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ORIGINAL EMPIRICAL RESEARCH

Unintended consequences of in-store technology for frontline employees: An empirics-first approach

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Abstract
This work illustrates a case in which the implementation of automated digital screens in an apparel retail store led to unintended side effects involving decreased customer spending. Using an empirics-first approach, researchers have investigated this topic through the conducting of field experiments, intercept surveys, and online experiments involving both consumers and frontline employees (FLEs). In this research, the unintended outcomes of technology implementation are first revealed, and then the potential reasons and boundary conditions underlying those outcomes are explored. The findings indicate that while automated digital screens increase customer convenience, they can also restrict the ability of FLEs to perform extrarole behavior. This restriction results in a negative shopping experience and reduced spending, particularly in settings in which FLE interaction is critical. The research also reveals that reintroducing extrarole behavior in the presence of technology can offset this negative effect. The theoretical and practical implications of these results are then discussed, and future research directions are proposed.

Keywords In-store technology · Frontline employees · Empirics first

Introduction

> "Consumers expect shopping to be **convenient** and instantaneous. Retailers are adding **technology** to their stores to make shopping in person a breeze." Karen Bomber, Senior Director of Marketing (Honeywell, 2022).
>
> "What truly makes for a good experience (in retail)? Speed. **Convenience**. Consistency. Friendliness. And one big connector **human touch**." (PwC, 2018).

It is widely recognized that the world is currently facing a significant decline in brick-and-mortar retailers in a shift toward online settings that is being referred to as the "Retail Apocalypse" by academics and practitioners (e.g., Mende et al., 2019). To address this trend, marketing managers are focusing on redesigning the in-store customer experience to make it smoother and frictionless through the use of high-convenience technologies (Larivière et al., 2017). Most of the high-convenience technologies that are adopted by brick-and-mortar stores are categorized as being high convenience-low social presence (HiCo-LoSo), which makes the customer experience smoother but does not imbue the encounter with a sense of social presence (Grewal et al., 2020). Examples of HiCo-LoSo technologies include in-store kiosks, digital displays, and self-check options.

Despite the increasing use of these technologies, empirical studies investigating their effects remain scarce, and the marketing literature has recently called for further research on this topic (Grewal et al., 2020). While the extant literature on HiCo-LoSo technologies has primarily identified the perceived benefits associated with their adoption in self-service settings (e.g., Johnson et al., 2008) and online contexts (e.g., Heller et al., 2019), much less is known about such adoption in other encounters involving frontline employees (FLEs). In other words, do the positive effects associated

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with HiCo-LoSo technologies extend to contexts that are not fully devoid of human interactions?

We consider the case of automated digital screens, a widely used HiCo-LoSo technology and the focus of the present research. Automated digital screen systems are platforms that combine digital displays with intelligent software to deliver automated messaging and real-time information to customers. In many service and retail settings, these digital signs are utilized to enhance customer convenience and streamline their experience. For instance, JW Marriott hotels have installed automated digital screens in various areas to inform customers about event schedules, conference timelines, and booking updates through cloud-based software (Ranjan, 2022). Similarly, numerous restaurants, such as the Wahlburgers restaurant chain, have implemented automated digital screens as smart menus. These screens are connected to a cloud-based interface that accounts for inventory, thereby informing customers about menu availability prior to their placing an order (Raydiant, 2022). Additionally, lifetime fitness centers have introduced automated digital screens that are seamlessly integrated with the company's back-end systems and display thousands of unique classes, events, and appointments daily (Navori, 2021).

What characterizes all these cases is that the technology, rather than fully replacing FLEs, assumes some of their tasks, as it is implemented in contexts in which human personnel continue to operate. This circumstance, which lies at the core of our investigation, raises the question of whether the insightful evidence regarding online and self-service contexts can be automatically extended to other more complex settings entailing the active involvement of FLEs and in which the interactions with customers constitute a component of the overall customer experience. In fact, in addition to enhancing customer convenience, brick-and-mortar store managers are facing the challenges posed by the surge of online shopping by leveraging the "human touch" that is provided by FLEs. In contrast to the online shopping experience, in-store customers often continue to be assisted by FLEs, who can engage, interact, and build rapport with customers (Gremler & Gwinner, 2008), as well as understanding their needs and responding with proper behavior (Selnes & Hansen, 2001).

The motivation for our research is as follows: marketers are under increasing pressure to improve the convenience of their service settings through the addition of HiCo-LoSo technology (such as automated digital screens) while also trying to provide human touch through the availability of FLEs. Most existing research on the impact of these technologies has been limited to online and self-service settings. Therefore, the question remains as to what happens when such technologies are implemented in contexts where FLEs continue to be involved in service delivery while having some of their tasks partially substituted by the technology. What are the effects of such implementation on customer shopping behavior?

Given the exploratory nature of our question and the fact that preconceived answers were difficult to advance in this case, we adopted an "empirics-first" approach for this research endeavor (Golder et al., 2022). In the first stage (*Stage 1: Identify opportunity*), we were able to conduct a field experiment (Study 1) in one of the stores of an apparel chain that had introduced automated digital screen technology that displays customer orders on digital screens. By randomly manipulating the presence of the technology in the store across different time windows, we found that the presence of digital screens reduced both customer spending and the number of purchased items, a finding that contrasts with previous studies on HiCo-LoSo technologies (as well as the expectations of the retail manager).

This evidence prompted us to conduct follow-up studies to investigate the factors that might more deeply explain this unexpected effect (*Stage 2: Explore Terrain*). At this stage, we combined our intermediate findings with insights from the literature "to pursue additional avenues for exploration, and to generate implications for theory and insights of interest to stakeholders" (Golder et al., 2022; p. 10). Drawing on the organizational frontline literature (Marinova et al., 2017), we first considered the possibility that automated digital screens modify not only customer behaviors but also FLE behaviors by delimiting the scope of personal interactions that can occur during a specific customer experience (Cadwallader et al., 2010). If such technology reduces the frequency and richness of FLE tasks, it might also undermine their interactions with customers, thus limiting their extrarole behaviors, i.e., such technology might constrain FLE behaviors that extends beyond prescribed actions, such as proactivity or responsiveness to customer needs (Netemeyer & Maxham, 2007). This line, we conducted four additional studies using multiple methods and sources (Davis et al., 2011).

We first found that the introduction of technology diminishes the interaction between FLEs and customers (Study 2) and reduces FLE extrarole behaviors, consequently leading to decreased customer spending and customer experience (Study 3). In Study 4, we found that reintroducing FLE extrarole behavior in the customer experience mitigates the negative impact of technology on customer shopping behavior. In Study 5, using FLEs as subjects, we corroborate the detected effect of technology on the intentions of FLEs to engage with customers and perform extrarole behaviors.

In the final phase of our study (*Stage 3: Advance Understanding*), we develop theoretical and practical insights into the implementation of technologies such as automated digital screens in service settings. The key message is that the introduction of HiCo-LoSo technology may not automatically improve customers' service experiences but could have an unintended effect on another key actor in the system: FLEs. Not accounting for such an effect can reduce our theoretical understanding of in-store technology adoption and lead to a misrepresentation of the practical implications of the phenomenon.

As per the *theoretical* contribution of our research, Table 1 lists the key empirical studies that investigated the effects of HiCo-LoSo technologies for customers thus far; the final row includes the present work, showing how it distinguishes from the extant literature.

First, compared to previous works on the topic of online and self-service contexts (e.g., Heller et al., 2019; Johnson et al., 2008), we examine more complex settings in which *both* technology and FLEs are involved in the service provision process. Second, we investigate the effect of HiCo-LoSo technologies on *both* real-world behaviors (e.g., customer shopping) and perceived outcomes (e.g., customer experience and FLE extrarole behavior), while prior studies have placed a sole focus on perceived outcomes (e.g., customer satisfaction). Third, our research extends the current literature by filling the gap concerning the (overlooked) possible effects of these technologies on FLE behavior. Our findings suggest that even if a technology does not directly target FLEs, its overall effect on customers can deviate from expectations, as technology can influence the interactions that FLEs have with customers.

In terms of *managerial* contributions, our insights are relevant for marketers that invest in technological solutions aimed at optimizing the service encounter design to ensure the convenience, ease, and frictionless nature of the customer experience. Due to the current push to make the consumer experience faster and more agile to better compete with online retail, managers can sometimes lose sight of the fact that ensuring service convenience can lead to a loss of social interaction, which is a foundational aspect of the customer experience. A rush to create a technologically advanced store can lead managers to make hasty decisions and implement technologies without considering all the possible consequences of their implementation. In this case, failing to provide employees with the necessary guidelines for coexisting with such technology can have negative consequences for the nature of their interactions with customers.

Finally, we consider the evidence of our work as impetus for future research that we hope can expand both our theoretical and empirical knowledge on the topic. Specifically, we suggest a range of potential avenues for future research to delve into technology shifts in service encounters and hope our research can deepen the understandings of both academics and marketing professionals alike and enrich the collective knowledge base on this subject.

Stage 1: Identify opportunity

Background literature

Although prior knowledge on the topic of interest, namely, the adoption of high-convenience technologies in settings involving FLEs, is limited, there is valuable background literature that can be used to determine the level of "theoretical sensitivity" to this topic (Glaser, 1978). Service convenience is a critical goal for retailers because it reduces the amount of time and effort that customers have to devote to various phases of their shopping journey (Berry et al., 2002). The time and effort that customers dedicate to shopping significantly affect their experiences, and cumulative evidence has shown that service convenience enhances customer evaluations of the service as well as customer satisfaction and retention (Seiders et al., 2007). Recently, companies have attempted to enhance convenience through the implementation of certain high-convenience technologies, such as self-checkout solutions, interactive kiosks, and augmented reality tools. These technologies, called High Convenience-Low Social Presence (HiCo-LoSo), are aimed at increasing convenience without triggering the perception of interacting with another human being (Grewal et al., 2020). Automated digital screens are an example of HiCo-LoSo technology. This type of technology provides specific information on digital screens that are positioned in convenient locations to facilitate the shopping experience. By giving consumers more control over their shopping time and effort, the technology increases the level of efficiency in their purchasing experience (Larivière et al., 2017).

As anticipated, prior studies have highlighted the positive effects of HiCo-LoSo technologies in online settings (Heller et al., 2019; van Beuningen et al., 2009) and self-service contexts (Meuter et al., 2000; Johnson et al., 2008), in which customers have limited or no interactions with FLEs. However, in many encounters, the service is not solely provided by technology but also involves employees, whose relationship with customers, which is known as rapport (Gremler & Gwinner, 2008), is one of the more critical aspects of the shopping process. In such cases, it is difficult to predict how the adoption of HiCo-LoSo technologies affects customer experiences when those customers continue to interact with FLEs. This difficulty is expressed well by Grewal et al.'s (2020, p. 109) probing challenge, in which they ask: "What if all futuristic in-store technology infusions became so convenient, without any social elements? Would this be beneficial or harmful to society?"

Table 1 Relevant empirical articles in which the effects of HiCo-LoSo technologies in service and retail settings are investigated

Article*	HiCo-LoSo Technology	Methodology	Service setting	Customers as subjects	FLEs as subjects	Main Findings	Dependent variables
Meuter et al., 2000	Various Self-Service Technologies (SSTs)	Critical Incident Technique	Online/ Self Service	X	-	– Satisfying SST incidents: Solved Intensified Need; Better than the Alternative; Did its Job – Dissatisfying SST incidents (Technology Failure; Process Failure; Poor Design; Customer-Driven Failure)	PERCEIVED/ INTENTIONAL: Customer Satisfaction
Selnes & Hansen, 2001	Online Banking	Telephone Survey	Online	X	-	– Transformation from personal service to self-service will have a negative or positive effect on loyalty based on the complexity of the relationships	PERCEIVED/ INTENTIONAL: Customer Loyalty
Johnson et al., 2008	Online Banking	Survey	Online	X	-	– Control/chaos, fulfill needs/create needs, and freedom/enslavement affect customer satisfaction	PERCEIVED/ INTENTIONAL: Customer Satisfaction
Wang et al., 2012	Self-service checkout	Longitudinal study	Self-Service OR FLEs	X	-	– Self-efficacy, satisfaction and habit affect customers' continued use of the technology	BEHAVIORAL OUTCOME: Customers adoption of the technology over time
van Beuningen et al. 2009	Online stock investment	Survey	Online	X	-	– Self-efficacy increases customers' financial performance perceptions, service value evaluations, and future usage intentions	PERCEIVED/ INTENTIONAL: Customers evaluation of their future usage intentions of the technology
Giebelhausen et al., 2014	Interactive Kiosk	Secondary Data Online Experiment	Self-Service OR FLEs	X	-	– Technology use during a service episode decreases service encounter evaluations when FLE engage in rapport building behavior, and increases evaluation when FLE do not do so	PERCEIVED/ INTENTIONAL: Service encounter evaluation
Heller et al., 2019	Augmented Reality	Lab experiments	Online	X	-	– Touch control, compared to voice control, positively affects consumer willingness-to-pay	PERCEIVED/ INTENTIONAL: Willingness to pay
Mishra et al. 2021	Augmented Reality/Virtual reality Mobile App	Lab experiments	Online	X	-	– Augmented reality/Virtual reality is more user-friendly, responsive and leads to a better user experience and recommendation intention compared to that of a mobile app in the context of buying hedonic products	PERCEIVED/ INTENTIONAL: Customers experience recommendation intentions
Present work	Automated digital Screens	Field Experiments Randomized survey Online Experiments	Technology AND FLEs	X	X	– Technology reduces FLE extrarole behavior and in turn, customer experience and customer shopping behavior – Technology reduces FLE intention to engage in proactive behaviors	BEHAVIORAL OUTCOME Customers' shopping behaviors & PERCEIVED/ INTENTIONAL: Customer experience FLE extrarole behavior

* The articles that investigated *customers' intention to adopt/use technology*, rather than the effects of using that technology, were excluded from the table because they lie outside the focus of our work. For the sake of completeness, we recall below the most important works identifying a number of factors that could influence the intention to use technology

The positive factors include ease of use (Dabholkar & Bagozzi, 2002; Curran & Meuter, 2005; Lin et al., 2007; Weijters et al., 2007), performance/fun (Dabholkar & Bagozzi, 2002; Weijters et al., 2007), perceived control (Lee and Allaway, 2002), consumer readiness (Meuter et al., 2005), capacity and relative advantage (Walker & Johnson, 2006), innovation characteristics (Meuter et al., 2005), usefulness, and reliability (Curran & Meuter, 2005; Lin et al., 2007; Weijters et al., 2007). In contrast, the negative factors include risk (Curran & Meuter, 2005; Walker & Johnson, 2006), cost, and time (Ding et al., 2007). Technology anxiety has also been shown to negatively impact the intention to adopt/use technology (Meuter et al., 2003), and forced use is associated with negative attitudes toward adopting/using the technology (Reinders et al., 2008). Furthermore, consumer demographics, such as age, gender, education, and income, have been studied as general influencing factors on technology adoption (Nilsson, 2007)

Marketing managers are increasingly relying on technology to increase the level of service convenience and optimize customer experience. Therefore, it is crucial for such managers to have a clear understanding of how to effectively implement the technology and its effects (Forbes, 2022). Despite this widespread pressure on technology adoption, the extant literature has yet to provide an answer to the challenge facing managers in regard to the effects of utilizing HiCo-LoSo technologies in more complex service settings in which FLEs play a key role. Therefore, we identified this lack as a valuable research opportunity.

> *Marketers are under pressure to increase service convenience using technology and FLE/customer rapport. However, the literature on the effects of HiCo-LoSo technologies has been limited to online or self-service contexts. Hence, what are the effects of these technologies in more complex settings that also involve FLE/customer interactions?*

Below, we start by describing the specific setting of the retailer that partnered with us for this research and the characteristics of the store technology that had been implemented.

Empirical setting

The managers who have decided to pursue service setting transformation to increase the level of service convenience include those of an apparel store chain that is located in a large European city. We partnered with these managers to investigate the impact of automated digital screens that had been introduced in one of their stores on customer shopping behaviors.

On average, customers spend 20 min to 1 h per visit in these stores, and ten FLEs are available during each work shift to provide expert advice, creative ideas, or simple assistance to these customers. To maximize the variety of products available, only one size of each item is displayed for sale: to obtain the desired size, the customer selects the displayed item and then visits the service counter. The FLE at the counter then sends the request to the warehouse, which is located in a separate section of the store. Then assigned a number, which corresponds to their order, and they wait in line next to the counter. Similar designs are used in various retail stores, such as Argos (apparel and sport equipment) or IKEA, in which customers must interact with employees to customize and complete their shopping experience.

The store that serves as our research target is relevant, representative, and consistent in size and product assortment with the other stores in the chain. The focal store recently introduced automated digital screens, which offer customers greater autonomy and flexibility. The way in which customers request their preferred clothing items remains the same, however. Customers still approach an FLE at the service counter to request the selected products, and the FLE sends a request to the warehouse to bring those items to the counter. However, sensors on the counter now read the labels on clothing items, and software matches the items to the corresponding orders. When the order is ready, the digital screens throughout the store automatically display the order number, and the appropriate customer can gather the requested product. This technology is aimed at providing customers with more freedom and autonomy in their shopping experience, as it enables them to continue browsing the store during order preparation rather than having to wait in a queue near the service counter.

The technology operates as follows: when the customer's order is entered into the system by the employee, a warehouse assistant sees the order on their terminal, prepares it, and sends it to the store through the lift. Sensors installed on the store's access door read the labels on the clothing items and transmit the information to the software. The software then matches the information received from the sensors with the appropriate item in the warehouse inventory and the customer's order number. In this way, the software can update the order numbers that have arrived at the service counter on all the screens in real time, thereby keeping the customers informed.

This technology enables the real-time/automated dissemination of information through software, and it qualifies as a "mechanical" form of AI (Huang & Rust, 2021), as it is a basic version capable of performing standardized tasks such as searching and matching information (reading labels and matching the labels with customer orders) and providing an appropriate response (updating the numbers on all the store screens in real time). It can be considered a HiCo-LoSo technology because it enables customers to reallocate their time in accordance with their preferences rather than having to wait in line. This allows them to engage in other activities, such as searching for other items or continuing to browse, while waiting for their order fulfillment. We have also empirically supported this assumption through an online study (see Web Appendix A).

Study 1: Technology and customer shopping behaviors

Procedure and design

This study is a field experiment aimed at investigating the effect of technology on shopping behavior (i.e., customer expense and number of purchased items). We conducted this study several months after the technology was first introduced in the shop. This should have been sufficient to reduce the potential biases that are associated with the "honeymoon effect", i.e., the benefits resulting from adopters' excitement in regard to novel options (Wells et al., 2010), as well as reducing the possible skeptical responses that reflect potential adopters' mental rigidities or resistance to change (Mani & Chouk, 2017).

To assess the effect of this technology, we randomly manipulated the presence of automated digital screens in the store during different time slots. Specifically, in some time slots customer orders did not appear on screens and numbers were called out by FLEs, thus requiring customers to remain near the counter to hear their orders, as had been the standard approach prior to adopting the technology (*technology absence*). Conversely, in other time slots, the orders typically continued to appear on screens throughout the shop, thus allowing customers to see them regardless of their location (*technology presence*). Figure 1 illustrates the service provision process used in both conditions, and Web Appendix B illustrates the digital screens that were used during the manipulation.

We conducted the experiment over a period of two weeks (aside from Mondays, when the store is closed). To avoid potential confounds, we selected two weeks in which no new promotions, changes in assortment, or special events were featured. We established 2-hour time slots, ranging from 11 am to 1 pm and from 3 pm to 5 pm, during which we implemented our manipulation. During these timeslots, the customer order numbers were not displayed on the screens, and the employee at the counter called either the numbers of the orders that were ready to be picked up (technology absence) *or* the numbers that remained displayed on the screens in the usual manner, thus leaving customers free to browse the shop (technology presence). We rotated the time slots to avoid any confounding factors related to the time of day. The retailer provided us with the observed measures for our dependent variables: these included, for each customer, the amount spent, and the number of items purchased during the period of manipulation. The main descriptive statistics of this study, as well as those of all the other studies that we conducted, are shown in Web Appendix C.

Results

As our dependent variables do not have right bounds in their measurement scales, we first conducted a test to check their level of skewness. Both customer spending (sk.= 3.58; $p<.001$) and the number of products bought (sk.= 4.69; $p<.001$) were heavily left skewed, and there were quite a few outliers in both distributions. For this reason, we tested the effect through the use of OLS estimation applying a logarithmic transformation of customer expenses as the dependent variable (b=-0.18; $p=.08$) (Table 2, Model 1). We also replicated our analysis using robust regression (Berk, 1990), in which each case is inversely weighted according to its level of influence in the OLS regression estimates, thus downplaying the role of outliers. When the order numbers were displayed on screens, customers spent significantly less than they did in the absence of technology (b=-22.05; $p=.036$) (Table 2, Model 2).

We then used Poisson regression to test the effect of the technology on the number of purchased items, and the results still reveal a small negative effect (b=-0.12; $p=.08$) (Table 2, Model 3). However, given the heavily skewed distribution of the number of purchased items, we replicated the analysis using an ordinal scale that features three levels (one product, two or three products, and more than three products). The results of an ordinal probit model replicate our original findings, showing that the presence of this technology reduces the number of purchased items (b=-0.25; $p=.042$) (Table 2, Model 4). A marginal analysis reveals that technology increases the chance of customers buying only a single product by 9.6% ($p=.039$) and decreases the chance of customers buying two or three products by 2.4% ($p=.039$) and that of customers buying more than three products by 7.2% ($p=.042$).

Robustness checks

First, it is possible that the effect of automated digital screens on both customer spending and the number of purchased items is weaker during weekends when customer volume is greater. Thus, we reconducted our analysis, this time including a dummy variable denoting the weekend. We found no interaction effect between the presence of the technology and the weekend on customer spending ($b=-0.77$; $p>.1$) or on the number of purchased items (b=-0.07; $p>.1$), thus suggesting that the negative effect of the technology on shopping behavior does not differ between the weekends and weekdays.

As an additional robustness check, we investigated whether our effect might differ for loyal customers (i.e., those with a loyalty card), who know the store very well and who had already tried the technology prior to the experiment. We first noted that there was no difference in the number of loyal customers across conditions ($\chi^2_{(1)}=1.90$, $p>.1$). We then replicated the analyses including a dummy variable for loyal customers: the results indicate that loyalty does not interact with our manipulation in predicting either customer spending ($b=12.95$, $p>.1$) or the number of purchased items ($b=0.28$, $p>.1$). The effect of this technology on customer shopping behaviors thus appears to be independent of customer loyalty.

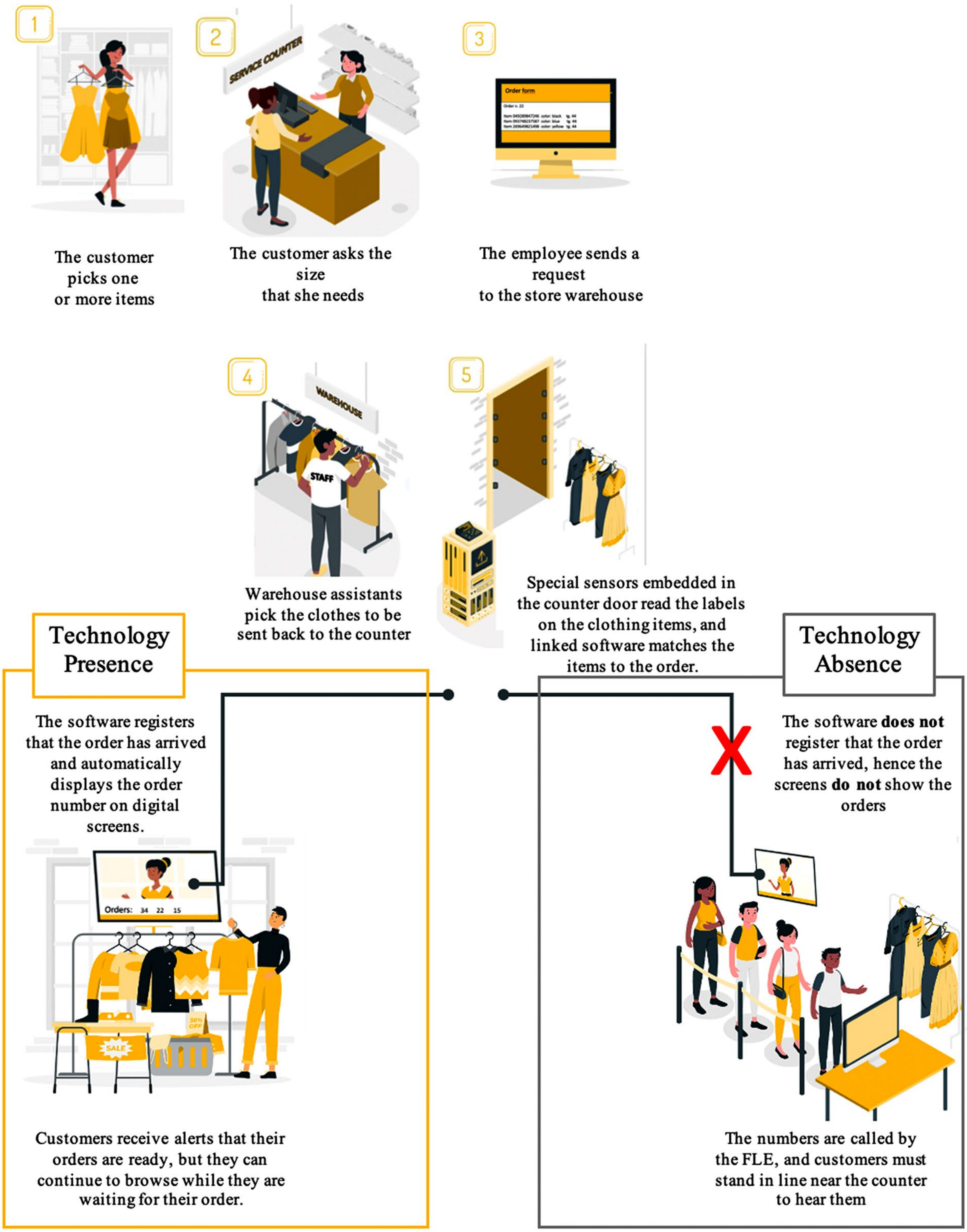

Fig. 1 Service provision in the technology-present and technology-absent conditions

Table 2 Results of study 1

	Model 1	Model 2	Model 3	Model 4
	Log Customer Spending (OLS)	Customer Spending (Robust Regression)	Purchased Items (Poisson)	Purchased Items (Ordinal Probit)
Technology Presence	-0.184*	-22.05**	-0.121*	-0.25**
	(0.106)	(10.47)	(0.069)	(0.12)
/cut1				-0.37**
				(0.17)
/cut2				0.70***
				(0.17)
Constant	4.874***	129.9***	1.019***	
	(0.147)	(14.59)	(0.091)	
Observations	779	779	779	779
R-squared	0.020	0.019		
Day FE	YES	YES	YES	YES
Hour FE	YES	YES	YES	YES

Notes: Standard errors are displayed in parentheses

*** $p < .01$, ** $p < .05$, * $p < .1$

Discussion

The results of Study 1 indicate the following evidence of interest:

i) The technology implementation in the apparel store chain did not produce the expected results. Specifically, store managers believed that allowing customers to roam freely around the store without having to wait in line would increase customer spending and the number of purchased items. However, the results show that the presence of the technology somewhat worsened customer shopping behavior, leading customers to buy fewer items and spend less.
ii) The positive results found by scholars investigating the effects of HiCo-LoSo technologies on consumers in self-service and online settings seem to not necessarily translate to a more complex setting such as ours, in which consumers interact with both technology and FLEs.

These interesting preliminary findings motivated us to delve more deeply into our investigation to understand the reasons underlying this unexpected effect of HiCo-LoSo technologies.

Stage 2: Explore terrain

Combining intermediate findings with prior knowledge

At this stage of our empirics-first approach, the detected evidence is further investigated, and the research question is expanded to facilitate a deeper understanding (i.e., exploring process mechanisms). In the following paragraph, we combine the results of Study 1 with the literature to identify the possible reasons behind the unexpected effect of automated digital screens on shopping behavior. This is important because this evidence is out of alignment with the results of previous studies, which have found positive effects of HiCo-LoSo technologies on customer satisfaction, evaluations, and willingness to pay in both online (Heller et al., 2019; van Beuningen et al., 2009) and self-service settings (Johnson et al., 2008). While searching for the factors that could account for this divergent evidence, one element that attracted our attention, and now qualifies our study, is the presence of FLEs when the consumer interacts with this technology.

Hence, drawing on the organizational frontline literature (Marinova et al., 2017), we begin by considering that automated digital screens may affect not only customer behavior (i.e., walking around the store rather than waiting in line) but also the relational behavior of the FLEs (i.e., FLEs interacting with the customers during the encounter). While HiCo-LoSo technologies are typically used to replace some of the tasks that had previously been performed by FLEs, thereby resulting in efficiency gains (Cadwallader et al., 2010), this approach can also reduce the frequency and richness of FLE tasks, potentially undermining their customer interactions.

The prior literature suggests that FLEs typically exhibit inrole and extrarole behaviors in regard to customers. Inrole behaviors generally reflect basic, scripted rules and specified job descriptions, while extrarole behaviors go beyond prescribed actions and include proactivity and responsiveness to customer needs (Netemeyer & Maxham, 2007). Bettencourt et al. (2001) showed that when FLEs take the initiative to communicate in detail with customers (i.e., extrarole), this communication can enhance the customer experience. In the presence of automated digital screens, the inrole scripts of FLEs might not be affected, but the overall scope of FLE actions can be reduced, including their extrarole behaviors taken to signal social commitment, proactivity, or the attitude needed for meeting customer needs. The reason for this is that technology makes customers more autonomous, thereby reducing their need for service (Di Mascio, 2010).

Along this line, Bitner et al. (2000) cited the lack of unprompted or unsolicited actions by FLEs as a main cause of service customer dissatisfaction; Wels-Lips et al. (1998) similarly found that the presence of extrarole behaviors improves the customers' reported experiences. Moreover, if automated digital screens encourage customers to reallocate their time and effort, it could be because they violate the social norms associated with close relationships with FLEs, potentially leading to negative effects on FLE extrarole attitudes (Williams & Aaker, 2002). For example, if customers avoid offers of assistance, FLEs may become less willing to devote extra effort to satisfying customer needs. Hence, the technology may not be effective as a result of these negative spillovers, which limit FLEs to in-role duties and discourage them from conducting extrarole activates to enhance customer service experiences.

Proposed mechanism: The negative effect of automated digital screens on shopping behavior may be due to fewer extrarole FLE behaviors.

Potential alternative explanations

While we proposed a possible mechanism for the impact of automated digital screens on not only consumers but also on the behavior of FLEs, we carefully scrutinized alternative explanations for the evidence detected in Study 1. The first alternative explanation involves a change in customer browsing behavior. The presence of digital screens may change not only customer behaviors when using the service, enabling them to walk around the store rather than waiting in line, but also their approach to searching for items *prior to* using the service. Customers in the technology absent condition may have noted that order numbers were not displayed on the monitors, and therefore people had to wait in line. This situation may have encouraged them to plan only a single visit to the service counter, thereby leading to a goal-directed search in which the customers deliberately focus on what they need prior to reaching the service counter (Moe, 2003; Janiszewski, 1998). In contrast, customers in the technology presence condition may have visited the service counter multiple times without waiting in line, employing an exploratory search in which the focus was less on consumption and making fewer or no purchases. This difference, if present, could explain the variation in customer spending between the two conditions.

A second alternative explanation concerns the behaviors that consumers exhibit in cases of service failure. Consumers in the technology absence condition may have perceived the technology manipulation as a service failure arising from equipment malfunction, and the presence of the equipment rather represents the status quo. Gabbott et al. (2011) argued that when consumers experience a non-severe service failure, they tend to engage in emotion-focused coping behavior, which involves the reinterpretation of the event to reduce the level of emotional tension. Coping through emotional processing leads to a positive reappraisal of stressor events (Stanton et al., 2000), which supports the claim that emotional management is positively associated with customer satisfaction and behavioral intentions. Consumers in the technology absence condition may thus have experienced minor service failures and employed an emotion-focused coping mechanism to compensate for the stressor event through the adoption of a more positive attitude and greater purchase willingness as compared to those consumers who did not experience service failure (i.e., those in the technology presence condition).

While such alternative explanations may have merit, they appear less likely than our proposed mechanism (i.e., change in FLE extrarole behaviors), as they both assume that consumers were already familiar with the technology before entering the store, which should have led to a less severe effect for loyal customers. As noted in Study 1, however, we did not find such an effect, which constitutes a piece of evidence that does not support those assumptions. In the following studies, in addition to providing support for our proposed mechanism, we attempt to empirically rule out these alternative explanations to further increase the robustness of our evidence.

Study 2: What happens at the service counter

We begin our exploration by investigating what "truly" happened at the service counter during our manipulation. Therefore, in Study 2, we replicated the manipulation of Study 1 during a weekend and developed an intercept survey that was administered to customers at the counter alongside observation. During the study, a researcher stood close to the service counter and asked all customers who approached about their level of interaction with employees while waiting for their orders. To measure the perceived interaction levels, we utilized a single-item scale (1 = "I did not interact with employees," 7 = "I interacted with employees the entire time"). The objective of this survey was to gather preliminary direct evidence that technology can alter the way in which FLEs engage with customers (i.e., our proposed mechanism). Additionally, the researcher calculated the actual waiting time for each customer and monitored the number of times that customers used the service. These measures helped us understand whether consumer search behavior is influenced by the presence of automated digital screens (i.e., the first alternative explanation described above). Usable information was obtained from all 98 customers who utilized the service, who made 103 total visits to the counter. The descriptive statistics are reported in Web Appendix C.

Results

An analysis of variance (ANOVA), which included the interaction level as the dependent variable and the presence of technology as the independent variable, revealed a strong effect ($F_{(1,102)} = 16.9$; $p < .001$; $\eta^2 = 0.143$). Specifically, we found that in the absence of technology, FLEs interacted with customers for an average of half of their waiting time (3.22, where 1 = no interaction and 7 = interacted the entire time), while in the presence of technology, the perceived time spent interacting with customers decreased to 1.81 (Fig. 2).

While administering the survey, the researcher also observed that in the absence of the technology, FLEs entertained customers near the counter, including helping them find additional clothes and accessories to include in their order that was already in progress. However, when the technology was present, these interactions decreased significantly because the customers were walking around the store while they waited for their orders, and the FLEs did not have opportunities or motives to interact with these customers. This observation is reflected in the significant difference in the amount of time that customers spent waiting for their orders between the two conditions ($F_{(1, 102)} = 6.58$; $p = .012$; $\eta^2 = 0.061$). A marginal analysis revealed that in the technology-present condition, the average waiting time was 7 min and 34 s, while in the technology-absent condition, the average waiting time was 10 min and 38 s. Although the technology was not aimed at reducing customer waiting time per se, which is also dependent on the warehouse's order fulfillment speed, such a time difference can also be attributed to the fact that FLEs interact with customers and suggest additional products that could be added to their orders, thereby increasing the preparation time on the part of the warehouse assistants.

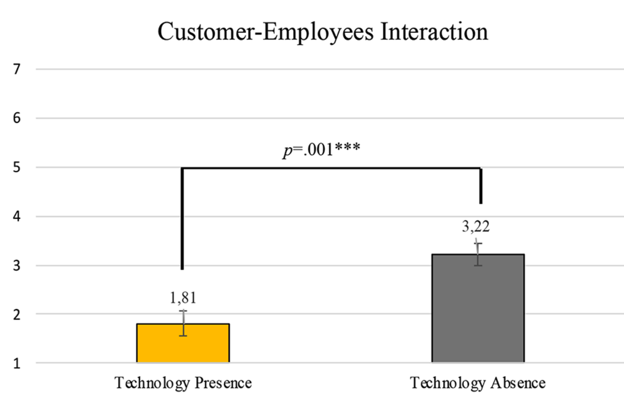

Fig. 2 Effect of technology on FLE interactions

We also tracked the number of times that customers visited the counter during their shopping visit: 95% of the customers visited the counter only once, and only 5% of the customers visited the counter twice. This proportion remained stable across conditions ($\chi^2_{(1)} = 0.05, p > .1$). Thus, regardless of the presence of the technology, consumers seemed to have already explored and chosen all the items that they wanted to try on or buy prior to visiting the counter. This evidence minimizes the possibility that customer search behavior contributes to the effect of technology on customer shopping behavior, thus empirically ruling out our first alternative explanation.

The results of Study 2 help clarify precisely what occurred at the service counter during our manipulation: customers felt that when the technology was absent and they had to stand in line, they engaged in more interaction with FLEs, who suggested additional items for their orders. Before proceeding with our investigation, two considerations are noteworthy. First, it is possible that the effect of technology is due to the suggestions of additional items by employees, creating a customer perception of being forced to buy more items they do not want, as it is easier to say no to a technology than it is to a person. This possibility seems unlikely because even if consumers feel pressured by FLEs at the counter to add more items to their order, once they collect their items from the counter, they go to the fitting room alone and are free to drop items that they do not want in the absence of FLE observation. Study 3, in which we collect measures of FLE extrarole behavior and customer experience, further clarifies the fact that customers do not feel pressured to purchase, as the FLE's extrarole behavior did not lead to a downgrading of their customer experience.

The second consideration pertains to whether suggesting additional or matching items is a behavior that employees consider an extrarole task. To clarify this, we surveyed 109 FLEs (average age: 38.6; 66% women) recruited from the Prolific Panel through an initial screening question available on the platform: "Are you employed in a customer-facing/frontline employee role such as retail or banking?" Participants who responded "yes" were asked to rate certain activities, including the suggestion of additional items to customers, as either in-role or extrarole behaviors on a scale ranging from −5 (in-role) to +5 (extrarole). Using a one-sided t test, we found that the score for suggesting additional items was significantly greater than 0 ($M = 0.53$; $t = 1.67$; $p = .049$), indicating that it is indeed viewed more as an extrarole (vs. in-role) behavior (see Web Appendix D for details).

Study 3: FLE extrarole behaviors

Procedure

In Study 3, our aim was to explore how FLE extrarole behaviors can affect the relationship between automated digital screens and customer shopping behavior. To this end, we conducted a randomized survey by intercepting a sample of customers outside the store after they had finished shopping over the course of two weekends. Specifically, a researcher stood outside the store during the study period to intercept and survey customers at the end of their shopping experience. This method enabled us not only to gather feedback from customers who did not make a purchase but also to obtain information regarding customer perceptions of their shopping experience. Although perceptual variables are less objective than the variables observed in Study 1, directly collecting customer assessments of their experiences in the store is useful for exploring our proposed mechanism.

To exclude mere visitors who might not have noticed the technology, we surveyed only those shoppers who indicated that they had requested at least one item from the warehouse. We obtained usable information from 186 customers, 97 of whom were in the technology-present condition and 89 of whom were in the technology-absent condition. Among these respondents, 144 (77%) made purchases, and 42 (23%) did not. Thus, the postpurchase survey captured a sizable number of potential customers; considering that the total number of purchasers in Study 1 was 335 over two weekends, we can estimate that our survey intercepted approximately 43% (144/335) of the total purchasers during the two weekends during which we conducted Study 3.

We are aware that postpurchase surveys impede randomization, but we checked for potential biases and found that they were not severe in this case. First, the proportion of customers who refused to participate in the survey was equivalent across conditions (37.8% vs. 36.2%, z =-0.41, $p > .1$). Second, the survey participants did not differ across conditions in terms of their average age (t = -1.51, $p > .1$) or level of education ($\chi^2_{(3)} = 1.39$, $p > .1$).

Measures

To measure FLE extrarole behaviors, we asked customers to provide their perceptions of the extent to which FLEs performed extrarole behaviors during their shopping experience. To capture these perceptions, we used a four-item scale adapted from Tax and Brown (1998) and Schneider et al. (1998), which is used to measure FLE readiness to address special requests or issues, engage in interactions, and exhibit empathy. A principal component analysis revealed that the scale is unidimensional and has high reliability (α = 0.94). However, the measure is strongly right skewed, with a median of 6, a standard deviation of 1.13, and a kurtosis index of greater than 5. This strong ceiling effect can be explained by the key role played by FLEs in this type of store and their overall service quality during the entire time that customers spent in the store rather than only during the time that they spent waiting at the counter (observed in Study 2). For empirical reasons, we dichotomized the original scale with a median split to account for the presence of FLE extrarole behavior only when customer perceptions were strictly above the median level (37%). Despite the loss of information associated with dichotomizing, the practice is acceptable in the presence of extreme skewness in the distribution of the original metric, which can lead to significant bias (MacCallum et al., 2002). Web Appendix E lists all of the measurement instruments.

Because the data were self-reported at the end of the shopping experience, we sought to minimize the potential for nonresponse due to privacy issues when measuring customer spending; accordingly, we used an ordinal scale with three levels to reflect the amount spent: 0 = 0€ (23%), 1 = less than 100€ (approximately the median value in Study 1) (31%), and 2 = more than 100€ (46%). We used a similar procedure to collect self-reports of the number of items purchased on an ordinal scale: 0 = zero items (26%), 1 = one item (24%), and 2 = more than one item (50%). Twenty-five out of the 186 respondents did not indicate the number of items that they bought, leaving us with a sample of 161 respondents for this variable.

For perceived customer experience, our goal was to measure the expectations regarding the experience in a specific context; hence, we adapted a subset of eight items from the scale developed by Schouten et al. (2007), who investigated customer experience in the specific context of a brand community. A principal component analysis revealed that the subscale is unidimensional and has good reliability (α = 0.90).

Moreover, to investigate whether customers engaged in emotion-focused coping mechanisms for minor service failures in the absence of technology (i.e., the second alternative explanation described above), we asked participants to indicate the extent to which they felt they had experienced a service failure during their shopping experience on a scale ranging from 1 to 7. Finally, we collected customer demographic information (age and level of education). The remaining descriptive statistics are included in Web Appendix C.

Results

To investigate the effect of the presence of the technology on our transformed binary measure of extrarole behavior, we used a probit regression featuring day and hour fixed effects and robust standard errors. The findings suggest that the presence of technology reduces FLE extrarole behavior (b = − 0.44, *p* = .026) (Table 3, Model 1). A marginal analysis revealed that the presence of automated digital screens decreased the probability of FLEs performing high levels of extrarole behavior by 16% points, taking it from 45 to 29%. When customer orders appeared on the screens, the FLEs were perceived as being less responsive and willing to engage in adaptive behaviors in their interactions with customers.

We checked whether customers who were exposed to the technology absence condition perceived the condition as a service failure to explore the possibility that customers had adopted emotion-focused coping mechanisms. The generally low perception of having experienced a service failure did not differ across groups (2.14 vs. 2.08; t = 0.27, *p* > .1). This suggests the second alternative explanation described above is somewhat unlikely.

Robustness checks

To increase the confidence in this outcome, we first investigated whether the effects of technology are dependent on visit frequency. We asked respondents how often they visited the store on a scale ranging from 1 ("this is the first time") to 7 ("every day"). We found that visit frequency did not moderate the effect of technology on FLE extrarole behavior (b = 0.06, *p* > .1), customer spending (b = 0.14, *p* > .1), number of purchased items (b = 0.16, *p* > .1), or customer experience (b = 0.06, *p* > .1). This evidence further reduces the likelihood of our second alternative explanation, as both

Table 3 Results of study 3

	Model 1	Model 2	Model 3	Model 4
	FLE Extra-Role Behavior (Probit)	Customer Spending (Ordinal Probit)	Purchased Items (Ordinal Probit)	Customer Experi-ence (OLS)
Technology Presence	-0.44**	-0.48***	-0.44**	-0.47***
	(0.196)	(0.17)	(0.19)	(0.18)
/cut1		-0.98**	-0.67**	
		(0.23)	(0.27)	
/cut2		-0.11	0.01	
		(0.22)	(0.26)	
Constant	-0.21			4.61***
	(0.226)			(0.23)
Observations	186	183	161	186
R-squared				0.08
Day FE	YES	YES	YES	YES
Hour FE	YES	YES	YES	YES

Notes: Robust standard errors are displayed in parentheses. OLS = ordinary least squares

*** *p* < .01, ** *p* < .05, * *p* < .1

the goal-directed search and emotional coping mechanism to a service failure presuppose consumer familiarity with the store and the technology. This explanation would imply an effect of technology that is attenuated by the frequency of visits, which is something that we did not observe.

Second, we checked how much time that customers thought that they had waited for their orders (1–7 scale) and found no difference in perceived waiting time across conditions (3.45 vs. 3.23; t = 1.05, *p* > .1). This finding is noteworthy because in Study 2, we observed that customers in the technology absence condition indeed waited longer, but customers did not seem to perceive this difference in their subjective assessments regarding waiting time.

Third, we tested whether the effects depended on individual perceptions of technology by collecting measures of optimism (α= 0.81), innovativeness (α= 0.80), and discomfort (α= 0.70) by using a subset of the technology readiness index scale (Parasuraman, 2000). None of these perceptions moderated the effect of the technology on customer spending (*p* > .1), the number of purchased items (*p* > .1), or customer experience (*p* > .1). Hence, the effects we found did not depend on the technology readiness of customers (see Web Appendix F).

The extrarole behavior of FLEs as a mediator

We then investigated a correlational mediation model that features our binary measure of FLE extrarole behavior as an intervening variable between technology and customer shopping behaviors. We began by estimating the total effect of the technology, and we found that an ordinal probit with robust standard errors supports the evidence found in Study 1 (b = − 0.48, *p* = .005) (Table 3, Model 2) while also acknowledging the possibility of nonpurchases. A marginal analysis revealed that the presence of the technology increased the chances that people would not buy by 14% (*p* = .004) and the probability that they would spend less than the median value by 4% (*p* = .012). Conversely, technology presence decreased the probability of customers spending more money by 18% (*p* = .003). A similar pattern of results emerged in regard to the number of purchased items (b = − 0.44, *p* = .019) and perceived experience (b = − 0.47, *p* = .009) (Table 3, Models 3 and 4).

To estimate the indirect effect, considering that our model includes a binary mediator and an ordinal dependent variable, we used the approach proposed by Kohler et al. (2011), in which the total effect is decomposed into its direct and indirect components for use in various nonlinear models. This analysis, which features bias-corrected bootstrapping (1,000 replications), revealed a significant indirect effect of FLE extrarole behavior on the relationship between the presence of this technology and our ordinal measure of customer spending (b = − 0.084; CI − 0.201, − 0.012). Regarding the number of items purchased, FLE extrarole behavior also exerts a negative indirect effect (b = − 0.111, CI − 0.284, − 0.020). Moreover, we found these same results for customer experience (b = − 0.117, CI − 0.294, − 0.021). This finding provides further evidence that in this context, FLE extrarole behaviors are not perceived as pressure by customers; rather, such behaviors seem to enhance (and not downgrade) the customer experience.

Discussion

Study 3 provides encouraging evidence that supports our proposed process mechanism, in that automated digital screens seem to reduce perceived FLE extrarole behaviors, which negatively impacts both customer experience and shopping behaviors. However, while meaningful, these findings have limitations, particularly regarding the correlational nature of the mediation results. For this reason, we conducted a follow-up analysis to detect process-by-moderation evidence (Vancouver & Carlson, 2015).

Follow-up study: Process-by-moderation

For this purpose, we leveraged one-week data that was similar to those used in Study 1, which also included shopping behavior during a lunch break (1 pm-3 pm). In this time window, the number of FLEs in the store is significantly reduced, which should limit their capacity to perform extrarole behaviors for customers. The interaction effect between technology manipulation and the lunchbreak indicator on purchase outcomes is consistent with the situation in which the effect of technology on shopping behavior is indeed dependent on the level of FLE extrarole behavior (which varies between regular and lunchbreak times).

The results of this follow-up study (see Web Appendix G for details) support the presence of significant moderation effects on both value (b = 0.61, $p = .019$) and volume of purchases (b = 0.96, $p = .002$). During the lunch break, the negative effect of technology disappears because, in the technology-absent condition, it is more difficult for FLEs to engage in the desired extrarole behavior. This evidence further corroborates our proposed explanation, yet it still indicates an "inferred" reduction in extrarole behavior. The next study (Study 4) addresses the attenuation of the negative effect of technology via the extrarole behavior of FLEs more directly through a controlled scenario-based experiment.

Study 4: Mitigation of the negative effect of technology

Procedure

Manipulating the actual behavior of FLEs, such as requiring FLEs to either serve or not serve customers, is both excessively invasive and unrealistic. For this reason, to investigate whether FLE extrarole behavior has the capacity to alter consumer shopping behavior in the presence of technology and attenuate its negative effect, we opted to conduct a scenario-based online experiment with four conditions, using customers as respondents. The goal of this study is to test whether, in the presence of technology, a restored interaction with FLEs who recommend additional items (extrarole behavior), at different points of the customer experience, affects customer intentions to add such items to their orders.

A total of 499 participants from the Prolific panel (49.5% women; average age: 36.8 years) were randomly assigned to one of four conditions. For each scenario, we determined how the service was to work in the store. Specifically, two scenarios simulate what had been observed in our previous studies, particularly in Study 2: the (1) absence of technology and interaction with FLEs who engage in extrarole behaviors while customers wait for their order (*notech-extrarole-waiting)* and the (2) presence of technology, under which customers are free to walk around the shop during their waiting time and FLEs do not engage with them (*tech-no extrarole)*. The comparison of these two conditions allows us to replicate the analysis conducted in the field studies, thereby adding to the robustness of our results.

The remaining two scenarios are focused on our expected attenuation mechanism and include the possibility that customers are exposed to FLE extrarole behaviors at two distinct moments even in the presence of technology. The first of these is 3) the presence of technology, with FLEs performing extrarole behavior *during the waiting period (tech extrarole waiting)*; and the final scenario is 4) the presence of technology, with FLEs performing extrarole behavior *while the customer is placing an order (tech extrarole order)*. The comparison of Conditions 2 with Conditions 3 and 4 is meant to assess whether the restoration of extrarole behavior can attenuate the effect of technology. The comparison of Conditions 3 and 4 is meant to illustrate whether the moment in which the extrarole is restored in the experience matters. We then asked participants to indicate the likelihood of adding additional items to their order using a single-item scale ranging from 0 to 100%. We also collected two measures related to FLEs: how *proactive* and how *intrusive* participants perceived the employee's behavior to be (on a single-item scale ranging from 1 to 7) The complete script of the experiment is provided in Web Appendix H.

Results

An ANOVA in which the likelihood of additional items being added to the order is used as the dependent variable and our scenarios are set as the independent variable reveals a statistically significant difference across conditions ($F_{(3, 495)}=18.54$; $p<.001$; $\eta^2=0.101$). To decompose this effect, we begin by examining the effect on the likelihood of additional items being added to the order in the first two conditions (*notech-extrarole-waiting* vs. *tech-no extrarole).* The contrast between these conditions reveals that in the scenario without technology and with FLE extrarole behaviors, the probability of adding additional items to the order increases by 17% compared to the scenario that includes the presence of technology but no extrarole behaviors ($M_{notech-extrarole-waiting}$ = 45.96, $M_{tech-no\ extrarole}$ = 28.97; $p<.001$). This result is consistent with the findings of our previous field studies, where we found that the presence of technology, which reduces FLE extrarole behavior, negatively impacts customer shopping behaviors.

Next, we tested our attenuating hypothesis by contrasting the *tech-no extrarole* condition with the two conditions in which FLEs perform extrarole behaviors, either during the waiting time (*tech-extrarole waiting*) or when customers place their order (*tech-extrarole order*). When FLEs perform extrarole behaviors during customer waiting times, there is a 21% increase in the likelihood of customers adding items to their order ($M_{tech-no\ extrarole}$ = 28.97, $M_{tech-extrarole-waiting}$= 50.45; $p<.001$). When FLEs engage in extrarole behaviors while customers are placing an order, that likelihood increases by 16% ($M_{tech-no\ extrarole}$ = 28.97, $M_{tech-extrarole-order}$ = 45.35; $p<.001$) compared to that in the scenario with no FLE extrarole behaviors. This evidence suggests that adding an extra role behavior in the presence of technology can eliminate the negative effect of such technology detected above, serving as an attenuation mechanism for this unintended effect of technology.

The contrast between *tech-extrarole-order* and *tech-extrarole-waiting* conditions is not significant ($M_{tech-extrarole-waiting}$ = 50.45, $M_{tech-extrarole-order}$ = 45.35; contrast: -5.10; $p>1$), suggesting that the timing at which FLEs perform extrarole behaviors is not relevant to their intention to add additional items to their orders. Similarly, our results show that the likelihood of additional items being added to the order in the two conditions of *tech-extrarole-waiting* and *tech- extrarole-ordering* is not significantly different from what we find in the *notech-extrarole-waiting* scenario ($M_{tech-extra-role-waiting}$ = 50.45, $M_{notech-extra-role-waiting}$ = 45.96; contrast: 4.49; $p>1$; $M_{tech-extra-role-order}$ = 45.35, $M_{notech-extra-role-waiting}$ = 45.96; contrast: − 0.610; $p>1$).

Regarding customer perceptions of FLE proactivity, which serves as the basis of their extrarole behavior, the results of an ANOVA show that this perception is significantly different across conditions ($F_{(3, 494)}=297.38$; $p<.001$, $\eta^2=0.644$). As expected, FLE behavior is perceived as more proactive in scenarios where there is interaction and extrarole behaviors than it is in scenarios where the FLEs do not engage with customers (*notech-extrarole-waiting* vs. *tech-no extrarole*: $M_{notech-extra-role-waiting}$ = 5.78, $M_{tech-no\ extra-role}$ = 2.50, contrast: 3.27, $p<.001$; *tech-extrarole-waiting* vs. *tech-no extrarole*: $M_{tech-extra-role-waiting}$= 5.68, $M_{tech-no\ extra-role}$ = 2.50, contrast: 3.18, $p<.001$; *tech- extrarole-order* vs. *tech-no extrarole*: $M_{tech-extra-role-order}$ =5.94, $M_{tech-no\ extra-role}$ = 2.50, contrast: 3.43, $p<.001$).

We also collected data on customer perceptions of FLE intrusiveness to determine whether there was a counterbalancing effect associated with FLE proactivity. As expected, customers' perceptions of FLE intrusiveness significantly differed across conditions ($F_{(3, 495)}=41.78$; $p<.001$; $\eta^2=0.102$). FLE behavior is perceived as somewhat more intrusive in scenarios where extrarole behaviors occur than in scenarios where they do not (*notech-extrarole-waiting* vs. *tech-no extrarole*: $M_{notech-extra-role-waiting}$ = 3.28, $M_{tech-no\ extra-role}$ = 2.28, contrast: 1.00, $p<.001$; *tech-extrarole-waiting* vs. *tech-no extrarole*: $M_{notech-extra-role-waiting}$ = 3.49, $M_{tech-no\ extra-role}$ = 2.28, contrast: 1.21, $p<.001$; *tech- extrarole-order* vs. *tech-no extrarole*: contrast: $M_{notech-extra-role-waiting}$ = 3.42, $M_{tech-no\ extra-role}$ = 2.28, 1.15, $p<.001$). It is worth noting, however, that although the average score for perceived intrusiveness is higher in scenarios that include FLE extrarole behavior, their average value is still low, at 3.39, which is below the midpoint of the scale (which ranges from 1 to 7).

We then tested the use of FLE perceived proactivity and intrusiveness as mediators in the relationship between FLE extrarole behaviors conditions (vs. no extrarole) and the likelihood of additional items being added to the order. We again used the KHB routine to decompose the effects of our correlated multiple mediators ($r=.23$; $p<.001$). Our results suggest that while intrusiveness produces small negative indirect effects on the outcome (indirect effects: *notech-extrarole-waiting* vs. *tech-no extrarole*: b = -4.34; $p<.001$; *tech-extrarole-waiting* vs. *tech-no extrarole*: b = -5.29; $p<.001$; *tech- extrarole-order* vs. *tech-no extrarole*: b= -4.99; $p<.001$), proactivity emerges as a stronger positive driver of the effect (indirect effects: *notech-extrarole-waiting* vs. *tech-no extrarole*: b = 20.83; $p<.001$; *tech-extrarole-waiting* vs. *tech-no extrarole*: b = 20.22; $p<.001$; *tech- extrarole-order* vs. *tech-no extrarole*: b = 21.86; $p<.001$). In short, the overall net indirect effect remains positive and statistically significant (indirect effects: *notech-extrarole-waiting* vs. *tech-no* *extrarole*: b = 16.49; $p < .001$; *tech-extrarole-waiting* vs. *tech-no extrarole*: b = 14.93; $p < .001$; *tech- extrarole-order* vs. *tech-no extrarole*: b = 16.86; $p < .001$), thereby indicating the dominant role played by FLE proactivity as the carryover mechanism.

Discussion

The results of Study 4 offer various insights. First, they support the findings of previous studies by indicating that technology, through its reduction of FLE extrarole behavior, diminishes customer shopping behavior. Second, and most importantly, the probability of adding items to an order significantly increases when FLEs engage in extrarole behavior even in the presence of technology. This effect occurs independently of the moment in which the extrarole behavior is provided, which occurs either while the customer waits for their order or during the actual order placement. This evidence suggests that reinstalling valuable customer/FLE interactions in the shopping experience can be a viable strategy for counterbalancing the potential unexpected effect of technology adoption in complex encounters. This finding also reinforces the explanation revealed through our previous studies, in which technology was deemed suboptimal because it constrained FLEs from engaging in valuable proactive interactions with customers. In fact, we also found that customers perceive FLE behavior as more proactive than intrusive; that is, they view employees suggesting additional items in a positive light.

As our proposed process mechanism concerns the impact of technology on FLE behavior, obtaining evidence through a direct investigation of the FLE side is important. We initially considered collecting data from the FLEs in the store, but this approach was deemed unsuitable. The FLEs, who were aware of our collaboration with the company's management, may have responded to our questions in a way that inflated their positive attitudes and behaviors, and the information thus provided may have suffered from social desirability biases, as is often the case in workplace surveys (Morrel-Samuels, 2002). Hence, we decided to proceed with a scenario-based online experiment to overcome the possible distortions that could emerge by the collection of field data from store employees.

Study 5: FLEs as a source of information

Procedure

We designed a scenario-based, online experiment in which we manipulated the presence of the technology and measured intentions to interact and perform extrarole behaviors among a sample of FLEs. We recruited 212 FLEs (50% women; average age: 28.3 years) from the Prolific panel by asking an initial screening question that was available on the platform: "Are you employed in a customer-facing/frontline employee role such as retail or banking?" Individuals who answered "yes" were randomly assigned to the technology-present or technology-absent conditions and asked to carefully read their scenario. The scenarios resembled the field manipulations conducted in previous studies. In the technology-present condition, these FLEs were asked to imagine that customers were free to walk around the shop, whereas in the technology-absent condition, they imagined that the customers had to wait in line near the counter to pick up their orders (see Web Appendix I). We then asked the participants to indicate the degree to which they would interact with customers as they waited (single item) and collected two measures of extrarole behavior: a reflective measure of specific proactive behaviors ($\alpha = 0.81$) and a general composite measure of proactivity (thinking ahead, being self-directed and bringing about change) (Bindl & Parker, 2011). We attempted to assess the willingness of FLEs to interact with customers and engage in extrarole behaviors, which required a different scale than that used in Study 3 for measuring customer perceptions of FLE extrarole behavior (see Web Appendix I)[1].

Results

An ANOVA utilizing FLE intention to interact with customers as the dependent variable and the presence/absence of automated digital screens as the independent variable revealed a statistically significant difference across conditions ($F_{(1, 211)} = 8.27$; $p = .004$, $\eta^2 = 0.038$). Among FLEs, we found greater willingness to interact with customers under the absence of this technology than under its presence ($M_{Tech-absent} = 4.73$; $M_{Tech-present} = 4.14$). Subsequently, a second set of ANOVA shows that FLE intentions to adopt both specific and general proactive behaviors were greater in the technology-absent condition. In particular, technology had a small negative effect on FLE intentions to engage in specific proactive behaviors in their interactions with customers ($F_{(1, 211)} = 3.04$; $p = .08$, $\eta^2 = 0.014$; $M_{Tech-absent} = 4.33$; $M_{Tech-present} = 4.04$), as well as a greater negative effect on their general proactivity ($F_{(1, 211)} = 7.86$; $p = .006$; $\eta^2 = 0.036$; $M_{Tech-absent} = 1.71$; $M_{Tech-present} = -0.50$).

[1] We also collected a measure of the extent to which FLEs were willing to entertain customers during their waiting time (single item). We found that FLEs would entertain customers more in the technology absence condition than in the technology presence condition ($F_{(1, 211)} = 5.23$; $p = .02$; $M_{Tech-absent} = 3.92$; $M_{Tech-present} = 3.41$, $\eta^2 = 0.024$). Moreover, as a check, we collected a measure of FLE extrarole behavior by adapting the scale that was used for customers in Study 3 ($\alpha = 0.79$). As expected, this measure was not informative here (mean: 6.02; SD:0.71; min: 3.5, max: 7) and thus was not used.

Discussion

These results, directly obtained from FLEs, reaffirm that the presence of this technology negatively affects FLE behavioral intentions. FLEs seem to be more willing to interact and engage in proactive behaviors with customers who are waiting at the counter, but they seem to refrain from engaging in these behaviors in presence of the technology.

Summary of studies

Our set of studies constitutes an in-depth investigation of a case in which the implementation of automated digital screens in an apparel retail store produced unexpected results. To increase our understanding of this phenomenon, we conducted three field studies (experiments, customer intercept surveys and observations) in the store and two experiments (with customers and FLEs as respondents) online.

In Study 1, we identified an unexpected effect of automated digital screens on customer shopping behavior and found that technology has a negative impact on both customer spending and the number of purchased items. In Study 2, drawing on the organizational frontline literature, we investigate whether technology modifies FLE behavior. We found the first evidence that technology reduces the level of customer/employee interaction in FLE/customer encounters. In Study 3, we analyzed the effect of automated digital screens on customer shopping behavior and customer experience, investigating whether FLE extrarole behavior can be considered a potential process mechanism. The results suggest that this technology inhibits FLEs from taking extra efforts to satisfy customer needs, which consequently reduces both customer experience and customer shopping behaviors. Hence, we show that in complex encounters that feature interactions among multiple actors, although the technology is addressed to one specific actor, it can have unintended spillover effects on other actors, which, if not managed, can offset the intended effect. In Study 4, we found that reintroducing FLE extrarole behavior, even in the presence of technology (i.e., customers freely walking around the store alone) positively influences the likelihood of customers adding items to their order, thus providing evidence of a possible means of attenuating the undesired effect of this technology. Finally, in Study 5, we investigated the unintended changes in FLE behavior from the perspective of the FLEs themselves. The results provided further support for our proposed process mechanism for the negative effect of technology on FLE intentions to interact with customers and perform extrarole behaviors. Table 4 summarizes the studies and their results.

Stage 3: Advance understanding

Theoretical insights: Greater convenience does not always entail a better customer experience

This work contributes to the extant body of research on technology transformations in service encounters. In contrast to previous findings (e.g., Heller et al., 2019), we propose that the implementation of HiCo-LoSo technology might not necessarily lead to an automatic enhancement of service provision. Rather we find evidence that the implementation of such technologies can have unintended negative effects on other actors, namely, FLEs, and that if not managed, this can backfire by negatively affecting the customer experience.

According to service-dominant logic, value is created through interdependent and mutually beneficial service exchanges among all the actors involved in the service system: technology, the firm, employees, and customers (Vargo & Lusch, 2014). Therefore, the effectiveness of a service system is determined by the interdependence of its interacting elements rather than by the individual consideration of any of them. A technology that increases service convenience and should therefore improve customer experience does not necessarily guarantee a positive overall customer experience if it also exerts undesirable effects on other actors in the system. Thus, the question remains as to how the potential of HiCo-LoSo technologies be exploited to improve the service experience.

To answer this question, we turn to configuration set theory (Doty et al., 1993), which suggests that the effectiveness of technologies in a specific context is not determined by a universal solution but rather by how the technology fits in with the other elements of the system (i.e., the firm, employees, and customers). Huang and Rust (2021) used a configurational approach to provide guidance for scholars and practitioners regarding which AI-powered technology should be implemented in stores according to the nature of the service task at hand. For utilitarian transactional service tasks, the most suitable technology is "mechanical" AI, which learns and adapts only to a minimal degree (Huang & Rust, 2021). In our empirical setting, order delivery at the service counter is a routine, transactional and utilitarian task because it "mainly provides instrumental, functional, and non-sensory benefits to customers" (Huang & Rust, 2021, p. 35). Therefore, adopting non-invasive and minimally adaptive mechanical AI, such as AI that enables automated digital screens, is expected to improve service outcomes. However, our findings suggest that this technology actually exerts a negative impact on the overall customer experience. Our research thus sheds light on a critical difference between technology and FLEs in regard to the performance of the

Table 4 Summary of the studies

Study	Method	Purpose	Main findings	Subjects
Study 1	Field experiment	• Investigate the effect of automated digital screens on shopping behavior	• The presence of automated digital screens has a negative effect on customer shopping behavior	Customers ($n=779$)
Study 2	Randomized survey (at the counter)	• Investigate the effect of technology on FLE customer interactions	• The presence of automated digital screens reduces FLE customer interactions s	Customers ($n=103$)
Study 3	Randomized survey (at the exit)	• Investigate the effect of automated digital screens on FLE extrarole behavior • Investigate the indirect effect of automated digital screens on customer shopping behavior (including nonbuyers) in response to FLE extrarole behavior	• The presence of automated digital screens reduces FLE extrarole behavior • Reduced extrarole behavior mediates the effect of the technology on customer shopping behavior	Customers ($n=186$)
Study 4	Online experiment	• Investigate whether FLEs extrarole behaviors, also in presence of the technology affect customers likelihood to add extra items to their order	• The probability of adding items to the order increases when FLEs engage in extrarole behavior even in the presence of technology (either while the customer waits for the order or during the order) • Perceived FLE proactivity mediates this effect • Customers perceive FLE behavior as more proactive than intrusive, that is, they view it positively when employees suggest additional items	Customers ($n=499$)
Study 5	Online experiment	• Investigate the effect of automated digital screens on FLE intentions to interact with customers • Investigate the effect of automated digital screens on FLE intentions to engage in extrarole behaviors	• The presence of automated digital screens reduces FLE intentions to interact with customers • The presence of automated digital screens reduces FLE intentions to engage in extrarole behaviors	FLEs ($n=212$)

service task. While technology performs the task efficiently, as predicted by Huang and Rust (2021), FLEs transform the routine task into a key relational moment with customers as those customers wait in line. This overlooked misalignment serves as the basis of our evidence, and this dynamic must be taken into careful consideration when adopting technology in a more complex service context.

This type of setting in which FLEs and technology coexist in service delivery has been somewhat neglected in previous literature, which has focused primarily on self-service or online settings. Our research extends the literature on this topic not only through an examination of the effects of technology in a more intricate setting but also through an exploration of its impact on the perceived and behavioral outcomes for both customers and FLEs. In this light, our studies also speak to organizational frontline research since our findings indicate that even if a technology does not directly target FLEs and involves a routine task, its overall effect may deviate from expectations because of its effect on FLE customer interactions. Similarly, in a recent article, Bonetti et al. (2022) investigated how the implementation of AI in retail and service settings can disrupt employees' methods of working, thereby causing them to resist change and the adoption of the technology. These authors have suggested that practice coevolution is the most effective strategy for ensuring that retail FLEs use in-store technologies. We extend the most recent observations of FLEs and show that the implementation of HiCo-LoSo technology can affect FLEs even if that technology is not directly targeted at them. Our findings highlight that such technology can unintentionally lead to employees placing a greater focus on in-role behaviors at the expense of extrarole behaviors, which, in turn, can impact customer experience and shopping behavior. In summary, we note that the overall effect of HiCo-LoSo technologies includes two components:

- The *planned effect* of technology on service convenience, which is to streamline the shopping experience, and.
- The *unintended effect* of technology on FLE behaviors through the reduction of their extrarole behaviors in customer interactions.

Both the *overall* effect and its sign are dependent on the relative magnitudes of the positive effect of service convenience and the negative effect of the reduced FLE extrarole behaviors. We graphically represent these two effects in Fig. 3.

Practical implications: Advising stakeholders of the unintended effects of in-store technology

Our theoretical insights are also relevant for managers who intend to invest in technological solutions to optimize their service encounter design and create a convenient, easy, and frictionless customer experience. Managers can sometimes overlook the fact that prioritizing service convenience through the use of in-store technologies as a means of competing with online retail can result in a loss of human interaction, which is a critical element in some in-person shopping experiences.

Additionally, for managers to consider the needs of employees when redesigning service encounters to increase the level of service convenience for customers is essential. Designing a service encounter that enables employees to work with commitment and conviction can ultimately lead to better customer experiences and business outcomes. Again, Bonetti et al. (2022) recently noted that many retailers fail to plan or execute any meaningful collaborative efforts with their FLEs during the implementation of such technologies. Manager eagerness to develop a cutting-edge store can prompt managers to make hasty decisions and implement technologies without fully considering their potential consequences. Failing to provide employees with the guidance needed to coexist with this technology can negatively impact employee customer interactions and the overall service outcomes.

Limitations and direction of future research

The widespread diffusion of technologies-in-store for the promotion of service convenience is an established phenomenon that has captured the attention of many scholars in recent years, and the rapid development and adoption of cutting-edge technologies, such as AI, has prompted scholars to predict and speculate about how these technologies can impact consumers (e.g., Huang & Rust, 2021; Marinova et al., 2017). However, most of the literature on this topic has been conceptual, while empirical analyses on the effects of implementing these technologies are lacking and tend to be focused on specific settings. Our work is one of the first empirical studies to investigate the effect of implementing HiCo-LoSo technologies on FLEs and, therefore, exhibits a reliance on obvious assumptions and limitations that can lead to further research. Below, we outline four main avenues for future studies, using our results as starting points and the impetus for future research (e.g., Cleeren et al., 2013; Golder & Tellis, 1997).

HiCo-LoSo interactive technologies

The main limitation of our study is that our findings rely on a single context; hence, additional empirical tests are needed to help expand and generalize our understanding of the identified phenomenon. For instance, what are the effects of HiCo-LoSo technologies other than automated digital screens, such as augmented reality and in-store kiosks, on customer shopping behavior and FLE behavior? Digital screens are not interactive. The active participation of customers in their interactions with the technology (e.g., through interactive kiosk touch screens) might attenuate the overall effect of reduced customer interactions with FLEs. What is the effect of HiCo-LoSo technologies that require customers to use their smartphones (e.g., augmented reality)? The unintended negative effect on FLE behavior could be further exacerbated by customers who focus all their attention on their smartphones, thereby neglecting to engage in interactions with FLEs. However, the use of smartphones may not cause customers to perceive a lack of interaction with FLEs, thereby reducing or reversing the overall effect of the technology on customer experience and shopping behavior. Further research can address these different cases.

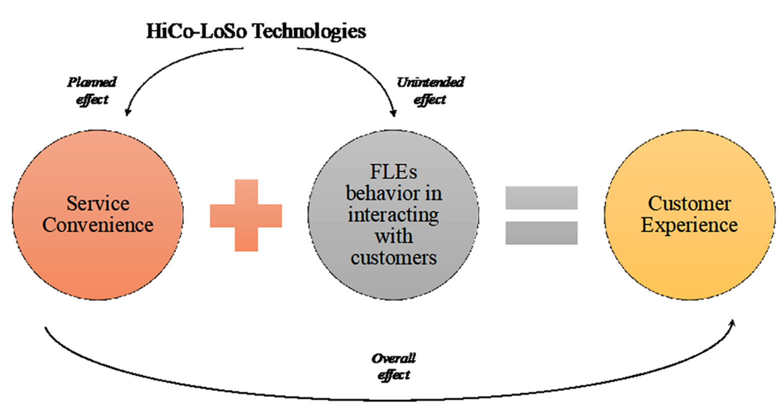

Fig. 3 Planned, unintended and overall effects of HiCo-LoSo technologies

Moderating factors on the effect of HiCo-LoSo technology on FLEs

What strategies can be adopted to reduce the unintended negative effects of this technology on FLEs? Can employees be motivated to engage in extrarole behaviors through training or incentives (e.g., monetary bonuses)? Bonetti et al. (2022) suggested that practice coevolution could be the best strategy for facilitating technology adoption and usage among FLEs. Can practice coevolution also work in the case of technologies that are not designed for FLE use? Can involving FLEs in the planning of technology implementation encourage their motivation or increase the risk of sabotage? Future research efforts can illuminate this aspect of technology adoption and identify the best ways to integrate FLEs into the technology adoption process.

Social pressure and concurrent purchasing

In our study, the interactions between customers and FLEs that occur at the service counter and at the moment of purchase happen at two distinct times, thereby allowing customers to independently and calmly decide whether to purchase the items suggested by FLEs. This delay between interaction and purchase helps to minimize the risk of social pressure unduly influencing the effect of technology on shopping behavior. However, in many retail and service contexts, the purchase occurs concurrently with the FLE interaction, such as in cafes or banks. In these scenarios, customers may feel forced into purchasing due to social pressure. The question then is, what is the effect of technology in these situations? On the one hand, the same effect of technology on customer spending that was detected in our study might be expected. On the other hand, an increase in customer spending might not correlate with an increase in customer satisfaction but might rather be a result of social pressure, potentially leading customers to reconsider their future purchases.

Choosing between HiCo-LoSo technology and FLEs

In our empirical setting, customers did not have the option to choose whether to use the technology or not. What is the effect of implementing an HiCo-LoSo technology if customers can choose to use it? For example, Giebelhausen et al. (2014) noted that technology use decreases (increases) service encounter evaluations when FLEs (do not) engage in rapport building. Similarly, Wang et al. (2012) explored HiCo-LoSo technology, namely, self-service checkouts, in a context where consumers were able to choose between FLEs and technology. Their findings revealed that self-efficacy, satisfaction, and habits influence continued customer use of the technology. However, what is the effect of this approach (in terms of the choice between FLEs and technology) on FLE behavior? According to configurational theory, FLEs might react positively to customers who choose to interact with them, dedicating time and effort to meeting the needs of those customers. However, FLEs may feel even more discouraged and demotivated by customers who prefer to engage with technology rather than engaging with them, thus leading to their avoidance of proactive behaviors with *all* customers before making a choice, thus ultimately driving more people to choose technology. Again, further evidence might help to extend our knowledge on this topic.

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