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RESEARCH PAPER

How smart technology empowers consumers in smart retail stores? The perspective of technology readiness and situational factors

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Abstract
Smart retail stores have been gaining momentum in smart retailing. Instead of relying on in-store staff like traditional counterparts, smart retail stores provide an unmanned environment purely enabled by various in-store smart technologies that support customers throughout the shopping journey. This unstaffed operating model also enables smart retail stores to provide competitive prices by reducing labor costs. However, studies have overemphasized the unique value offered by smart technology but discounted the common value strengthened in smart retail. This study applies the situational factor framework to identify both unique and common factors empowered by smart technology from a comprehensive perspective; then, technology readiness is incorporated to explore consumer purchase intentions in smart retail stores. A total of 283 survey data were collected and analyzed. The main results indicate that most situational factors have a direct effect on purchase intention, and technology readiness enhances the unique situational factors enabled directly by smart technology.

Keywords Smart retail store · Human-technology interactions · Smart retail · Smart technology · Situational factors · Technology readiness

JEL Classification L81 · C83

Introduction

With the rising tide of smart technology use in retail and smart retailing, delivering innovative retail services has become an unstoppable trend (Grewal et al., 2020; Shankar et al., 2021). The reasons are multifaceted. Nowadays, shoppers have gotten used to technology-empowered lifestyles; it becomes strategically imperative to promote sales by adopting in-store technology to offer novel experiences to increasing technology-ready consumers. The early move of the tech giant companies, e.g., Amazon Go (Amazon, 2022), toward futuristic retail modes, also inspires other players in the traditional retail industry to embrace smart retail transformation, such as Walmart's Intelligent Retail Lab (Walmart, 2019) and Aldi's Shop&Go (Aldi, 2022). Furthermore, the onslaught of the COVID-19 pandemic has made technology-driven retail businesses with less human contact more important and urgent than ever (Shankar et al., 2021).

The smart retail store is one of the emerging innovative retailing forms, enabling an unmanned and technology-driven retail environment that differs from traditional retail stores. It not only provides a superior physical retail experience that is unlikely to realize in online retailing, but also empowers customer purchases by combining various smart technologies, including facial recognition, QR codes, smart shelves, virtual shopping carts, product tracking, product recognition settlement, mobile payments, and self-service checkouts throughout the entire shopping process (Chang & Chen, 2021; Grewal et al., 2020; Shankar et al., 2021). With a competitive edge in providing 24/7 self-services and effective and efficient shopping

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experiences, smart retail stores also feature the notion of "first-mile" purchase convenience (Nayyar, 2019). Moreover, the contactless (i.e., "untact") service strategy facilitating customer encounters without interacting with frontline employees is favored by increasing consumers who emphasize autonomy, simplicity, efficiency, cost-effectiveness, and time management (Lee & Lee, 2020; Olsson et al., 2022). In light of a recent industry report, the market for smart retail stores has enormous growth potential, as it is forecasted to reach approximately 63 billion U.S. dollars by 2025, with a compound annual growth rate of a staggering 24% (Markets & Markets, 2020).

Smart technology empowers consumers in two aspects along the purchase process in smart retail stores. First, smart technology brings about *unique value* reflected in the higher level of convenience and the lower level of social presence (Grewal et al., 2020). Drawing on in-store smart technology, consumers obtain convenient shopping experiences, such as streamlined purchase processes, autonomous purchases, customized services, and improved efficiency (Adapa et al., 2020; Fan et al., 2020; Lin, 2022). With the real-time response of human-technology interaction, customers also acquire timely shopping support (Chang & Chen, 2021). In terms of social presence, smart technology can be seen as disruptive to the traditional retail industry by displacing in-store salespersons and cashiers and transferring partial shopping task responsibilities (e.g., checkout and shopping guide) from staffs to consumers (Lee & Lee, 2020). Smart technology eventually becomes the only medium consumers need to interact with throughout the shopping process. Therefore, the unique value is derived from technology per se.

Second, and more easily overlooked, the empowerment of smart technology is also embodied through strengthening product offerings, which is common/traditional value shared with traditional retail. Although smart technology is the main character in innovative retail modes, product value is still centered on the needs of consumers who are keen on value-for-money purchases (Lee & Lee, 2020). Smart retail stores also show advantages in fulfilling such utilitarian demand apart from novel experiences. Smart technology takes over traditional mechanical processes (e.g., cashiers and salespersons) involving substantial unskilled human labor for essential and repetitive works, which at the same time are non-creative and low-value-added (Huang & Rust, 2021). Thanks to the cost reduction of this kind of workforce, smart retail stores are financially able to sell homogeneous products at cheaper prices compared to traditional attended retail stores in the long run. Thus, products of high-cost performance also solidify the competitiveness of smart retail stores to distinguish them from competitors.

In general, smart technology provides win–win opportunities whereby retailers engage consumers with retail innovations and consumers acquire convenient and novel experiences and cost-effective items (Lee & Lee, 2020; Shankar et al., 2021). To the best of our knowledge, most studies nevertheless have only focused on the unique value, investigating technological motivations at the antecedent level (Chang & Chen, 2021; Lin, 2022; Park & Zhang, 2022) and in-store technology adoption at the consequence level (Aw et al., 2022; Barann et al., 2022; Roy et al., 2020). Smart technology empowerment is not only limited to technological aspects, but very little is known about how smart technology empowers consumers in a holistic and comprehensive manner in smart retail. To fill this gap, from an integrative perspective, this study aims to explore both the unique and common factors empowered by smart technology throughout the purchase process and their impacts on consumer purchase intention in smart retail stores.

From a consumer's point of view, the entire purchase process of performing self-service purchase tasks involves four main procedures: entrance, product selection, transaction, and exit, with intensive human-technology interactions throughout the process (Fig. 1). Specifically, new entrants need to complete registration and enter the store by scanning the QR code with their mobile phones. Since smart retail stores feature cost-effective products, customers whose shopping goal is to buy value-for-money products will then make purchasing decisions based on comprehensive evaluations of price and quality. Moreover, smart technology will serve as a virtual shopping assistant providing consumer support, including information searching, shopping guidance, and self-service checkout.

This study employs the framework of situational factors (Belk, 1975) to capture the aforementioned crucial factors embedded in the entire purchase process. Four dimensions are adopted to identify relevant consumer situations in smart retail stores. Specifically, entrance convenience is characterized as physical surroundings to reflect consumer assessments of the entrance design. Ease of interaction and usefulness of interaction are characterized as social surroundings enabled by human-technology interactions in the unmanned shopping environment. Transaction convenience is characterized from a temporal perspective to reflect customer perceptions of shopping efficiency. Merchandise price and merchandise quality are characterized as task definitions to reflect product value that is regarded as the common grocery shopping goals of most ordinary consumers. Furthermore, as suggested by several recent studies (Grewal, et al., 2020; Guha et al., 2021), this study considers technology readiness (Parasuraman, 2000) as a relevant consumer trait to explore how it shapes consumer perceptions of the situational factors that related to human-technology interactions. In particular, this study aims to address the following questions:

(1) What are the main situational factors empowered by smart technology in smart retail stores?
(2) How do these situational factors facilitate customers' purchase intention?
(3) How does technology readiness affect customers' perceptions of situational factors?

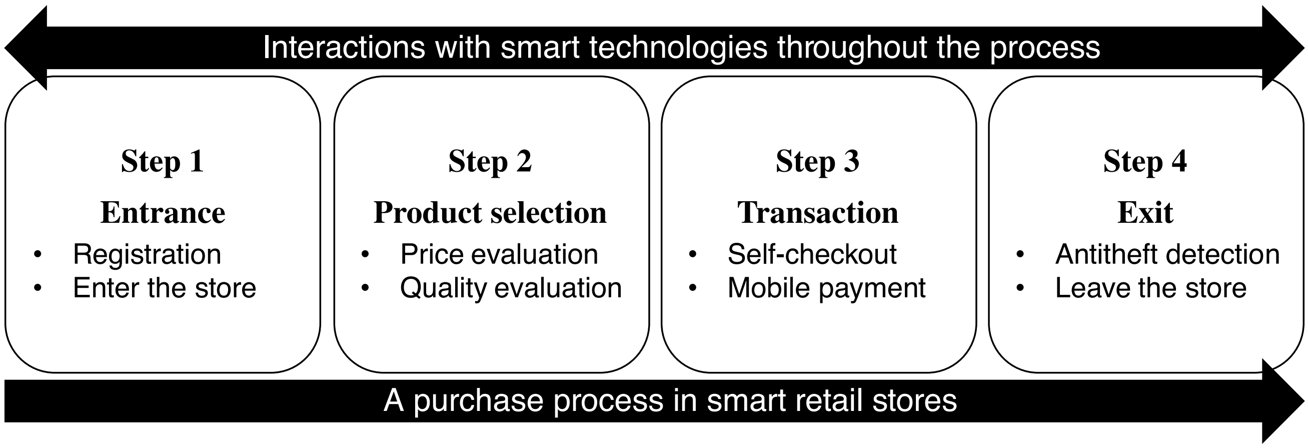

Fig. 1 Purchase process in smart retail stores. Notes: The purchase process of a smart retail store varies depending on the business model the store applies

The theoretical implications are threefold. First, this study contributes to the smart retail literature by exploring the factors driving customer purchases in smart retail stores from a comprehensive perspective. The study not only considers unique factors directly enabled by smart technology but also common factors shared with traditional retail but enhanced in smart retail. Second, this study identifies six smart technology–empowered situational factors throughout the shopping process and investigates their impacts on purchase intention. Third, technology readiness is considered an antecedent of situational factors in the research model to explore the role of an individual's inclination to accept and use new technologies.

This study also contributes to the innovation and technology management of smart retail stores and provides managerial suggestions that could facilitate retailer performance and service quality. The results indicate that customers are willing to shop in smart retail stores because they can shop with novel smart technologies and fewer expenses than shopping in other alternatives. In addition to adhering to the strategy of providing cost-effective products, retailers are suggested to create a supportive, convenient, and customer-centric shopping environment that facilitates customers' positive perceptions of their purchase situations, which in turn boosts purchase intention. Moreover, in the case of different levels of technology readiness, customer acceptance of emerging smart retail stores may vary. Thus, tailored publicity and marketing campaigns should be carried out to cater to diverse customer characteristics and develop a wide-ranging customer base.

The remainder of this study is organized as follows. The "Literature review" section reviews the previous literature on smart retail stores, situational factors, and technology readiness. The "Hypothesis development" section proposes the research model and hypotheses. The "Methodology" section presents the research methodology, followed by the result analysis in the "Results" section. The "Discussion" section discusses the main findings and theoretical and practical implications. The "Conclusion" section presents the conclusions and limitations.

Literature review

Smart retail store

Smart retail stores are unmanned physical stores that employ smart technology to provide innovative and self-service retail experiences. In-store smart technology in smart retail stores can be categorized into two types, retailer-facing and consumer-facing technologies (Shankar et al., 2021). The retailer-facing type refers to technologies that are implemented in the stores but cannot be directly perceived or touched by customers, such as inventory management systems, personalization and recommendation systems, Internet of Things (IoT), and 5G infrastructure for smart retail (Chang & Chen, 2021; Lin, 2022; Riegger et al., 2022; Roe et al., 2022; Shankar et al., 2021). The consumer-facing type refers to technologies that are exposed to consumers and intended for consumer interaction, including digital displays, smart interactive devices, RFID tags, QR codes, smart shelves, smart mirrors, and self-checkouts (Grewal et al., 2020; Hauser et al., 2021; Maass & Varshney, 2008; Resatsch et al., 2008). This study focuses on the latter as it is of higher consumer relevance in purchase situations.

Smart retail stores differ from traditional offline and online retailers. As to physical retail, smart retail stores are different from either traditional attended retail stores or digitally transformed/developed retail stores. The core distinction lies in that (1) traditional attended retail stores totally rely on the operation and management of in-store personnel to deal with consumer inquiries and checkout and that (2) digitally transformed/developed retail stores are only an upgraded version of the former through adopting e-service touchpoints (Barann et al., 2022) or implementing partial technological solutions reducing, rather than replacing, manual operation, including retail information systems (e.g., inventory management, retail enterprise resource planning), self-service checkouts, and mobile payments; in other words, digitally transformed retail stores still largely provide a staffed shopping environment for customers. Additionally, smart retail stores do not encompass vending machines alike self-service business models that do not offer an immersive in-store shopping environment with various embedded smart technologies (Stoyanov, 2021). Apparently, the "brick and mortar" nature also distinguishes smart retail stores from online retailers, which can never fulfill consumers' need for a tactile retail experience.

Scholars showed optimism about technology-driven smart retail. Huang and Rust (2021) claimed that technology applications, such as self-service technologies, will replace more and more mechanical tasks that have long been undertaken by retail salespersons, and reform traditional service encounters. Similarly, Lee and Lee (2020) referred to this unstaffed service strategy, involving less or even no human contact, as the "untact" service, which is defined as "service that is provided without face-to-face encounters between employees and customers through the use of digital technologies" (p. 3). The technology-driven retail becomes more important than ever in response to the COVID-19 disruptions (Olsson et al., 2022; Shankar et al., 2021). As emphasized by Grewal et al. (2020), smart retail stores representing one of the futuristic retail modes feature increased convenience through various smart technologies assisting consumer shopping journeys (Roy et al., 2020) and decreased social presence through the unmanned store environments enabling pure self-service purchases (Lin, 2022). Furthermore, the success of smart retail also depends on consumers with an increasing level of technology readiness facilitating both utilitarian and hedonic shopping experiences (Chang & Chen, 2021).

Various smart technology applications in the retail industry have attracted increasing academic attention, with an emphasis on unique value generated by technology. For example, RFID technology enables smart store environments through automatic product movement tracking (Hauser et al., 2021), IoT applications contribute to experiential components in the consumer journey (Roe et al., 2022), technology-enabled personalization facilitates consumer in-store decisions (Riegger et al., 2022), smart mirrors leveraging augmented reality (AR) allow consumers to digitally try on the clothes visualized in three dimensions (Ogunjimi et al., 2021; Qasem, 2021), and interactions with in-store technology improve consumer shopping effectiveness (Adapa et al., 2020; Roy et al., 2020).

Smart technology also reinforces traditional value concerning shopping needs, such as reasonable prices and good quality (Lee & Lee, 2020). Thanks to the unstaffed business model reducing manual operation costs, smart retail stores generally sell homogeneous products at cheaper prices compared to traditional competitors; the improved product value can also be their competitive advantage. Therefore, smart retail stores not only provide consumers with unique value of technology convenience and novelty but also improve traditional value reflected in product cost-effectiveness. However, the aforementioned studies have only emphasized the unique value purely brought about by smart technology adoption but discounted the strengthened common/traditional value in product offerings shared with traditional retail, thereby leading to the limited perspective of the empowerment of smart technology for consumers in smart retail stores.

Overall, smart technology empowers consumers in every stage of the shopping process in smart retail stores (Fig. 1). At the entrance stage, consumers need to register by scanning QR codes to enter the store, and transaction convenience is key for this procedure. Cost reduction of frontline employees contributes to competitive pricing; thus, merchandise price and merchandise quality are key criteria for consumer evaluation of product value in the product selection stage. The transaction stage entails self-checkout to complete the payment, and transaction convenience is key in this situation. Finally, consumers leave the store by passing through the smart door embedded with anti-theft detection in the exit stage. Moreover, smart technology plays a vital role in assisting consumers throughout the shopping process, and ease of interaction and usefulness of interaction are key for the entire process. Overall, because consumer situations in smart retail stores are quite different from those in traditional counterparts, this study uses the situational factor framework ("Situational factors" section) to capture these abovementioned factors to investigate consumer purchase intention.

Furthermore, facing smart technology–driven retail innovation, some consumers may appreciate it, but some may treat it negatively (Chang & Chen, 2021; Roy et al., 2020). In other words, when every shopping step must be conducted by customers themselves, using smart technologies to complete purchases may require a high level of technology readiness, and insufficient technology readiness may even hinder purchases (Park & Zhang, 2022). Thus, this study further incorporates technology readiness ("Technology readiness" section) to explore its effect on situational factors in the smart retail context, which also responds to several scholars' calls for research focusing on the role of technology readiness in smart retail (Grewal et al., 2020; Shankar et al., 2021).

Situational factors

Belk (1975) defines situational factors as “all those factors particular to a time and place of observation which do not follow from a knowledge of personal (intra-individual) and stimulus (choice alternative) attributes and which have a demonstrable and systematic effect on current behavior” (p. 158). Later, situational factors, as forgettable “little things” but crucial determinants, began to be roundly investigated in academia, including physical decoration, social interaction, time cost, and merchandise attributes (Chen et al., 2020, 2022; Collier et al., 2015). In the retail context, situational factors have also been identified as the main factors of consumers’ behavioral intentions (Barros et al., 2019; Kvalsvik, 2022; Olsson et al., 2022).

Situational factors can be divided into five dimensions, namely physical surroundings, social surroundings, temporal perspective, task definition, and antecedent states (Belk, 1975). Physical surroundings refer to the visible store environment, including layout designs, color, and cleanliness, which can influence customers’ positive emotions and promote their shopping decisions (Chen et al., 2022). Social surroundings refer to the social dimension of consumer situation, such as the need for interpersonal interactions, the presence of other people (e.g., supportive sales staff and friends), and social interactions, which can also increase the possibility of customer purchases and innovation adoption (Atulkar & Kesari, 2018; Chocarro et al., 2013; Collier et al., 2015). Temporal perspective refers to a time-related dimension that captures the effects of time on individual behavior, such as transaction time, waiting time, and time consciousness (Chen et al., 2018; Olsson et al., 2022); these factors significantly affect consumer purchase (Chang et al., 2014; Chocarro et al., 2013). Task definition is described as being task-oriented and regarding personal beliefs and motivations in shopping situations. For example, consumer purchases may depend on the extent of urgency and necessity of the products (Kazancoglu & Aydin, 2018); customers would like cost-efficient products (Chen et al., 2022; Lee & Lee, 2020). Antecedent states can be regarded as temporary emotions (or conditions) in both physical and psychological aspects, including anxiety, pleasure, fatigue, and illness (Barros et al., 2019).

Studies have validated the role of the above-mentioned multidimensional situational factors in explaining consumer motivations and behaviors in traditional shopping modes (Chang et al., 2014; Poncin & Mimoun, 2014). Belk’s (1975) framework for situational variables is a flexible and comprehensive theoretical foundation that has been widely used to analyze the situations facing consumers and explain consumer purchase behaviors. As summarized in Appendix 1 Table 4, by combining five dimensions of situational variables or attributing the relevant constructs in the framework of situational factors, researchers have identified an array of situational factors relevant to consumer shopping experiences.

In the smart retail context, this study adopts four dimensions (i.e., physical surroundings, social surroundings, temporal perspective, and task definition) to comprehensively capture unique and common value empowered in the shopping processes. Specifically, given that smart retail stores are unmanned and self-service, the impact of entering the stores might stand out in other physical layouts. Therefore, entrance convenience is characterized as physical surroundings. Considering that in-store smart technology replaces salespersons and plays a helpful assistant role in customer shopping processes through human-technology interactions, the interfaces and functionalities of smart technology would be essential in this study. Therefore, ease of interaction and usefulness of interaction are characterized as social surroundings. This study describes transaction convenience as a temporal perspective because the speed of self-checkout might be crucial for customer shopping decisions without the traditional manual checkout option. Considering that purchasing cost-effective merchandise would be general customers’ grocery shopping goal, merchandise price and merchandise quality are characterized as task definitions. Exit-related factors are not considered determinants of purchase intention, as consumers generally complete their purchases before leaving the stores.

These situational factors also implicitly echo the notion of the 4Cs. 4Cs suggest the consumer-centric marketing strategy entailing customer needs and wants, cost, convenience, and communication. Merchandise quality is a component of the “customer” dimension reflecting consumer demand for value-for-money products in everyday grocery shopping situations; merchandise price is a component of the “cost” dimension reflecting price competitiveness; entrance convenience and transaction convenience are components of the “convenience” dimension reflecting purchasing efficiency; and ease of interaction and usefulness of interaction are components of the “communication” dimension reflecting human-technology interactions.

While the other four situational factors (i.e., entrance convenience, ease of interaction, usefulness of interaction, and transaction convenience) are characteristically relevant to smart retailing, merchandise price and merchandise quality may seem not. Although smart retail stores differ from the majority of existing retail business models, they still share commonalities (i.e., homogeneous products). In other words, smart retail stores indeed provide customers with novel shopping experiences, but the products of the stores are not unique at all to distinguish them from competitors. Nonetheless, thanks to the cost savings of manual operations in smart retail stores, the same products in smart retail stores are generally cheaper than their traditional counterparts. Product cost-effectiveness can be a competitive edge for smart retailers to attract consumers. Therefore, inclusion of merchandise price and quality is also relevant in consumer situations, and consumers may tend to evaluate these factors with reference to the same or similar products in other retail channels before making a purchase decision.

On the other hand, inclusion of these two factors in the research model is not only for the complete application of Belk's (1975) work to depict comprehensive in-store consumer purchase situations but also to explore whether price or quality factors are still important for shopping decisions as they are in traditional retail stores. Studies have revealed that consumer perceptions and behaviors vary across different purchase situations; for example, shoppers are less price-sensitive with (vs. without) a shopping companion (Merrilees & Miller, 2019) and spend more time in the store (Grewal et al., 2018) and purchase more (Kowatsch & Maass, 2010) with (vs. without) in-store use of smart mobile apps. However, given the novel shopping environments, the effects of price and quality perceptions in smart retail stores remain uncertain. As the first attempt of applying a situational perspective to smart retailing, this study also examines the role of merchandise price and merchandise quality in purchase intention.

Technology readiness

Technology readiness is defined as "people's propensity to embrace and use new technologies for accomplishing goals in home life and at work" (Parasuraman, 2000, p. 308). In the seminal work of Parasuraman (2000), cutting-edge technologies do bring about better experiences for some tech-savvy users, but innovative technologies may be too complex for other users. In other words, new technologies can not only increase user adoption but also cause user disillusion and frustration. However, a person can harbor positive and negative perceptions of such new technologies simultaneously. He/she can perceive that innovative technologies can enhance efficiency, enrich heterogeneous functionalities, and realize friendly interfaces. Conversely, he/she may feel hesitant and disappointed due to the deficiency of trust and confidence in new technologies and his/her self-efficacy (Parasuraman, 2000).

Consequently, technology readiness can be divided into two aspects (Blut & Wang, 2020). The favorable aspect contains the subdimensions of optimism and innovation, while discomfort and insecurity constitute the unfavorable aspect, which collectively reflects a person's dual perceptions of new technologies (Parasuraman & Colby, 2015). Parasuraman (2000, p. 311) defines optimism as "a positive view of technology and a belief that it offers people increased control, flexibility, and efficiency in their lives," innovation as "a tendency to be a technology pioneer and thought leader," discomfort as "a perceived lack of control over technology and a feeling of being overwhelmed by it," and insecurity as "distrust of technology and skepticism about its ability to work properly." Under the collective effect of the four subdimensions, the formation of technology readiness mirrors individuals' tendency to approach and use new technologies from a holistic level.

Studies have explored the combinations of technology readiness with various well-known theories and research models in the field of information systems to extend the understanding of technology readiness in ever-changing technology-driven business models (see Appendix 2 Table 5). Additionally, the concept of technology readiness has shown robustness and adaptiveness in a wide range of theoretical models for investigating the impact of individuals' propensity differences on their adoption of new technologies (Chang & Chen, 2021; Chung et al., 2015; Park & Zhang, 2022). For example, technology readiness was first incorporated into the technology acceptance model (TAM) to trigger user perceptions of technological utility, ease of use, and adoption of information systems (Lin et al., 2007). Chang and Chen (2021) incorporated technology readiness as a moderator into the hedonic information systems acceptance model (HISAM) to explain consumer shopping intention. Technology readiness is also leveraged to investigate the adoption of various emerging technologies in smart retail, such as AR (Huang & Liu, 2021; Qasem, 2021), self-service technologies (Park & Zhang, 2022), and other in-store smart technologies (Roy et al., 2020).

In this study, technology readiness is combined with the situational factor framework to gain insight into how individuals' technology characteristics shape their purchase situations in smart retail. According to a meta-analysis of technology readiness (Blut & Wang, 2020), an individual with a higher level of technology readiness has greater positive perceptions of technology features (i.e., ease of use and usefulness) and technology-related value, satisfaction, and performance. In this vein, this study believes that technology readiness could shape the situational factors (i.e., entrance convenience, ease of interaction, usefulness of interaction, and transaction convenience) that are unique values directly generated by smart technology. Although smart technology also indirectly empowers consumers in terms of traditional product offerings (i.e., merchandise price and quality), evaluating them does not necessarily require technology readiness.

Hypothesis development

Effects of situational factors on purchase intention

Entrance convenience is defined as the time it takes to enter the smart retail store to measure the customers' overall evaluations of the complexity of the entrance process. Past studies have verified that entrance, as a crucial area for traditional retailers, directly influences customer emotions and moods (Otterbring, 2017; Pantano, 2016). Attentive services at the point of entrance provide customers with a good first impression of the store and contribute to customer pleasure and satisfaction, which further stimulates consumption (Otterbring, 2018; Pantano, 2016). For smart retail stores with technically supported self-check-in entrances, consumers need to scan the QR code using their mobile phones and then enter the store to start shopping. The time it takes to pass through the entrance gate could reflect how easily consumers can access the smart retail services, which may have a direct impact on subsequent purchasing decisions (Vyt et al., 2022). Consequently, a user-friendly entrance design might be a necessity and appealing service for smart retailers to attract and retain customers in the early stage of the purchase process. Only when customers can easily understand and master the skills of visiting the store can they have opportunities to experience the new shopping mode in smart retail stores. Therefore, we hypothesize the following:

H1: The greater the entrance convenience is, the stronger the purchase intention.

Self-service technology is considered a potential substitute for salespersons and provides intelligent interactions between retailers and customers and even between merchandise and customers. Customers can receive helpful and prompt information through virtual interactions with smart technology. In this regard, human-technology interaction can also be seen as a kind of social surroundings for unmanned smart store shoppers (Ogunjimi et al., 2021; Park & Zhang, 2022). In this study, ease of interaction and usefulness of interaction are thus characterized as salient social surroundings of consumer purchase situations in smart retail stores.

Ease of interaction refers to the extent to which customers can interact with smart technology with ease to complete shopping in smart retail stores; usefulness of interaction refers to the extent to which customers can efficiently and effectively make purchases in smart retail stores by interacting with smart technology. As proposed by TAM, perceived ease of use directly influences user behavioral intentions and also indirectly influences user behavioral intentions via perceived usefulness. In smart retailing, perceived ease of use is positively related to the perceived usefulness of smart technology, and the two constructs positively affect technology adoption (Roy et al., 2018) and shopping intention (Chang & Chen, 2021). In a similar vein, we hypothesize the following:

H2: The greater the ease of interaction is, the greater the usefulness of interaction.

H3: The greater the ease of interaction is, the stronger the purchase intention.

H4: The greater the usefulness of interaction is, the stronger the purchase intention.

This study considers transaction convenience as a time perspective of customer situations. Transaction convenience represents the time it takes to complete a purchase in a smart retail store and measures transaction efficiency. From the viewpoint of consumers, they prefer convenient and fast shopping processes in grocery stores and obtain their desired goods as quickly as possible. A long queue for check-out will negatively affect the service quality of shopping (Seiders et al., 2007) and reduce shopping efficiency and desire (Collier et al., 2015). Especially for customers with limited time, inefficient transaction procedures and slow shopping speed may even lead to passive emotions, such as time pressure (Chang et al., 2023; Chen et al., 2020; Chocarro et al., 2013). In this case, if customers can efficiently and quickly conclude the purchase tasks and complete the payment, then they will be more satisfied with the service quality of smart retail stores and will like to make a purchase (Jih, 2007; Li, 2018). Therefore, we hypothesize the following:

H5: The greater the transaction convenience is, the stronger the purchase intention.

The major attractive product attributes can refer to merchandise price and merchandise quality, which drive consumption. Since the general buyers' grocery shopping goals may be to purchase economical products of good quality, merchandise price and merchandise quality are characterized as task definitions in this study. Besides bringing about the aforementioned unique value, smart retail stores also fulfill ordinary consumers' utilitarian needs for product offerings better than traditional competitors. The cost reduction of manual operations enables smart retail stores to sell homogeneous products at cheaper prices than traditional retail counterparts, thereby increasing consumer perceptions of value for money. Although retail service innovations stress the unique value of convenience and novelty, it does not imply that the traditional value regarding product prices and quality is disregarded (Fan et al., 2020; Lee & Lee, 2020). Therefore, the common/traditional value shared with traditional retail modes and appealing to consumers still stands in the context of smart retail. If consumers deem that they can even get great value for money along with a convenient and innovative shopping experience, then they will tend to purchase in smart retail stores. Therefore, we hypothesize the following:

H6: Merchandise price is positively related to purchase intention.
H7: Merchandise quality is positively related to purchase intention.

Effects of technology readiness on situational factors

Technology readiness is described as a formative second-order factor that reflects individuals' overall characteristics of accepting or using new technologies. Technology readiness includes four subdimensions (Parasuraman, 2000). Two dimensions are related to an individual's positive aspects (i.e., optimism and innovativeness) of new technologies that contribute to technology readiness, while the other two dimensions pertain to an individual's passive thoughts (i.e., discomfort and insecurity) of new technologies that attenuate technology readiness (Parasuraman & Colby, 2015). If a customer has great anticipations of the optimism and innovativeness of new technologies, then it indicates that he/she would be more likely technologically ready to accept smart technology and experience new shopping modes in smart retail stores. In contrast, the high levels of discomfort and feelings of insecurity feelings will decrease the level of technology readiness. Recent studies have also shown ample evidence supporting the abovementioned relationships (Chang & Chen, 2021; Park & Zhang, 2022). Therefore, this study hypothesizes the following:

H8a: The greater the optimism is, the greater the technology readiness.
H8b: The greater the innovativeness is, the greater the technology readiness.
H8c: The greater the discomfort is, the lesser the technology readiness.
H8d: The greater the insecurity is, the lesser the technology readiness.

As an individual-specific and system-independent factor, technology readiness has been integrated into other theoretical models to explain its role in smart retailing (Park & Zhang, 2022; Qasem, 2021). These studies regarded technology readiness as the antecedent of customer acceptance of in-store smart technologies and shopping behavior. Similarly, technology readiness, representing a person's inclination to accept or reject emerging technologies, may have an impact on customer beliefs about smart technology (Chang & Chen, 2021; Qasem, 2021; Roy et al., 2020). In other words, technology readiness will be closely related to the shopping process that is technically powered by in-store smart technology. As mentioned above, the situations faced by customers in smart retail stores include physical surroundings (i.e., entrance convenience), social surroundings (i.e., ease of interaction and usefulness of interaction), time perspective (i.e., transaction convenience), and task definitions (i.e., merchandise price and merchandise quality). Excluding task definitions, the other three aspects are directly enabled by smart technology. Therefore, this study proposes that customers' technology readiness may only influence their perceptions of these situational factors.

In smart retail stores, if customers are tech-savvy, then they are less likely to encounter technical problems and generate passive emotions related to smart technology interactions during the shopping process. In contrast, a higher level of technology readiness might trigger individuals' perceptions of greater entrance convenience, ease of interaction, usefulness of interaction, and transaction convenience. Previous studies have evidenced that technology readiness can enhance users' perceived ease of use and perceived usefulness of technologies, and shopping effectiveness (Blut & Wang, 2020; Lin & Chang, 2011; Park & Zhang, 2022; Roy et al., 2018). Therefore, this study hypothesizes the following:

H9: The higher the level of technology readiness is, the greater the entrance convenience.
H10: The higher the level of technology readiness is, the greater the ease of interaction.
H11: The higher the level of technology readiness is, the greater the usefulness of interaction.
H12: The higher the level of technology readiness is, the greater the transaction convenience.

The detailed hypothesized relationships are shown in Fig. 2.

Methodology

Measures

The current study conducted structural equation modeling (SEM) to examine the proposed hypotheses. Content validity is important for a survey study that evaluates whether the measures adopted by researchers can properly reflect the full domains of the constructs. To do so, all the scales and operational definitions of the constructs

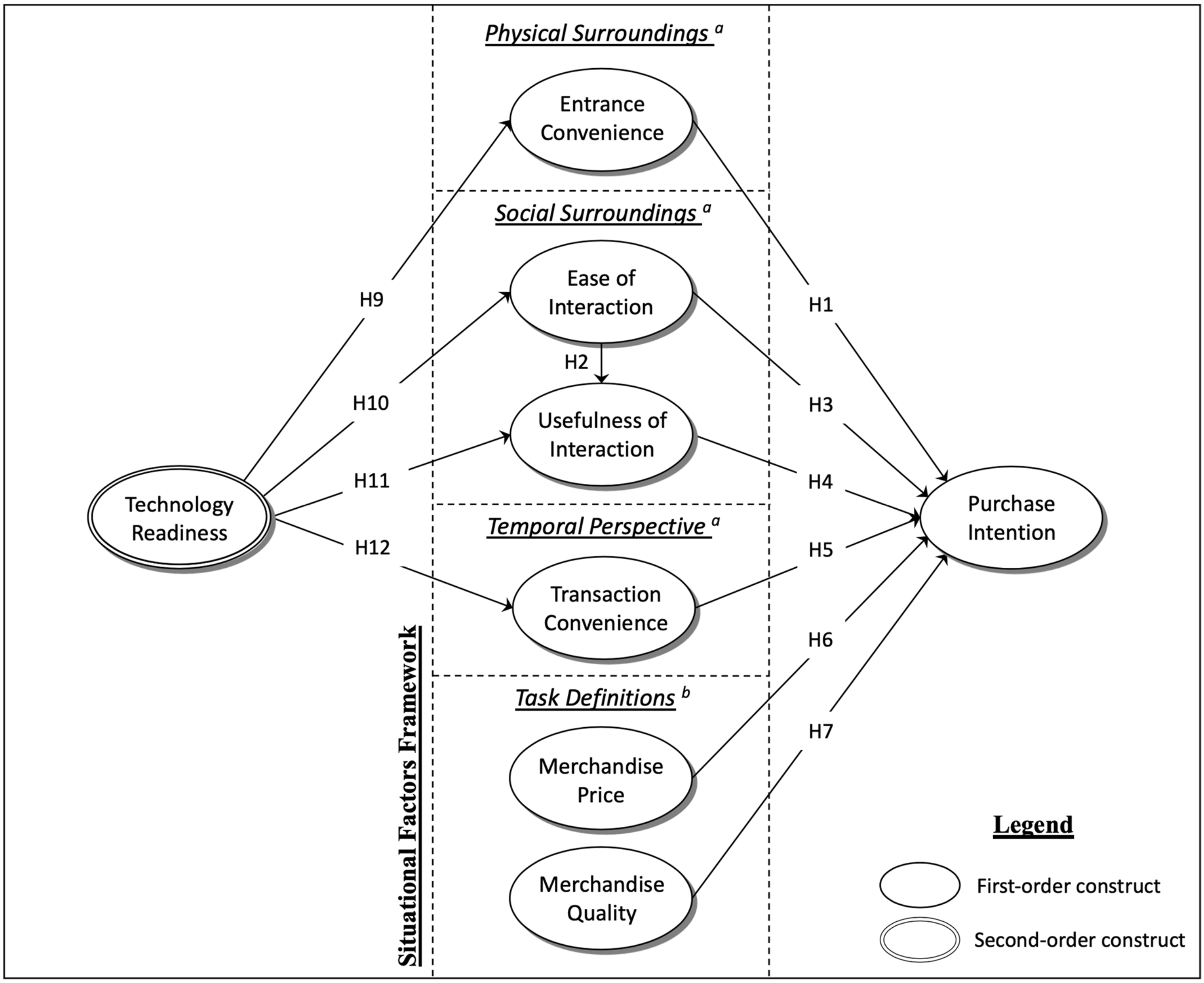

Fig. 2 Theoretical research model. Notes: [a]: Unique value brought about by smart technology and featured in smart retail; [b]: Common/traditional value strengthened by smart technology and shared with traditional retail; [b]: H6 and H7 are proposed not only for completeness of Belk's (1975) situational framework but also for reexamining the role of merchandise price and merchandise quality—which have been widely recognized as vital determinants in traditional retail stores—in consumer purchase in the context of smart retail

were developed based on the previous literature and were slightly adapted to the research context of smart retail stores. As to technology readiness, four measurement items for optimism and innovativeness and three measurement items for discomfort and insecurity were all adopted from Parasuraman and Colby (2015). Collectively, these four latent variables compose the first-order dimensions of technology readiness. In terms of situational factors, three items for entrance convenience and transaction convenience were adopted from Seiders et al. (2007). Four items for ease of interaction and usefulness of interaction were adopted from Davis (1989) Three and four items for merchandise price and merchandise quality, respectively, were adopted from Dodds et al. (1991). For the dependent variable, three items for purchase intention were adopted from Venkatesh et al. (2003). Detailed information is presented in Appendix 3 Table 6.

Because this study was developed in China, the Chinese version of the online questionnaire was used to collect the sample data. To guarantee the conceptual equivalence between the English and Chinese versions of the questionnaire, this study also applied a back-translation method to avoid interpretation discrepancies. We also invited industry experts, university professors, and research assistants in related fields to form a professional panel and conduct the pilot study. Based on their feedback, the scale items for each construct were carefully polished in terms of format, wording, and length. Finally, a total of 37 observable variables were retained and scored on a seven-point Likert scale, spanning from 1 "strongly disagree" to 7 "strongly agree."

Research design and data collection

A popular smart retail store chain brand—Bingobox[1]—was selected as the research subject. Bingobox was initially founded in 2016 and was the first to launch 24/7 unmanned convenient stores in China. The stores feature a smart technology–driven retail mode to provide customers with a novel shopping experience. From a technical perspective, the stores are equipped with various smart technologies, including facial recognition, merchandise recognition, tracking, and settlement, machine learning, dynamic inventory management, smart shelves, self-checkout technology, and so on. Customers need to master certain technical skills to complete purchases on their own, from scanning the QR code to registrations (only for new customers) and entering the store to selecting items, self-service checkout, and exiting. As of 2020, this chain brand has quickly expanded its business and operated hundreds of smart retail stores in 28 first- and second-tier cities in China, such as Beijing, Shanghai, and Hangzhou. Benefiting from the unmanned business model, the same products in this smart retail store are approximately 5% cheaper than traditional attended retail stores.

A survey was conducted to collect the sample data. Before performing a full-scale investigation, this study pretested the proposed model using a small sample. The results indicated that the construct measurements were valid and reliable. Subsequently, online questionnaires were disseminated to the on-site participants. By cooperating with the manager of a Bingobox airport chain store in a first-tier city in China, this study conducted the on-site random recruitment and survey at the terminal building. The airport chain store was selected because of (1) high passenger traffic, (2) increased possibility of participant recruitment given waiting time, and (3) this store provides products that are cheaper than other traditional attended convenience stores nearby.

This study recruited potential consumers who were trying to enter the store. Figure 3 presents the on-site survey scenario. One of the research assistants recruited volunteers at the entry to experience a completed shopping process in this store. The research assistant did not provide any shopping guidance but introduced the survey to the potential participants. When the participants accomplished the transaction and left the store, another research assistant at the exit invited each of them to fill out an online questionnaire based on the entire purchasing process they had just experienced. To encourage survey participation, each participant was promised the in-store transaction rebate as a thank-you gift, up to a maximum of RMB 20. Respondents were required to upload their anonymous transaction screenshots to apply for the rebates. Responses without proof of transaction were regarded as invalid because we ensured every participant had indeed undertaken the entire shopping process to be eligible to answer the questionnaire. The questionnaire contains two parts: the measurements of construct items and demographics.

Data analysis

Partial least square-structural equation modeling (PLS-SEM)—a multivariate analysis method—was employed to empirically test the proposed hypotheses. SEM allows researchers to evaluate constructs at an observable level and examine the relationships between constructs at a theoretical level. In general, SEM includes PLS-SEM and covariance-based-SEM (CB-SEM). Compared to CB-SEM, PLS-SEM is suitable for both exploratory research and theory confirmation in a complex multivariate model with fewer constraints on the normal distribution of samples, sample sizes, and model fit (Hair et al., 2016). Furthermore, PLS-SEM supports the assessments of both measurement and structural models, especially, and is a preferred method when a study involves a formative construct (Hair et al., 2016).

Considering that the conceptual research model is relatively complicated and comprises a second-order formative construct as an antecedent, situational factors as mediators, and purchase intention as a consequence, this study adopted SmartPLS 3.2.8 (Ringle et al., 2015) to perform a data analysis and model testing. Model testing had two phases. First, the measurement model was tested to assess the reliability and validity of the latent variables and observable indicators. Second, the structural model was tested to examine the path significance of the hypothesized relationships in the research model.

Results

This study disseminated 800 questionnaires to eligible participants. As a result, a total of 283 valid questionnaires were finally collected, with a valid response rate of 35.4%. Before data collection, a priori power analysis was performed through G*Power 3.1 to evaluate the minimum sample size. Given the effect size of 0.15, α level of 0.05, and power $(1-\beta)$ level of 0.8, the required sample size is 55. This study also referred to Kock and Hadaya (2018) who drew on the gamma-exponential method and suggested that a new rule of thumb for assessing the minimum sample size should be 146 when using PLS-SEM. Thus, the sample size of 283 is suitable for PLS-SEM.

[1] Official website: https://www.bingobox.com

Fig. 3 On-site survey scenario. Notes: The grey arrow line denotes survey procedures from participant recruitment to a typical shopping process and survey invitation; Pixelation is to protect private information

Demographic statistics

Among valid respondents, gender was evenly distributed in the survey sample, that is, 134 males (47.3%) and 149 females (52.7%). More than half of the respondents were 26 to 35 years old (50.2%). Most of the participants had a bachelor's degree, accounting for 67.8% of the total sample. In terms of vocation, professional and technical workers, business and service personnel, and management personnel accounted for more than half of the sample, namely, 21.9%, 20.1%, and 15.9%, respectively. Besides, most of the respondents had monthly incomes of more than RMB 10,500 (21.6%) and purchased in smart retail stores approximately once per week (76.6%). The other detailed information is shown in Appendix 4 Table 7.

Common method bias (CMB)

Harman's one-factor analysis is used to rule out potential CMB. This method notes that the variance accounted by every single construct should not be greater than 50%; otherwise, the CMB will become a problem (Harman, 1976; Podsakoff & Organ, 1986). In this study, eleven constructs contribute to a cumulative variance of 80.659%, among which the greatest (smallest) variance explained by a single factor is 48.908% (0.788%). The values are all less than the threshold value of 50%. Besides, we further observe variance inflation factors (VIFs) to detect underlying CMB. The VIFs span from 1.787 to 3.654, which is less than the critical value of 5 (Kline, 1998). Thus, the results imply that CMB is not a salient threat.

Measurement model

The measurement model of this study is examined by verifying reliability, convergent validity, and discriminant validity. First, reliability and convergent validity are measured by four recommended indicators: factor loadings, Cronbach's α, composite reliability (CR), and average variance extracted (AVE). As shown in Table 1, the factor loadings for all the items range from 0.83 to 0.96, which are higher than the cutoff value of 0.7. Cronbach's α and CRs for all the constructs range from 0.86 to 0.95 and 0.92 to 0.96, respectively, which are also higher than the cutoff value of 0.7. In addition, the AVEs of all the constructs span from 0.78 to 0.90, which are higher than the cutoff value of 0.5 (Hair et al., 2019). Thus, the reliability and convergent validity of this model are verified.

Second, the discriminant validity is measured by three recommended indicators. First, as shown in Table 2 of the Fornell-Larcker criterion, the square root of the AVE of the corresponding constructs in the diagonal line is higher

Table 1 Reliability and convergent validity

Construct	Item	Factor loading	Cronbach's α	CR	AVE
OPTM	OPTM1	0.93	0.95	0.96	0.87
	OPTM2	0.94			
	OPTM3	0.92			
	OPTM4	0.94			
INNV	INNV1	0.88	0.91	0.93	0.78
	INNV2	0.89			
	INNV3	0.89			
	INNV4	0.86			
DISC	DISC1	0.93	0.92	0.95	0.87
	DISC2	0.94			
	DISC3	0.93			
INSE	INSE1	0.95	0.94	0.96	0.90
	INSE2	0.96			
	INSE3	0.94			
EC	EC1	0.87	0.86	0.92	0.79
	EC2	0.88			
	EC3	0.91			
EOI	EOI1	0.91	0.92	0.94	0.80
	EOI2	0.83			
	EOI3	0.92			
	EOI4	0.92			
UOI	UOI1	0.91	0.92	0.94	0.80
	UOI2	0.91			
	UOI3	0.89			
	UOI4	0.87			
TC	TC1	0.89	0.89	0.93	0.82
	TC2	0.93			
	TC3	0.90			
MPRI	MPRI1	0.94	0.93	0.96	0.88
	MPRI2	0.95			
	MPRI3	0.93			
MQUA	MQUA1	0.88	0.93	0.95	0.83
	MQUA2	0.93			
	MQUA3	0.92			
	MQUA4	0.91			
PURI	PURI1	0.92	0.94	0.96	0.90
	PURI2	0.96			
	PURI3	0.96			

Notes: OPTM is optimism, INNV is innovation, DISC is discomfort, INSE is insecurity, EC is entrance convenience, EOI is ease of interaction, UOI is usefulness of interaction, TC is transaction convenience, MPRI is merchandise price, MQUA is merchandise quality, PURI is purchase intention

than that between the construct and its counterparts. Second, the inter-factor loading of each item of the corresponding construct is higher than the cross-factor loadings of the other counterparts. Third, this study also examines the Heterotrait-Monotrait Ratio (HTMT; Henseler et al., 2015). Table 3 demonstrates that the highest value is 0.85, which is lower than the critical value of 0.9 (Henseler et al., 2015). Thus, discriminant validity is established in the research model.

Moreover, the highest VIF value between technology readiness and its four first-order factors is 2.62, which is less than the conservative upper cutoff value of 3 (Hair et al., 2019) and implies that there is no collinearity issue in terms of technology readiness. As a result, the measurement model in this study is validated.

Structural model

The structural model was tested using the bootstrapping technique with 100,000 subsamples and the percentile method for constructing bootstrap confidence intervals (Becker et al., 2023). The results indicate a powerful explanation for the endogenous variables: 47.9% for entrance convenience, 49.5% for ease of interaction, 64.1% for usefulness of interaction, 31.7% for transaction convenience, and 69.3% for purchase intention. As shown in Fig. 4, except for H5, which hypothesizes a positive relationship between transaction convenience ($\beta = -0.051$, $p > 0.05$) and purchase intention, the other proposed relationships between exogenous and endogenous variables are all statistically supported.

In terms of purchase intention, entrance convenience ($\beta = 0.189$, $p < 0.05$) positively influences purchase intention, supporting H1. Ease of interaction ($\beta = 0.470$, $p < 0.001$) significantly affects usefulness of interaction, providing support for H2. In turn, ease of interaction ($\beta = 0.259$, $p < 0.001$) and usefulness of interaction ($\beta = 0.187$, $p < 0.001$) have positive effects on purchase intention; thus, H3–4 are supported. Merchandise price ($\beta = 0.181$, $p < 0.05$) and merchandise quality ($\beta = 0.186$, $p < 0.01$) are found to positively affect purchase intention, supporting H6–H7, respectively.

Regarding the second-order construct, optimism ($\beta = 0.509$, $p < 0.001$) and innovation ($\beta = 0.503$, $p < 0.001$) positively influence technology readiness, whereas discomfort ($\beta = -0.114$, $p < 0.01$) and insecurity ($\beta = -0.151$, $p < 0.001$) negatively influence technology readiness. Thus, H8a–d are all supported. Regarding situational factors, technology readiness positively influences entrance convenience ($\beta = 0.694$, $p < 0.001$), ease of interaction ($\beta = 0.705$, $p < 0.001$), usefulness of interaction ($\beta = 0.398$, $p < 0.001$), and transaction convenience ($\beta = 0.565$, $p < 0.001$), supporting H9–12, respectively.

Discussion

Main findings

This study employs situational factors as a theoretical framework and extends the research model by integrating

Table 2 Fornell-Larcker criterion for discriminant validity

	OPTM	INNV	DISC	INSE	EC	EOI	UOI	TC	MPIR	MQUA	PURI
OPTM	**0.93**										
INNV	0.66	**0.88**									
DISC	− 0.18	− 0.09	**0.93**								
INSE	− 0.21	− 0.17	0.78	**0.95**							
EC	0.59	0.69	− 0.15	− 0.19	**0.89**						
EOI	0.63	0.67	− 0.13	− 0.19	0.74	**0.90**					
UOI	0.62	0.71	− 0.19	− 0.24	0.74	0.75	**0.90**				
TC	0.45	0.63	− 0.06	− 0.11	0.75	0.67	0.65	**0.91**			
MPRI	0.54	0.58	− 0.07	− 0.14	0.73	0.66	0.69	0.65	**0.94**		
MQUA	0.55	0.59	− 0.17	− 0.18	0.65	0.68	0.63	0.62	0.73	**0.91**	
PURI	0.71	0.71	− 0.18	− 0.17	0.73	0.75	0.73	0.62	0.72	0.70	**0.95**

Note: the bold values are the square root of the AVE

technology readiness to investigate consumers' purchase intention in smart retail stores. The research model explains 69.3% of the variance in purchase intention and supports 14 of the 15 proposed hypotheses; thereby, verifying the important roles of technology-related individual characteristics and situational factors empowered by smart technology in purchase intention.

Entrance convenience is validated as a crucial situational factor—physical surroundings—that significantly influences customer purchase intention. Previous studies have also proposed that entrance or access is important to physical retail stores, and providing attentive shopping services at this stage effectively and directly influences customer moods and shopping decisions (Otterbring, 2018; Pantano, 2016; Vyt et al., 2022). The entrance is the first phase of shopping in which customers need to open the technology-controlled door themselves and then start shopping in smart retail stores. Entrance convenience can directly affect consumers' willingness to interact with smart technology at the door. The less time customers spend, the easier it is for them to enter the store. Such convenience of shopping will ultimately stimulate purchase behaviors in smart retail stores.

This study depicts ease of interaction and usefulness of interaction as social surroundings and elucidates the role of human-technology interactions in smart retail stores. The results corroborate that ease of interaction has a significant positive impact on usefulness of interaction and that both constructs have a significant positive impact on purchase intention, which are consistent with previous studies (Chang & Chen, 2021; Lin, 2022; Roy et al., 2020). In the smart retail store context, no salesperson can aid customers in person; thus, customers totally rely on in-store smart technology for self-service shopping. In this case, smart technology acts as a virtual shopping assistant offering shopping guidance, which is analogous to a frontline salesperson. Therefore, ease of interaction and usefulness of interaction with smart technology are essential social surroundings enabled by smart technology, which reflect customer evaluations of human-technology interactions and further affect their purchase intentions.

Other noticeable situational factors that affect purchase intention are merchandise price and merchandise quality, which have been discounted by prior studies on smart retail with an emphasis on only technology-driven unique value

Table 3 Heterotrait-Monotrait Ratio for discriminant validity

	OPTM	INNV	DISC	INSE	EC	EOI	UOI	TC	MPIR	MQUA
OPTM										
INNV	0.71									
DISC	0.19	0.10								
INSE	0.22	0.18	0.84							
EC	0.65	0.77	0.16	0.21						
EOI	0.68	0.74	0.14	0.21	0.84					
UOI	0.65	0.77	0.20	0.26	0.83	0.82				
TC	0.49	0.70	0.07	0.11	0.85	0.74	0.72			
MPIR	0.58	0.63	0.08	0.15	0.81	0.71	0.74	0.71		
MQUA	0.58	0.65	0.18	0.19	0.72	0.73	0.68	0.68	0.78	
PURI	0.75	0.77	0.19	0.18	0.81	0.81	0.78	0.68	0.77	0.75

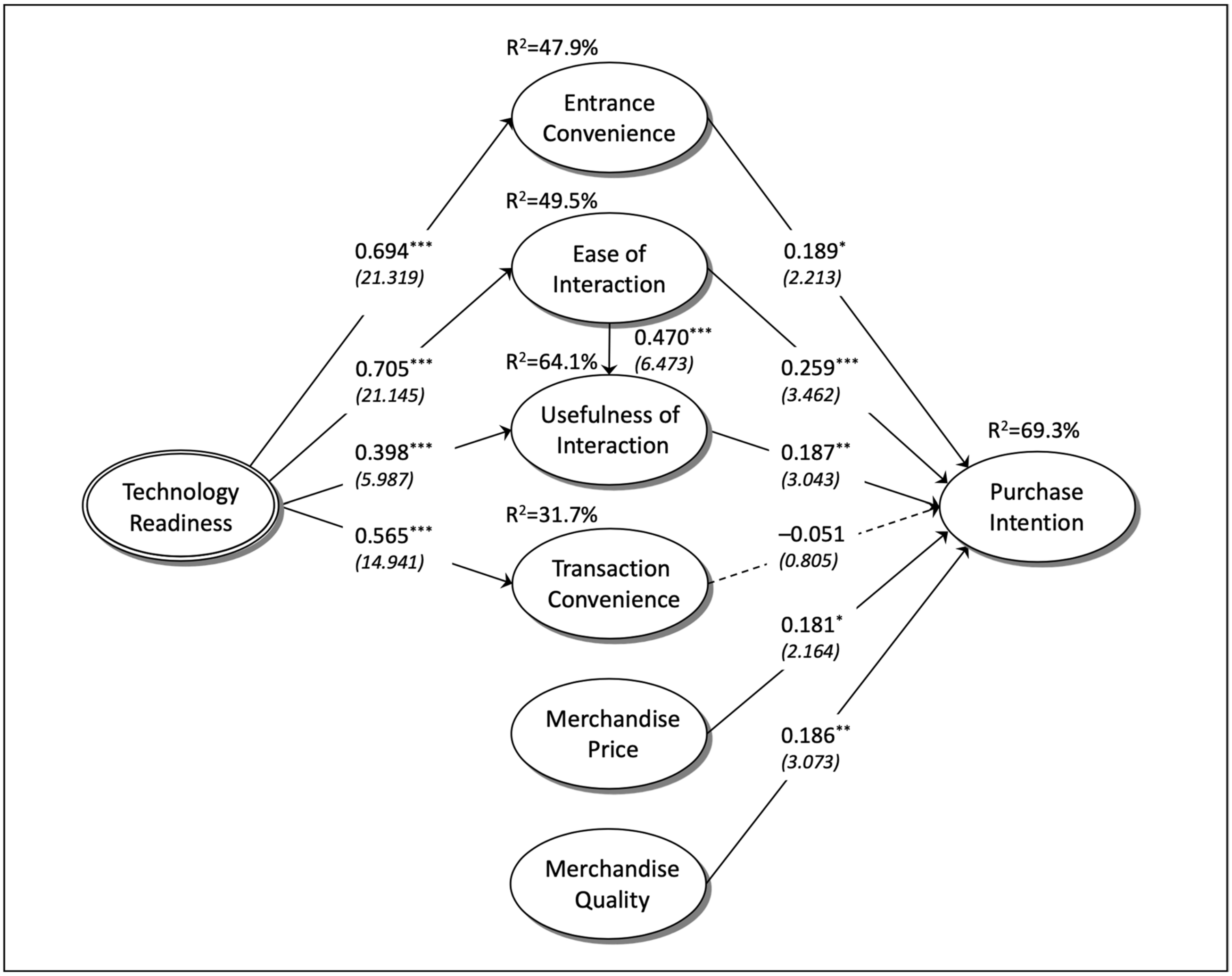

Fig. 4 Empirical results. Note: $^{*}p<0.05$; $^{**}p<0.01$; $^{***}p<0.001$; the bracketed values are *t* statistics; the dotted arrow line denotes the nonsignificant relationship

(Grewal et al., 2020; Shankar et al., 2021). In contrast, this study argues that merchandise price and merchandise quality are also the competitive edges of smart retail stores, as cost reduction of frontline employees enables retailers to adopt competitive pricing strategies. Both constructs are described as task definitions referring to consumers' general grocery shopping goals. For most ordinary consumers, purchasing high-quality goods at relatively low prices has high shopping value, is the source of consumer satisfaction, and can stimulate consumption (Atulkar & Kesari, 2018; Lee & Lee, 2020). The findings indicate that merchandise price and merchandise quality still play vital roles in purchase intention in the smart retail context, although the technology-enabled situational factors might be more influential than them.

In contrast, transaction convenience is not substantiated to have a significant effect on purchase intention. This finding is controversial, as it echoes the work of Seiders et al. (2007) but is inconsistent with other studies, such as Ozturk et al. (2017), Jih (2007), and Li (2018). To the best of our knowledge, although transaction convenience has not been widely used to investigate consumer purchase behaviors in the smart retail settings, many researchers have claimed that other similar time-related factors, such as time pressure, tolerance to wait, and time availability, are vital factors affecting consumer decision-making in self-service technology use (Barros et al., 2019; Chang et al., 2023; Chocarro et al., 2013; Collier et al., 2015; Wang et al., 2012). This study refers to Seiders et al.'s (2007) reasoning when they also found similar insignificance of transaction convenience for purchasing decisions. They proposed that transaction convenience perhaps is a "failure preventer" rather than a "success provider." In other words, transaction convenience may not assure a purchase but at least prevent the purchase from being abandoned. Similarly, the low-level transaction convenience in smart retail stores may cause purchase abandonment, whereas the high-level may not contribute to purchase. On the other hand, Seiders et al. (2007) further explained that the low-purchase-frequency subjects were another plausible reason for the insignificant finding. Transaction convenience might be only relevant in the high-purchase-frequency shopping scenarios (e.g., traditional attended retail stores) as consumers may be more sensitive to time costs in routine consumption scenarios they are already familiar with. However, smart retail stores are still in their infancy (i.e., low penetration rate), and it may take some time for this innovative shopping mode to become consumers' habitual choice; thus, smart shopping has not yet been prevalent among ordinary consumers. According to the sample demographics (Appendix 4 Table 7), participants who had no more than a purchase per week in smart retail stores constituted 76.6% of the sample, indicating that most participants were low-frequency buyers. For these buyers, the novelty of in-store smart technology is a more effective determinant of purchase than shopping efficiency.

Besides, our research model also encompasses technology readiness, which represents individuals' general propensity to use emerging technologies. This construct is described as a formative second-order factor composed of four subdimensions, namely, optimism, innovativeness, discomfort, and insecurity. The results show that optimism and innovativeness have a significant positive impact on technology readiness, while discomfort and insecurity have a significant negative impact on technology readiness. Our findings are in line with the original propositions of Parasuraman (2000) and the conclusions of other recent studies (Chang & Chen, 2021; Roy et al., 2018). An individual can simultaneously harbor two types of attitudes (i.e., favorable and unfavorable) when accepting new technologies. Collectively, these attitudes constitute an individual's holistic level of technology readiness.

Furthermore, this study also validates that technology readiness is positively related to consumers' evaluations of technology-enabled situational factors in smart retail stores, namely, entrance convenience, ease of interaction, usefulness of interaction, and transaction convenience. Our findings are consistent with those in the extant literature (Blut & Wang, 2020). After Parasuraman (2000) conceived the notion of technology readiness and called for more academic attention to be paid to exploring its role by incorporating it with other theoretical models, many researchers have verified technology readiness as a vital antecedent that promotes human-technology interactions and drives users' technology adoption in various extended research models (Blut & Wang, 2020; Park & Zhang, 2022; Qasem, 2021; Roy et al., 2018). Technology readiness represents a person's overall inclination to accept emerging technologies, which also shows his/her confidence in and capability for solving technical problems when shopping in smart retail stores. Compared with customers with a low level of technology readiness, a consumer with a high level of technology readiness is more likely to have no trouble using such technology, thus possessing a relatively strong shopping performance in which he/she can utilize smart technologies to assist himself/herself in accomplishing shopping tasks effectively and efficiently. Therefore, technology readiness is a crucial factor that explains customer assessments of entrance convenience, ease of interaction, usefulness of interaction, and transaction convenience.

Theoretical implications

First, this study contributes to the smart retail literature by exploring both unique and common factors empowered by smart technology and their impacts on consumer purchase intention in smart retail stores. Smart technology empowers consumers not only in novel shopping experiences but also in traditional product offerings. The uniqueness is embodied through the higher level of convenience and the lower level of social presence. As to common value, thanks to smart technologies replacing checkout alike mechanical work that has long been fulfilled by frontline employees, the operation cost reduction enables more competitive and enticing pricing strategies for smart retailers. However, prior studies have only emphasized the unique value brought about by smart technology but discounted the common value concerning product offerings shared with traditional retail (Chang & Chen, 2021; Grewal et al., 2020; Roy et al., 2020). This study offers a holistic understanding of how smart technology empowers consumers in smart retail stores by analyzing both two aspects of unique and common value.

Second, since the concept of situational factors is only a framework (Belk, 1975), this study also contributes to the existing theory and future research on smart retailing by constructing situational factors empowered by smart technology and relevant to consumer purchase situations in smart retail stores. Specifically, this study identifies the main situational factors surrounding the entire purchase process, from entering the stores to human-technology interactions, product selection, and self-checkout. Entrance convenience is characterized as a physical surrounding capturing customer assessment of entrance designs. Ease of interaction and usefulness of interaction, as measures of interactions between customers and in-store smart technology, are characterized as social surroundings. To reflect customer perceptions of shopping speed, transaction convenience is characterized as a temporal perspective. Finally, given that smart retail stores provide cost-efficient products to ordinary consumers whose daily grocery shopping goal is to purchase value-for-money products, merchandise price and merchandise quality are characterized as task definitions.

In such model conceptualization, unique factors of smart retail stores contain entrance convenience, ease of interaction, usefulness of interaction, and transaction convenience, while common factors shared with traditional retail stores contain merchandise price and merchandise quality. Although all situational factors (except transaction convenience) are significant determinants of purchase intention, empirical evidence still suggests that smart technology–related situational factors (i.e., entrance convenience, ease of interaction, and usefulness of interaction) can be more influential among them. This study is an early attempt in the field but serves as a foundation that inspires future research advancing the field from a situational perspective. For instance, more relevant situational factors could be identified according to different business models driven by other smart technologies; comparisons of consumer behaviors among different retail channels also warrant further exploration.

Third, the study further combines technology readiness to investigate the impacts of personal traits concerning new technologies on situational factors and purchase intention. Although in essence, a smart retail store is a physical store, it differs from a traditional retail store because it is an unmanned store that introduces various smart technologies to realize self-service shopping. Customers should possess a certain level of technology readiness to help them complete purchase tasks in smart retail stores smoothly. This study also contributes to the empirical research by verifying technology readiness as a formative second-order variable. It is a system-independent factor and contains optimism and innovativeness regarding the positive subdimensions and discomfort and insecurity regarding the negative subdimensions, thereby mirroring an individual's dual evaluation of emerging technology use (Blut & Wang, 2020; Chang & Chen, 2021; Park & Zhang, 2022; Roy et al., 2020). In this study, technology readiness is found to strengthen customer perceptions about smart technology–related situational factors and thus is a necessary prerequisite for customers to have positive perceptions of convenience and benefits of human-technology interactions in smart retail stores. As also emphasized by Grewal et al. (2020), future work can also incorporate technology readiness to explain consumer behaviors in other technology-driven businesses.

Practical implications

This study provides several practical implications for the operation and management of smart retail stores in smart retailing. First, entrance convenience, as a physical surrounding, is recognized as a crucial situational factor perceived by consumers in the first stage of shopping and affects purchase intention. Smart retailers should give full attention to consumers' entrance experience. Customers may lose patience and decide not to purchase when they need to spend a great deal of time finishing complicated preliminary procedures and entering stores. Therefore, entrance procedures should be streamlined as much as possible to shorten customers' waiting time. For example, smart retailers should achieve first registration with fewer manual clicks, make the QR code compatible with mainstream mobile applications, and improve the response rate of automatic doors; hence, smart retail stores can provide customers with an effortless self-service experience at the beginning of the shopping process.

Second, ease of interaction and usefulness of interaction are important properties of social interactions between consumers and in-store smart technology. Smart technology is the key to distinguishing smart retail stores from traditional retail counterparts and is also most valued by consumers among other factors. Customers totally depend on smart technology to complete purchases because there is no salesperson available in the stores. In this case, smart technology plays the role of a virtual shopping guide when consumers need it. Therefore, retailers should deeply explore and incorporate more technological solutions into the consumer purchase process to attract consumers. This study suggests that in addition to the provision of user-friendly interfaces, smart retailers should strive to enrich smart technology functionalities to continuously facilitate customers' sense of novelty and enjoyment from the dimension of social surroundings. For example, they can implement intelligent voice services, such as AI chatbots, to provide more vivid anthropomorphic interactions (Aw et al., 2022). Mobile recommendations and individualized promotions based on consumer consumption history or location can also be deployed (Riegger et al., 2022).

Moreover, this study corroborates that consumers still appreciate the improved common/traditional value concerning product price and quality in smart retail stores. Indeed, smart retailers can rely on smart technology to deliver unique and novel value in the short run, still, they need an effective product differentiation strategy to retain consumers in the long term. Therefore, product cost-effectiveness will be another key strategic differentiator that smart retailers should leverage to establish competitive advantages in terms of common value shared with traditional counterparts. Initiating a smart retail store indeed requires a relatively high initial investment (e.g., procurement, implementation, and installation and test costs) compared to traditional retail stores, whereas, in the long run, smart retailers are financially able to afford to provide preferential merchandises to benefit consumers because of considerable cost reduction of the unstaffed operating model (Fan et al., 2020; Huang & Rust, 2021; Pantano et al., 2018). Thus, smart retailers should realize that smart technology can add value to common/traditional value. This study suggests smart retailers to provide homogeneous products at competitive prices to attract consumers and establish a broad customer base.

The findings also validate that technology readiness is the psychological basis for customers to perform self-service purchases in smart retail stores. Individuals can simultaneously harbor two different types of views (i.e., favorable and unfavorable) about new technologies. Optimism and innovativeness represent positive perspectives, while discomfort and insecurity represent negative perspectives. Collectively, four subdimensions constitute customers' overall levels of technology readiness, which in turn has a significant positive effect on four technology-enabled situational factors. In this regard, smart retailers should implement tailored marketing strategies and campaigns based on customer segmentations by technology readiness.

Specifically, consumers with high technology readiness will be more tech-savvy and more willing to proactively experience new technologies and novel shopping modes, so they will also not easily give up on shopping because of technical barriers. Retailers should maintain good customer relationships with this segment of consumers to cultivate their loyalty and attract prospects by promoting novel shopping modes and the convenience of the stores. Moreover, this study suggests that smart retailers should take the following approaches to alleviate the negative feelings of consumers with relatively low levels of technology readiness and exploit a wider customer group. For instance, smart retailers can establish a remote service encounter (e.g., call centers and social media) that offers timely and necessary operator services to customers who suffer from negative feelings (e.g., stress, discomfort, and insecurity) when encountering technical problems. In addition, for customers who distrust and reject new technologies, retailers can utilize word-of-mouth marketing to reduce the resistance of such customers and further attract them to try shopping in smart retail stores by providing enticing product promotions. On the other hand, human-technology interactions should be optimized to offer customers more customer-centric and supportive user experiences, which may mitigate the pressure and overwhelming feelings caused by innovative technologies.

Conclusion

In smart retail stores, smart technology empowers consumers through bringing about unique value and strengthening common value shared with traditional retail stores. This study employs the framework of situational factors to theorize the unique and common factors and combines technology readiness to explore their roles in purchase intention in smart retail stores. The results reveal that consumer purchases are attributable to increasing technology-ready consumers, smart technology–enabled convenience and human-technology interactions, and improved product value benefiting from unmanned operating models. With the increasing penetration of smart technology, it is believed that smart retail stores would become a popular shopping channel where consumers shop with more novel experiences and fewer expenses.

However, this study has the following possible limitations. First, our sample population was customers who had recently shopped in smart retail stores; hence, it may not be appropriate to evaluate those who had no experience in such stores. It is recommended to take this type of consumers into account so that future scholars can further explore the obstacles that render customers not interested.

Second, this study did not consider consumers who prefer shopping alone in self-service transactions and regard the presence of salespersons as a disturbing deterrence and restraint (Chocarro et al., 2013; Lee & Lee, 2020). Such feelings may lead to consumer anxiety and stress and reduce shopping efficiency and enjoyment (Collier et al., 2015). Thus, we suggest that other personal traits (e.g., extrovert, introvert, isolated, avoidant, and individualistic) should be studied to inform customer segmentation.

Third, this study was grounded in China and investigated a local smart retail store chain brand. The issue of generalizability should be treated with caution when replicating the study for the validation and extension of the discoveries in other countries with different cultural contexts and other smart retail stores with differentiated business models. In this study, the model conceptualization is rooted in the four-step shopping process of Bingobox (Fig. 1), which only represents one possible type of business models for smart retailing. For instance, Amazon Go and Aldi Shop&Go feature the "grab-and-go" and "till-free" shopping modes, respectively, wherein entrance convenience may not be an issue, and instead, payment risk may emerge as a primary barrier to consumers because they would be automatically (and sometimes incorrectly) charged without any forms of checkout. Moreover, futuristic smart retail services are expected to involve increasing empathetic intelligence compared to mechanical or analytical intelligence (Huang & Rust, 2021). In such smart retailing, emotional and relational bonds facilitated by smart technology would be more valuable than utilitarian benefits.

Fourth, all the sample data were cross-sectional and cannot reflect consumers' actual purchase behaviors. Future studies can conduct longitudinal investigations to confirm the impacts of technology readiness and situational factors on actual purchases.

Appendix 1

Table 4 A review of literature on situational factors

Source	Taxonomy of situational factors (Belk, 1975)					Method	Research context
	Physical surroundings	Social surroundings	Temporal perspective	Task definition	Antecedent states		
Wang et al. (2012)	N/A	Companion influence	Waiting time	Task complexity	N/A	Interview	Self-service technology adoption in supermarkets
Chocarro et al. (2013)	Distance-to-shore, store cleanness, website layout	Others presence, social interactions	Time for purchase per day, time pressure	N/A	N/A	Experiment & Survey	Selection between online and offline shopping channels
Chang et al. (2014)	Store environmental characteristics	Social characteristics	Time availability	Task definition	Money availability	Survey	Purchase behaviors in physical retail stores
Chung et al. (2015)	N/A	N/A	N/A	N/A	Facilitating conditions	Survey	Tourist visiting behaviors in smart tourism
Collier et al. (2015)	Location convenience	Employee presence	Tolerance to wait	Order size	N/A	Survey	Self-service technology adoption
Chen et al. (2018)	Location convenience	N/A	Time pressure	N/A	N/A	Survey	Self-service parcel delivery service use in online retailing
Atulkar and Kesari (2018)	Shop environment	Retailers' motivational activities	N/A	Product attributes	Personal situation	Survey	Purchase behaviors in hypermarkets and supermarkets
Kazancoglu and Aydin (2018)	Consumer location	N/A	Goods transportation	Product types, urgency and necessity of the product	N/A	Interview	Purchase behaviors in omnichannel shopping
Barros et al. (2019)	Store environment	Social characteristics	Time availability	Task definition	Money availability	Survey	Purchase behaviors in fashion retail
Chen et al. (2020)	N/A	N/A	Time pressure	N/A	Purchase intention	Experiment & Survey	Mobile payment adoption
Olsson et al. (2022)	N/A	Limited social interactions	Time savings Flexibility	N/A	Reduced stress	Interview & direct observation	Unattended grocery delivery service use
Present study	Entrance convenience	Ease of interaction, usefulness of interaction	Transaction convenience	Merchandise price, merchandise quality	N/A	Survey	Purchase intention in smart retail stores

Appendix 2

Table 5 A review of literature on technology readiness

Source	First/Second order	Factors	Effect	Method	Research context
Lin and Chang (2011)	Second order	Technology readiness (+, sig. direct effect) (−, sig. moderating effect)	Direct effect, Moderating effect	Survey	Adoption of self-service technology
Wang et al. (2012)	NA	Technology readiness (+)	Direct effect	Interview	Self-service technology use in supermarket
Chung et al. (2015)	Second order	Technology readiness (+, sig.)	Direct effect	Survey	Adoption of augmented reality in smart tourism
Chen et al. (2018)	First order	Optimism (+, sig.), Innovativeness (+, sig.)	Direct effect	Survey	Self-service parcel delivery service use in online retail
Roy et al. (2018)	Second order	Technology readiness (+, sig.)	Direct effect	Survey	In-store smart technology adoption
Roy et al. (2020)	Second order	Technology readiness (+, insig.)	Direct effect	Survey	In-store smart technology adoption
Chang and Chen (2021)	Second order	Technology readiness (+, sig.)	Moderating effect	Survey	Shopping intention in smart stores
Park and Zhang (2022)	First order	Optimism (+/−, †), Innovativeness (+/−, †), Discomfort (+/−, †), Insecurity (+/−, †)	Direct effect	Survey	Continuance use of unmanned convenience store
Present study	Second order	Technology readiness (+, *)	Direct effect	Survey	Purchase intention in smart retail stores

Note: + represents the positive effect proposed; − represents the negative effect proposed; sig. represents the significant result examined; insig. represents the insignificant result examined; † represents partially significant results; * represents the expected result in this study

Appendix 3

Table 6 Measurement items

Constructs	Measures	Sources
Entrance convenience	1. It is easy for me to enter this smart retail store 2. I can quickly enter this smart retail store 3. I spent very little time entering this smart retail store	Seiders et al. (2007)
Ease of interaction	In this smart retail store, … 1. …learning to interact with smart technology to make purchases would be easy for me 2. …I would find it easy to interact with smart technology to do what I want it to do 3. …it would be easy for me to become familiar with interacting with smart technology 4. …I would find interacting with smart technology to make purchases is easy	Davis (1989)
Usefulness of interaction	In this smart retail store, … 1. …interacting with smart technology would enable me to accomplish purchases more quickly 2. …interacting with smart technology would make it easier to make purchases 3. …interacting with smart technology would enhance the effectiveness on my purchases 4. …I would find interacting with smart technology useful	Davis (1989)
Transaction convenience	In this smart retail store, … 1. …it is easy for me to complete my transaction 2. …I can quickly complete my purchase 3. …I spent very little time paying for my purchase	Seiders et al. (2007)
Merchandise price	In this smart retail store, … 1. …the merchandise is good value for money 2. …at the price shown, the merchandise is economical 3. …the merchandise is a good buy	Dodds et al. (1991)
Merchandise quality	In this smart retail store, … 1. …the merchandise is reliable 2. …the workmanship of the merchandise is high 3. …the merchandise has good quality 4. …the merchandise is dependable	Dodds et al. (1991)
Optimism	1. New technologies contribute to a better quality of life 2. Technology gives me more freedom of mobility 3. Technology gives me more control over my daily life 4. Technology makes me more productive in my personal life	Parasuraman and Colby (2015)
Innovativeness	1. Other people come to me for advice on new technologies 2. In general, I am among the first in my circle of friends to acquire new technology when it appears 3. I can usually figure out new high-tech products and services without help from others 4. I keep up with the latest technological developments in my areas of interest	Parasuraman and Colby (2015)
Discomfort	1. When I get technical support from a provider of a high-tech product or service, I sometimes feel as if I am being taken advantage of by someone who knows more than I do 2. Technical support lines are not helpful because they don't explain things in terms I understand 3. Sometimes, I think that technology systems are not designed for use by ordinary people	Parasuraman and Colby (2015)
Insecurity	1. Too much technology distracts people to a point that is harmful 2. Technology lowers the quality of relationships by reducing personal interaction 3. I do not feel confident doing business with a place that can only be reached online	Parasuraman and Colby (2015)
Purchase intention	1. I plan to purchase at this smart retail store in the future 2. I intend to purchase at this smart retail store in the future 3. I predict I would purchase at this smart retail store in the future	Venkatesh et al. (2003)

Appendix 4

Table 7 Sample demographics

Measures	Items	Frequency	Percentage
Gender	Male	134	47.3
	Female	149	52.7
Age	18–25	63	22.3
	26–35	142	50.2
	36–45	52	18.4
	46–55	23	8.1
	56–65	3	1.1
Education	Senior high school	41	14.5
	Bachelor's degree	192	67.8
	Master's degree	43	15.2
	Doctoral degree	7	2.5
Occupation	Management personnel	45	15.9
	Professional and technical worker	62	21.9
	Office clerk	12	4.2
	Business and service personnel	57	20.1
	Production operators	4	1.4
	Soldier	3	1.1
	Others	100	35.3
Monthly income (RMB)	< 1500	21	7.4
	1501–3000	17	6.0
	3001–4500	46	16.3
	4501–6000	48	17.0
	6001–7500	27	9.5
	7501–9000	31	11.0
	9001–10,500	32	11.3
	> 10,500	61	21.6
Weekly frequency of shopping in smart retail stores	< 1	119	42.0
	1	98	34.6
	2	32	11.3
	3	9	3.2
	4	7	2.5
	5	6	2.1
	> 5	12	4.2

Data Availability Data available on request from the authors

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