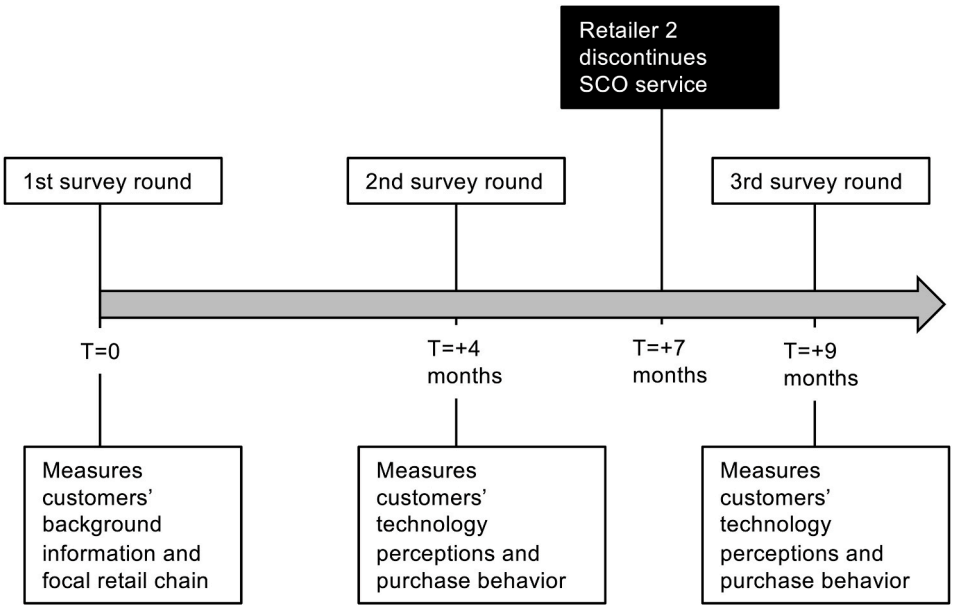


**Fig. 2.** Timeline of events and data collection.

multiple items adapted from the prior literature on technology use and retail SST (Bhattacherjee, 2001; Davis, 1989; Lin and Hsieh, 2006; Venkatesh et al., 2012; Vijayasarathy, 2004; Weijters et al., 2007). For preference for cash payment we composed new items as we could not find established ones from the literature.

In order to discover the possible effects of service discontinuance on customer response, we needed make sure that the observed changes occur because of the discontinuance and not because of other factors. Thus, we chose six commonly used control variables that were also leveraged for matching purposes later. First, we controlled for *age*, as some prior research (e.g. Dean 2008) indicates that the availability of technological solutions is of higher relevance to younger people. Second, we captured *gender,* because prior research has shown that men have higher preference for technological solutions (e.g., online shopping, Van Slyke et al., 2002) than women, and this could have implications on SST discontinuance's effect on them. Third, we measured the level of *education*, since people with higher education tend to be more receptive to technological advances such as SSTs (Weijters et al., 2007). Fourth, we considered *household size* to be an important factor for our analysis since we expected it correlate strongly with basket size. It is also possible that large households' purchasing behavior is less sensitive to service changes such as discontinuance. Fifth, we measured the level of *income* as higher income has been found to be associated with greater receptiveness of SST due to more frequent exposure and access to technological solutions (Meuter et al., 2005). Finally, due to the importance of location in the retail context, we controlled for the *distance to the focal store* from the respondent's home.

### 4.4. The data

Table 1 provides the summary statistics of our sample used for empirical analysis. The sample consists of 66% of female respondents with an average age of 50 years. The typical household size of an average respondent is between 2 and 3 inhabitants, with an annual income of 28,776 euros for the respondent. The average length of formal education is almost 12 years, indicating that an average respondent has finished grammar school and either upper secondary school or vocational school. We use respondent addresses (as reported by the respondents) to measure their distance to their focal store. Average distance to the store was 7.2 km. Basket size averages at 14.57 purchases (number of products) on a shopping trip.

**Table 1**
Summary of the data.

| Variable | Mean | SD |
|---|---|---|
| Age (years) | 49.99 | 13.61 |
| Formal education (years) | 11.90 | 1.82 |
| Household size (persons) | 2.32 | 1.17 |
| Yearly income (€) | 28776.22 | 14725.16 |
| Distance to focal store (meter) | 7220.39 | 9328.51 |
| Basket size (# of items) | 14.57 | 10.73 |

The constructs and their measurement items, reliabilities calculated based on the responses of the second survey round, and summary statistics for each construct in the final sample are provided in Appendix A. The reported composite reliabilities show that the items measure their constructs consistently. All survey items loaded well on latent constructs, and average variance extracted (AVE) values of most of the constructs were greater than 0.70. For our analysis, we use the means of the items as composite scores for each construct. Correlations of construct means are presented in Table 2.

Table 2 shows that each construct's AVE estimate is greater than its shared variance with other constructs, indicating sufficient discriminant validity (Fornell and Larcker 1981). We further examined the correlations' heterotrait–monotrait (HTMT) ratios (Henseler et al., 2014) and found them to be 0.85 or less, which confirmed the constructs'

**Table 2**
Correlations, shared variance, and average variance extracted.

| Construct | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| (1) Satisfaction | **.774** | .645 | .475 | .384 | .458 | .010 |
| (2) Intention to Use | .803*** | **.902** | .503 | .411 | .419 | .011 |
| (3) Perceived Efficiency | .689*** | .709*** | **.757** | .513 | .434 | .017 |
| (4) Perceived Simplicity | .620*** | .641*** | .716*** | **.743** | .356 | .030 |
| (5) Perceived Enjoyment | .677*** | .647*** | .659*** | .597*** | **.829** | .000 |
| (6) Preference for Cash | −.098* | −.107* | −.130** | −.172*** | −.008 | **.536** |

Note: Correlations are reported below the diagonal, significances noted as follows ***p ≤ .01, **p ≤ .05, *p ≤ .10. Squared correlations are reported above diagonal and AVE estimates are presented in bold on the diagonal.

discriminant validity. Running a common-method bias test (Podsakoff et al., 2003) showed that the maximum variance accounted by a single factor is 25.86%, leading us to conclude that common method bias was not a problem in this study.

Following recent literature in retailing and management science (Kumar et al., 2016; Song et al., 2015), we use the difference-in-differences (DID) modeling framework to establish the causal effect of SCO discontinuance on customer behavior. To account for potential respondent attrition bias, we note that the survey response rates were roughly similar between Retailer 1 and Retailer 2 customers in both the second (Retailer 1: 53% vs. Retailer 2: 46%) and the third (Retailer 1: 64% vs. Retailer 2: 60%) survey round, indicating that respondent drop-out should not be a cause of concern.

### 4.5. Model-free evidence

In Table 3, we present the "raw" or average DID measures for the response variables. The comparison of "raw" mean measures of response variables across the two groups of customers and across the two time periods allows us to establish the effect of SCO discontinuance on the treatment-group customers in comparison to the control-group customers. The "difference" measure is based on the paired-sample t-test. The DID measure is determined by calculating the difference in the outcome variables between post- and pre-periods and then comparing the means of these differences between the treatment and control groups.

We find significant differences in satisfaction with SCO technology (3.5175 vs. 3.5822), intention to use SCO technology (3.3798 vs. 3.4869), and perceived simplicity of SCO technology (3.1888 vs. 3.1783) for the treatment-group customers between post- and pre-periods. These differences are not significant for the control-group customers. The overall DID values in Table 3 indicate that SCO discontinuance leads to a decreases in satisfaction with SCO technology ($-0.0192$, $p < .01$), behavioral intention to use SCO technology ($-0.1305$, $p < .01$), perceived simplicity of SCO technology ($-0.0699$, $p < .01$), and basket size ($-3.2671$, $p < .01$) of the treatment-group customers as compared to the customers in the control group. We find no significant overall effect of SCO discontinuance on customers' perceived efficiency of SCO technology, perceived enjoyment of SCO technology, or preference for cash payment across the two groups. These raw DID results suggest that SCO discontinuance impacts customers' perceptions.

### 4.6. Difference-in-differences (DID) model

We use two-period DID model specification as demonstrated in current literature (Huang et al., 2012; Shi et al., 2017) to capture the causal effect of SCO service discontinuance on the treatment group. Thus, for customers from both the treatment group and the control group, we model the following:

$$CustSat_{ht} = \lambda_0 + \lambda_1 TreatD_h + \lambda_2 ScoD_{ht} + \lambda_3 (TreatD_h \times ScoD_{ht}) + \Lambda X_{ih} + \varepsilon_{ht}^{CustSat} \quad (1)$$

$$IntUse_{ht} = \eta_0 + \eta_1 TreatD_h + \eta_2 ScoD_{ht} + \eta_3 (TreatD_h \times ScoD_{ht}) + NX_{ih} + \varepsilon_{ht}^{IntUse} \quad (2)$$

$$Efficiency_{ht} = \beta_0 + \beta_1 TreatD_h + \beta_2 ScoD_{ht} + \beta_3 (TreatD_h \times ScoD_{ht}) + BX_{ih} + \varepsilon_{ht}^{Efficiency} \quad (3)$$

$$Simplicity_{ht} = \delta_0 + \delta_1 TreatD_h + \delta_2 ScoD_{ht} + \delta_3 (TreatD_h \times ScoD_{ht}) + \Delta X_{ih} + \varepsilon_{ht}^{Simplicity} \quad (4)$$

$$Enjoyment_{ht} = \omega_0 + \omega_1 TreatD_h + \omega_2 ScoD_{ht} + \omega_3 (TreatD_h \times ScoD_{ht}) + \Omega X_{ih} + \varepsilon_{ht}^{Enjoyment} \quad (5)$$

$$BsktSz_{ht} = \alpha_0 + \alpha_1 TreatD_h + \alpha_2 ScoD_{ht} + \alpha_3 (TreatD_h \times ScoD_{ht}) + AX_{ih} + \varepsilon_{ht}^{BsktSz} \quad (6)$$

$$Cash_{ht} = \theta_0 + \theta_1 TreatD_h + \theta_2 ScoD_{ht} + \theta_3 (TreatD_h \times ScoD_{ht}) + \Theta X_{ih} + \varepsilon_{ht}^{ModeOfPay} \quad (7)$$

In Equations (1)–(7), $h$ represents a customer either from the control group or the treatment group, and $t$ denotes the time period (pre/post). $TreatD_h$ is a dummy variable that takes value 1 if the customer belongs to the treatment group (i.e., customer of Retailer 2), and $ScoD_{ht}$ is a dummy variable that denotes discontinuance of SCO service and takes value 1 and 0 in post- and pre-period respectively for customer $h$. Variables *CustSat, IntUse, Efficiency*, *Simplicity*, *Enjoyment, BsktSz,* and *Cash* correspond to customer satisfaction with SCO technology, intention to use SCO technology, perceived efficiency of SCO technology, perceived simplicity of SCO technology, perceived enjoyment of SCO technology, basket size, and preference for cash, respectively. Items for these scales and summary statistics are provided in Appendix A. $X_h$ is a vector of customer demographics (age, gender, education, household size, income, and store distance) and $\Lambda$, $N$, $B$, $\Delta$, and $\Omega$ are the corresponding coefficients in Equations (1)–(7), respectively. These variables control for the non-randomness[3] of customers' selection into treatment and control groups (Shi et al., 2017). The error term $E = (\varepsilon_{ht}^{CustSat}, \varepsilon_{ht}^{IntUse}, \varepsilon_{ht}^{Efficiency}, \varepsilon_{ht}^{Simplicity}, \varepsilon_{ht}^{Enjoyment}, \varepsilon_{ht}^{BsktSz}, \varepsilon_{ht}^{Cash})'$ is distributed normally, i.e., $E \tilde{} N(0, \Sigma)$. The main parameters of interest are $\lambda_3, \eta_3, \beta_3, \delta_3, \omega_3, \alpha_2$, *and* $\theta_2$ in Equations (1)–(7), respectively, as they capture the change in corresponding behavior of treatment-group customers' post-SCO discontinuance relative to the behavior of control-group customers whose focal stores did not discontinue SCO technology. For example, $\lambda_3$ captures the causal effect of SCO discontinuance on customer satisfaction of the treatment-group customers as compared to the customer satisfaction of the control-group customers.

## 5. Results

Next, we discuss the results of the main DID model, our additional analyses that serve as robustness checks to the main model, and qualitative evidence that lends support to the analyses. A more detailed discussion of robustness checks can be found in Appendix B.

### 5.1. The main model

We present the parameter estimates of the proposed model in Table 4. Our results suggest that SCO discontinuance has a significant negative impact on customer satisfaction with SCO technology ($-0.0227$; $p \leq .01$), intention to use SCO technology in the future ($-0.1368$; $p \leq .01$), perceived simplicity of SCO technology ($-0.0772$; $p \leq .05$), and basket size ($-3.2727$; $p \leq .01$). The control-group customers do not report such decreases in technology perceptions and purchase behavior. By contrast, their perceptions of SCOs' efficiency, simplicity, and enjoyment are significantly increased between pre- and post-

[3] The non-randomness comes due to the fact that the retail chains introduced the SCO service selectively in only some stores.

**Table 3**
Average DID: treatment vs. control group.

| Response | Outcome Variable | Group | Post-Period | Pre-Period | Difference | DID |
|---|---|---|---|---|---|---|
| Technology Perceptions | Customer Satisfaction | Treatment | 3.5175 | 3.5822 | −0.0647*** | −0.0192*** |
| | | Control | 3.4948 | 3.5402 | −0.0455 | |
| | Intention to Use | Treatment | 3.3798 | 3.4869 | −0.1071*** | −0.1305*** |
| | | Control | 3.3660 | 3.3426 | 0.0234 | |
| | Perceived Efficiency | Treatment | 4.0734 | 3.7920 | 0.2815 | 0.0717 |
| | | Control | 4.1801 | 3.9703 | 0.2098 | |
| | Perceived Simplicity | Treatment | 3.1888 | 3.1783 | 0.0105*** | −0.0699*** |
| | | Control | 3.4703 | 3.3899 | 0.0804 | |
| | Perceived Enjoyment | Treatment | 3.2483 | 3.0963 | 0.1521 | 0.0437 |
| | | Control | 3.0524 | 2.9441 | 0.1084 | |
| Purchase Behavior | Basket Size | Treatment | 10.7989 | 12.8772 | −2.0783*** | −3.2671*** |
| | | Control | 16.7013 | 17.8901 | −1.1888 | |
| | Preference for Cash | Treatment | 2.9528 | 3.0612 | −0.1084 | 0.0682 |
| | | Control | 2.8269 | 3.0035 | −0.1766 | |

***p ≤ .01, **p ≤ .05, *p ≤ .10.

**Table 4**
Parameter estimates of the DID model.

| Variable | *CustSat* | *IntUse* | *Efficiency* | *Simplicity* | *Enjoyment* | *BsktSz* | *Cash* |
|---|---|---|---|---|---|---|---|
| *Intercept* | 3.2431*** (.2516) | 3.3223*** (.2600) | 4.4314*** (.2148) | 3.0587*** (.1815) | 2.9439*** (.2134) | 2.1634 (1.8576) | 3.6305*** (.2271) |
| *TreatD* | −.0351 (.0972) | −.1054 (.1005) | .0623 (.0830) | .1398 (.3701) | .1069 (.0824) | .7762 (.4995) | .1498 (.0977) |
| *ScoD* | .1498 (.2595) | −.6226* (.3616) | 1.0285*** (.0509) | 1.605* (.9430) | 1.1888*** (.0505) | .8745 (.7610) | .3884 (.2537) |
| *TreatD* × *ScoD* | −.0227*** (.0074) | −.1368*** (.0140) | .0674 (.1155) | −.0772** (.0376) | .0382 (.1147) | −3.2727*** (1.1384) | .0748 (.1220) |
| *Age* | −.0150*** (.0020) | −.0144*** (.0021) | −.0011 (.0017) | −.0051*** (.0015) | −.0088*** (.0017) | −.0102*** (.0021) | −.0035* (.0018) |
| *Gender* | .0277 (.0577) | .1397** (.0597) | .0145 (.0493) | −.0009 (.0416) | −.1309*** (.0489) | .0666 (.0591) | .0010 (.0521) |
| *Education* | .0788*** (.0165) | .0581*** (.0171) | −.0299** (.0141) | .0318*** (.0119) | .0206 (.0140) | .0412** (.0169) | −.0340** (.0149) |
| *HH Size* | .0542** (.0248) | .0932*** (.0256) | .0126 (.0212) | .0225 (.0179) | .0882*** (.0210) | .2414*** (.0254) | .0193 (.0224) |
| *Income* | −1.9E-07 (1.6E-06) | −2.3E-06 (1.7E-06) | −3.2E-06** (1.4E-06 | −9.5E-07 (1.2E-06) | −3.0E-06** (1.4E-06) | 4.0E-06** (1.7E-06) | −6.0E-06*** (1.5E-06) |
| *Store Distance* | −5.1E-07 (4.5E-07) | −2.8E-07 (4.7E-07) | 7.2E-07* (3.9E-07) | −6.7E-08 (3.3E-07) | 3.5E-07 (3.8E-07) | −4.1E-07 (4.6E-07) | 1.0E-06** (4.1E-07) |
| $R^2$ | 0.0695 | 0.1085 | 0.2952 | 0.5037 | 0.2295 | 0.1924 | 0.0583 |
| *F-statistic* | 14.74 | 23.99 | 58.72 | 200.00 | 82.56 | 46.96 | 12.21 |
| *p-value* | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

***p ≤ .01, **p ≤ .05, *p ≤ .10.
(Numbers in parentheses are estimated standard errors of the corresponding parameter estimates).

periods. However, the effect of SCO discontinuance on perceived efficiency and enjoyment of SCOs is non-significant. Hence, we find support for Hypotheses 1, 2, 4, and 6, but not for Hypotheses 3, 5, and 7.

With respect to control variables, we find that age has a negative impact on both basket size (−0.0102; $p \leq .01$) and preference for cash payment (−0.0035; $p \leq .10$). Households with higher education (0.0412; $p \leq .05$), higher number of family members (0.2414; $p \leq .01$), and larger income (4.0E-06; $p \leq .05$) tend to have larger basket size. We find that higher education (−0.0340; $p \leq .05$) and income (−6.0E-06; $p \leq .01$) negatively impacts customers' preference for cash payment option. Moreover, age and household size both impact satisfaction (−0.0227; $p \leq .01$ and .0542; $p \leq .05$), intention to use (−0.0144; $p \leq .01$ and .0932; $p \leq .01$), and enjoyment (−0.0088; $p \leq .01$ and 0.0882; $p \leq .01$). Finally, we find education (−0.0299; $p \leq .05$) and income (−3.2E-06; $p \leq .05$) have a negative influence on efficiency whereas the effect of store distance (7.2E-07; $p \leq .10$) is positive. On simplicity, we find consumers' education (0.0318; $p \leq .01$) has positive influence whereas age (−0.0051; $p \leq .01$) has a negative impact.

### 5.2. Supplementary analysis

*Simplest setup for DID model.* We estimated the DID model in Equations (1)–(7) in its simplest setup without including the control variables $X_{ih}$. The results were similar to the main findings.

*Propensity score matching and fixed-effects model.* We note that both the retail chains introduced the SCO service selectively in only a few of their stores. Therefore, despite the occurrence of natural events in our context, one can argue that there could be a non-random assignment of consumers who experience the event and those who do not (Lee 2008). To address the potential non-randomness, we relied on propensity score matching (PSM) techniques (Guo and Frasier 2010; Kumar et al., 2016). We estimated a fixed-effect model (helps control for customer level unobserved heterogeneity) where intercept terms of Equations (1)–(7) are made individual-specific. The parameter estimates of the DID model based on the matched sample (à la Kumar et al., 2016) were similar to the main results of the DID model. The PSM procedure is reported in Appendix B.

### 5.3. Qualitative evidence

*Customer Feedback.* Altogether 346 and 102 respondents from Retailer 1 and Retailer 2 respectively gave informal feedback via an open-ended questionnaire in the third survey round. We analyzed their feedback by tabulating the comments in a chart and tagging and inspecting the ones related to the respondents' perceptions of SCOs, satisfaction, and the SCO discontinuance. This analysis reveals that both retailers have a mixed set of customers: those who like SCOs and those who are less excited about them. Remarkably, altogether 18% of the feedback from Retailer 2 customers concerns the discontinuance of SCOs. While these customers express their disappointment and frustration with losing the SCO service in their comments, many seem to post-rationalize the reasons behind the discontinuance, even though Retailer

2 did not publicly comment on the decision.

These post-rationalizations provide supporting evidence for the negative signaling effect. For instance, some customers assumed that low usage was the reason for discontinuing SCOs: *"Our focal store discontinued SCOs due to low usage, unfortunately"* and *"We are extremely disappointed because the SCOs were recently discontinued, presumably due to lack of interest in them."* Others concluded that SCOs were discontinued because they did not effectively support retail operations, for instance: *"It seems that having SCOs did not turn out worthwhile since they were discontinued"* and *"The store where I was trialing with SCOs discontinued the service due unsuitability with their practices. However, every time I shopped there I was called for random check. This made SCO use frustrating because I would have gotten out faster using the traditional checkout."* The latter quote suggests that the discontinuance may have prompted customers to emphasize their negative experiences with SCOs. This was reflected in another comment, too: *"It's a pity that our store discontinued the SCO option. Although I feel that whenever I used SCO, they performed this 'random check' on me, and that slowed down the self-checkout process."* Collectively, these statements indicate that SCO discontinuance may have had a decreasing effect on customers' satisfaction with SCO technology.

In addition, some never got to learn SCO use and were left to make their own conclusions about the technology's simplicity based on little to none use experience: *"I have used SCO sporadically but never really got to the full adoption! Using SCO could be flexible and easy if I was able to get started with it."* Another customer stated: *"Well, [Retailer 2] had discontinued SCOs so I never got the chance to trial them. And someone really should teach us how use the self-scanner. Maybe they could hold some special training week where staff would come to guide the customers in SCO use. I do not dare to go ask advice myself … "* Having no access to SCOs may have thus contributed to decreased perceptions of simplicity.

Overall, the qualitative evidence supports the assertion that SCO discontinuance caused a negative signaling effect on customers' SCO technology perceptions. This is in line with our DID analyses, suggesting that the customers have adjusted their previous beliefs about SCOs as a result of their omission. Furthermore, a number of customers specifically mentioned that hedonic motivations have nothing to do with their SCO use, which could explain why we found no statistically significant effect of SCO discontinuance on perceived enjoyment.

*Interviews with Managers.* To gain a better understanding of the background of the SCO implementation and discontinuance at Retailer 2, we conducted interviews with the store manager (45 min) and the chain managers responsible for Retailer 2's SST infrastructure (60 min). While the first interview was recorded and transcribed, in the second one we had to rely on making notes due to data-security concerns of the company.

First, we interviewed the store manager and discussed his take on the discontinuance decision and its subsequent consequences. After the interview, we also discussed our empirical results with the manager. Overall, the interview lends support to our analysis, as the store manager reported receiving lots of negative and disappointed feedback from the customers after the SCO discontinuance. The decision came from the retail chain management; thus, the store manager could not influence it. He was not satisfied with the decision as he sees that introducing such a service for customers and then taking it away from them is a bad approach to customer service: *"… at the time I solemnly swore that I will not take SCOs into my store again."* The manager noted that customers' disappointment with the decision came *"radically apparent from their feedback."* He described the decision to discontinue SCOs as *"pulling the rug from under the feet,"* further elaborating: *"… the outcome of that decision was extremely bad from my point of view, it honestly acerbated thousands of our customers."*

To shed more light on the discontinuance decision, we then interviewed managers at the retail chain level who make decisions on technology deployments across the organization. We learned that at the time of piloting SCOs, the organization was facing a larger transformation of cash-register systems in its stores, and the piloted SCO solution was found too costly to be left in place, and it was therefore discontinued. Therefore, piloting and discontinuing SCO services at the store represented just one aspect of a larger organizational change. Potential effects on customers' perceptions were not considered in the upper levels of the organization, as their main concern was to find both financially feasible and operationally deployable technology solutions for the retail organization. As the store manager summed up: *"… at the level of the retail chain it's not a problem that the piloting of a service gets discontinued here [in my store], it is a problem at the store level."*

## 6. Discussion

Our study is among the first ones to investigate the effects of SST discontinuance. Understanding how such service change shapes technology perceptions is crucial, especially when considering newly introduced technologies. Overall, we find support for four of our hypotheses (see Table 5): our results suggest that customers' perceptions of SCO technology (in terms of satisfaction, intention to use, and simplicity) and purchase behavior (in terms of basket size) are negatively impacted by SCO discontinuance. To our best knowledge, no other internal or external events than the SCO discontinuance occurred that could have explained the observed changes in customers' perceptions and behavior. Next, we discuss the implications of our findings.

First, we argue that the effect of SCO discontinuance materializes into altered customer perceptions through unintended signaling (Spence 1973). Specifically, customers interpret the SCO discontinuance as a negative signal of its benefits and capabilities and, thus, re-evaluate the technology. This prompts customers to emphasize their negative use experiences with the technology or their incumbent suspicions toward it. The observed deterioriation in customers' technology perceptions support this assertion. Decreased satisfaction with SCO technology after SCO discontinuance suggests that customers have lowered their evaluation of SCO technology's benefits. Even though the observed drop may seem meagre in terms of its absolute value, it is nevertheless a significant drop. Such an effect may negatively affect the users' future acceptance and use of that technology: decreased satisfaction and intentions to use SST indicate that customers will be less willing to use similar technology in the future (Curran, Meuter, and Surprenant 2003; Shih and Venkatesh 2004), which will make its reintroduction (Abraham and Hayward 1984; Soliman and Rinta-Kahila 2020) more difficult. This was further manifested as a decreased intention to use SCO technology. While such decrease could also stem from the practical issue of no longer having access to SCO in their focal store, we believe that the respondents' global SCO use intentions (Curran et al., 2003) shifted down as well due to discontinuance. This assessment is supported by the fact that we urged the respondents to report their overall intentions to use SCO technology when given a chance.

Second, we connect the drop in perceived simplicity to the process by

**Table 5**
Summary of results.

| Hypothesis | | Supported |
|---|---|---|
| $H_1$: | Discontinuance of an SCO service has a negative effect on satisfaction with SCO technology. | ✓ |
| $H_2$: | Discontinuance of an SCO service has a negative effect on intention to use retail SCO technology. | ✓ |
| $H_3$: | Discontinuance of an SCO service has a negative effect on perceived efficiency of retail SCO technology. | × |
| $H_4$: | Discontinuance of an SCO service has a negative effect on perceived simplicity of retail SCO technology. | ✓ |
| $H_5$: | Discontinuance of an SCO service has a negative effect on perceived enjoyment of retail SCO technology. | × |
| $H_6$: | Discontinuance of an SCO service decreases customer's basket size. | ✓ |
| $H_7$: | Discontinuance of an SCO service increases customer's preference for cash payment. | × |

which users learn to operate new technology. It is likely that customers who are less comfortable with technology use are more sensitive to service failures and making mistakes (Collier et al., 2017; Zhu et al., 2013), and thus trial with SST only sporadically. Therefore, they may need time to reach the point of discontinuous jump in their learning (Foubert and Gijsbrechts 2016; Lakshmanan and Krishnan 2011), after which using the service suddenly becomes intuitive. This learning process gets disrupted because of the SST discontinuance, possibly resulting in the technology to be perceived more complex than in the time when it was available for them to trial. This is especially significant among users with low experience, but also intensive SST users may perceive the system as less intuitive because of its discontinuance. The fact that the control-group customers evaluated SCO simplicity higher after having them continuously available further speaks for the significance of SST discontinuance affecting users' perceptions. The existence of such an effect is plausible especially when considering that SCOs had been introduced in the stores fairly recently at the time of data collection, and, thus, customers were still in the process of forming perceptions about them.

Third, while SST discontinuance resulted in a drop in perceived simplicity, perceptions of the technology's efficiency and enjoyment were found resistant to discontinuance. This indicates that distancing the technology from the users does not specifically affect its perceived utilitarian or hedonic value.[4] This may seem counterintuitive against the fact that in the classic technology acceptance theories, efficiency and enjoyment are key determinants of use intentions along with perceived simplicity, and the three are highly correlated (Davis 1989; Morris et al., 2003; Venkatesh et al., 2012). Therefore, one might expect them to move correspondingly when perceptions of simplicity are adjusted. Yet, while the constructs may be correlated, efficiency, simplicity, and enjoyment represent discrete dimensions of technology perceptions that need to be measured with unique sets of items that are different across the constructs (see, e.g., van der Heijden 2004, p. 700). Although these dimensions have been argued to have causal connections in the context of technology acceptance (e.g., simplicity contributes to efficiency and enjoyment), we do not know if similar logic would hold in reverse situations where technology is discontinued. Instead of being a mere flipside of technology adoption or continuance, the technology discontinuance phenomenon has been argued to represent a qualitatively different behavioral dimension that needs to be studied separately (Soliman and Rinta-Kahila 2020; Turel 2015). In a similar vein, van der Heijden (2004) has noted that a person's motivation to use a technology "may follow a different pattern from a motivation *not* to use" the same technology (p. 700).

Further, SCO efficiency can be verified somewhat objectively even without hands-on involvement with the technology: observing shorter queues and faster checkout processes signal of efficiency benefits also to those customers who are not users. Therefore, efficiency benefits may appear undeniable, and, possibly for this reason, they are not affected by discontinuance. Our qualitative evidence reveals that many customers who did not like SCOs still acknowledged their efficiency benefits. With regard to perceived enjoyment, it is likely to hold less relevance with such a utilitarian technology as SCO that offers little hedonic value. This assertion is supported by customers' open-ended survey feedback that indicates the low importance of enjoyment in the current context. Although customers may perceive some hedonic benefits in the technology, these perceptions are not relevant enough to be affected by its discontinuance. To contrast, we argue that customers' SST simplicity perceptions are not only central to the SCO use experience but also subject to high interpersonal variation due to different levels of customers' tech savinness. Simplicity perceptions depend heavily on customers' ability to trial and use the technology, making such perceptions vulnerable to technology discontinuance that removes this ability. The drop in one construct but not others may also signal of the potential issues in the technology's usability: while its efficiency and enjoyability may have been on a sufficiently high level, it may not have been simple enough to use, making customers adjust their perceptions downwards soon after the service is no longer available. Due to these reasons, the potential effect of hindsight bias is also likely to be higher with simplicity.

Fourth, SCO discontinuance's negative effect on basket size makes sense in light of previous findings on customers' limited time resources (Jones et al., 2015), and how SSTs can expand those resources and encourage customers to stay shopping around in the store for longer (Weijters et al., 2007). This finding supports the proposition that technology-enabled convenience can stimulate purchases (Grewal et al., 2020). Overall, it seems that the servicescape's lower convenience after SCO discontinuance is likely to explain the decrease in basket size.

### 6.1. Managerial implications

Our findings are of critical importance for service providers, such as retail chains, as they show the negative effects of downsizing the servicescape on customers' technology perceptions. They can inform managerial decision-making when it comes to the question of retaining or discontinuing SST in retailing and various other settings. The significant drops in customers' perceptions and behavior are worrisome for any service provider who plans to downgrade their current servicescape but wishes to retain the option of re-introducing the same or other SST in the future. If the negative effects persist, it could be increasingly difficult to get customers to use contemporary service technologies in the future.

Our empirical results put offering an SCO service on the side of traditional checkout services in positive limelight as the continuous availability of SCOs was found to contribute to increasingly favorable perceptions of SCOs. Thus, having the technology available helps to facilitate its overall acceptance as customers gradually learn to operate it and possibly to further leverage it to their utilitarian and hedonic ends. Overall, our results lend support to prior work suggesting that offering multiple complementary service delivery options can work in favor of upholding and improving existing customer relationships (Meuter et al., 2000; Scherer et al., 2015).

### 6.2. Limitations and future research

It is important to acknowledge that this study comes with certain limitations. First, even though SST is proliferating (The Economist 2004) and thus giving rise to self-service economy (Castro et al., 2010), we advise the reader to interpret our findings within the retailing context. For instance, regarding perceived efficiency, perceived simplicity, and perceived enjoyment, the finding that only perceived simplicity was significantly affected by discontinuance may be specific to the retailing context due to the context's utilitarian nature and due to a customer's ability to judge efficiency benefits without necessarily using the technology. Research in different technology use contexts may yield contrasting results. Second, our study is a survey-based investigation of customer perceptions and may thus be affected by measurement errors. Future research can reach beyond perceptions and self-assessed behavior examine customers' actual purchase behavior by leveraging sales data or other behavioral metrics. Third, although we used a longitudinal design, our findings lack the long-term effect of SCO discontinuance. However, considering that we measured the customer response two months after the discontinuance event, we are confident that the observed changes were not mere initial, exaggerated reactions that would fade away shortly after the event. We expect that the effect of discontinuance had stabilized by the time of the post-period survey and

[4] Although there was no statistically significant effect, informal survey feedback from customers hints to the existence of hindsight bias. That is, even without explicit information about the motivations behind SCO discontinuance, customers rationalize the decision by assuming that it must have resulted from low usage or low efficiency.

thus the discontinuance is likely to have had a lasting effect to some extent. Still, to establish the persistence of these effects, more research should be conducted using an even longer time interval. Also, our collaboration with the retailers started only after they had introduced the SCO services in their stores, and thus we did not have a chance to collect data before the introduction of the service. An empirical setting where data is collected prior to implementation, during implementation and post-implementation would make an intriguing research design for exploring the interplaying effects of reference points (Tversky and Kahneman 1991) and service changes on customers' technology perceptions. In addition, that way one could also verify the initial effect of SST introduction on customer perceptions. Fourth, we study how SCO discontinuance affects customer perceptions of that same technology. Future research can look into how discontinuing a specific type of technology affects customer perceptions of other types of SSTs or technologies in general. In similar vein, while our focus has been on customers as end users, an interesting extension would be to investigate how staff's perceptions of technology and their own job performance (Jiang et al., 2001) are affected by discontinuance. Finally, we investigated a situation where a service provider discontinues the SCO and reverts to the original state before SCO introduction. However, in some cases service providers have introduced other value-adding services to replace the discontinued SCO; consider for instance Kroger's move to eliminate their SCOs and add metro checkout service as a part of their store remodeling project (FierceRetail 2011). Looking into such cases could bring invaluable insights into the phenomenon. In spite of these limitations, we contend that the findings of this study have valuable implications for both theory and practice and that our work has successfully opened avenues for future research of a previously under-explored topic.

## Declaration of competing interest

None.

## Appendix A. Constructs from the Surveys

**Table A1**
Measurement items

| Construct | Composite Reliability | Mean | SD |
|---|---|---|---|
| ***Satisfaction with SCO Technology*** [1,2] | .93 | 3.56 | 1.07 |
| I am satisfied with retail stores that have SCOs | | | |
| I am pleased to frequent retail stores that have SCOs | | | |
| SCOs improve the service of retail stores | | | |
| SCOs have a positive effect on my retail shopping experience | | | |
| ***Intention to Use Retail SCOs*** [3,4] | .96 | 3.41 | 1.31 |
| I intend to use retail SCO in the near future | | | |
| It is likely that I will use retail SCO from now on | | | |
| I will be using retail SCO whenever going to a retail store | | | |
| ***Perceived Efficiency of Retail SCOs*** [5,6] | .93 | 3.28 | 1.08 |
| I do my grocery shopping faster when I use retail SCO | | | |
| I spend less time at the store if I use retail SCO | | | |
| Paying for groceries is more efficient using retail SCO | | | |
| Using retail SCO expedites the checkout | | | |
| ***Perceived Simplicity of Retail SCOs*** [5,6] | .90 | 3.88 | .86 |
| I believe that I can use retail SCO without problems | | | |
| Using retail SCO is easy | | | |
| Self-scanning products is effortless | | | |
| Learning to operate retail SCO is easy | | | |
| ***Perceived Enjoyment of Retail SCOs*** [3,5] | .95 | 3.02 | 1.13 |
| Using retail SCO is fun | | | |
| Using retail SCO is entertaining | | | |
| Self-scanning products is fun | | | |
| Checkout experience is more enjoyable with retail SCOs | | | |
| ***Preference for Cash Payment*** [7] | .82 | 3.03 | 1.05 |
| I want SCOs to have the same payment mode than traditional checkouts | | | |
| A cash payment option would make SCO more useful | | | |
| Sometimes I prefer to pay my groceries with cash | | | |
| I would be more likely to use SCO if it had a cash payment option | | | |

*Note*: Items adapted from.
[1] Bhattacherjee (2001).
[2] Lin and Hsieh (2006).
[3] Venkatesh, Thong, and Xu (2012).
[4] Vijayasarathy (2004).
[5] Weijters et al. (2007).
[6] Davis (1989).
[7] Self-composed items. The items were measured on a 5-point Likert-scale: 1. Strongly disagree, 2. Disagree, 3. Neither agree nor disagree, 4. Agree, and 5. Strongly agree.

## Appendix B. Propensity Score Matching

The objective of PSM is to select treatment group (i.e., customers who experience SCO service discontinuance) and control group (i.e., customers who do not experience SCO service discontinuance) who are *similar* to each other in all relevant observable characteristics before the event of interest takes place (in our context, the discontinuance of SCO service). This method allows the creation of statistical equivalence between the two groups where control group acts as base case thereby facilitating comparison of causal effect of the event on treated customers (Rosenbaum and Rubin 1983). Based on prior studies, we use age, gender, education, household size, yearly income, and store distance as observable matching variables for propensity score analysis using a logistic model formulation (Guo and Frasier 2010; Ma et al., 2013; Wangenheim and Bayón 2007). Following PSM, we

were able to match 143 treatment group customers to *similar* 143 customers from the control group. Thus, we used a sample of 286 customers from both treatment and control groups for our subsequent empirical analysis using proposed DID method. Furthermore, we do not find significant effects of customer-specific demographic variables. This is understandable as we estimate our model on a matched pair of control and treatment group customers who resemble each other on these observable characteristics. Table B1 reports the PSM model parameters.

**Table B1**
Parameters from the logit model used for matching

| Variable | Estimate | Std. Error |
|---|---|---|
| Intercept | −.5151 | .8847 |
| Age | .0262*** | .0074 |
| Gender | .2012 | .2195 |
| Education | −.1844** | .0595 |
| Household Size | .4261*** | .0920 |
| Income | −3.4E-05*** | 7.0E-06 |
| Store Distance | 3.0E-05** | 1.2E-05 |

***$p \leq .01$, **$p \leq .05$, *$p \leq .10$.

We adopted one-to-one nearest neighborhood matching algorithm to obtain the propensity scores for matched pair of customers from control and treatment groups.[5] Table B2 shows the balancing of data before and after matching. After the matching step, the noticeable differences between treatment and control group reduce significantly.

**Table B2**
Balancing of data before and after matching.

| Variable | Treatment Group (T) | Control Group (C) | | | |
|---|---|---|---|---|---|
| | | Before matching (b) | | After matching (a) | |
| | *Mean* | *Mean* | *Difference* | *Mean* | *Difference* |
| | *(T)* | $C_b$ | $T\text{-}C_b$ | $C_a$ | $T\text{-}C_a$ |
| Age | 49.7483 | 45.0092 | 4.7391 | 50.2308 | −.4825 |
| Gender | .6993 | .6110 | .0883 | .6294 | .0699 |
| Education | 11.9860 | 12.9274 | −.9414 | 11.8042 | .1818 |
| Household size | 2.3916 | 2.0518 | .3399 | 2.2448 | .1469 |
| Income | 28881.1189 | 38113.5225 | −9232.4037 | 28671.3287 | 209.7902 |
| Store Distance | 7003.5664 | 4837.5927 | 2165.9738 | 7437.2168 | −433.6503 |

We also report the distribution and histogram of propensity scores of matched and unmatched control group customers to compare it against the propensity scores of the treatment group customers in Figures B1 and B2 respectively. Figure B1 shows the distribution of propensity score for the treatment group, matched control group and unmatched control groups customers. Before matching the distributions of unmatched control group and treatment group are quite different. This difference disappears after matching.

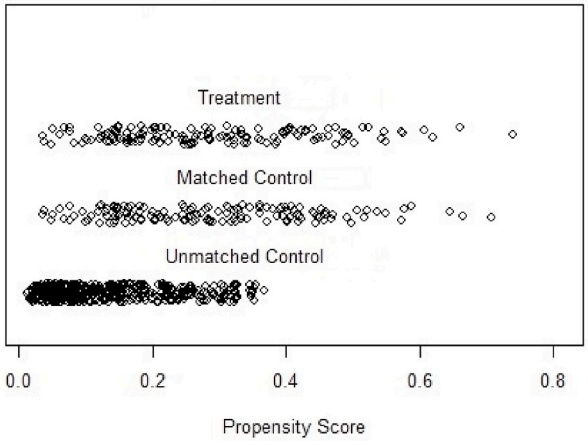


**Fig. B1.** Distributions of propensity scores.

Figure B2 shows the histograms of propensity scores for the treatment and, matched and unmatched control groups customers. Histograms for unmatched control group and treatment group are quite different. This difference vanishes after the matching, making the histograms of treatment group and matched control group similar.

[5] We checked the further robustness of our results by utilizing other matching algorithms too.

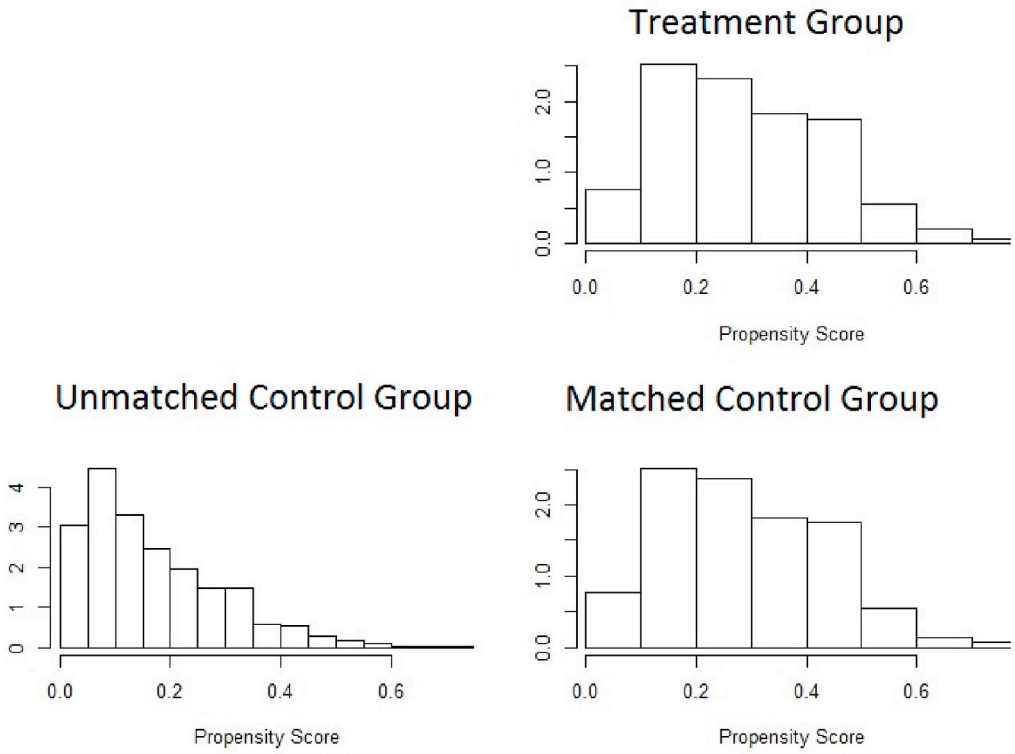


**Fig. B2.** Histograms of propensity scores.

Table B3 presents the DID model estimates for the matched sample (n = 286). The results are similar to the main model.

**Table B3**
Parameter estimates of the DID model on the matched sample

| Variable | *CustSat* | *IntUse* | *Efficiency* | *Simplicity* | *Enjoyment* | *BsktSz* | *Cash* |
|---|---|---|---|---|---|---|---|
| *Intercept* | 2.9905*** (.4042) | 2.8319*** (.4827) | 3.0869*** (.3959) | 3.4016*** (.3191) | 3.0485*** (.4228) | 2.2242 (1.7850) | 4.4173*** (.3844) |
| *TreatD* | −.0455 (.1286) | .0234* (.0136) | .0105 (.1259) | .2815*** (.1015) | .1084** (.0545) | .6280 (.1616) | −.1766* (.1023) |
| *ScoD* | .0163 (.1289) | .1109 (.1540) | .2051** (.1013) | .1706* (.1018) | .1168 (.1349) | .9354*** (1611) | .0748 (.1226) |
| *TreatD × ScoD* | −.0192*** (.0048) | −.1305*** (.0217) | .0699 (.1781) | −.0717** (.0344) | .0437 (.1902) | −3.1399*** (1.0277) | .0682 (.1729) |
| *Age* | −.0044 (.0036) | −.0084** (.0043) | −.0006 (.0035) | −.0024 (.0028) | −.0073* (.0037) | −.0018 (.0045) | .0018 (.0034) |
| *Gender* | .0988 (.0995) | .0999 (.1188) | .0264 (.0974) | −.0129 (.0785) | .1891* (.1041) | .0323 (.1223) | −.0835 (.0946) |
| *Education* | .0307 (.0267) | .0367 (.0318) | −.0029 (.0261) | .0254 (.0210) | −.0052 (.0279) | .0719 (.0433) | −.1056 (.0253) |
| *HH Size* | .1007 (.0426) | .1224 (.0509) | .0391 (.0417) | .0220 (.0336) | .1423 (.0445) | .5342 (.0332) | .0757 (.0405) |
| *Income* | 1.7E-06 (3.4E-06) | 3.8E-06 (4.0E-06) | 1.2E-06 (3.3E-06 | 5.0E-06 (2.7E-06) | −4.3E-06 (3.5E-06) | 1.2E-05 (4.2E-06) | −1.3E-05 (3.2E-06) |
| *Store Distance* | 9.4E-06 (5.1E-06) | 7.1E-06 (6.1E-06) | 2.7E-06 (5.0E-06) | 3.3E-06 (4.0E-06) | 1.0E-06 (5.3E-06) | 1.3E-05 (6.4E-06) | −8.6E-07 (4.9E-06) |

***$p \leq .01$, **$p \leq .05$, *$p \leq .10$.
(Numbers in parentheses are estimated standard errors of the corresponding parameter estimates).

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