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**Article — Published Version**

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Journal of Consumer Behaviour

**Provided in Cooperation with:**

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*Suggested Citation:* Schultz, Carsten D.; Zacheus, Patrick (2024) : Smart Shopping Carts in Food Retailing: Innovative Technology and Shopping Experience in Stationary Retail, Journal of Consumer Behaviour, ISSN 1479-1838, Wiley Periodicals, Inc., Hoboken, NJ, Vol. 24, Iss. 1, pp. 436-454, <https://doi.org/10.1002/cb.2426>

This Version is available at:

<https://hdl.handle.net/10419/313783>

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SPECIAL ISSUE ARTICLE OPEN ACCESS

# Smart Shopping Carts in Food Retailing: Innovative Technology and Shopping Experience in Stationary Retail

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## ABSTRACT

In the development of the Internet of Things, smart shopping carts present a digital innovation that can realize cost-cutting potential and improve the shopping experience. The impact of smart shopping carts on customers' shopping experience is analyzed in stationary grocery retailing. We explore first whether customers are willing to use these technological innovations, specifically smart shopping carts. Second, the effect of smart shopping carts on customers' shopping experiences is evaluated. For this, we employed a mixed method approach combining a survey study and an interview follow-up study. A purposive sampling recruited 291 stationary grocery shoppers. A variance-based structural equation analysis tests the research model for the adoption of smart shopping carts and their relevance to customers' shopping experience. Next, 22 interviews were conducted with grocery shoppers following an intervention approach. Customers are willing to use smart shopping carts when shopping for groceries in stationary retailing. Customers focus on the ease of use and usefulness of the shopping carts, whereas privacy risk and temporary enjoyment are less relevant. However, our empirical results show that affective, social (employee), and physical components predominantly shape the shopping experience compared with the technical component of smart shopping carts. Smart shopping carts similarly affect the cognitive component and the social (customer) component. In contrast to other digital retail innovations, customers seem to value utility of smart shopping carts above else. Stationary retailers can, thus, focus their introduction of smart shopping carts on countering technology anxiety and highlighting customer benefits of shopping comfort and reduced checkout times.

## 1 | Introduction

Digitalization is extensively changing all areas of life. Especially the Internet of Things improves everyday private and work life and the quality of life (Caro and Sadr 2019; Roe et al. 2022; Sestino 2024). Examples are smart home devices that enable homeowners to turn on/off lights and heating remotely. Digital voice assistants also support these tasks as well as information search, scheduling, listening to music, and shopping via voice (Schultz and Paetz 2023). Smart devices also provide feedback, such as smart refrigerators that draw attention to missing items potentially adding those to the grocery list. Digitalization

also creates various avenues for transformation in grocery retailing (Grewal et al. 2020, 2021; Knof, Stock-Homburg, and Schurer 2024; Shankar et al. 2021). One key avenue is enhancing customers' shopping experience in stationary retailing (Breugelmans et al. 2023; Grewal et al. 2023).

Intensified by the challenges of the pandemic and developments in e-food (Brüggemann and Olbrich 2022; Verhoef, Noordhoff, and Sloot 2023), food retailers are integrating digital innovations to realize cost reduction potential and improve customers' shopping experience (Grewal et al. 2020; Verhoef, Noordhoff, and Sloot 2023). The COVID-19 pandemic particularly increased

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the online shopping experience, creating awareness of the online benefits and inducing consumer demands, for example, in larger assortments and easier-to-use technology in stationary stores (Verhoef, Noordhoff, and Sloot 2023). All in all, this development increases the competition between online and stationary retailing as well as induces more omnichannel strategies (Thaichon et al. 2024).

From a retail perspective, digital innovations may intensify shopping experience in stationary retailing (Breugelmans et al. 2023; Grewal et al. 2023; Thaichon et al. 2024) and offer means to counter new types of competitors (Breugelmans et al. 2023; Verhoef, Noordhoff, and Sloot 2023), such as quick commerce (e.g., Flink, Getir), aggregators (e.g., Glovo, Gopuff), and category specialists (e.g., Flaschenpost). Although demand is still predominantly focused on stationary retailing, digital food retailing is considered “the fastest-growing product category in e-commerce” (Statista 2024). The dynamics of this wave of digitalization in the grocery trade represent at the very least a challenge, with potential pressure to change the existing retail systems.

One example of digital innovation in stationary food retailing is a smart shopping cart (Chiang et al. 2016; Knof, Stock-Homburg, and Schurer 2024; Verhoef, Noordhoff, and Sloot 2023). Smart shopping carts possess digital displays, barcode scanners, and built-in scales (e.g., Shailesh et al. 2021; Venkata Sai Prasad et al. 2023; Vidhya Kamala Lakshmi et al. 2020). During their stationary shopping experience, customers can observe their shopping basket on a digital display, follow an optimized shopping route, and receive further shopping information. Amazon Fresh, for example, uses a so-called dash cart, and EDEKA's smart shopping cart, called Easy Shopper, is used in 90 German EDEKA stores (EDEKA 2024). Potential benefits of smart shopping carts are cost reduction through accelerated payment processes and increased shopping experience (Venkata Sai Prasad et al. 2023; Vidhya Kamala Lakshmi et al. 2020), for example, create shopping basket transparency, show product or promotion locations, offer (targeted) promotions, and suggest products based on shopping basket or menu recipe. These benefits are potentially offset by smart shopping cart purchase and maintenance costs (Inman and Nikolova 2017; Yewatkar et al. 2016).

Retailers are still evaluating smart shopping carts in trial phases or have rolled out smart shopping carts in selected groups of stores. The market size of smart shopping carts is projected to be USD 1780.41 million in 2024, with an anticipated increase to USD 9741.24 million by 2030, reflecting a compound annual growth rate (CAGR) of 27.48% throughout the forecast period from 2024 to 2030 (Virtue Market Research 2023). Although smart shopping carts can provide benefits for customers and retailers, research on smart shopping carts is still scarce. Customers weigh potential benefits against the privacy intrusiveness of such digital innovations (Inman and Nikolova 2017; Sohn, Schnittka, and Seegebarth 2024). Interestingly, shopping basket information stimulates budget shoppers to spend more by buying national brands, whereas nonbudget shoppers spend less by replacing national brands with private labels (van Ittersum et al. 2013). The information provided by smart shopping carts may also induce healthier purchases (Eriksson et al. 2023).

Beyond the existing research, the present study contributes to digital innovations in retailing by analyzing the role of smart shopping carts in customers' shopping experiences. As a prerequisite, we first study customers' adoption and use intention based on the established technology acceptance model (Davis 1989). Building on the previous discussion of digital innovations, we specifically include perceived risk (e.g., Pizzi and Scarpi 2020; Sohn 2024) as a barrier and perceived enjoyment (e.g., Lorente-Martínez, Navío-Marco, and Rodrigo-Moya 2020; Park, Ha, and Jeong 2021) as a driver in this framework as additional antecedents. Second, we go beyond focusing on the adoption of smart shopping carts and consider smart shopping carts as a technological component of customers' shopping experience. Thus, the present study aims to answer two research questions. First, are customers willing to adopt smart shopping carts considering both their perceived risk and enjoyment? Second, how relevant are smart shopping carts as a technological component of customers' shopping experience?

First, based on the technology acceptance framework, the study answers the first research question (RQ1) of whether customers are willing to use smart shopping carts. This is a prerequisite for determining the importance of smart shopping carts as a technological innovation compared with other elements of the shopping experience (RQ2). By using customers' intention to use smart shopping carts as a technological component of the shopping experience, we then answer the second question of how relevant smart shopping carts are compared with other elements of customers' shopping experience when grocery shopping.

Thus, this study explicitly compares smart shopping carts as a technological component to other components of customers' shopping experience. Customers' shopping experience traditionally includes cognitive, affective, social, and physical components (Verhoef et al. 2009). Accordingly, merchandize assortment, interaction with staff, the internal shop environment, and customers' in-shop emotions positively impact supermarket in-store customer experience (Terblanche 2018) without even considering digital innovations. Digital innovations are sources of value creation on the company level and provide perceived benefits on the customer level (Reinartz, Wiegand, and Imschloss 2019). In particular, digital innovations have the potential to increase customers' shopping experience in retailing (Breugelmans et al. 2023; Grewal et al. 2023). Smart shopping carts provide value for nearly all digital value propositions identified by Ziaie, ShamiZanjani, and Manian (2021)—namely, connectivity, information availability, interactivity, mobility, personalization, telepresence, vividness, and co-creation opportunity. Consequently, the present study contributes to the literature by introducing smart shopping carts as an innovative digital technology element in the context of customers' shopping experience.

To achieve the research objective, purposive sampling targeting grocery shoppers is conducted, 291 final responses are collected in an online questionnaire, and the data are analyzed through variance-based structural equation modeling. The grocery shopper sample is diverse in age, occupation, and retailer preferences. As a follow-up study, 22 interviews are conducted following an intervention approach targeting users of smart shopping carts and traditional grocery carts.

## 2 | Theoretical Background

### 2.1 | Smart Shopping Carts

According to Grewal et al. (2020), smart retail technologies can be categorized according to the dimensions of convenience and social presence. Smart shopping carts are generally assigned a high level of convenience, while the degree of social presence is linked to interactions with the customer. On the one hand, smart shopping carts can be presented as systems with low social interaction, comparable with checkout-free payment systems. On the other hand, smart shopping carts, like smart screens, offer opportunities to address and interact with individual customers.

Smart shopping carts are activated by customer identification using, for example, a smartphone app, partner program card, or face recognition (Chiang et al. 2016; Venkata Sai Prasad et al. 2023). Customers either scan the products themselves or the products are automatically identified using comprehensive sensors, for example, cameras, scales, or RFID (Chandrasekar and Sangeetha 2014; Chiang et al. 2016; Shailesh et al. 2021; Venkata Sai Prasad et al. 2023; Vidhya Kamala Lakshmi et al. 2020). A touchscreen usually displays the shopping cart with all products and corresponding amounts. Further, customers can use the screen to navigate to desired products, to call staff, and receive up-to-date individual offers (EDEKA 2024). The payment process can take place both at checkouts and at the smart shopping cart—potentially without taking the products out. Using a connected card terminal, customers can also pay for their purchase directly—without having to wait for the checkout (Chiang et al. 2016; Venkata Sai Prasad et al. 2023). Avoiding waiting times during the payment process is, thus, a direct customer benefit of smart shopping carts (Kim and Kim 2008; Venkata Sai Prasad et al. 2023), meaning that smart shopping carts can contribute to the attractiveness of stationary food retailing. For cashless payments, the purchases can also be charged to the corresponding customer account using NFC.

Although research exists on the technological development of smart shopping carts (e.g., Shailesh et al. 2021; Venkata Sai Prasad et al. 2023; Vidhya Kamala Lakshmi et al. 2020; Yewatkar et al. 2016), academic research on smart shopping cart acceptance and use is comparatively scarce. Real-time balance information provided by the shopping basket affects spending behavior (van Ittersum et al. 2013). Surprisingly, the authors identify a diverging impact of balance information on spending for people who are budget-constrained (“budget” shoppers) and those who are not (“nonbudget” shoppers). Balance information stimulates budget shoppers to spend more (by buying more national brands), whereas such feedback leads nonbudget shoppers to spend less (by replacing national brands with store brands). Eriksson et al. (2023) also consider information on the smart shopping cart screen, especially health-related information. In their conjoint experiment that includes details on nutrition, health stimuli, price, and taste, the authors conclude that the health stimuli on smart shopping carts motivate healthier purchases. In their study, Estes and Streicher (2022) find that parallel-handle shopping carts significantly increased sales across a broad range of categories, including both vice and virtue products, due to a higher activation of flexor muscles.

Most closely related to the present research, Fazal-e-Hasan et al. (2021) identify perceived novelty and compatibility as positive antecedents, whereas perceived risk negatively affects customers' intention to use smart shopping carts. This study extends the work on smart shopping carts by first reflecting on consumers' acceptance of this technology and then integrating smart shopping carts as part of the customer shopping experience into our consideration.

### 2.2 | Technology Acceptance

As the development of information and communication technology has progressed, research into the acceptance of technologies has become more widespread. The technology acceptance model is based on Ajzen and Fishbein's theory of planned behavior (Davis 1989; Davis, Bagozzi, and Warshaw 1992; Venkatesh and Bala 2008) and provides the fundamental theoretical frame here. Despite its critique (e.g., Bagozzi 2007; Benbasat and Barki 2007), the technology acceptance model provides a general research framework for innovative technologies (King and He 2006; Manis and Choi 2019). Although the technology acceptance model has been revised and expanded in several stages, the original approach has also been widely accepted due to its flexible applicability regarding the acceptance and use of new technologies. The primary factors measured by the technology acceptance model are the perceived ease of use and perceived usefulness of a technology, which subsequently determine attitude toward use, behavioral intention, and actual use (Davis 1989).

The adaptability of the technology acceptance framework provides a strong foundation for studying innovative technologies. In retailing, Roy et al. (2018) study smart retail technologies, such as smart checkouts, personal shopping assistance, point-of-sale smart displays, NFC systems, and augmented reality based on the underlying structure of the technology acceptance model. Similarly, Park, Ha, and Jeong (2021) analyze consumer acceptance of self-service technologies in fashion retail stores—extending the pragmatic properties of the technology acceptance model with hedonic properties of self-service retail technologies. In line with this research, we also apply the technology acceptance framework for smart shopping carts.

Regarding the use of smart shopping carts in food retailing, the present study also includes perceived risk (Forsythe and Shi 2003; Reinartz, Wiegand, and Imschloss 2019; Sohn, 20224) and perceived enjoyment (Moon and Kim 2001; Park, Ha, and Jeong 2021; Reinartz, Wiegand, and Imschloss 2019) to extend the technology acceptance model toward the research area. Smart shopping carts collect personal data that go beyond shopping cart analysis, such as shopping patterns within the point of sale. Naturally, privacy risk is a relevant barrier when introducing retail technologies (Pizzi and Scarpi 2020). The authors particularly studied store beacons, facial recognition, smart mirrors, and automatic checkouts. Consumers also fear the misuse of personal data with other innovative technologies, for example, augmented reality (Rauschnabel, He, and Ro 2018), digital voice assistants (Schultz and Paetz 2023), and Internet of Things (Inman and Nikolova 2017) in the context of bricks-and-mortar retail. Furthermore, to use the direct payment function,

financial information is required, which can pose a significant risk in the event of data theft. To take this potential risk into account, the perceived risk (Forsythe and Shi 2003; Sohn 2024) of smart shopping carts is considered as part of the technology acceptance model. Regarding autonomous retail technologies, Sohn, Schnittka, and Seegebarth (2024), for example, identifies various perceived risks with consumers (i.e., time, health, financial, privacy, and social) that are mitigated by innovativeness, trustworthiness, and self-efficacy. Furthermore, technological innovations are associated with stimuli based on gimmickry or novelty of the technology. For example, Dekhili and Ertz (2024) find that AR eco labels that provide extensive information increase the intention to buy when packaging is also novel. Retail technology's hedonism positively affects its acceptance (Pizzi and Scarpi 2020). Similarly, fun to use is the strongest technological factor in the context of in-store technologies for small and medium-sized retailers (Lorente-Martínez, Navío-Marco, and Rodrigo-Moya 2020). Perceived enjoyment also creates positive attitudes toward the use of self-service retail technologies (Park, Ha, and Jeong 2021). Thus, we also consider perceived enjoyment in smart shopping carts.

### 2.3 | Shopping Experience

Shopping experience is considered a subaspect of the customer experience, alongside product, service, brand, and consumer experience (Leischnig, Schwertfeger, and Enke 2012). Shopping experience refers to the impressions and experiences inside (Terblanche 2018; Terblanche and Boshoff 2004) and outside the retail store as well as to interactions, for example, with staff (Bustamante and Rubio 2017) or with smart shopping carts. Terblanche and Boshoff (2004) see shopping experience as all customer perceptions from arriving at the store to leaving the store vicinity.

Building on the shopping experience concept and theory, we can capture the various elements of customers' experiences during a shopping visit. Shopping experience, thus, provides a theoretical foundation for identifying the role of smart shopping carts (as a technological component) compared with other elements of the shopping experience, such as cognitive, affective, social, and physical components (Verhoef et al. 2009; Bustamante and Rubio 2017).

Shopping experience entails customers' perceptions through various stimuli during the purchase journey. Thus, the concept of shopping experience implies that customers do not (merely) go shopping for rational/functional reasons (as purely completing a task) but the customers are driven by a collection of different motives (Tauber 1972). Examples are utilitarian and hedonic attributes of the shopping experience (Babin, Darden, and Griffin 1994). From the retailer's perspective, the objective is, therefore, to positively shape and intensify all experiences in the store context to elevate the retailer brand to the customer's primary source of supply. Customers who experience many positive stimuli while shopping are more attracted to the store, spend more time there, and, therefore, usually spend more money (Singh and Sahay 2012). Following the simple two-type classification, Yoon (2013) classifies (a) recommendations, comfort, cleanliness, and speed as utilitarian elements, whereas (b) store

design, smell, liveliness, and music elements are examples of hedonic elements of customers' shopping experience. In a recent methodological extension, including neuromarketing into the shopping experience measurement, Rancati et al. (2023) identify social environment, store atmosphere, employee service, product quality, price, and previous experience as key determinants of customers' shopping experience.

According to Verhoef et al. (2009), cognitive, affective, social, and physical components can be identified as central elements of the shopping experience. The cognitive component refers to the customer's ability to process information through perception, acquired knowledge, and subjective characteristics (Bustamante and Rubio 2017). Products and services should encourage customers to think, arouse their curiosity, promote creativity, and inspire them. Emotions and moods form the affective component, which has an impact on customer behavior. The affective component influences, for example, what information is processed, how customers react to stimuli, and whether customers feel comfortable shopping (Gaur, Herjanto, and Makkar 2014). The social component refers to the quality and intensity of interactions in the context of stationary retailing. Bustamante and Rubio (2017) refer to interactions among customers and between customers and employees. The physical component refers to the perception of the store. Central components are, for example, the layout and atmosphere of the store and are determined by the perception of sounds, smells, haptics, and temperature. In addition, we consider the smart shopping cart as a technological component of the shopping experience in this study.

## 3 | Research Model and Hypotheses Development

### 3.1 | Research Model

The research model consists of two parts. First, we analyze the adoption of smart shopping carts by means of the technology acceptance framework (Davis 1989) enhanced by perceived enjoyment and risk. For the general structure of the technology acceptance model, we refer to Davis (1989) and Venkatesh and Bala (2008). Despite its critique (e.g., Bagozzi 2007; Benbasat and Barki 2007), the technology acceptance model provides a general framework (King and He 2006; Manis and Choi 2019) that we extend toward smart shopping carts in stationary food retailing. The technology acceptance model is particularly adaptable concerning antecedents that are relevant to the specific technology innovation. Building on previous research, we consider a key barrier—perceived risk—and a key driver—perceived enjoyment—to enhance the technology acceptance framework regarding smart shopping carts. The technology acceptance model helps to establish customers' intention to use smart shopping carts.

In the second step, we use “intention to use” from the technology acceptance model as a technological component in our second part. Thus, we establish the importance of this technological component in relation to other aspects of the shopping experience (Terblanche 2018; Verhoef et al. 2009) in stationary food retailing. Shopping experience then leads to customer satisfaction and loyalty. Figure 1 presents the research model and related hypotheses for answering the research questions.

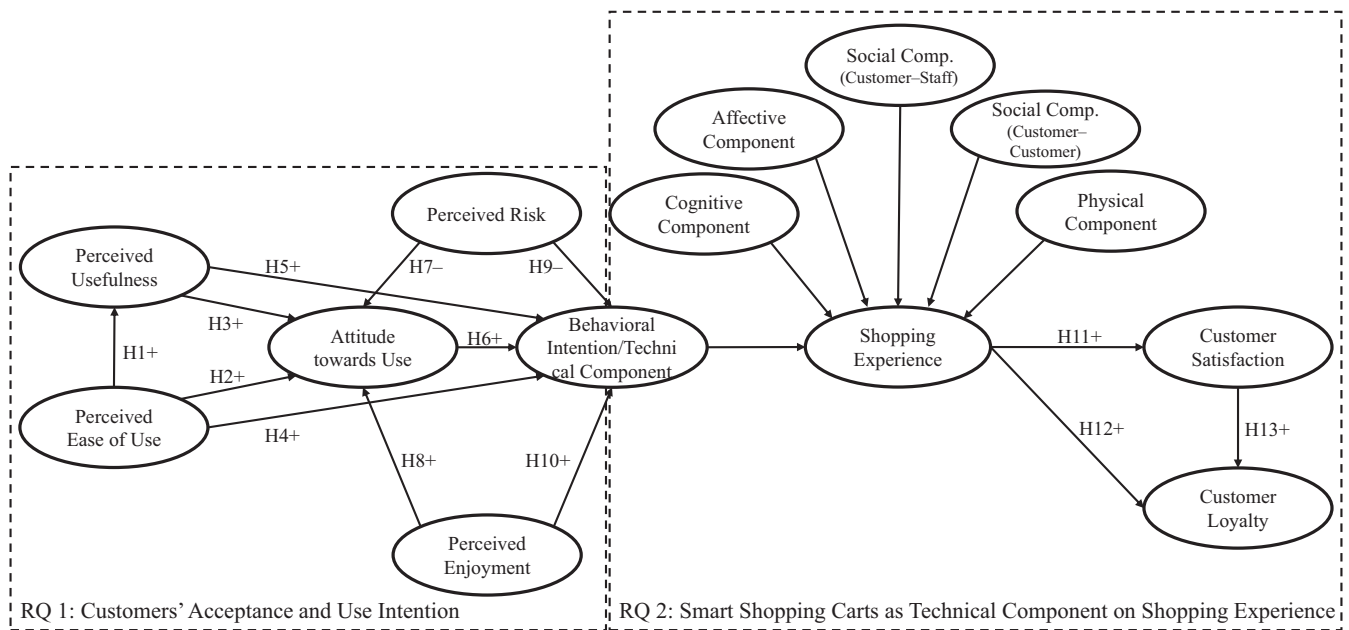


FIGURE 1 | Research model.

### 3.2 | Hypothesis Development

#### 3.2.1 | Technology Acceptance Model

An established basis for studying the acceptance and use of disruptive, innovative technologies is the technology acceptance model (Manis and Choi 2019). This study generally follows the established argumentation (Davis 1989; Davis, Bagozzi, and Warshaw 1989). Next, we briefly outline the central hypotheses in the technology acceptance model.

The key antecedences in the technology acceptance model are perceived ease of use and usefulness (Davis, Bagozzi, and Warshaw 1989). Perceived ease of use refers to “the degree to which a person believes that using a particular system would be free from effort” (Davis, 1989, 320). Perceived ease of use is an antecedent of perceived usefulness (Davis, Bagozzi, and Warshaw 1989; Manis and Choi 2019). A user who perceives the use of a technological innovation as effortless is more likely to perceive the technology as useful. The relationship is supported in the context of smart retail technologies (e.g., Roy et al. 2018), smart shops (e.g., Chang and Chen 2021; Chen and Chang 2023), and retailing self-service technologies (e.g., Park, Ha, and Jeong 2021). Smart shopping carts can be similarly used as traditional carts (Chiang et al. 2016) but provide additional benefits in part subject to a registered account (Inman and Nikolova 2017; Yewatkar et al. 2016). Perceived ease of use helps to improve the smart shopping carts' usefulness by reducing the effort required to utilize them. Hence, we propose:

**H1.** *Perceived ease of use of smart shopping carts has a positive effect on their perceived usefulness.*

The technology acceptance model also explains the technology's ease of use on shoppers' attitudes toward adopting the technology. In retailing, the ease of use of smart retail technologies,

such as smart checkouts, personal shopping assistance, and smart displays forms positive shopper attitudes (Roy et al. 2018). Similarly, retailers' self-service technologies also support this positive relationship (Park, Ha, and Jeong 2021). Since smart shopping carts mostly augment traditional carts, shoppers can easily adopt the technology. Such ease of use leads to shoppers' positive attitudes toward smart shopping carts. Hence, we propose:

**H2.** *Perceived ease of use of smart shopping carts has a positive effect on the attitude toward using them.*

Following the argumentation on perceived ease of use, the technology acceptance model also posits that perceived usefulness drives shoppers' attitudes (Davis 1989; Davis, Bagozzi, and Warshaw 1989). Smart shopping carts usefulness resolves around checkout time savings, shopping basket transparency, product or promotion locations, (targeted) promotions, and product suggestions (Inman and Nikolova 2017; Venkata Sai Prasad et al. 2023; Yewatkar et al. 2016). Previous literature in retailing, such as augmented reality (e.g., Schultz and Kumar 2024), self-service retailing technologies (Park, Ha, and Jeong 2021), and smart retailing technologies (e.g., Roy et al. 2018) find support for this positive relationship. The perceived usefulness thus positively shapes shoppers' attitudes toward using smart shopping carts. Hence, we propose:

**H3.** *Perceived usefulness of smart shopping carts has a positive effect on the attitude toward using them.*

Beyond the attitudinal route toward a technology (e.g., Park, Ha, and Jeong 2021), perceived ease of use and usefulness also directly stimulate shoppers' intention to use innovative technologies, such as smart shopping carts. In the context of smart stores, perceived ease of use and perceived usefulness impact purchase intention (Chang and Chen 2021; Chen and Chang 2023), whereas Kowalczyk (2018) only identifies a positive direct effect

of perceived usefulness on shoppers' behavioral intention to use smart speakers. The positive effect of perceived usefulness is also supported in retail smart technologies (Roy et al. 2018) and augmented reality for retailing (Schultz and Kumar 2024). Following the development of the technology acceptance model (Venkatesh and Bala 2008), this study analyzes the positive effects of perceived ease of use and usefulness on shoppers' behavioral intention. Hence, we propose:

**H4.** *Perceived ease of use of smart shopping carts has a positive effect on the behavioral intention to use them.*

**H5.** *Perceived usefulness of smart shopping carts has a positive effect on the behavioral intention to use them.*

Last, the technology acceptance model proposes that shopper attitudes strongly influence behavioral intention (Davis 1989; Davis, Bagozzi, and Warshaw 1989). Even though, developments in the domain of information systems have subsequently removed this attitude-behavior relationship (Venkatesh and Bala 2008). Examples of such influences in (smart) retailing are, for example, Chang and Chen (2021), Chen and Chang (2023), and Kowalczyk (2018). In contrast, Park, Ha, and Jeong (2021) find support for this relationship in the context of self-service technologies in fashion retailing. Similarly, this relationship is supported in smart retail technologies (Roy et al. 2018) and augmented reality retailing (Schultz and Kumar 2024). Furthermore, the marketing literature also prominently documents the relationship between attitudes and behavior. Hence, we propose:

**H6.** *Attitude toward using smart shopping carts has a positive effect on the behavioral intention to use them.*

### 3.2.2 | Perceived Risk

Previous research considers various effects of perceived risk on the elements of the technology acceptance model, for example, attitudes and behavioral intention (Schultz and Brüggemann 2022). One dominant route in previous research seems to be the effect on behavioral intention (Kowalczyk 2018; Liao et al. 2019). Fazal-e-Hasan et al. (2021) especially suggest a negative effect of perceived privacy on customers' intention to use smart shopping carts. Similarly, privacy risk is identified as a threat to customers' acceptance of store beacons, facial recognition, smart mirrors, and automatic checkouts (Pizzi and Scarpi 2020). Sohn, Schnittka, and Seegebarth (2024) further outlines time, health, financial, privacy, and social risks as key barriers to autonomous retail technologies. Thus, we propose:

**H7.** *Perceived risk of smart shopping carts has a negative effect on the attitude toward using them.*

**H9.** *Perceived risk of smart shopping carts has a negative effect on the behavioral intention to use them.*

### 3.2.3 | Perceived Enjoyment

Attig et al. (2017) identify numerous technology-related personality constructs that have been analyzed in previous literature,

for example, computer attitudes, computer anxiety, playfulness, affinity to technology. Beyond perceived risk discussed above, this study intends to consider a positive anchor in technology adoption that is perceived enjoyment (Venkatesh and Bala 2008). Retail technology's hedonism positively affects customers' acceptance (Pizzi and Scarpi 2020). Perceived novelty, which relates to the newness and potentially gimmicky aspect of the innovation, positively affects customers' use intention (Fazal-e-Hasan et al. 2021). Customers' innovativeness similarly mitigates perceived risk and positively affects customers' intention to use autonomous retail technologies (Sohn 2024). Perceived enjoyment has been considered to positively shape the elements of the technology acceptance model in augmented reality research (Schultz and Kumar 2024). Accordingly, Lorente-Martínez, Navío-Marco, and Rodrigo-Moya (2020) identify fun to use as the strongest technological factor in the context of in-store technologies. Perceived enjoyment also increases customers' acceptance and, subsequently, their usage intention of self-service retail technologies (Park, Ha, and Jeong 2021). Furthermore, Chang and Chen (2021) identify entertainment as a key element in adopting smart shops. Hence, we propose:

**H8.** *Perceived enjoyment of smart shopping carts has a positive effect on the attitude toward using them.*

**H10.** *Perceived enjoyment of smart shopping carts has a positive effect on the behavioral intention to use them.*

### 3.2.4 | Shopping Experience

Following existing literature, cognitive, affective, social, and physical components constitute the central elements of the shopping experience (Verhoef et al. 2009). This study extends this understanding by including a technological element, namely, the use of smart shopping carts in food retailing. The service quality model (Storbacka, Strandvik, and Gronroos 1994) suggests that customer experiences perceived as satisfactory lead to customer loyalty. Thus, if a recent shopping experience exceeds prior expectations, customers perceive a positive retail/service encounter, creating customer satisfaction and, subsequently, customer loyalty. Roozen and Katidis (2019), for example, demonstrate that a positive shopping experience creates customer satisfaction. Satisfied customers are generally willing to pay more, are less likely affected by competitors, and, thus, more loyal toward the current retailer (Hansemark and Albinsson 2004).

Customer loyalty is predominantly attributed to brand and store loyalty (Kim, Park, and Jeon 2021; Srivastava and Kaul 2016), which are strongly related and intertwined and directly impact business success. Furthermore, research in brand loyalty suggests that exceptional experiences positively influence loyalty (Brakus, Schmitt, and Zarantonello 2009; Chang 2020). Finally, total customer experience leads to lasting customer satisfaction and loyalty (Mascarenhas, Kesavan, and Bernacchi 2006). Retail innovations may also positively moderate the relationship between shopping experience and customer loyalty (Channa et al. 2020). Therefore, we conclude a positive relationship between shopping experience and customer satisfaction as well as customer loyalty:

**H11.** *Shopping experience has a positive effect on customer satisfaction.*

**H12.** *Shopping experience has a positive effect on customer loyalty.*

Literature on customer relationship management supports the positive effect of customer satisfaction on customer loyalty (e.g., Storbacka, Strandvik, and Gronroos 1994; Malhotra and Agarwal 2002). In summary, when a customer is satisfied with a retail store, the customer is more likely to revisit the store (Bolton 1998) and develop customer loyalty toward the brand and the store (Shankar, Smith, and Rangaswamy 2003). Consequently, we propose:

**H13.** *Customer satisfaction has a positive effect on customer loyalty.*

## 4 | Methodology and Empirical Study

### 4.1 | Quantitative Study

#### 4.1.1 | Overview

We use partial least squares structural equation modeling (PLS-SEM) to estimate the parameters in our measurement model (outer model) and structural model (inner model). The R package *plspm* (Sanchez, Trinchera, and Russolillo 2015) is used for data analysis. This variance-based SEM approach has limited distributional needs regarding the measured items and minimal computational requirements for the underlying algorithm (Hair Jr., Howard, and Nitzl 2020). The use of PLS-SEM is appropriate because it supports the prediction and explanation of dependent variables in a theoretically grounded structural model (Hair Jr. et al. 2021; Sarstedt et al. 2014). In addition, PLS-SEM allows for complex models in terms of the number of variables and relationships as well as modeling flexibility, limited requirements for the distributional assumptions of the variables and sample size, and convergence and stability of the results (Sarstedt et al. 2014). PLS-SEM generally achieves high levels of statistical power for hypotheses testing. For power analysis, we used *G\*power* ( $f^2 = 0.15$ ,  $\alpha = 0.05$ , power = 0.80, and predictors = 6) for the minimum required sample size to explore our research model at a 0.05 significance level and effect size = 0.15. The power analysis recommends a minimum  $n$  of 98 for the structural equation analysis.

#### 4.1.2 | Measurements

All measurement scales are based on previous research and modified to the context of smart shopping carts in food retailing. All items are measured on a 7-point rating scale, ranging from 1 (“strongly disagree”) to 7 (“strongly agree”). Appendix A lists all measurement items.

The measurement of the acceptance of smart shopping carts in food retailing follows the technology acceptance framework. All constructs based on the technology acceptance model are measured by items from Davis (1989) and Davis, Bagozzi, and

Warshaw (1992). Perceived risk is measured with three items adopted from Forsythe and Shi (2003), whereas perceived enjoyment is based on five items from Moon and Kim (2001).

The components of shopping experience are adapted from existing literature. The cognitive component is based on Raju (1980). Richins (1997) and Laros and Steenkamp (2005) provide the measurement for the affective component. For the social component in terms of relationships between customers, McAlexander, Schouten, and Koenig (2002) and Moore, Moore, and Capella (2005) are used, while the measurement refers to Baker, Grewal, and Parasuraman (1994) for the relationship between customers and employees. The physical component is measured using items from Yalch and Spangenberg (2000). Last, the technological component refers back to the usage intention of the technology acceptance framework.

The items for customer satisfaction are based on the original conceptualization by Oliver (1980). Srivastava and Kaul (2016) provide the measurement items for customer loyalty.

#### 4.1.3 | Data Collection and Sample

Purposive sampling was used for data collection through an online survey. Participants were screened regarding whether they had experience in grocery shopping. We conducted the online survey in October and November 2021. Due to pandemic regulations on contact minimization, the survey was not conducted within the context of stationary food retailing. Although the participants were not interviewed in a direct thematic context, they could answer the extensive questionnaire without time pressure. Using an online sample biases the sample toward technology affinity, which is purposeful for the introduction of stationary retailing technology. The participants were explicitly introduced to the topic of stationary food retailing by being asked about their preferred food retail outlet and the retailer brand (including discounters and supermarkets). The preferred retailer brand then served as the basis for the survey. Table 1 provides an overview of the diverse preferred stationary retailers.

Smart shopping carts were introduced in text as well as by illustrations. As control variables, we also surveyed demographic data, experience with smart shopping carts, and affinity toward technology as potential model contingencies. The individual measurement items were formulated in such a way that they accounted for participants' previous experience with smart shopping carts.

The authors invited people to take part in the survey and asked them to forward the survey also to personal contacts. The authors used several private and professional contacts as seeds for data collection. To ensure data quality, we collected participants' consent for the study at the beginning of the survey and directly asked about the seriousness of their participation at the end of the survey. Furthermore, the survey used items from established scales, and the items were randomly rotated in each questionnaire. We used recoded measurement items to test attention. All questionnaires were further checked for completeness, processing time (relative speed index < 1.75), and response behavior (“straightlining”).



**TABLE 1** | Overview of sample characteristics.

Variable	Absolute frequency	Relative frequency
Gender		
Female	199	68.4%
Male	92	31.6%
Diverse	—	—
Age		
18–24	33	11.3%
25–29	69	23.7%
30–39	54	18.6%
40–49	55	18.9%
50–59	65	22.3%
60+	15	5.2%
Occupation		
Employees	188	64.6%
Trainees	5	1.7%
Civil servants	15	5.2%
Self-employed	10	3.4%
Students	46	15.8%
Pensioners/retirees	11	3.8%
Other occupations	16	5.5%
Retailer preference		
Aldi	31	10.7%
Edeka	83	28.5%
Kaufland	18	6.2%
Lidl	34	11.7%
Marktkauf	62	21.3%
Rewe	45	15.5%
Other retailers	18	6.2%

The final sample comprises 291 data entries. The sample is characterized by 68% (199) female and 32% (92) male participants. The gender split follows the stereotypical role distribution (Bundesforschungsinstitut für Ernährung und Lebensmittel 2008). 65.4% of female shoppers still perform the majority of grocery shopping in Germany—similarly, 68% of women identified themselves as primary shoppers in the US in 2023 (FMI 2023). The sample covers a wide range of ages. 11% of the participants are between 18 and 24 years old, 24% between 25 and 29, 19% between 30 and 39, 19% between 40 and 49, 22% between 50 and 59, and 5% are 60 years and older. The majority of the sample is employed (75%), including those in training (2%), employed (65%), civil servants (5%), and self-employed (3%). Sixteen percents are students, 4% are retirees or pensioners, and 6% follow other occupations.

#### 4.1.4 | Acceptance of Smart Shopping Carts

A variance-based structural equation analysis tests the presented research model (see Figure 1) for the adoption of smart shopping carts. The measurement models are assessed by inspecting the individual item reliability, composite reliability, and discriminant validity. For validation purposes, this study employs bootstrap resampling with 5000 cases and a significance level of 0.05.

The measurement models following the technology acceptance model demonstrate reliable and valid measurement overall. Considering indicator reliability, two measurement items must be excluded due to low loadings (PEU2 = 0.645 and ENJ1 = 0.070). We retain item RI3 = 0.667, considering the number of measurement items for perceived risk. A sensitivity analysis without this item leads to comparable results. All other loadings of the measurement items lie between 0.719 and 0.973 and exceed the required value of 0.7. We can also assume construct reliability with values for Cronbach's alpha (between 0.777 and 0.959) and Dillon-Goldstein's rho (between 0.874 and 0.973) over 0.7 for all latent constructs. In addition, the average variance extracted (AVE) for all constructs is at least 0.50 (between 0.655 and 0.924), so that convergence validity can be assumed. Table 2 presents an overview of the measurement results.

The discriminant validity is evaluated using Fornell-Larcker criteria, evaluating the cross-loadings, and the heterotrait-monotrait ratio 2 (HTMT2). All construct correlations are below the corresponding diagonal value that represents the square root of the AVE. Moreover, the cross-loadings confirm that every item has the highest loading with the corresponding construct. The HTMT2 ratios are all below the conservative threshold value of 0.85 or the recommended threshold value of 0.90—ranging from 0.370 to 0.888 (Table 3).

The empirical results of the structural model show an overall positive attitude and high customer willingness to use smart shopping carts in stationary food retailing. The relationships of the technology acceptance model are consistently supported in the study (H1–H6 at  $p < 0.05$ ). The perceived risk (H7:  $\beta = -0.072$ ,  $p = 0.014$ ) shows the expected negative influence and the perceived enjoyment (H8:  $\beta = 0.306$ ,  $p < 0.001$ ) a positive influence on the attitude toward the use of smart shopping carts. However, neither the perceived risk (H9:  $\beta = -0.040$ ,  $p = 0.158$ ) nor the perceived enjoyment (H10:  $\beta = -0.028$ ,  $p = 0.466$ ) have a direct, significant effect on the intention to use smart shopping carts. Table 4 summarizes the standardized path estimates and hypotheses results.

Overall, the perceived ease of use explains  $R^2 = 34.0\%$  of the variance in perceived usefulness. The model explains a high proportion of variance in the attitude toward using ( $R^2 = 81.1\%$ ) and consumers' intention to use ( $R^2 = 82.5\%$ ) smart shopping carts in stationary food retailing. While perceived ease of use influences perceived usefulness ( $f^2 = 0.515$ ) and perceived usefulness influences customers' attitude toward using ( $f^2 = 0.646$ ), the attitude toward smart shopping carts also has a considerable effect on consumers' intention to use them ( $f^2 = 0.370$ ).

**TABLE 2** | Overview of measurement results.

Latent variable	Item	Loading	Alpha	Rho	AVE
Perceived ease of use	PEU1 <sup>a</sup>	0.719	0.893	0.919	0.655
	<i>PEU2<sup>a</sup></i>	0.645			
	PEU3	0.724			
	PEU4	0.824			
	PEU5 <sup>a</sup>	0.775			
	PEU6	0.877			
	PEU7	0.917			
Perceived usefulness	PU1	0.932	0.964	0.972	0.875
	PU2	0.949			
	PU3	0.940			
	PU4	0.912			
	PU5	0.943			
Attitude	ATT1	0.958	0.948	0.967	0.906
	ATT2	0.965			
	ATT3	0.932			
Perceived risk	RI1	0.912	0.777	0.874	0.702
	RI2	0.910			
	RI3	0.667			
Perceived enjoyment	<i>ENJ1</i>	0.070	0.909	0.936	0.786
	ENJ2	0.928			
	ENJ3	0.938			
	ENJ4	0.870			
	ENJ5	0.803			
Behavioral intention	BI1	0.971	0.959	0.973	0.924
	BI2	0.973			
	BI3	0.940			

Note: Items in italics dropped; other values after item reduction.

<sup>a</sup>Reversed scales.

**TABLE 3** | Heterotrait–monotrait ratio 2 (HTMT2).

	PEU	PU	ATT	RI	ENJ	BI
PEU						
PU	0.611					
ATT	0.670	0.888				
RI	0.562	0.525	0.564			
ENJ	0.460	0.706	0.798	0.370		
BI	0.706	0.861	0.830	0.575	0.690	

Previous experience with smart shopping carts has a statistically significant effect on the relationship between ease of use and attitude toward using smart shopping carts. Customers with previous experience (EX+) assign a higher importance to ease of use than customers without previous experience (EX–)

( $\beta_{EX-} = 0.096$ ,  $\beta_{EX+} = 0.322$ ,  $p = 0.001$ ). Consequently, the (positive) experience with smart shopping carts plays an important role for the future use of them. Although not statistically significant, users who have already experienced smart shopping carts assign a positive value to the relationship between perceived pleasure and their usage intention, whereas customers without experience attest a negative value to this relationship ( $\beta_{EX-} = -0.069$ ,  $\beta_{EX+} = 0.052$ ,  $p = 0.093$ ). Considering the influence of previous experience, stationary retailers should encourage use, for example, by employees introducing smart shopping carts or by showing explanatory videos in the entrance area. Customer testimonials in hand-outs can also motivate customers to use these systems.

When comparing participants with less affinity (TA–) and more affinity (TA+) toward technology, the empirical results show that the importance of perceived ease of use for both groups' intention to use is statistically different ( $\beta_{TA-} = 0.212$ ,  $\beta_{TA+} = 0.061$ ,

**TABLE 4** | Standardized path estimates and hypotheses summary.

Independent	Dependent	Hypothesis	Path estimate	<i>p</i>
Perceived ease of use	Perceived usefulness	H1 (+)	0.583	<0.001
Perceived ease of use	Attitude	H2 (+)	0.170	<0.001
Perceived usefulness	Attitude	H3 (+)	0.517	<0.001
Perceived risk	Attitude	H4 (-)	-0.072	0.014
Perceived enjoyment	Attitude	H5 (+)	0.306	<0.001
Perceived ease of use	Behavioral intention	H6 (+)	0.150	<0.001
Perceived usefulness	Behavioral intention	H7 (+)	0.250	<0.001
Attitude	Behavioral intention	H8 (+)	0.583	<0.001
Perceived risk	Behavioral intention	H9 (-)	-0.040	0.159
Perceived enjoyment	Behavioral intention	H10 (+)	-0.028	0.467

$p=0.035$ ). The results suggest that users with high technology affinity attribute a high level of technical competence to themselves, meaning that ease of use is of comparatively little importance. As food retailers have to accommodate a wide range of customers, they should pay consistent attention to the ease of use of their smart shopping carts.

Finally, we examine socio-demographic differences. While participants' age shows no statistically significant differences, there is a significant difference when comparing male and female customers. In terms of personal perception, men perceive a negative effect of the perceived enjoyment on behavioral intention, whereas women show a positive but low effect ( $\beta_{\text{men}} = -0.147$ ,  $\beta_{\text{women}} = 0.031$ ,  $p = 0.018$ ). We cannot conclusively clarify whether the perceived negative effect of shopping enjoyment is due to grocery shopping or due to the smart shopping cart.

#### 4.1.5 | Smart Shopping Carts and Shopping Experience

After first determining customers' intention to use smart shopping carts, we next examine the role of smart shopping carts regarding the shopping experience. Overall, the individual components of the shopping experience as well as customer satisfaction and customer loyalty show reliable and valid measurements. We had to remove four items from the affective component (AC3 to AC6) relating to negative affective elements. Following a sensitivity analysis, we retained items SKK6 (0.688) and KL1 (0.648). All other item loadings are between 0.703 and 0.973. The values for testing construct reliability (Cronbach's alpha [0.882; 0.959] and Dillon-Goldstein's rho [0.911; 0.973]) and for convergence validity (AVE [0.589; 0.924]) are also above the corresponding threshold values. Discriminant validity can also be assumed based on cross-loadings and the Fornell-Larcker criterion.

The second-order formative construct "shopping experience" is measured by the repeated indicator approach (RIA). This approach estimates all constructs in one step and reduces the risks of interpretative error (Becker, Klein, and Wetzels 2012). The RIA is proposed either with all measurement items or keeping

the same number of measurement items per construct. Both approaches lead to comparable results, so we report the values for the former. As VIF values are below 5 and considerably low (1.097 to 2.795), we can assume that multicollinearity in the measurement is not a prevalent issue of the shopping experience. We can also assume discriminant validity for this formative construct on the basis of correlations below 0.9 (from 0.255 to 0.822) with the other constructs.

As expected, the shopping experience has a positive effect on customer satisfaction (H11:  $\beta = 0.722$ ,  $p < 0.001$ ) and customer loyalty (H12:  $\beta = 0.351$ ,  $p < 0.001$ ). In line with the literature on customer relationship management, there is also a significant positive effect of customer satisfaction on customer loyalty (H13:  $\beta = 0.496$ ,  $p < 0.001$ ).

Overall, the model explains a high proportion of variance in customer satisfaction ( $R^2 = 0.521$ ) and customer loyalty ( $R^2 = 0.621$ ). Comparing the path coefficients for the shopping experience, the technological component—smart shopping carts—(0.209) has a comparatively similar effect as the cognitive component (0.190) and the social (customers) component (0.198). In contrast, the affective (0.271), social (employees) (0.281), and physical components (0.296) seem to be more relevant in our empirical results. Despite the general acceptance of smart shopping carts, this technological component does not play a dominant role in the customer shopping experience for food retailing compared with the other shopping experience components.

## 4.2 | Qualitative Study

### 4.2.1 | Approach of the Qualitative Study

In order to provide more insights into the quantitative empirical findings, we conducted a qualitative follow-up study. Based on an intervention technique, 22 interviews were conducted in person in front of one German supermarket. The supermarket offers both traditional and smart shopping carts. The intention of the explorative interview approach is to provide further insights into the empirical findings. Naturally, explorative results

are indicative and warrant some caution before generalization. Appendix B provides an overview of the interviewees who are diverse in age, gender, and shopping behavior. Sixteen interviews were conducted with users of smart shopping carts reaching saturation after 14 interviews. In addition, we carried out six interviews with users of traditional shopping carts to avoid selection bias for the benefits of smart shopping carts. The interview structure follows the research objectives. First, questions were asked about the acceptance of smart shopping carts (SSC). Shoppers' acceptance included positive and negative aspects. Second, interviewees enquired about smart shopping carts' relevance to the shopping experience. The questions targeted the key aspects for shoppers' selection of a grocery store.

## 4.2.2 | Findings From the Interviews

**4.2.2.1 | Acceptance of Smart Shopping Carts.** A frequently mentioned advantage of smart shopping carts at the supermarket is the reduced shopping effort. For example, interviewees (IP 8, 9) mention that bags can be filled and packed directly in smart shopping carts and, therefore, have not to be put up and down during the checkout. Afterward, bags can directly be placed in the car trunk (IP 12). This positive aspect is even more relevant the busier the store is (IP 7, 10)—primarily depending on the time of day and the shopping basket. “Smart shopping carts for large shopping trips and self-scan checkouts for smaller purchases” (IP 10). Similarly, “for three items the smart shopping cart does not matter, but it is worth it for large shopping trips (IP 13)” and “I use smart shopping carts for many shopping items (IP 11).” “When the supermarket is full, smart shopping carts, it is not only convenient (IP 15, 13) but faster (IP 13).” Almost all interviewees who use smart shopping carts at the supermarket mention time-saving as an advantage, primarily attributed to the faster checkout process. It is no longer necessary to place goods on the checkout conveyor belt without queueing at the cashier (IP 7).

Furthermore, the ability to view current information on the smart shopping cart' display is seen as an advantage at the supermarket. This includes an overview of the current shopping basket (IP 5) and impressions of sales (IP 11). Not only general offers are displayed but also personalized special offers and recommendations based on previous purchases (IP 7). IP 10 particularly mentioned the display of the (current) total amount of the shopping basket and product prices for possible price comparisons. The total amount is also helpful when the store offers a voucher for purchases over a certain value (IP 10). Thus, the smart shopping cart indicates how much is left before the voucher can be used. The display can also show the route toward products on the shopping list and promotional products (IP 6, 8, 13). “If you don't know where to find something, you are guided there (IP 13).” Finally, smart shopping carts present a hedonic factor. “[I found the use of smart shopping carts] immediately exciting; there is a playful aspect of scanning (IP 1)” and “after trying it out, using smart shopping carts is cool (IP 4).” These statements suggest that beyond practical reasons, shoppers also find the shopping experience important when using smart shopping carts.

A mentioned negative aspect of smart shopping carts was the uncertainty of how to use them before their initial usage (IP 4,

12). However, after using a smart shopping cart several times, IP 4 became more confident and enjoyed using it. Similarly, “the first few times were difficult in terms of handling the technology (IP 16).” “I was concerned about what happens if something was scanned incorrectly (IP 12).” The interviewee also mentioned that it was annoying if the scanning processes did not work. Consequently, if the scanner does not work, you have to go to the traditional cashier checkout and do not save any time (IP 12). Depending on the model of the smart shopping cart, IP 2 who normally uses smart carts does not use them at the supermarket when there is no folding seat for small children. Concerning displayed information, not all interviewees found the information on product sales beneficial. “I look at product offers in paper before shopping (IP 9).” The user interface of the smart shopping carts also needed multiple iterations to be optimized (IP 10). Last, the interviewees discussed the consequences on the checkout process. Some interviewees mentioned concerns that shopping in the retail store and the checkout process become more impersonal (IP 19, 21). Another concern was that cashiers may lose their jobs (IP 14, 22). A key challenge for nonadopters is to familiarize themselves with smart shopping carts (IP 18, 19). These customers and older customers (IP 13) should be encouraged by on-site demonstrations and details to use smart shopping carts.

In summary, interviewed adopters of smart shopping carts at the supermarket advocate their use. “If available (IP 13), I always use smart shopping carts (IP 5, 13).” Some shoppers “go the extra mile to use a smart shopping cart (IP13)” and “specifically select the grocery store with smart shopping carts (IP 8).” Another interviewee phrased the choice of retailer, as follows: Since the introduction of smart shopping carts here, I go less often to other retailers (IP 11). Even though smart shopping carts are not key for most interviewees when choosing the retail store, the majority of interviewees are prepared to accept a little longer trips to use smart shopping carts.

**4.2.2.2 | Significance of Smart Shopping Carts for the Shopping Experience.** For the majority of customers at the supermarket, the role of smart shopping carts is subordinate to other elements of the shopping experience—in support of the empirical findings. The interviewees valued product freshness, especially fruits and vegetables, as important (IP 3, 12, 16, 21). Other interviewees at the supermarket also mentioned sustainability of meat (IP 18), regionality (IP 9, 20), and quality per se (IP 7, 20) as relevant criteria. These elements support the relevance of the physical criteria of the shopping experience. Other elements mentioned in our qualitative study are store layout (IP 19), price (IP 7, 22), discounts (IP 13), broad and deep assortment (IP 4, 9, 16), and product availability (IP 5, 17). One interviewee also mentioned the availability of private labels as relevant (IP 21). One-stop shopping speed of shopping, especially in the case of small children (IP 2), are also relevant aspects of store selection. Last, one interviewee does not what to shop “with blinders on” and values social interactions (IP 21).

## 5 | Discussion

Customers' intention to use smart shopping carts is determined in particular by their attitude toward them, which is, in turn, impacted by perceived ease of use and usefulness.

Overall, customers are willing to use smart shopping carts. The dominant reason for using smart shopping carts at the supermarket was saving time followed by information availability of, for example, basket details, discounts, and product locations. Considering that online participants are potentially more inclined to use smart retail innovations, this result provides an outlook on the not-so-distant future. Such early adopters who now already use smart shopping carts indicate increased ease of use. The interviewed early adopters also express a high continuance usage at the supermarket. Compared with other aspects of the shopping experience, however, this digital technical component plays a subordinate role. As such, the present study contributes to the literature beyond the adoption and willingness to use innovative retail technology (Lorente-Martínez, Navío-Marco, and Rodrigo-Moya 2020; Park, Ha, and Jeong 2021; Roy et al. 2018) by providing a comparison of the relevance of this technological component to other elements of customers' shopping experience.

Considering the extension of the technology acceptance model, the empirical results show no significant effect of either perceived potential risk or enjoyment associated with smart shopping carts on users' behavioral intention to use such shopping carts. Our findings are, thus, in contrast to previous studies that identify perceived risk (e.g., Pizzi and Scarpi 2020; Sohn 2024) as a barrier and perceived enjoyment (e.g., Lorente-Martínez, Navío-Marco, and Rodrigo-Moya 2020; Park, Ha, and Jeong 2021) as a driver of retail technology. The use of smart shopping carts is neither negatively influenced by the inherent data protection risk nor positively influenced by the technological innovation. Instead, customers in the survey assign the greatest importance to the practicality of smart shopping carts. This statement is further supported as customers who already have experience with smart shopping carts assign greater importance to their perceived ease of use. The interviews further confirmed this line of thought. The interviewees at the supermarket who do not use smart shopping carts mentioned general technological adversity and fear of change as primary reasons not to use smart shopping carts. Based on the empirical findings, smart shopping carts are considerably less affected by perceived risk and enjoyment than other retail technologies, such as self-service technologies (Park, Ha, and Jeong 2021) and autonomous retail technologies (Sohn 2024). Our results suggest that functional customer benefits (convenience of smart shopping carts) are independent of risk and enjoyment, which is in line with findings by Pizzi and Scarpi (2020).

In comparison to other factors influencing the shopping experience, we also find that smart shopping carts are subordinate to the affective (emotions toward the shopping location), social (employees at the shopping location), and physical (sensory perception of the shopping location) components. Hence, our study outlines the general willingness of customers to use smart shopping carts although customers' shopping experience is more strongly determined by the affective, social, and physical component. The interviews further revealed that shoppers enjoy the benefits of smart shopping carts but if smart shopping carts are not available, it is not a reason to not visit a retail store. If two retailers perform similarly regarding these traditional components, one retailer may increase customers' shopping experience when introducing smart retail technologies, such as smart

shopping carts, smart checkouts, personal shopping assistance, and augmented reality.

Consequently, we need to defer the question to which extent convenience, such as control over the shopping basket and time savings when shopping and checking out, can outweigh the potential challenges of smart shopping carts to future research. In general, the purchase and maintenance costs of smart shopping carts significantly exceed the costs of conventional shopping carts. Retailers may also shy away from introducing smart shopping carts at present because of the potential risk of theft, the maintenance costs, and the possible deterrence (or irritation) of customers caused by overly smart shopping assistants.

In addition to the customer benefits discussed above, smart shopping carts allow individual in-store communication with the customer. In addition to digital price tags and individualized augmented reality approaches, smart shopping carts can be used for direct communication, recommending additional products and providing customer recommendations. Beyond time-saving, interviewees revealed that information on discounts, product locations, and personalized coupons are reasons to use smart shopping carts. For example, the smart shopping cart may recommend the right wine after identifying all ingredients in the shopping basket for tarte flambée. Dekhili and Ertz (2024) also find that AR smart labels increase perceived quality and information credibility as well as purchase intention. Smart shopping carts can mainly provide communication through the screen but potentially also through audio. Retailers may provide additional information to augment aspects such as sustainability. They can also address price-sensitive customers by displaying discounts. As demonstrated by Eriksson et al. (2023), additional information may also lead to healthier product choices, therefore, both retailers and research need to consider how information can contribute to customer shopping and well-being.

Smart shopping carts also allow retailers to collect additional customer data that can personalize customers' shopping experience (e.g., personalized coupons). Further research may address such opportunities by novel data regarding various retailer- and shopper-related goals.

Food retailers may generate customer loyalty by introducing smart shopping carts. Customers often only come (back) to this particular store due to the availability of smart shopping carts. The corresponding authentication system may also prevent customers from visiting other food retailers (IP 16).

Smart shopping carts also pose some challenges for retailers. For example, as bags can remain in the smart shopping cart, it creates the risk of deliberately deceiving products and their numbers may increase. One interviewee (IP 15) pointed out that retailers already carry out more sample checks of smart shopping carts. Another key challenge seems to be the introductory phase. Whereas younger shoppers found it easy to familiarize themselves with smart shopping carts, older people were mentioned to back away from using smart shopping carts.

Last, the interviews revealed social concerns regarding smart shopping carts. One interviewee mentioned the lack of social

interactions with in-store employees. Other interviewees seemed to be concerned about job loss of cashiers. Retailers need to be aware of such concerns and communicate that in most cases it is not a decision of either or but one of providing an additional opportunity to support customers and employees.

## 6 | Implications, Limitations, and Further Research

### 6.1 | Theoretical Implications

The present empirical results suggest that not all digital innovations are equally perceived as innovative and influencing shopping experience. Whereas previous research suggests that digital innovations either pose high challenges through perceived risk (e.g., Kowalczyk 2018; Liao et al. 2019; Schultz and Paetz 2023) or create opportunities through perceived enjoyment (e.g., Attig et al. 2017; Schultz and Kumar 2024), smart shopping carts are, in contrast, perceived as considerably little intrusive. This result contrasts the results of Fazal-e-Hasan et al. (2021), who suggest a positive novelty factor and a negative effect through perceived risk. In Fazal-e-Hasan et al. (2021), perceived risk is more related to ability to use whereas the present study addresses privacy risks related to personal data. As perceived risk can be categorized into various components of risk, such as financial, performance, privacy, psychological, social, and time risks, future research may look beyond the functional performance and privacy risks to understand what types of risk are relevant for smart shopping carts and similar functional types of digital innovations.

Beyond hedonic or novelty effects, the empirical results still encourage the inclusion of an innovative technological component—smart shopping carts—into the measurement of shopping experience. This is a natural extension of the shopping experience construct as shopping experience is a collection of different motives (Tauber 1972). The addition of a technical component is necessary to an extensive and encompassing concept, such as shopping experience (Bustamante and Rubio 2017; Terblanche 2018; Terblanche and Boshoff 2004). Therefore, research on innovative developments in retailing and shopping encounters needs to consider how such an innovative component—here referring to developments in digitization and artificial intelligence—can be integrated into extensive conceptualizations.

### 6.2 | Practical Implications

Digitalization and the Internet of Things extensively change all areas of life. Stationary food retailers face challenges through new types of competitors and online grocery shopping as a general trend (Brüggemann and Olbrich 2022). Digital innovations, such as smart shopping carts, may add to shopping experience in stationary retailing and offer additional customer benefits through individual shopping and reduced shopping time. As we found no hedonic aspect in form of perceived enjoyment related to the use of smart shopping carts, stationary retailers do not profit from early excitement but also do not need to fear fast

familiarization with “playful” technology. As such, stationary retailers should primarily focus on outlining the functionality and promoting the customer benefits when introducing smart shopping carts. The follow-up study revealed that users of smart shopping carts have a high tendency to continue using smart shopping carts.

Stationary retailers may experience potential customer rejection when customers perceive the introduction of smart shopping carts as a way to reduce staff. Therefore, retailers should clarify that the inclusion of such technology aims to take pressure from existing staff members who now have more time for keeping stock and delivering customer service. The introduction of digital innovations, in fact, needs the addition of staff for maintenance and customer service. Especially during the introduction of the smart shopping carts, customers should encounter additional staff to explain smart shopping carts. Last, in today's retail landscape, food retailers may take away some pressure when launching smart shopping carts by aligning the digital systems and the in-store information on the smart shopping carts.

### 6.3 | Limitations and Future Research

Although we conducted our study thoroughly, some limitations need to be mentioned that can also provide potential avenues for future research. First, the sample was limited to Germany and food retailing. Even though our sample is suited for our research objective and diverse in age, occupation, and retailer preferences, the sample may be slightly skewed to female shoppers. Based on stereotypical role distribution, female shoppers still perform the majority of grocery shopping (Bundesforschungsinstitut für Ernährung und Lebensmittel 2008). Here, further research can address grocery shopping beyond traditional, stereotypical role distribution. Future studies can also include other cultural contexts to provide more generalizability to the study. Further research can also include cultural dimensions that may account for diversity. Based on the positive experiences with smart shopping carts, researchers may also consider how retailers may commercialize smart shopping carts further. Additionally, research can extend beyond smart shopping carts in stationary food retailing, for example toward DIY stores. Second, our findings suggest that privacy risks and enjoyment are not important for the users, so future research may explore why that is the case. Using qualitative methods might bring a deeper understanding of such a phenomenon. We specifically envision the inclusion of perceived convenience as an antecedent explicitly accounting for customer benefits in future studies. Third, since we used an online questionnaire due to COVID-19 Pandemic restrictions, the participants were more likely to have a higher technology affinity than grocery shoppers in general. Even though this may have increased participants' willingness and tendency to use smart shopping carts, the sample mirrors future demographic developments. However, taking this possible limitation into account, further research should extend the study and continue to analyze the development of digital innovations in stationary retailing. Fourth, the explorative results from the interviews are from one supermarket. Even though the interviews extend our empirical results, a broader inspection is warranted to replicate our findings. Last, to further enhance the understanding of technology

acceptance behavior toward smart shopping carts, researchers can explore additional boundary conditions, for example, demographics and technology affinity. Time pressure (Kim and Kim 2008), visitor traffic (Shailesh et al. 2021), financial situation (van Ittersum et al. 2013), and type of shopping (weekly/monthly shopping vs. spontaneous) seem insightful examples of boundary conditions to test in future research.

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#### Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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## Appendix A

### Measurement Items

Item	Statement
Perceived ease of use (PEU) (Davis, Bagozzi, and Warshaw 1989)	
PEU1	The use of smart shopping carts often overwhelms me.
PEU2	I make mistakes when using smart shopping carts (e.g., double scanning, mistyping, etc.).
PEU3	If I make mistakes when using smart shopping carts, I can easily rectify them.
PEU4	Learning to operate smart shopping carts would be easy for me.
PEU5	The use of smart shopping carts is cumbersome.
PEU6	It would be easy for me to operate smart shopping carts.
PEU7	I find smart shopping carts easy to use.
Perceived usefulness (PU) (Davis, Bagozzi, and Warshaw 1989)	
PU1	Using smart shopping carts enhances my efficiency when grocery shopping.
PU2	Using smart shopping carts saves me time when grocery shopping.
PU3	Smart shopping carts make grocery shopping easier.
PU4	Smart shopping carts increase my productivity when grocery shopping.
PU5	I think smart shopping carts are useful for grocery shopping.
Attitude toward using (ATT) (Davis, Bagozzi, and Warshaw 1989)	
ATT1	I think smart shopping carts are a good idea for grocery shopping.
ATT2	Using the smart shopping cart offers me advantages for grocery shopping.
ATT3	I think using smart shopping carts is beneficial for my grocery shopping.
Perceived risk (RI) (Forsythe and Shi 2003)	
RI1	When using contactless payment with smart shopping carts, my bank details might not be secure.
RI2	When using smart shopping carts, my private data may not be secure.
RI3	If the smart shopping cart does not work properly, I could unnecessarily lose time when grocery shopping.
Perceived enjoyment (ENJ) (Moon and Kim 2001)	
ENJ1	When I use smart shopping carts, I forget everything that is going on around me.
ENJ2	When I use smart shopping carts, I have fun shopping.
ENJ3	When I use smart shopping carts, I enjoy shopping.
ENJ4	When I use smart shopping carts, it arouses my curiosity.
ENJ5	When I use smart shopping carts, it awakens my imagination.
Behavioral intention (BI)/technological component (Davis, Bagozzi, and Warshaw 1989)	
BI1	If a retail store makes smart shopping carts available, I will use them.
BI2	I will use smart shopping carts in the future.
BI3	I will recommend to others to use smart shopping carts.
Technological component (BI) (Davis, Bagozzi, and Warshaw 1989)	
BI1	If a retail store makes smart shopping carts available, I will use them.
BI2	I will use smart shopping carts in the future.
BI3	I will recommend to others to use smart shopping carts.
Cognitive component (CC) (Raju 1980; Schmitt 1999)	
CC1	This retail store arouses my curiosity.
CC2	This retail store increases my creativity.
CC3	This retail store makes me reflect.

Item	Statement
CC4	This retail store gives me new ideas.
CC5	This retail store shows me interesting things.
Affective component (AC) (Richins 1997; Laros and Steenkamp 2005)	
AC1	This retail store makes me happy.
AC2	This retail store makes me optimistic.
AC3	This retail store makes me unhappy.
AC4	This retail store makes me angry.
AC5	This retail store irritates me.
AC6	This retail store frustrates me.
AC7	This retail store surprises me.
AC8	This retail store inspires me.
Social component customer (SCC) (McAlexander, Schouten, and Koenig 2002; Moore, Moore, and Capella 2005)	
SCC1	I met wonderful people when I visited this retail store.
SCC2	I feel a certain connection with other customers of this retail store.
SCC3	I am friends with other customers that I meet in this retail store.
SCC4	I enjoy spending time with other customers in this retail store.
SCC5	Other customers make my time in this retail store enjoyable.
SCC6	I may very well meet my friends in this retail store.
SCC7	This retail store allows me to talk to customers who have similar interests.
Social component staff (SCS) (Baker, Grewal, and Parasuraman 1994)	
SCS1	The staff in this retail store are interested in me.
SCS2	The staff in this retail store are helpful.
SCS3	The staff in this retail store take time to advise me.
SCS4	The staff in this retail store are friendly.
SCS5	I am treated with respect in this retail store.
Physical component (PC) (Yalch and Spangenberg 2000)	
PC1	Visiting this retail store is comfortable.
PC2	The acoustics in this retail store are good.
PC3	The retail store smells good.
PC4	The temperature in this retail store is pleasant.
PC5	The articles in this retail store are attractively presented.
PC6	This retail store is overall sensibly furnished.
Customer satisfaction (CS) (Oliver 1980)	
CS1	Overall, I am always satisfied with this retail store.
CS2	I think very positively about this retail store.
CS3	I like coming to this retail store to grocery shop.
CS4	I think I get the best shopping experience at this retail store.
Customer loyalty (CL) (Srivastava and Kaul 2016)	
CL1	I am prepared to pay more for items that I buy in this retail store.
CL2	I identify with this retail store more than with any other store.
CL3	I speak positively about this retail store to others.
CL4	I am willing to share my shopping experience with my family and friends.

Item	Statement
CL5	Next time I grocery shop, this retail store will be my first choice again.
CL6	I recommend this retail store to other people.
CL7	I would remain a customer at this retail store even if the prices went up.
CL8	I am willing to make all my future purchases at this retail store.

## Appendix B

### Characteristics of the Interviewees

No.	Intervention	Age	Gender	Household size	Shopping frequency	Basket size	Experience
01	Smart user	32	M	2	1	Large	Little
02	Smart user	28	F	2	1	Large	Plenty
03	Smart user	30	M	2	1-2	Large	Little
04	Smart user	47	F	3	1	Large	Plenty
05	Smart user	21	F	2	2	Small	Plenty
06	Smart user	57	F	1	2	Large	Extensive
07	Smart user	54	F	4	1	Large	Plenty
08	Smart user	32	M	2	1-2	Large	Plenty
09	Smart user	71	F	2	1-2	Medium	Extensive
10	Smart user	30	M	1	2	Medium	Extensive
11	Smart user	27	M	2	2	Large	Extensive
12	Smart user	42	F	4	1-2	Large	Plenty
13	Smart user	25	M	2	1	Large	Plenty
14	Smart user	40	F	4	2	Large	Extensive
15	Smart user	64	M	2	1	Large	Extensive
16	Smart user	28	F	2	1-2	Small	Extensive
17	Non user	25	M	2	2-3	Medium	Plenty
18	Non user	60	M	3	1-2	Small	None
19	Non user	54	F	3	1-2	Large	None
20	Non user	62	M	3	2	Medium	None
21	Non user	24	F	2	2-3	Medium	None
22	Non user	75	M	2	3	Small	None

Note: F = female, M = male. Shopping frequency = trips per week. Experience with smart shopping carts (none → rare → some → plenty → extensive).