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More than meets the eye: In-store retail experiences with augmented reality smart glasses

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ABSTRACT

Augmented reality smart glasses (ARSGs) promise to enhance consumer experiences and decision-making when deployed as in-store retail technologies. However, research to date has not studied in-store use cases; instead, it has focused primarily on consumers' potential adoption of these devices for everyday use. Nor have prior studies compared ARSG uses with the now-common use of AR on touchscreen devices. The current research addresses these knowledge gaps by examining whether ARSGs outperform AR on touchscreen devices in the context of in-store retail experiences. Testing with an actual retail application (n = 308) shows that ARSGs are superior to AR on touchscreen devices for evoking consumers' perceptions of immersion and mental intangibility. Furthermore, this superiority leads consumers to evaluate their shopping experiences more positively in terms of their decision comfort, satisfaction, and ease of evaluation, with significantly positive effects on their purchase intentions. These results highlight the relevance of implementing ARSGs in-store and provide retailers with recommendations for effective ARSG strategies.

1. Introduction

Although wearable technologies such as activity trackers and smartwatches have permeated consumers' everyday lives (Ferreira, Fernandes, Rammal, & Veiga, 2021), there is an ongoing debate about whether Augmented Reality Smart Glasses (ARSGs) will achieve similar market reach. Growing investment in ARSGs and new product announcements by technology leaders such as Apple and Lenovo seemingly belie the early failures of ARSG launches (e.g., Google Glass), leading to diverse market forecasts (e.g., $15 billion by 2027; Fortune Business Insights, 2020). Furthermore, persistent stigmata surrounding ARSGs' price, privacy, and safety (Zuraikat, 2020) cause uncertainty about the business case for second-generation devices such as Microsoft's HoloLens 2 (Bastian, 2023). An emerging view asserts that ARSGs can only live up to their potential if they address relevant consumer needs (Flavián et al., 2019a; Orús et al., 2021). In this paper, we take a different perspective from that commonly articulated in the literature about when ARSGs address these needs. Rather than investigating whether consumers might acquire their own ARSGs for everyday use (Rauschnabel, 2018), we propose that ARSGs can be deployed effectively as in-store retail technology, for consumers to use during their shopping journeys, which can create extraordinary experiences that improve product evaluations, boost shopping satisfaction, increase comfort with products, and stimulate purchase intentions.

Thus far, most research on Augmented Reality (AR) in retail has focused on online solutions or mobile applications, such as virtual-try-ons (Christ-Brendemuehl & Schaarschmidt, 2022) or furniture placements (Smink et al., 2020). However, retailers increasingly pilot ARSG applications in-store. For example, at a newly opened Meta store in California, consumers can wear "Ray-Ban Stories" glasses to browse the product assortment and take pictures or videos to post on social media. Additionally, with the rise of the Metaverse, accessible via ARSGs, we see a shift in commerce and retailing. For example, research by McKinsey & Company shows that nearly 80% of consumers look to shift their retail shopping into immersive digital environments (Elmasry et al., 2022). Compared with AR on mobile devices, ARSGs promise greater enhancement of such retail experiences, because they offer more embodied experiences in which digital replicas of products get seamlessly integrated into consumers' fields of vision, controlled through natural movements (Flavián et al., 2019a). Through the introduction of ARSGs within stores, retailers aim to create new "smart" retail environments, leading to more exciting and pleasant shopping experiences

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for consumers (Holdack et al., 2022). In-store ARSGs have been conceptually linked to advanced product visualization and interaction possibilities during the shopping process (Rese et al., 2017).

However, we know of no research that explores the potential value and underlying mechanisms of such interactions with ARSGs in physical retail settings. Researchers have documented improved retail experiences and decision-making when consumers use AR on touchscreen devices or virtual mirrors (e.g., Alimamy & Gnoth, 2022; Javornik et al., 2022; Hilken et al., 2017), but they have not compared such devices with ARSGs. The ARSG literature mainly offers segmentation options for target markets (Rauschnabel et al., 2016) or tests well-known drivers of technology acceptance (Kalantari & Rauschnabel, 2018). A notable exception is a study by Orús et al. (2021), who compare wearable versus handheld AR and Virtual Reality (VR) technology in the context of previewing tourism destinations. Furthermore, research highlights the potential that consumers will not embrace ARSGs due to concerns about privacy or a loss of autonomy (Rauschnabel et al., 2018). Investigating in-store retail experiences, with ARSGs as promising applications, thus appears highly necessary.

To fill this knowledge gap, we address a central research question: *How do consumers' evaluations of the interface and shopping experience as well as purchase intentions differ according to whether they use ARSGs or AR touchscreen devices in physical (in-store) retail settings?* We seek to make two main contributions. First, by drawing on theorizing of embodied cognition and technological embodiment (Balsamo, 1995; Flavián et al., 2019a; Wilson, 2002), we theorize and empirically demonstrate differences in consumer purchase intentions according to their use of ARSGs versus touchscreen devices for in-store shopping. We thus offer a theoretical basis for and initial evidence that ARSGs enhance retail experiences. Second, we identify the underlying human–computer interaction process that drives these effects. Specifically, we propose and test a sequential mediation in which enhanced interface evaluations manifest in reduced mental intangibility of products and enhanced immersion, followed by an improved shopping experience, which manifests as greater decision comfort, satisfaction, and ease of evaluation.

The remainder of this article is organized as follows: We summarize relevant scientific literature on ARSGs to identify common themes and gaps. We then introduce embodied cognition and technological embodiment as theoretical bases for developing our hypotheses, which we divide into three overarching themes: interface evaluation, shopping experience evaluation, and purchase intentions. Subsequently, we outline our research method and present the results of our experimental study, and conclude by offering implications for theory, practice, and future research.

2. Literature review & hypotheses development

2.1. Defining ARSGs

As head-mounted devices that project digital content into the user's field of view, ARSGs can be classified as "wearables" (Rauschnabel, 2018). Using AR technology, content is presented on a display located directly in front of the user's eye; interface design and control modalities differ according to the device (e.g., controller, voice, or gesture-based; (Syberfeldt et al., 2017). Users can perform various actions simultaneously without having to hold the devices in their hands, except for handling controllers (Litvak & Kuflik, 2020), such that ARSG interactions are more natural than those with touchscreen devices. In keeping with the key principles of AR (Azuma, 1997), ARSGs enhance users' views of their real-world environments with digital elements while they have real-time interactions and experience three-dimensional registration of digital and real objects.

2.2. Current business literature on ARSGs

We took a systematic approach to reviewing current business literature on ARSGs, as this offers a robust and replicable method to map and assess the existing body of knowledge on the topic. Specifically, following a systematic approach helps us to pinpoint knowledge gaps that we seek to address with our research, whilst ensuring that we can draw on all relevant ARSG research for our hypotheses development and discussion. We followed a three-step approach that consisted of (1) defining the search string and conducting the search, (2) excluding irrelevant literature, and (3) reporting on the findings. In step one, we conducted a keyword search on the Web of Science database, querying title, abstracts, and keywords with the following search string:

TS = ("augmented reality smart glasses") OR ("augmented reality" AND "smart glasses") OR ("augmented reality" AND "head-mounted display") OR ("augmented reality" AND "HMD") OR ("augmented reality" AND "headset") OR ("augmented reality" AND "wearable*") OR ("augmented reality" AND "retailing"))

We searched for peer-reviewed articles written in English and published in the categories of Business, Management, Psychology Multidisciplinary, Hospitality, Leisure, Sport, Tourism, Operations Research, and Management Science. We excluded conference publications and book chapters from the search. The initial search yielded 93 articles that we evaluated in step two. Specifically, we excluded articles that (a) did not focus on ARSGs (59), (b) were not relevant to retail experiences (14), or (c) did not focus on consumers but employees (10). Applying these criteria reduced the literature corpus to 10 articles published between 2018 and 2022. In step three, we report the findings of our review of this literature.

As summarized in Table 1, we find that researchers have studied ARSGs in consumer application contexts (Rauschnabel, 2018), such as tourism (Han et al., 2019; Tussyadiah et al., 2018), cultural heritage (Tom Dieck et al., 2018, or retailing (Heller et al., 2019a, 2019b). This research has primarily studied general characteristics and consumer perceptions of ARSGs as emerging technologies. For example, Rauschnabel et al. (2015) identify target segments for ARSGs and examine the relationship between personality and early adoption of the Google Glass headset. Their findings, based on the Big Five personality model (Fiske, 1949), reveal that users characterized by openness, curiosity, extraversion, and emotional stability have greater intention to adopt ARSGs. Applying the technology acceptance model (TAM), Kalantari and Rauschnabel (2018) study consumers' motivations for adopting ARSGs and find that intentions to use them are driven largely by general aspects such as usefulness, ease of use, and image, while hedonic values play a less relevant role. However, other research indicates that utilitarian, hedonic, and symbolic benefits positively affect usage intentions (Rauschnabel et al., 2018). Rauschnabel and Ro (2016) similarly identify functional benefits, ease of use, brand attitudes, and social norms as acceptance drivers of ARSGs. According to Rauschnabel (2018), intentions to use also result from gratifications, such as life efficiency (utilitarian) and enjoyment (hedonic), as well as sensual gratifications, including desired enhancement of reality and wearing comfort. Furthermore, socializing and self-expression further contribute to intentions to wear ARSGs, especially in public settings. That is, even though ARSGs are more likely to be used at home than in public (Rauschnabel, 2018), users' perceptions are influenced by fashion and design aspects (Rauschnabel et al., 2016).

Notably, only limited research has studied the deployment of ARSGs as a decision-support tool in shopping environments. Heller et al. (2019b) study ARSGs in a retail context but focus mainly on interface characteristics, comparing touch- versus voice-control. Orús et al. (2021) compare the effectiveness of real and digital content on handheld versus wearable VR and AR devices in the context of tourism booking intentions. Erdmann et al. (2021) study ARSGs in online retail and find that consumers' technical innovativeness directly increases purchase intentions through ARSGs. Most recently, Holdack et al. (2022) evaluated the drivers of consumer acceptance of ARSGs in retail contexts and found that perceived enjoyment largely predicts attitudes towards and

Table 1
Overview of relevant ARSG literature.

Study	Context and Method	Theory Base	Predictor Variables	Outcome Variables	Key Findings
Holdack et al. (2022)	Consumer acceptance of ARSGs; survey	TAM	Perceived Informativeness, ease of use, usefulness, enjoyment, attitude	Behavioral Intention	Perceived enjoyment largely mediates the influence of perceived informativeness, usefulness, and ease of use on the attitude towards and usage intention of ARSGs.
Erdmann et al. (2021)	Drivers of consumers' perceived value of ARSG; survey	VAM	Immersion, complexity, subjective norm, usefulness, difficulty, perceived value, innovativeness	Purchase Intention	Immersion and subjective norm positively influence consumers' online purchase intentions; technical innovativeness increases directly purchase intention through ARSGs.
Orús et al. (2021)	Comparing AR and VR devices and content for tourism pre-experiences; experiment	Embodiment-Presence-Interactivity Cube	AR vs. VR (manipulated through HMDs vs. smartphones and "real" vs. digital content), presence, ease of imagination, visual appeal	Booking intention	"Real" VR content (vs. digital AR content) positively affects perceptions of presence, ease of imagination, visual appeal, and booking intentions, particularly when viewed through HMD (vs. smartphones).
Han et al. (2019)	Consumer adoption of ARSGs in tourism; interviews	TAM	–	Adoption intention	ARSG adoption framework for cultural tourism includes four main themes: societal impact, perceived benefits, perceived attributes of innovation, and visitor resistance.
Heller et al. (2019b)	Role of ARSGs in online retailing; experiments	Active Inference Theory	ARSG control modality (touch vs. voice), sensory feedback, assessment orientation, mental intangibility, decision comfort	Willingness to purchase	Touch control (vs. voice control) benefits of ARSGs affect consumer's willingness to purchase through reduced mental intangibility and increased decision comfort, particularly when sensory feedback is provided.
Rauschnabel (2018)	Consumer expectations of ARSGs; survey	Uses & Gratifications Theory	Utilitarian, hedonic, sensual, social, and symbolic gratifications	Usage intention (private and public)	Life efficiency, enjoyment, desired enhancement of reality and wearable comfort, socializing, and self-expression needs predict ARSG usage intentions of ARSGs.
Tom Dieck et al. (2018)	Learning experiences with ARSGs; interviews	Generic Learning Outcome Framework	–	–	ARSG application helps visitors to see connections between paintings and personalise their learning experience
Tussyadiah et al. (2018)	ARSGs in tourism; survey	Technological mediation	Ownership, location, agency, enjoyment,	Technological embodiment	ARSG-enabled technology embodiment affects enjoyment and enhances the experience with tourism attractions.
Kalantari & Rauschnabel (2018)	Drivers of ARSG adoption; survey	TAM	Usefulness, hedonic values, image, technology & privacy risk, ease of use, norms	Adoption intention	Perceived usefulness, image, ease of use, and descriptive norms positively affect adoption intention; technology risks negatively affect this intention. Consumers tend to associate benefits rather than risks with ARSGs.
Rauschnabel et al. (2018)	Consumer expected benefits of using ARSGs; survey and interviews	Uses & Gratifications Theory	Utilitarian, hedonic, and symbolic benefits, perceived risks: privacy, loss of autonomy	Adoption intention	All expected benefits (utilitarian, hedonic, symbolic) positively affect intention to adopt ARSGs. Risk of threatening other people's privacy relates negatively to adoption intention.
This study	Exploring the in-store retail experience with ARSGs; experiment	Embodied Cognition Theory	Technological embodiment (ARSG vs. touchscreen device), mental intangibility, immersion, decision comfort, satisfaction, ease of evaluation	Purchase intention	ARSGs outperform AR on touchscreen devices in retail experiences, because they lead to higher levels of immersion, and reduce mental intangibility, which positively affects shopping-experience evaluation criteria (i.e., decision comfort, satisfaction, and ease of evaluation), and, ultimately, higher purchase intentions.

Notes: TAM = Technology Acceptance Model, HMD = Head-mounted Device, VAM = Value Based Adoption Model.

intentions to use AR in stores. However, we still lack insights into whether and how ARSGs might enhance in-store retail experiences and assist consumers' decision-making processes compared with AR on touchscreen devices. Moreover, we need a theoretical framework that explains how ARSGs differ from AR on touchscreen devices (e.g., smartphones, tablets) in terms of interface and shopping experience evaluations.

Due to competitive pressures and emerging innovations, online and in-store retail experiences represent a crucial marketing context in which novel technologies such as AR often get implemented first (Chylinski et al., 2020). In this area, AR applications on smartphones already allow users to try on clothes or place furniture virtually in their homes through touchscreen devices (Ozturkcan, 2021; Parekh et al., 2020). With the emergence of ARSGs, it seems reasonable to incorporate them into the customer journey using a similar approach. Currently, glasses of this type are trialed mostly by users; market entries by companies such as Microsoft, with its HoloLens, are very recent (Hachmann, 2019). However, no empirical knowledge exists regarding their actual use in store environments; previous research has mainly considered private applications (e.g., wearing ARSGs at home for entertainment). Because of price and other barriers, ARSGs are yet to be widely distributed in private homes. All these factors indicate it may be more feasible to consider in-store retail applications of ARSGs, for which there are more opportunities for use.

2.3. *Embodied cognition and technological embodiment*

We introduce *embodied cognition* and *technological embodiment* as our guiding theories and then, on this basis, hypothesize that ARSGs positively affect consumer purchase intentions through enhanced evaluations of the interface and shopping experience (Fig. 1).

According to Tussyadiah et al. (2018), ARSGs provide consumers with a revolutionary “try-before-you-buy” experience that enhances their decision-making processes. Although it seems that the same effect would apply to AR on touchscreen devices, there are differences between the interfaces that can be described according to current theorizing about embodied cognition and technological embodiment. Embodied cognition theory stems from cognitive sciences and regards the human body as pivotal in shaping a person’s information processing and decision making (Wilson, 2002). Specifically, embodied cognition theorists posit that information processing is not an isolated activity within the mind but relies heavily on the human body, which can facilitate (e.g., finger counting) but also shape a person’s thoughts, feelings, and behavior (e.g., feel more distant from others when the outside temperature is cold) (Carmichael et al., 2012; Clark, 1999). Applying this concept to marketing contexts, Krishna and Schwarz (2014) highlight the many ways vicarious sensory experiences affect consumers’ judgments and decision making. Furthermore, the impact of embodiment extends beyond cognitive responses to physiological and emotional responses, which so far have received little attention in extant research (Krishna et al., 2017).

The emergence of technological devices such as smartphones or smart glasses expands the theory of embodied cognition. Underlying these developments is the notion of technological embodiment, which implies that the human body and technology can become interconnected when technology takes over certain functions of the body, leading to *technological corporeality* (Balsamo, 1995). Depending on the level of intensity, through embodiment, devices can enhance users’ bodies and senses, thus altering their experiences and perceptions while helping them interact with their environments (Ihde, 1990).

According to these theories, the levels of technological embodiment experienced by consumers using AR devices can range from external (low technological embodiment) to internal (high technological embodiment); the higher the involvement with the body and the closer the proximity to the senses, the more likely a device is perceived as “internal” (Flavián et al., 2019a) and the displayed content as “psychologically closer” (Elder et al., 2017). Furthermore, how users control this digital content (e.g., touchscreens, natural hand movements in space) determines how “real” or “simulated” the physical interactions feel (Hilken et al., 2017); ARSGs support both these aspects because they offer head-mounted, see-through displays as well as natural controller-based or gesture-based interactions such as pointing, grabbing, or pushing objects. In contrast, when consumers use AR on touchscreen devices, they are very much aware that they are looking “through” devices’ cameras to control objects “on” the touchscreen. Accordingly, ARSGs can be classified as more internal devices because of the way they are worn and their resulting proximity to the human body (Flavián et al., 2019a). In contrast, consumers might regard AR on touchscreen devices as linked more externally to their bodies. In the future, brain–computer interfaces may achieve even higher levels of technological embodiment than ARSGs, whereby devices—instead of being controlled through the senses (e.g., gestures)—are connected to the human brain and controlled merely by thinking about movements (Hilken et al., 2022).

According to the fundamental premise that ARSGs offer greater technological embodiment, we next hypothesize about how ARSG use versus AR use on touchscreen devices might result in more tangible and immersive interface experiences, which translate into relevant decision-making benefits and subsequent behavioral intentions.

2.4. Interface evaluation

We contend that interface evaluations in AR contexts refer to consumers’ perceived *mental intangibility* and *immersion*. Mental intangibility describes consumers’ difficulty of envisioning the full multisensory experience of using a product or service before purchasing (Heller et al., 2019b). Such mental intangibility is widely recognized as a purchase barrier and a disruptor of online and offline shopping experiences (Laroche et al., 2005). Retail stores typically have physical products on display, but they often cannot present their full range of products to consumers because of space constraints on the sales floor.

Furthermore, even when products are physically available for examination, consumers often still struggle to fully grasp their features and benefits of use (Laroche et al., 2005). By using AR, however, retailers can mitigate this challenge because the technology provides life-like digital representations of products and the necessary sensory feedback from viewing and interacting with these product replicas (Heller et al., 2019b). AR on touchscreens allows for simple, intuitive interaction with products; and touchscreens can help consumers to connect with products (Brasel & Gips, 2014). However, ARSGs offer an even higher degree of embodiment, because they offer a wider range of sensory control and feedback (Kalantari & Rauschnabel, 2018). As the source of mental intangibility is a lack of sensory experience rather than mere ease of interaction, we expect ARSGs to afford a lower degree of mental intangibility. That is, users of ARSGs should have a more precise and tangible representation of retail products in their minds.

Second, we anticipate that ARSGs prompt higher immersion because of the greater technological embodiment they provide (Flavián et al., 2019a; Slater, 2009). According to Witmer and Singer (1998), immersion is a psychological state in which a person integrates and interacts with an environment, experiencing a continuous stream of stimuli. Immersion is widely recognized as a critical success metric in technology-enabled experiences (Suh & Prophet, 2018), including those offered within retail stores (Grewalet al., 2020). In the context of AR technologies, immersion entails the extent to which users perceive they are part of an enhanced experience (Parise et al., 2016), as well as the extent to which digital product “holograms” are experienced as real products (Hilken et al., 2017; Yim et al., 2017). While AR use on conventional devices can already create a sense of immersion, consumers should derive a more immersive experience from ARSGs, because the wearable modality and sensory attachment of such devices elicit intense levels of technological embodiment (Flavián et al., 2019a; 2019b). A

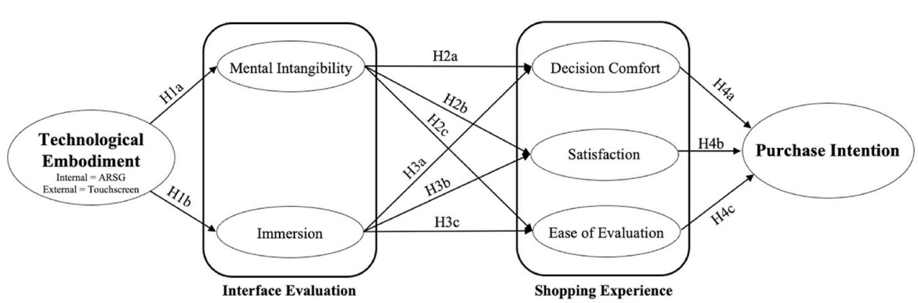

Fig. 1. Conceptual model.

simple counterargument would be that with ARSGs, consumers might be more likely to become distracted and lose their sense of immersion within the physical retail environment, as opposed to AR on touchscreens that can simply be put down. However, ARSGs preserve the ability to interact and move freely, ensuring the devices do not hinder users from observing their real surroundings (Carmichael et al., 2012). In fact, when using AR on touchscreen devices, the effort required to mentally imagine products is greater because the real and virtual worlds are more likely to be perceived as separate (Flavián et al., 2019a). Greater technological embodiment thus implies that devices become invisible to users as the users experience them as parts of their bodies, creating more immersive experiences in which digital elements (e.g., product holograms) become more mentally tangible. Taken together, we thus hypothesize that compared with users of external devices (i.e., AR on touchscreens), users of internal devices (i.e., ARSGs) perceive higher degrees of immersion and lower degrees of mental intangibility.

H1. *Use of ARSGs (vs. touchscreen devices) for in-store retail experiences (a) reduces mental intangibility and (b) increases perceived immersion.*

2.5. Shopping experience evaluation

We expect the benefits of technological embodiment to spill over to more positive evaluations of the shopping experience. As relevant metrics, we consider consumers' *decision comfort*, *satisfaction within the decision process*, and *ease of evaluation*. Decision comfort describes "the degree of psychological (and physiological) ease, contentment, and well-being one feels in relation to a specific decision" (Parker et al., 2016, p. 114), and according to Parker et al. (2016), it is essential to establish decision comfort because it allows consumers to feel at ease with their purchase decisions and the anticipated benefits of using the purchased products. In turn, decision comfort drives consumers' choice commitment and recommendation intentions (Parker et al., 2016), making it a managerially relevant variable for retailers. While there is evidence of how AR use on touchscreens helps consumers to feel comfortable with purchase decisions (e.g., Hilken et al., 2017), we lack such insights for ARSGs. We contend that users perceive ARSGs as more internal devices and experience heightened mental tangibility and immersion when browsing products; and they therefore should be more comfortable with their purchase decisions. Support for this conjecture comes from research showing that the reduced mental intangibility achieved through ARSGs enables customers to feel at ease when making a purchase decision (Heller et al., 2019b). Furthermore, interacting with a product through ARSGs has been linked with heightened feelings of psychological ownership (Carrozzi et al., 2019), which is likely to be conducive to feeling more comfortable with its purchase. Therefore, we expect that the lower mental intangibility associated with using ARSGs (compared with touchscreen devices) improves decision comfort.

Furthermore, when infusing in-store retail experiences with AR technology, it is paramount to ensure that consumers are satisfied with the increased "e-atmospherics" of the experience (Poncin & Mimoun, 2014). In line with Poushneh and Vasquez-Parraga (2017), we view satisfaction as the overall pleasurableness of the AR experience and the perception that it was at least as good as expected. AR use on touchscreens has a significantly positive impact on consumers' experiences and, ultimately, their satisfaction with decision-making processes, while the effect of ARSGs remains unclear to date. We argue that the reduced mental intangibility and increased immersion afforded by ARSGs fulfill consumers' expected benefits of the technology (Han et al., 2019; Rauschnabel et al., 2018), while also providing a better-than-expected enjoyable and personalized experience (Tom Dieck et al., 2018; Tussyadiah et al., 2018), compared to the more conventional experience of AR on a touchscreen device.

A final important determinant of the shopping experience is the ease of evaluating products – that is, the extent to which consumers face limited difficulty and effort in judging, distinguishing, and choosing between products (Laroche et al., 2005). AR use has been shown to reduce cognitive dissonance, the perceived similarity of product alternatives, and confusion by over-choice (Barta et al., 2023). On this basis, considering ARSGs' greater capacity for reduced mental intangibility and immersion, we anticipate that compared with touchscreen devices, ARSGs enable consumers to evaluate products more easily. Taken together, we posit.

H2. *Reduced mental intangibility, achieved by using ARSGs (vs. touchscreen devices), positively affects (a) decision comfort, (b) satisfaction, and (c) ease of evaluation.*

H3. *Perceived immersion, achieved by using ARSGs (vs. touchscreen devices), positively affects (a) decision comfort, (b) satisfaction, and (c) ease of evaluation.*

2.6. Purchase intentions

A positive retail experience through enhanced decision making ultimately should affect purchase decisions. Previous literature on AR has mostly considered consumers' purchase intentions to investigate this impact. None withstanding an ongoing debate about their predictive validity, people's intentions are still considered one of the critical predictors of their behavior (Fishbein & Ajzen, 1977). Purchase intentions describe the degree of willingness to buy products or services (Kim & Ko, 2010; Pavlou, 2003), as well as the degree of interest in products and the likelihood of actually purchasing them (Younus et al., 2015). The ability of AR to increase purchase intentions has received widespread support, for example the contexts of tourism (Orús et al., 2021), eyewear and cosmetics (Wang et al., 2022; Whang et al., 2021), and retail furniture (Kowalczuk et al., 2021; Watson et al., 2018). Regarding ARSGs, we expect that heightened immersion and tangibility increase decision comfort, ease of evaluation, and satisfaction related to the decision-making process; which in turn positively impacts purchase intentions. In support of this conjecture, previous research shows that low levels of mental intangibility and increased feelings of immersion relate positively to purchase intentions and willingness to pay (Heller et al., 2019b; Suh & Chang, 2006). Furthermore, increased decision comfort (Parker et al., 2016), satisfaction (Taylor & Baker, 1994), and ease of evaluation (Laroche et al., 2005) have all been linked to greater intentions to purchase. On this basis, we hypothesize that consumers who use ARSGs should have greater purchase intentions compared with consumers using AR on touchscreen devices when shopping.

H4. *Consumers' increased (a) decision comfort, (b) satisfaction, and (c) ease of evaluation from using ARSGs (vs. touchscreen devices) positively affect their purchase intentions.*

3. Empirical study

3.1. Design and procedure

We conducted a study in a controlled lab setting at a large European university. To pursue the research objectives, we employed a two-group (ARSG vs. touchscreen device) between-subject design, in which we randomly assigned all participants to one of two device conditions. We used separate rooms for each condition toensure that participants were not biased by each other's use of the other device. We divided the study procedure into three stages: introduction, try-out, and survey. In the first stage, we welcomed participants and clarified the study procedure. In addition, we briefly explained how to use the assigned device; the ARSG condition required additional instruction time because of the participants' lack of experience with the device. In the second stage, we asked participants to furnish the room digitally, using the following prompt: "Imagine you would like to buy new furniture and therefore visit a furniture store. This store offers you the possibility of viewing other pieces of furniture that are not presented in the showroom by using Augmented Reality."

In the touchscreen condition, participants used an iPad device with a pre-installed retail furniture app that featured a default shopping cart with five different items (see Appendix A). We asked participants to view and interact with all five products through the app's AR feature, which enabled them to project life-sized products digitally into the physical room, using the touchscreen and the camera function. Participants were also able to access detailed product information on the product page. In the second room, we provided participants with two ARSGs (Magic Leap One). We again used the retail furniture app from the same company as that offered to the touchscreen group (see Appendix A). We provided a brief introduction about how to use the ARSG with gestures and the associated controller. Participants could then choose from a selection of digital furniture to place in the physical room as well as swap, move, and delete items, and read the relevant product information. The try-out time of both devices differed, as the functionalities and guidance demands were considerably higher for the ARSGs. The average time spent using the touchscreen devices was approximately 5 minutes; the average time spent using the ARSGs was approximately 10 minutes.

In the third and final stage, once participants had returned the devices, we invited them to complete a computer-based survey. We prepared a different survey for each condition, with the wording adapted to the device. Respondents first evaluated the interface, then assessed their shopping experiences and purchase intentions, and finally provided basic demographic data.

3.2. Sample

We recruited 317 participants (n_{ARSG} = 158, $n_{touchscreen}$ = 159) for the study. All participants were students at a large European University who received course credit in exchange for participation. Ages ranged from 19 to 33 years (mean [M] = 21.73, standard deviation [SD] = 2.34), and 52% were women. These younger participants represents an appropriate target group for this study because their high degree of technology readiness makes them the primary audience for novel technological developments (Foroudi et al., 2018). Organizations seek to attract these consumers when they deploy AR technologies such as ARSGs (Heller et al., 2019b). In the survey, we used the following attention-check question: "If you read this, choose 'strongly disagree.'" After data screening, we excluded the responses of 9 participants because of incompleteness or attention-check failure, resulting in a final sample of 308 responses (n_{ARSG} = 153, $n_{touchscreen}$ = 155). Table 2 summarizes the demographics across conditions.

Table 2
Descriptive statistics.

	Condition		
	Touchscreen	ARSG	Total
Gender			
Female	81	79	160
Male	74	74	148
Age			
19.0	18	25	43
20.0	35	44	79
21.0	27	24	51
22.0	22	11	33
23.0	17	21	38
24.0	15	11	26
25.0	7	8	15
26.0	5	4	9
27.0	4	4	8
28.0	2	1	3
29.0	2	0	2
33.0	1	0	1
Total	**155**	**153**	**308**

3.3. Measures

Wherever possible, we adapted measurement items for the constructs from previously validated scales. We adapted the mental intangibility scale from the 5-item construct by Laroche et al. (2001), which was also applied by Heller et al. (2019b) in the context of ARSGs. We assessed immersion with a 3-item scale derived from Fornerino et al. (2008), which Flavián et al. (2019b) also used to compare head-mounted VR glasses with other devices that incorporate lower levels of technological embodiment. We adapted the scale for decision comfort from the 5-item construct developed by Parker et al. (2016) and measured satisfaction with the shopping experience using a 3-item scale adapted from Poushneh and Vasquez-Parraga (2017). To measure ease of evaluation, we developed a 4-item construct on the basis of research by Olsson et al. (2012). Finally, we assessed purchase intention using five items adapted from Poushneh and Vasquez-Parraga (2017) and Papagiannidis et al. (2014). All items were assessed on 7-point Likert scales ranging from 1 = "strongly disagree" to 7 = "strongly agree."

3.4. Reliability and validity analyses

As shown in Table 3, the Cronbach's alpha values of all constructs indicated acceptable internal consistency. Furthermore, the composite reliability and average variance explained (AVE) indices of all constructs exceeded the respective thresholds of 0.70 and 0.50 – except for mental intangibility with an AVE score of 0.418, which, however, was counterbalanced by an acceptable composite reliability score of 0.794 (Fornell & Larcker, 1981). Table 4 lists the inter-construct correlations and the square root of AVE measures on the diagonal. In support of discriminant validity, the square root of each construct's AVE was higher than any inter-construct correlation as per the Fornell-Larcker criterion (Fornell & Larcker, 1981).

4. Analysis and results

4.1. Descriptive statistics and baseline tests

We first considered descriptive statistics to obtain preliminary insights into the data. As shown in Table 5, the means in the ARSG condition were higher than 4.0 for all constructs, except for mental intangibility, thus indicating overall positive responses. Participants in the touchscreen condition also tended to assess their experiences positively, but the mean values were notably lower (higher) than those of the ARSG group for all constructs (for mental intangibility). We conducted multiple independent sample t-tests to identify significant differences between the two groups. The results showed significant differences on all constructs: the mean values were significantly higher for the ARSG condition compared to the touchscreen condition for all constructs, except for mental intangibility where the pattern of means was reversed, as expected. These results constitute important first support for our hypotheses.

Table 3
Reliability and validity statistics.

Variable	Cronbach's alpha	Composite reliability (rho_a)	Average variance extracted (AVE)
Mental Intangibility	.70	.794	.418
Immersion	.78	.846	.685
Decision Comfort	.90	.909	.710
Satisfaction	.96	.957	.920
Ease of Evaluation	.91	.921	.795
Purchase Intention	.91	.915	.744

Table 4
Discriminant validity (Fornell-Larcker criterion).

Variable	Mental Intangibility	Immersion	Decision Comfort	Ease of Evaluation	Satisfaction	Purchase Intention
Mental Intangibility	**.647**					
Immersion	−.256	**.827**				
Decision Comfort	−.559	.404	**.842**			
Ease of Evaluation	−.531	.422	.682	**.892**		
Satisfaction	−.434	.448	.641	.693	**.959**	
Purchase Intention	−.440	.391	.695	.715	.810	**.863**

Note: The numbers in bold are the square root of AVE; the numbers below are the standardized inter-construct correlations.

Table 5
Results comparing ARSG and touchscreen conditions.

Variable	ARSG		Touchscreen		
	M	SD	M	SD	t
Mental Intangibility	3.103	.953	3.499	.938	3.676***
Immersion	4.346	1.324	3.050	1.372	−8.442***
Decision Comfort	5.046	1.109	4.239	1.247	−6.000***
Satisfaction	5.318	1.525	4.069	1.650	−6.902***
Ease of Evaluation	4.838	1.260	4.019	1.327	−5.552***
Purchase Intention	4.648	1.392	3.964	1.416	−4.280***

Notes: M = Mean; SD = Standard deviation.
***$p < .01$, **$p < .05$, *$p < .1$.

4.2. Hypotheses testing

To test our hypotheses, we used the PROCESS macro (Hayes (2017), creating a customized model that includes both parallel and sequential mediators in the relationship between technological embodiment and purchase intention. Table 6 presents an overview of the regression results.

4.2.1. Step 1: interface evaluation

Our first objective was to investigate how participants evaluated the interface, specifically to determine whether using an ARSG (versus touchscreen) device causes perceptions of lower mental intangibility and greater immersion. Technological embodiment (internal vs. external devices) significantly reduced mental intangibility (β = −0.396, t = −3.676, $p < .001$) and increased immersion (β = 1.297, t = 8.442, $p < .001$). That is, ARSGs outperformed touchscreen devices for these dimensions, in support of H1a and H1b.

4.2.2. Step 2: Shopping experience evaluation

Proceeding to the next stage of the conceptual model, our objective was to analyze how participants' evaluations of the interface affected their shopping experience. As Table 6 shows, mental intangibility negatively affected decision comfort (β = −0.550, t = −8.954, $p < .001$), satisfaction (β = −0.422, t = −4.745, $p < .001$), and ease of evaluation (β = −0.492, t = −7.168, $p < .001$) during the shopping experience, implying a positive impact of reduced mental intangibility as per H2a–2c. Furthermore, immersion had a significantly positive effect on all three measures of shopping experience evaluation (decision comfort: β = 0.274, t = 6.914, $p < .001$; satisfaction: β = 0.455, t = 7.929, $p < .001$; ease of evaluation: β = 0.329, t = 7.425, p < .001), in support of H3a–3c.

4.2.3. Step 3: Purchase intention

Finally, we ascertained whether the three evaluation criteria of the shopping experience increased purchase intention. Table 6 reveals strong evidence for an effect of each measure: decision comfort (β = 0.244, t = 4.866, $p < .001$), satisfaction (β = 0.455, t = 12.241, $p < .001$), and ease of evaluation (β = 0.212, t = 4.347, $p < .001$). Accordingly, H4a, H4b, and H4c are supported.

4.2.4. Indirect effects

The PROCESS macro provided further information about the indirect effects of technological embodiment on purchase intention along six different paths. A bias-corrected bootstrap analysis with 5000 samples reveals that the 95% confidence interval (CI) for the total effect (estimate = 0.617) of technological embodiment on purchase intention, including the effects through the five different mediators, ranged from 0.436 to 0.811 (i.e., 2.5% of the estimate below and above, respectively; Hayes, 2017). We then examined all six indirect effects individually. As summarized in Table 7, all indirect effects of technological embodiment through mental intangibility and immersion, and subsequently all three

Table 6
Regression results.

	Mental Intangibility	Immersion	Decision Comfort	Satisfaction	Ease of Evaluation	Purchase Intention
Constant	**3.499*** ** (.076, 46.078)	**3.050*** ** (.108, 28.161)	**5.444*** ** (.268, 20.283)	**4.402*** ** (.389, 11.327)	**4.836*** ** (.300, 16.127)	**.098** (.174, .566)
Technological Embodiment (1 = ARSG; 0 = touchscreen)	**−.396*** ** (.108, −3.676)	**1.297*** ** (.154, 8.442)	–	–	–	–
Mental Intangibility	–	–	**−.550*** ** (.062, −8.954)	**−.422*** ** (.089, −4.745)	**−.492*** ** (.069, -7.168)	–
Immersion	–	–	**.274*** ** (.040, 6.914)	**.455*** ** (.057, 7.929)	**.329*** ** (.044, 7.425)	–
Decision Comfort	–	–	–	–	–	**.244*** ** (.052, 4.866)
Satisfaction	–	–	–	–	–	**.455*** ** (.037, 12.241)
Ease of Evaluation	–	–	–	–	–	**.212*** ** (.049, 4.347)
R-squared	.042	.189	.317	.235	.279	.722
MSE	.894	1.818	1.068	2.239	1.333	.584
F	13.512***	71.260***	70.853***	46.903***	59.140***	263.328***

Note: n = 308. Unstandardized coefficients are shown in bold; the numbers in parentheses are standard errors followed by t-statistics.
***$p < .01$, **$p < .05$, *$p < .1$.

Table 7
Bootstrapped indirect effects.

Indirect Effect	Estimate	Boot SE	95% CI
Technological embodiment → Mental intangibility → Decision comfort → Purchase intention	.053	.022	.019 to .109
Technological embodiment → Mental intangibility → Satisfaction → Purchase intention	.076	.030	.029 to .148
Technological embodiment → Mental intangibility → Ease of evaluation → Purchase intention	.041	.018	.016 to .088
Technological embodiment → Immersion → Decision comfort → Purchase intention	.087	.026	.045 to .150
Technological embodiment → Immersion → Satisfaction → Purchase intention	.269	.056	.172 to .389
Technological embodiment → Immersion → Ease of evaluation → Purchase intention	.091	.031	.043 to .165

Note: Boot SE = Bootstrapped standard error, CI = Confidence interval.

shopping experience evaluation measures, on purchase intentions were positive and significant since the CIs did not include 0 (Preacher et al., 2007). The mediation effects appear successful and positive, and we can thus confirm that using ARSG (vs. touchscreen) devices increases purchase intentions through all the predicted mediators, in support of our hypotheses.

5. Discussion

5.1. Summary of findings

The objective of this study was to determine whether ARSGs outperform AR on touchscreen devices (e.g., smartphones or tablets) during consumer in-store retail experiences and whether such outperformance generates higher purchase intentions. We also aimed to identify the underlying psychological mechanisms that explain these effects. In line with previous literature, we considered two types of evaluations: interface and shopping experience. Our results provide evidence for the proposed hypotheses, demonstrating the positive effect of using ARSG devices on purchase intention, explained by the mediators of immersion and tangibility, as well as by decision comfort, satisfaction, and ease of evaluation.

First, participants who used a more internal device with greater technological embodiment (i.e., ARSGs) evaluated the interface more positively than those who used an external device (i.e., AR on a touchscreen). That is, they experienced less mental intangibility when they shopped for furniture. This finding reflects previous findings that more intense technological embodiment has stronger effects on the body and the senses (Ihde, 1990). It shows that ARSG users have different, more intense perceptions and experiences than touchscreen device users. Users of ARSGs benefit from closer connections between AR technology and the senses, which enables them to interact more deeply with digital content.

Moreover, they feel increased immersion in the digitally augmented environment while their real environment is preserved, such that they experience a heightened sense that products are real (Hilken et al., 2017)—possibly because the attachment of the devices to the body allows more freedom of movement. In contrast, viewing products through AR technology using touchscreen devices requires holding the devices, which limits the visibility of the products on the screens. With ARSGs, users can view entire rooms simply by adjusting their gazes. These differences in handling cause the experience through ARSGs to be much closer to reality and better resemble the experience of visiting a retail store.

Second, due to superior tangibility and immersion, users of the internal (ARSG) device, compared with users of the external device (touchscreens), felt more comfortable in their decision-making, were more satisfied, and found it easier to evaluate the displayed products. Since reduced mental intangibility improves the power of imagination and feelings of closeness to products, it also facilitates users' ability to assess individual product characteristics and make decisions more easily and confidently (Heller et al., 2019b). Similarly, enhanced feelings of immersion contribute to intensified shopping experiences; a heightened sense of presence conveys more profound perceptions of control and ownership to users (Carrozzi et al., 2019; Song et al., 2019), simplifying the product selection processes. These findings validate the ability of interactive technology to support consumers by generating more accurate decisions and evaluating available product ranges more effectively, thanks to experiences which are more enjoyable than those created by touchscreen devices (Fiore et al., 2005).

Third, establishing convenient shopping experiences—in which consumers feel comfortable with decision-making, are satisfied with how they experience their shopping channels, and can deliberate easily—is a crucial stimulant of sales-relevant behavior. Moreover, our study reveals that more positively perceived shopping experiences have a greater impact on the purchase intentions of internal device (ARSG) users than external device (touchscreen) users. This result is congruent with the conventional wisdom that the more satisfied consumers feel while shopping, the more likely they are to consider buying products. Greater willingness to buy products previewed using AR increases the chances that purchases will be completed too (Wang et al., 2022). An underlying rationale for the higher purchase intentions may be that consumers who use ARSGs can make more considered decisions, due to the greater depth and quality of the information presented. Because AR technology offers superior functionality and interactivity in ARSGs than on touchscreen devices—resulting in enhanced quality of entertainment and satisfaction—the probability that users will become buyers—or even regular buyers—increases (Fiore & Jin, 2003).

Fourth, our key finding, derived from the confirmed indirect effects, is that the pathways from technological embodiment to purchase intention are sequentially mediated by interface evaluation (i.e., immersion and tangibility) and shopping experience evaluation (i.e., decision comfort, satisfaction, and ease of evaluation). This result reconfirms that the superior user experiences of ARSGs (vs. touchscreen devices) during the shopping experience can generate valuable behavioral (purchase) intentions. Consequently, the sequential and parallel mediating effects of various pathways provide further evidence for our hypotheses and substantiate our claim that ARSGs outperform touchscreen devices overall.

5.2. Theoretical contributions

To date, ARSGs have attracted little research, primarily because of their novelty. The results of our study provide four important contributions to existing theoretical knowledge. First, to the best of our knowledge, this study is the first to compare ARSGs with AR on touchscreen devices in the context of consumer retail experiences and examine resulting differences in purchase intentions. Most previous studies have investigated only ARSGs or AR on mobile devices (e.g., Flavián et al., 2019a; Heller et al., 2019b; Poushneh & Vasquez-Parraga, 2017); they have not compared the two devices within consumer retail experiences, with the exception of Orús et al. (2021), who emphasize an interaction effect between the two devices and the type of content (i.e., AR versus VR content) in the context of tourism. Because our study demonstrates that ARSGs can outperform AR on touchscreen devices, in terms of interface and shopping experience evaluations, as well as behavioral purchase intentions, it highlights the relevance of research on ARSGs from academic and managerial perspectives.

Second, our research fills an existing research gap by conceptualizing and empirically testing the impact of greater technological embodiment, as is enabled by ARSGs (vs. touchscreen devices), on consumer experiences and purchase intentions. According to Krishna and Schwarz

(2014), the impact of technological embodiment on the body and perceptions constitutes a research field that requires further exploration. Our study contributes to and expands this field by demonstrating that higher levels of technological embodiment (executed by ARSGs) lead to differentiated sensing, and this differentiation affects human cognition and decision-making. We also identify the cognitive and emotional responses generated by embodied perceptions and experiences—another research area that rarely has been addressed (Krishna et al., 2017). According to our conceptual framework, high levels of embodiment positively affect three stages sequentially (i.e., interface evaluation, shopping experience evaluation, and purchase intention). The more closely the technology is attached to the body, the more realistic the shopping experience, and the more satisfying the consumer experience.

Third, we identify crucial mediating mechanisms of enhanced immersion and reduced mental intangibility, which translate into superior shopping experiences and ultimately stimulate sales-relevant behavior. Previous studies indicate that immersion and mental intangibility are relevant factors for creating value-adding AR experiences; they exceed the capabilities of traditional media (Gatter et al., 2022; Heller et al., 2019a, 2019b; Kowalczuk et al., 2021). We extend this existing literature on AR, specifically ARSGs, by finding that both measures are stronger for ARSGs than AR on touchscreen devices. Furthermore, immersion and mental tangibility significantly influence product evaluation criteria, including decision comfort, satisfaction, and ease of evaluation, which highlights the need for further investigation of their effects.

Fourth, we contribute to the knowledge base on ARSGs by demonstrating that these devices can drive purchase intentions and achieve higher purchase intentions than AR on touchscreen devices. Previous literature has mainly examined the influence of ARSGs on adoption intentions (e.g., Kalantari & Rauschnabel, 2018; Rauschnabel et al., 2015; Rauschnabel et al., 2018; Rauschnabel & Ro, 2016) and booking intentions (e.g., Orús et al., 2021), so this finding represents a novel insight. Furthermore, because past research has mainly considered private, at-home applications of ARSGs, we help fill an existing knowledge gap by testing ARSG applicability to in-store environments.

5.3. Managerial implications

Beyond its theoretical contributions, our study offers valuable practical implications for managers, especially retail managers. By demonstrating that ARSGs perform more favorably than AR on touchscreen devices, we show that these novel technological devices can achieve retail experience superiority. Although the convenience of touchscreen devices (e.g., mobile devices) currently might yield greater returns on investment than ARSGs, their future potential should be acknowledged. Noting predictions that the use of these devices will proliferate (Fortune Business Insights, 2020), their potential and importance for the future appears strong. However, consumers thus far remain relatively unaware of ARSGs, which embody a new type of technology (Rauschnabel, 2018). Businesses can benefit from their barriers—unfamiliarity and high prices—because individual consumers are less likely to own such glasses. Therefore, we suggest retail managers to integrate ARSGs into their store environments to enhance experiences (e.g., in special try-out areas). Managers can deploy ARSGs strategically for high-involvement retail products that are difficult to assess (e.g., furniture, cars). We advise that they initiate early-stage investments in ARSGs to secure first-mover advantages and offer unique selling propositions.

We also identify some key design principles for ARSG experiences, including immersion and mental tangibility. Compared with AR on touchscreen devices, ARSGs can create more immersive experiences and make products more mentally tangible. It is crucial to ensure that the glasses offer high degrees of immersion and tangibility, while providing users with unique, high-quality experiences, to make digital content appear almost real. High levels of immersion and tangibility, along with the resulting strong connections to senses and perception, cannot be achieved to the same extent by using AR on touchscreen devices. Therefore, though managers should be aware that the functionality of AR technology induces significantly superior effects using ARSGs, when choosing specific ARSGs, they should ensure that the particular devices can achieve high levels of immersion and tangibility. Depending on the brand and model (e.g., Magic Leap, HoloLens, Google Glass), devices differ in their levels of immersion and tangibility. Mobility might be more relevant for use cases such as the tourism industry, in which users wander through entire exhibitions. However, managers should prioritize immersion and tangibility in relatively confined retail environments. As our study results demonstrate, these factors positively affect evaluation criteria during the decision-making process, and purchasing intentions; therefore, using ARSGs empowers retail managers and businesses to deliver superior decision-making processes and purchasing experiences to consumers. Moreover, high levels of decision comfort (e.g., generated by ARSGs) can positively affect word of mouth (Hilken et al., 2017). Considering how ARSGs can generate higher sales and outperform touchscreen devices in many aspects, they are rewarding investments for delivering valuable outcomes to retailers.

Although young people seemingly are shifting back to traditional in-store shopping (McKinsey & Company, 2020), they still expect brands to create unique experiences and keep up with changing times; devices such as ARSGs can meet this requirement. Compared with older consumers, younger age groups are more likely to engage with and adopt new technologies (Tully, 2003). Therefore, when deploying ARSGs for in-store experiences, retail managers should address younger consumers in particular. Because these consumers enjoy greater access to information, prompting heightened expectations of shopping experiences, implementing AR technologies constitutes an appropriate innovation strategy for redefining interactions in the storefront (Heller et al., 2021; Hilken et al., 2017). By employing novel ARSGs in stores, businesses can achieve a completely different level of redefinition or even revolution of the consumer retail experience.

5.4. Limitations and suggestions for further research

In addition to the contributions and implications of our study, we note some limitations that offer space for further research. Although our lab setting offers a proper context for a first study on ARSGs for physical (in-store) retail experiences, continued studies should undertake field studies to increase the external validity of our findings. Furthermore, we only surveyed students, representing an early-adopter segment and the leading target group of technology providers. Compared with older generations, members of this group might be more accustomed to using novel technologies, so they can understand more easily how such devices work. Finally, continued research should assess whether the superiority of ARSGs holds across other consumer segments.

Some limitations arose during our experiment related to participants who wore spectacles; it appeared difficult for them to put on the ARSGs, which may have impacted their responses. We suggest finding an ARSG model that both spectacle-wearers and non-wearers can wear in the same way. The ARSG treatment group also may have been affected by their enthusiasm for ARSG use, which could have exaggerated their responses in the subsequent survey. To control for this possibility, future studies should account for participants' level of experience with such technologies.

We designed our study to examine in-store experiences where ARSGs serve as special tools. If and when ARSGs conquer the mass market, the effects we measure must be reassessed in other settings (e.g., at home, on the go). Moreover, our results cannot be generalized to all product types; we considered only furniture items in our study. Therefore, additional research might test multiple product types and establish comparisons (e.g., hedonic vs. utilitarian products; high-involvement vs. low-involvement products). Another worthwhile approach would be to explore the use of ARSGs for purposes other than driving purchases, as immersion and mental tangibility have also been shown to facilitate other marketing objectives, namely well-being (e.g., healthcare) and prosocial benefits (e.g., VR usage to drive donations; Kandaurova & Lee, 2019). Qin et al. (2021) recommend assessing continuous use intentions as an outcome variable, as purchase intentions do not represent holistic consumer behavior. Further research also might determine the extent to which consumers are willing to continue using ARSGs (e.g., to shop for furniture). We further recommend that research incorporate moderators to enhance understanding of ARSGs and user behavior within retail environments—such as the need for touch or cultural and educational backgrounds—and account for differences across consumers.

It also seems reasonable to move analyses of ARSGs closer to the target environment (i.e., in-store). For example, if glasses are offered to consumers within stores, several users would be exposed to them simultaneously. Therefore, we need research that investigates the performance of ARSGs used in stores by multiple users simultaneously, or in virtual ecosystems, such as the metaverse (Golf-Papez et al., 2022). Carrozzi et al. (2019) offer some insights into such parallel usage, but the shared social consumer experience of ARSGs remains to be explored.

Finally, our research shows that ARSGs (vs. touchscreen devices) can create more immersed experiences and make products seem more mentally tangible; further research should contrast ARSGs with other immersive technologies, such as VR headsets, to compare their effectiveness in stores. Some studies have uncovered the beneficial effects of (web) VR on purchase intentions (Park & Kim, 2021; Martínez-Navarro et al., 2019), but we know of no comparisons of the two technologies in the same in-store consumer environment. Such research could have exciting implications; compared with AR, VR uses computer-generated environments to completely immerse users in virtual worlds (Bonetti et al., 2019), adding an extra layer of immersion that our study does not observe.

In conclusion, this research provides initial evidence that ARSGs outperform AR on touchscreen devices. Thus, ARSGs represent compelling investments for retailers. However, this evidence of ARSG superiority also highlights the need for further investigations that can deepen scientific knowledge about ARSGs as these devices hit the broader market.

Credit author statement

Pauline Pfeifer: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Writing – original draft. Tim Hilken: Conceptualization, Methodology, Resources, Supervision, Writing – original draft, Writing – Reviewing and editing. Jonas Heller: Conceptualization, Formal analysis, Writing – original draft, Writing – Reviewing and editing. Saifeddin Alimamy: Resources, Funding acquisition, Formal analysis, Writing – original draft, Writing – Reviewing and editing. Roberta Di Palma: Writing – original draft, Formal analysis, Writing – Reviewing and editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Appendix A. Overview of experimental stimuli

Augmented reality smart glasses (ARSG) device	Augmented reality (AR) on touchscreen device
	

Appendix B. Overview of constructs and measurement items

Construct	Items
Mental Intangibility	I need more information about the items to make myself a clear picture of what it is. I have a clear picture of the items. The images of the items come to my mind right away.

(continued on next page)

(*continued*)

Construct	Items
	These are not the sort of items that are easy to picture.
	These are difficult items to think about.
Immersion	The technology created a new world that suddenly disappeared at the end of the experience.
	During the experience with the technology, I was unaware of my real surroundings.
	The technology made me forget about the realities of the world outside.
Decision Comfort	I would feel comfortable with choosing one of these products.
	I would feel good about choosing one of these products.
	I would experience negative emotions about choosing one of these products.
	Whether or not it is "the best choice", I would be okay with choosing one of these products.
	Although I don't know if one of these products is the best, I would feel perfectly comfortable with the choice.
Satisfaction	Overall, I am satisfied with using the smart glasses (iPad) during shopping.
	Being a user of smart glasses (iPad) has been a satisfying experience.
	Having experienced these products using smart glasses (iPad) was pleasurable.
Ease of Evaluation	I was able to make good evaluations of the products.
	I was able to thoroughly evaluate the products.
	I was able to elaborately assess the products.
	I would say that I got a good understanding of the products' benefits.
Purchase Intention	I would be willing to buy my furniture using smart glasses (iPad).
	In future, I would buy my furniture using smart glasses (iPad.)
	After using the smart glasses (iPad), I would consider buying one of these products.
	The AR experience with smart glasses (iPad) would be helpful in aiding me to make a purchase decision if I am considering buying one of these products.
	The AR experience with smart glasses would increase my intention to buy one of these products.

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