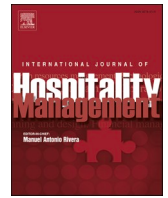Contents lists available at ScienceDirect

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Augmented and virtual reality in hotels: Impact on tourist satisfaction and intention to stay and return

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A B S T R A C T

Augmented reality (AR) and virtual reality (VR) have emerged as transformative technologies, revolutionizing the way tourists engage with hospitality service providers. A prime application is facilitating hotel bookings. Employing quantitative methods, this study establishes and validates a conceptual model that deciphers tourists' inclinations towards hotel reservations and returns via AR and VR. Findings indicate that the perceived ease of use, innovativeness, and usefulness of AR and VR positively influence tourists' satisfaction, driving them to embrace these technologies for hotel bookings. While there might be underlying concerns about associated risks, these risks do not significantly deter repeat visits. Consequently, this study illuminates the immense potential of AR and VR in elevating tourist experiences and promoting revisits. Hoteliers and marketers are advised to leverage these findings, fine-tuning their strategies to synchronize with this tech evolution and cater to evolving tourist expectations.

1. Introduction

The hospitality and tourism sector has experienced significant changes due to technological advancements in recent times (Guttentag, 2010). Over the past two decades, information and communication technologies with various characteristics have been increasingly adopted to create value and provide unique services, enhancing tourists' experiences throughout their journeys (Wei, 2019). Among the most transformative technologies in the digitalized world are augmented reality (AR) and virtual reality (VR), which are being progressively utilized in the hospitality and tourism sector for end-user benefits. These technologies allow for a first-person view of an integrated or simulated world (Soon et al., 2023), catering to tourist expectations (Zarantonello and Schmitt, 2023).

Destination marketers and hospitality and tourism service providers have recognized AR and VR as innovative marketing tools to promote local offerings and tourism destinations (Chung et al., 2018; Scholz and Smith, 2016). AR is characterized by the augmentation of real-life environments with layers of computer-generated images via a device (Guttentag, 2010; Jung et al., 2015), while VR generates a 3D environment where users can navigate and interact, immersing themselves

in real-time simulations (Burdea and Coiffet, 2003; Gutierrez et al., 2008; Guttentag, 2010). Specifically, AR and VR are revolutionizing the way tourists experience destinations by providing immersive and interactive previews (Han et al., 2018). With AR and VR, service providers in the hospitality and tourism sector are developing innovative methods to optimize tourist experiences within resource constraints.

Booking hotel accommodations is often a critical travel decision due to various risks and uncertainties (Casaló et al., 2015). As such, the information search stage is crucial for potential tourists' satisfaction and their likelihood to repeat visits (Kalantari et al., 2023; Sun, 2014). As decision-makers, tourists seek to assess all available information to make the most appropriate choices (Flavián et al., 2021; Kalantari et al., 2023). AR and VR have transformed hotel operations, aiming to provide superior experiences and encourage repeat usage. AR and VR enable tourists to virtually experience hotel services before encountering them in real life (Bogicevic et al., 2021; Pillai et al., 2021), serving as marketing tools (Loureiro et al., 2020; Yung and Khoo-Lattimore, 2019). Consequently, potential guests can acquire the necessary information to simplify their hotel decision-making processes (Israel et al., 2019).

As AR and VR facilitate hassle-free trips, the number of users has increased. According to a report by Technavio, New York, the metaverse

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market (AR/VR) size in the hospitality and tourism sector is projected to reach USD 188.24 billion by 2026, with a CAGR of 26.01%. With the growing significance of AR and VR, research on the technologies' applications in the hospitality and tourism sector has surged, especially in recent years.

Numerous studies have examined the effectiveness of AR and VR (Bogicevic et al., 2021; Bogicevic et al., 2019; Flavián et al., 2021; Leung et al., 2020; Zeng et al., 2020). However, existing literature has seldom explored the factors guiding tourists to use AR and VR specifically for hotel bookings and their intention to not only stay but also return. While the effect of hedonic behavior and continued used of AR and VR for travel has been investigated (Kim and Hall, 2019), the impact of its utilitarian counterpart remains underexplored. Noteworthily, further research in this direction is necessary for several pertinent reasons, including but not limited to:

(i) contributing to the growing body of academic research on AR and VR applications in the hospitality and tourism sector, particularly in the hotel industry (*1st theoretical motivation*);

(ii) closing knowledge gaps and extending current understanding of the factors that influence tourists' adoption of AR and VR and their impact on guest experiences and repeat visits (*2nd theoretical motivation*);

(iii) reaffirming or refuting the theoretical generalizability of existing theories such as the technology acceptance model (relating to tourist adoption of AR and VR), expectation-disconfirmation theory, and value-percept theory (relating to tourist satisfaction of AR and VR) (*3rd theoretical motivation*);

(iv) comprehending how AR and VR technologies can improve tourist experiences (*1st practical motivation*);

(v) understanding how AR and VR technologies can enable hotels to create more engaging, immersive, and personalized experience (*2nd practical motivation*); and

(vi) driving revenue growth from repeat stays emerging out of marketing strategies leveraging on AR and VR (*3rd practical motivation*).

To this end, this article aims to investigate the application of AR and VR in hotels and their impact on tourists' satisfaction and their propensity to stay and return to hotels. The technology acceptance model Davis (1989), expectation-disconfirmation theory (Oliver, 1980), and value-percept theory (Westbrook and Reilly, 1983) are adopted as a foundational theory that will be used to guide this investigation and expanded to account for the unique peculiarities of the context accordingly in line with Lim (2018). Noteworthily, this investigation contributes to in five notable ways: three major contributions to theory and three interrelated contributions to practice.

To begin, this study contributes to the existing body of literature on AR and VR applications in the hospitality and tourism sector, particularly in the hotel industry, by providing a comprehensive understanding of the factors that influence tourists' decisions to use AR and VR for hotel bookings and their likelihood to become repeat users (*1st theoretical contribution*).

Next, this study contributes to the theoretical generalizability of existing theories, namely the technology acceptance model, expectation-disconfirmation theory, and value-percept theory (*2nd theoretical contribution*), as well as to the theoretical expansion of these theories through the extended concepts of perceived innovative and perceived risk (*3rd theoretical contribution*), which signify the identification of new constructs and relationships pertaining to the unique peculiarities of new technologies such as AR and VR, thereby providing a robust theoretical explanation on the adoption and repeated use of AR and VR in hotel bookings.

Moreover, this study contributes to improving product development (*1st practical contribution*), marketing strategy (*2nd practical contribution*), and industry growth and innovation (*3rd practical contribution.*

Noteworthily, understanding the factors that drive tourists to use AR and VR for hotel bookings and their propensity for repeat usage can enable destination marketers, hoteliers, and hotel booking service providers to develop more user-friendly and appealing AR and VR applications for hotel bookings and enhance the design of hotel rooms in order to better target potential customers, create more engaging experiences, and foster long-term relationships with tourists.

Given the above, the research questions (RQs) that this study seeks to address can be presented as follows:

RQ1. How do tourists' perceptions of the usefulness, ease of use, and innovativeness of AR and VR technologies in hotels influence their overall satisfaction and intention to use these technologies for bookings?

RQ2. What roles do satisfaction and intention to stay play in determining tourists' intent to return for subsequent stays, especially when they have experienced AR and VR technologies in hotels?

RQ3. How do tourists' perceptions of risk influence their intentions to return for a subsequent stay, particularly when they have engaged with AR and VR technologies in hotels?

2. Literature review and hypothesis development

2.1. AR and VR

The evolution of AR and VR has driven notable shifts in consumer behavior and perception across various domains. Huang and Liao (2015) focused on AR interactive technology (ARIT) and identified that consumers with higher cognitive innovativeness tend to prioritize the usefulness, aesthetics, and service aspects of ARIT. In contrast, less innovative users emphasize the technology's playfulness and ease of use. This emphasis on usability is seen in other research too. For instance, Oyman et al. (2022) observed that perceptions of AR in mobile apps boost users' perceived enjoyment, usefulness, informativeness, and ease of use. This is particularly salient in the context of virtual cosmetics trial applications, wherein consumer novelty seeking shapes intentions.

Understanding how users perceive and interact with these technologies is crucial. Rauschnabel et al. (2018) explored the appeal of AR smart glasses (ARSGs), highlighting that users are primarily drawn by their utilitarian, hedonic, and symbolic benefits. Intriguingly, while personal privacy remains a concern, apprehensions about violating others' privacy are more influential in decisions to adopt ARSGs. In a more comprehensive approach, Flavián et al. (2019) introduced the "EPI Cube," a taxonomy that neatly integrates technological (embodiment), psychological (presence), and behavioral (interactivity) dimensions to categorize current and potential AR, VR, and mixed reality (MR) technologies. This categorization is valuable for understanding and designing hybrid customer experiences.

There is no denying the importance of perceived usefulness in driving technology adoption. Sagnier et al. (2020) found that the user intention towards VR is primarily driven by its perceived usefulness, although it faces setbacks from user experiences of cybersickness. Similarly, a study by Acikgoz et al. (2023) involving European fitness app users found that personal innovativeness and subjective knowledge heavily influenced perceived usefulness, which in turn was a dominant driver of user intention.

Yet, as AR and VR further infiltrate everyday experiences, especially with the emergence of the metaverse (Kraus et al., 2023), researchers urge caution. Camilleri (2023) illuminated the metaverse's vast potential in offering immersive and captivating experiences. Still, there is a concurrent need to address looming challenges like privacy concerns, security risks, potential addictions, and mental health issues. Dwivedi et al. (2023) added nuance to this conversation by discussing the marketing implications of AR and VR within the metaverse, emphasizing the challenges and opportunities these platforms present for branding, digital marketing, and consumer well-being. The marketing lens is further sharpened by Jayawardena et al. (2023), who presented a model based on the elaboration likelihood model (ELM) to understand

consumer persuasion through AR and VR advertisements. They delineate the nuances of central route factors like ad quality and peripheral route factors such as source credibility.

Rounding off this exploration, Soon et al. (2023) delved into the emotional domain, positing that AR has the capacity to trigger a spectrum of emotions in users. Positive emotions kindled by AR consistently bolster the willingness to engage with the technology, reinforcing the argument for designing AR experiences that resonate positively with users. In sum, while AR and VR hold immense promise in reshaping consumer experiences, their success hinges on understanding and catering to diverse user perspectives, needs, and concerns.

2.2. AR and VR in hospitality and tourism

AR and VR have emerged as significant technological advances influencing the hospitality and tourism sector. These advancements have created numerous opportunities. Companies like Disney, Emirates, and Virgin employ AR and VR for a "try before you buy" experience (Rogers, 2020). Hotels such as Hyatt and Marriott utilize these technologies to influence tourist behavior. AR enhances the tourist experience from the trip planning stage by providing location-based information on holiday destinations (Lee et al., 2021; Katkuri et al., 2019). Tourists can preview hotels, access information, navigate destinations, and explore attractions and facilities using their mobile devices (Buhalis et al., 2022).

Chung et al. (2015) conducted a study on AR application users at Deoksugung Palace, South Korea, establishing that technology readiness, visual appeal, and situational factors are determinants for tourist AR utilization. He et al. (2018) investigated AR in museums and highlighted that dynamic verbal cues, especially in high virtual presence environments, positively influence visitors' willingness to pay. Tom Dieck and Jung (2018) emphasized the acceptance of AR in urban heritage tourism, introducing an AR acceptance model based on focus groups in Dublin.

Tussyadiah et al. (2018) demonstrated that VR content's sense of presence significantly elevates tourist enjoyment and inclination towards destinations. Kim and Hall (2019) found that hedonic behaviors, like enjoyment and flow state, play a pivotal role in continued VR tourism use. Interestingly, Li and Chen (2019) noted that if VR enjoyment surpasses expected real-world enjoyment, it could deter actual travel intentions. Kim et al. (2020) revealed that authentic VR tourism experiences prominently influence cognitive and affective responses, fostering attachment and visit intentions. Lee et al. (2020) showcased that VR quality, system reliability, and vividness boost customers' intentions to visit destinations. Ali (2022) formulated a three-dimensional scale to gauge consumers' AR experiences in restaurants, focusing on utilitarian, hedonic, and social facets. Meanwhile, Fan et al. (2022) identified "presence" as the core feature shaping VR and AR experiences in tourism.

While AR allows users to experience the real world with digital overlays, VR immerses users in a fully simulated environment (Yung and Khoo-Lattimore, 2019). AR enhances the tourist experience from the trip planning stage by providing location-based information on holiday destinations (Lee et al., 2021; Katkuri et al., 2019). Tourists can preview hotels, access information, navigate destinations, and explore attractions and facilities using their mobile devices (Buhalis et al., 2022). VR technology, in contrast, creates a computer-generated version of the real world that enables tourists to immerse themselves in a destination before visiting (Israel et al., 2019; Liang et al., 2021). Beck et al. (2019) explain that VR primarily enables virtual touristic experiences that stimulate not only the visual sense but also other senses. Both AR and VR employ sensory marketing to captivate tourists and sway their behavior (Alyahya and McLean, 2022). Therefore, hospitality and tourism service providers can leverage AR and VR to engage all senses, including visual, auditory, tactile, gustatory, and olfactory (Carlisle et al., 2023).

Although these technologies offer considerable benefits, uncertainties and challenges persist. Key questions include understanding tourists' motivations to adopt AR and VR and whether their actual experiences align with their expectations. Comprehensive research is imperative to determine the alignment between tourist expectations and augmented or virtual campaigns, potentially driving repeat business and referrals (Moise et al., 2018; Shin and Jeong, 2021).

2.3. AR and VR for hotel bookings

The evolution of AR and VR technologies has reshaped many industries, including the hospitality sector. Their application, particularly in hotel bookings, has attracted academic and commercial interest due to its potential to revolutionize customer experience and influence booking decisions. A close inspection of the existing literature paints a vivid picture of this transformation and hints at the trajectory of future developments.

Israel et al. (2019) underscored the role of telepresence in VR, emphasizing that it amplifies the perceived enjoyment and usefulness for potential hotel customers, directly bolstering their booking inclinations. This finding hints at VR's potential to not just enhance customer experience but also uplift hotel bookings and, by extension, profitability.

Leung et al. (2020) observed a contrasting phenomenon. While VR commercials for hotels initially outperformed traditional advertisements, especially among those with high elaboration likelihood levels, they led to a subsequent decline in purchase intentions. Conversely, traditional advertisements fostered more positive viewer attitudes.

Exploring the interplay between VR and online reviews, Zeng et al. (2020) revealed an intriguing insight: while both have a direct bearing on consumer hotel booking intentions, the potency of online reviews fades when presented alongside VR. Yet, the synergistic effect of VR combined with online reviews on booking intention outperforms online reviews in isolation.

Orús et al. (2021) delved deeper into the immersive nature of AR and VR. Their findings highlight the significance of high factual realism, like 360-degree videos, in enhancing perceptions of presence, ease of imagination, visual allure, and most importantly, booking intentions, especially when experienced via head-mounted displays.

The financial implications of these technologies also cannot be overlooked. Yoon et al. (2021) demonstrated that guests' perceived value of VR, shaped by performance expectancy, social dynamics, and a blend of utilitarian and hedonic motivations, directly dictates their intention to use VR. More notably, there is a willingness among guests to shell out more for hotels that integrate VR content during the booking process.

Fast forward, McLean and Barhorst (2022) emphasized VR's role in shaping tourists' attitudes and intentions across the booking journey. Their study reinforced the notion that VR augments tourists' comprehension of hotel offerings and shapes their visit intentions, primarily by delivering authentic experiences and constructing vivid pre-visit mental visualizations.

However, VR's dominance as a promotional tool was put to the test by Slevitch et al. (2022). By juxtaposing VR visualizations against traditional 2D photos, their research unveiled that while variables such as pleasure and satisfaction varied significantly between the two, VR might not uniformly eclipse 2D imagery as a promotional mainstay for hotels.

This literature backdrop brings us to the present study in 2023. Emanating from the corpus of prior research, this study reaffirms that the perceived ease of use, innovativeness, and practicality of AR and VR are potent catalysts that elevate tourists' satisfaction. They not only express an augmented propensity to employ these technologies for hotel bookings, but any concerns about associated risks do not substantially curb their enthusiasm. This signals the burgeoning promise of AR and VR in enriching tourist experiences and catalyzing repeat visits (Table 1).

Table 1
Key literature on AR and VR.

No	Author (s)	Year	Key contribution
Panel A. AR and VR in general			
1	Hung and Liao	2015	This study examines how consumers' cognitive innovativeness influences their relationship with augmented-reality interactive technology (ARIT). Those with high innovativeness value ARIT's usefulness, aesthetics, and service, while those less innovative prioritize playfulness and ease of use.
2	Rauschnabel et al.	2018	This study delves into AR smart glasses (ARSGs) and reveals that consumers are drawn to them due to anticipated utilitarian, hedonic, and symbolic benefits. However, concerns about violating others' privacy, rather than personal privacy, play a significant role in user' decisions to adopt ARSGs.
3	Flavián et al.	2019	The study introduces the "EPI Cube," a new taxonomy that integrates technological (embodiment), psychological (presence), and behavioral (interactivity) dimensions to classify current and potential technologies shaping hybrid customer experiences in the evolving landscape of AR, VR, and mixed reality (MR). This framework aids in understanding and categorizing technologies that can enhance or create novel experiences throughout the customer journey, providing valuable insights for both academia and industry.
4	Sagnier et al.	2020	This study introduces an enhanced TAM to assess user acceptance of VR, discovering that users' intentions to use VR are positively driven by its perceived usefulness and hampered by cybersickness, with hedonic quality-stimulation and personal innovativeness influencing perceived usefulness, while perceived ease of use remains unaffected by pragmatic quality.
5	Oyman et al.	2022	This study investigates the influence of AR in mobile applications on consumers' intentions to use the app, employing the TAM. Findings revealed that consumer novelty seeking positively impacts perceptions of AR, which in turn enhances perceived enjoyment, usefulness, informativeness, and ease of use, ultimately driving positive behavioral intentions to use the app, especially in the context of a virtual cosmetics trial application.
6	Acikgoz et al.	2023	This study on 331 European fitness app users, informed by the TAM and innovation diffusion theory, found that subjective knowledge and personal innovativeness strongly influence the perceived usefulness of fitness apps, with the latter being the primary driver of user intention. While health consciousness impacts ease of use, it does not directly influence the behavioral intention to use the apps.
7	Camilleri	2023	The study critically reviews the potential of AR and VR in the metaverse, highlighting its immersive and engaging capabilities that can enhance experiences. However, it also emphasizes the need for caution, pointing to potential pitfalls such as privacy concerns, security risks, potential addictions, and mental health issues.
8	Dwivedi et al.	2023	The study explains the critical role of AR and VR in the metaverse and delves into the marketing implications of the potential widespread adoption of the metaverse, highlighting its challenges and opportunities for marketers. Based on expert insights, it proposes a comprehensive framework and future research directions, emphasizing the metaverse's potential benefits for digital marketing, branding, and consumer wellbeing.
9	Jayawardena et al.	2023	Utilizing the elaboration likelihood model (ELM), this study proposes a model to

Table 1 (*continued*)

No	Author (s)	Year	Key contribution
			understand consumer attitude persuasion via AR and VR advertisements, identifying central route factors like advertisement quality and peripheral route factors such as source credibility. The study offers a structured future agenda, emphasizing the dual pathways of persuasion and their distinct variables in AR and VR advertising.
10	Soon et al.	2023	This study demonstrates that the use of AR can trigger a range of emotions in users, encompassing both affective and physiological aspects. It was found that positive emotions induced by AR consistently amplify the desire to engage with AR, emphasizing the importance of inducing positive emotional experiences in AR app design for effective consumer engagement.
Panel B. AR and VR in hospitality and tourism			
1	Chung et al.	2015	This study, conducted on 145 AR application users at Deoksugung Palace, South Korea, determined that technology readiness, visual appeal, and situational factors are key determinants in encouraging tourists to utilize AR. The findings revealed that technology readiness influences perceived usefulness, while visual appeal and facilitating conditions influence perceived ease of use, subsequently impacting tourists' intentions to use AR and visit destinations through their AR attitudes.
2	He et al.	2018	This study explores the influence of information type and environmental augmentation on visitors' evaluation of AR-enhanced museum experiences and their purchase intentions. Findings show that dynamic verbal cues, compared to visual ones, increase visitors' willingness to pay, especially when the environment offers a high level of virtual presence, due to the mental imagery mechanism.
3	tom Dieck and Jung	2018	This study delves into the acceptance of AR in the context of urban heritage tourism, identifying a gap in previous research that overlooked context-specific dimensions. Through focus groups with young British female tourists in Dublin using a mobile AR application, the study proposes an AR acceptance model that incorporates seven key dimensions: information quality, system quality, costs of use, recommendations, personal innovativeness, risk, and facilitating conditions.
4	Tussyadiah et al.	2018	This study found that a heightened sense of presence in VR tourism content significantly enhances enjoyment and fosters a more favorable attitude towards destinations, which, in turn, boosts visitation intention. These findings, based on research conducted in Hong Kong and the UK, underscore the effectiveness of VR in influencing consumers' attitudes and behaviors.
5	Kim and Hall	2019	This study examines the influence of hedonic behaviors on the continued use of VR tourism, incorporating elements like enjoyment, flow state, and subjective well-being. Results reveal a significant impact of perceived enjoyment on flow state, which in turn influences subjective well-being and continued VR use, with the relationship between usefulness and flow state varying for visitors and non-visitors of the depicted destination.
6	Li and Chen	2019	VR in tourism marketing, while generally effective, can paradoxically deter travel intentions if the perceived enjoyment of VR exceeds tourist' expected enjoyment of the actual destination. This study underscores that, under certain conditions, high enjoyment of VR content may diminish the desire to visit the

Table 1 (*continued*)

No	Author (s)	Year	Key contribution
7	Kim et al.	2020	actual travel destination, highlighting the nuanced implications of technology in tourism. This study, rooted in the stimulus-organism-response (S-O-R) theory, found that authentic experiences in VR tourism significantly influence cognitive and affective responses, with these responses acting as pivotal mediators for attachment and visit intention. The intention to explore destinations displayed in VR is primarily driven by attachment to VR, with cognitive responses outweighing affective ones in shaping this intent.
8	Lee et al.	2020	VR positively influences customers' attitudes and intentions to visit a destination when the VR content is of high quality, system reliability is ensured, and it offers vivid experiences. This study, based on DeLone and McLean's IS success model, develops a quality-centric VR framework, showing that superior VR content, system quality, and immersive vividness drive customers towards favorable attitudes and heightened telepresence, ultimately influencing their visit intentions.
9	Ali	2022	This study develops and validates a three-dimensional measurement scale to assess consumers' AR-enhanced experiences in restaurants, encompassing Utilitarian, Hedonic, and Social aspects. Notably, it pioneers in capturing insights on a nascent technology's integration into the hospitality sector.
10	Fan et al.	2022	This study explores the role of AR and VR in tourism, identifying "presence" as the central feature influencing tourist experiences. The effect of presence on tourism experiences is moderated by factors like simulation type and social interaction positively, while prior visitation negatively influences it; however, experience type does not have a significant impact.
Panel C. AR and VR for hotel bookings			
1	Israel et al.	2019	This study finds that telepresence in smartphone-based VR enhances the perceived enjoyment and usefulness for potential hotel customers, directly influencing their booking intentions, suggesting its potential to increase hotel bookings and profits.
2	Leung et al.	2020	VR commercials in hotels yield superior immediate results compared to traditional ads, particularly among participants with high elaboration likelihood levels. However, VR commercials also lead to a notable drop in purchase intentions, while traditional ads enhance viewer attitudes.
3	Zeng et al.	2020	This study reveals that while online reviews and VR both directly influence consumer hotel booking intentions, the impact of online reviews diminishes when combined with VR. However, the combined effect of VR and online reviews on booking intention is stronger than online reviews alone, offering valuable insights for enhancing marketing strategies in the travel industry.
4	Orús et al.	2021	VR and AR significantly influence customers' pre-experiences with hotels, with contents showcasing high factual realism, such as 360-degree videos, enhancing perceptions of presence, imagination ease, visual appeal, and booking intentions, especially when viewed through head-mounted displays. The study underscores the paramount importance of fostering presence in VR and AR as a pivotal determinant of behavioral intentions in the hospitality sector.
5	Yoon et al.	2021	The study reveals that hotel guests' perceived value of VR, influenced by performance expectancy, social influence, and both

Table 1 (*continued*)

No	Author (s)	Year	Key contribution
			utilitarian and hedonic motivations, directly impacts their intention to use VR and their readiness to pay a premium for hotels offering VR content during booking. Utilizing the S-O-R framework, the research offers a fresh perspective on the integration of VR in the hotel booking process and its potential to drive increased revenue for establishments.
6	McLean and Barhorst	2022	This study explored the impact of VR on tourists' attitudes and intentions during both the prepurchase and postpurchase phases across three hotel preview formats. The research determined that VR enhances understanding of hotel offerings and intention to visit, and crucially manages tourists' expectations by offering authentic experiences and fostering vivid pre-visit mental imagery.
7	Slevitch et al.	2022	This study explored the efficacy of VR visualizations in comparison to traditional 2D photos as marketing tools on hotel websites, with a focus on affective, attitudinal, behavioral responses, and cognitive load. While there were significant differences in variables like pleasure and satisfaction between the two formats, the findings indicate that VR might not be consistently superior to 2D photos as a promotional tool for hotels.
8	The present study	2023	The present study reveals that the perceived ease of use, innovativeness, and usefulness of AR and VR significantly enhance tourists' satisfaction and propensity to utilize these technologies for hotel bookings. Despite some concerns about associated risks, these do not notably inhibit repeat use, suggesting that AR and VR hold considerable promise in enhancing tourist experiences and fostering repeat visits.

2.4. AR and VR adoption for hotel bookings in hospitality and tourism

In the digital age, AR and VR have transitioned from being mere technological novelties to formidable agents of transformation, especially evident in sectors like hospitality and tourism. These technologies are redefining customer experiences, offering immersive pre-visits, and creating enriched interactive engagements. Given their profound impact, the imperative to discern the determinants influencing their adoption has emerged as a cardinal research avenue, critical for the strategic evolution of the industry.

The technology acceptance model (TAM), proposed by Davis (1989), remains an influential theoretical lens in explicating the dynamics of technological integration. Central to TAM is the proposition that an individual's intent to embrace a particular technology is fundamentally anchored in their prevailing attitudes towards it. An elucidation of this relationship reveals two pivotal constructs: the perceived ease associated with the technology's usage and its envisaged utility. Davis (1989) elucidated perceived ease of use within TAM as the individual's conviction that the utilization of a particular technology would necessitate minimal effort. Conversely, perceived usefulness was discerned from the vantage of the user, evaluating whether the technology would amplify their task's efficacy.

Although TAM's significance is robustly established, exemplified by empirical endorsements from studies such as Ukpabi and Karjaluoto (2017), and lauded for its theoretical robustness by scholars like Carlisle et al. (2023) and Lim (2018), it is quintessential to underscore that TAM was formulated during a markedly different technological era. To make TAM commensurate with the intricate dimensions of AR and VR requires its refinement and enhancement.

Inspired by empirical endeavors of luminaries such as Han et al. (2018), Huang et al. (2013), Kim et al. (2019), and Wei (2019), our research introduces two pivotal extensions to the TAM: perceived

innovativeness and perceived risk. Perceived innovativeness extends beyond mere user convenience or utility, encapsulating the consumer's inclination toward cutting-edge solutions (Kamboj et al., 2022), epitomizing the allure exuded by pioneering technologies such as AR and VR. This construct accentuates novelty, emphasizing the forward-leaning nature of these technologies. Conversely, perceived risk acts as a counterbalance, a voice of caution. While AR and VR dazzle with immersive experiences, they also bring along new realms of concerns. Concerns extend beyond mere potential fiscal losses, as delineated by Featherman and Pavlou (2003). More profound apprehensions pertain to potential data breaches and breaches of privacy, as underscored by Meuter et al. (2005) and Tan and Teo (2000). Furthermore, there resides the latent risk of these technologies potentially not fulfilling their lofty promises.

While TAM provides a robust framework for understanding technology acceptance, the dynamic and ever-evolving landscapes of AR and VR demand a more nuanced approach. By integrating perceived innovativeness and perceived risk into the TAM, we not only acknowledge the multifaceted nature of these technologies but also align our understanding with the contemporary challenges and opportunities they present in the realm of hospitality and tourism, particularly in the context of hotel bookings.

2.5. Customer satisfaction and retention for hotels in hospitality and tourism

Within the hospitality and tourism domain, understanding customer satisfaction and retention is pivotal. This importance is encapsulated in multiple theories, each elucidating the dynamics between customer expectations and their subsequent experiences.

In line with the expectation-disconfirmation theory postulated by Oliver (1980), satisfaction emanates when the rendered service—whether during a hotel stay or during a tour—surpasses the antecedent expectations held by the guest or tourist. Conversely, a service falling short of these expectations precipitates dissatisfaction. Parallelly, Westbrook and Reilly's (1983) value-percept theory asserts that satisfaction is an affirmative emotional response engendered from an individual's evaluative juxtaposition of their experience against its anticipated value. These theoretical insights accentuate the imperativeness of meticulously managing, and even surpassing, customer expectations to cultivate satisfaction and engender consistent patronage.

In the current era of ubiquitous digitalization, there is an intensified emphasis among stakeholders in hospitality and tourism sector on customer satisfaction. This emphasis stems from the well-established link between elevated satisfaction levels and ensuing customer retention, loyalty, and augmented profitability (Szymanski and Henard, 2001; Tarasi et al., 2013). As the digital evolution augments tourists' expectations and intensifies competition amongst service providers, a paramount objective for enterprises in this sector is the provision of offerings that precisely resonate with the evolving customer preferences (Pereira et al., 2016). This dynamism has spurred service providers to explore avant-garde modalities, such as leveraging AR and VR, to curate compelling experiences that transcend conventional marketing paradigms (Balasubramanian et al., 2022).

Notwithstanding the delivery mechanism, actual tourist satisfaction and propensities for repeat engagements are realized when the experiential reality echoes tourists' preconceived expectations. Tourist retention remains a salient objective within hospitality and tourism (Back and Parks, 2003). This importance is underscored by Reichheld and Sasser's (1990) revelation that a modest 5% enhancement in customer retention can magnify profitability by a range of 25–125% across certain service industries. The rationale for such magnification is multifaceted: recurrent patrons typically exhibit increased spending, amplify word-of-mouth referrals, and manifest decreased price sensitivity (Reichheld, 1996; Reichheld and Sasser, 1990). Further emphasizing this is the finding by Heiens and Pleshk (1996) highlighting the substantial cost differential, with acquiring new customers being sevenfold

more expensive than retaining existing ones.

Given these insights, there emerges an unambiguous directive for hospitality and tourism enterprises intent on sustained profitability: assess how AR and VR can be harnessed to elevate both customer satisfaction and retention rates. Yet, a significant gap remains. Notwithstanding the burgeoning practitioner interest in AR and VR, there is a conspicuous dearth of empirical research exploring their tangible impact on customer satisfaction and retention (Kim et al., 2020; Bogicevic et al., 2019; Tussyadiah et al., 2018). Concurrently, the technological renaissance has unfortunately also amplified vulnerabilities, with the hospitality and tourism sector being identified as the second most susceptible to digital threats as per the 2019 IBM X-Force Threat Intelligence Index. Emerging threats, such as hotel booking fraud, are becoming increasingly prevalent. As such, delineating the motivations guiding tourists in their adoption of AR and VR for hotel booking is of paramount importance. This study, therefore, embarks with the objectives to: (1) examine the factors affecting tourists' intention to use AR and VR for hotel booking; (2) identify the factors affecting tourists' intention to book and repeat a stay; and (3) develop and validate a conceptual model to illustrate tourist engagement with AR and VR and its impact on tourist satisfaction and intention to stay and return. Consequently, the following hypotheses can be tested: (Fig. 1).

H1. Tourists' perceptions of usefulness (**H1a**), ease of use (**H1b**), and innovativeness (**H1c**) of experiencing AR and VR of hotels have a significant positive influence on their satisfaction.

H2. Tourists' perceptions of usefulness (**H2a**), ease of use (**H2b**), and innovativeness (**H2c**) of experiencing AR and VR of hotels have a significant positive influence on their intention to stay.

H3. Tourists' perceptions of usefulness influence their perceptions of ease of use of experiencing AR and VR of hotels.

H4. Tourists' perceptions of ease of use influence their perceptions of innovativeness of experiencing AR and VR of hotels.

H5. Tourists' satisfaction has a significant positive influence on their intention to stay.

H6. Tourists' satisfaction (**H6a**) and intention to stay (**H6b**) have a significant positive influence on their intention to return for a subsequent stay.

H7. Tourists' perceptions of risk have a significant negative influence on their intention to return for a subsequent stay.

H8. Tourists' satisfaction positively mediates the relationship between their perceptions of usefulness (**H8a**), ease of use (**H8b**), and innovativeness (**H8c**) with their intention to return for a subsequent stay.

H9. Tourists' intention to stay positively mediates the relationship between their perceptions of usefulness (**H9a**), ease of use (**H9b**), and innovativeness (**H9c**) with their intention to return for a subsequent stay.

H10. Tourists' satisfaction and intention to stay positively mediates the relationship between their perceptions of usefulness (**H10a**), ease of use (**H10b**), and innovativeness (**H10c**) with their intention to return for a subsequent stay.

H11. Tourists' perceptions of risk moderate the mediating effect of their satisfaction on the direct effect of their perceptions usefulness (**H11a**), ease of use (**H11b**), and innovativeness (**H11c**) of experiencing AR and VR of hotels on their intention to return for a subsequent stay.

H12. Tourists' perceptions of risk moderate the mediating effect of their intention to stay on the direct effect of their perceptions usefulness (**H12a**), ease of use (**H12b**), and innovativeness (**H12c**) of experiencing AR and VR of hotels on their intention to return for a subsequent stay.
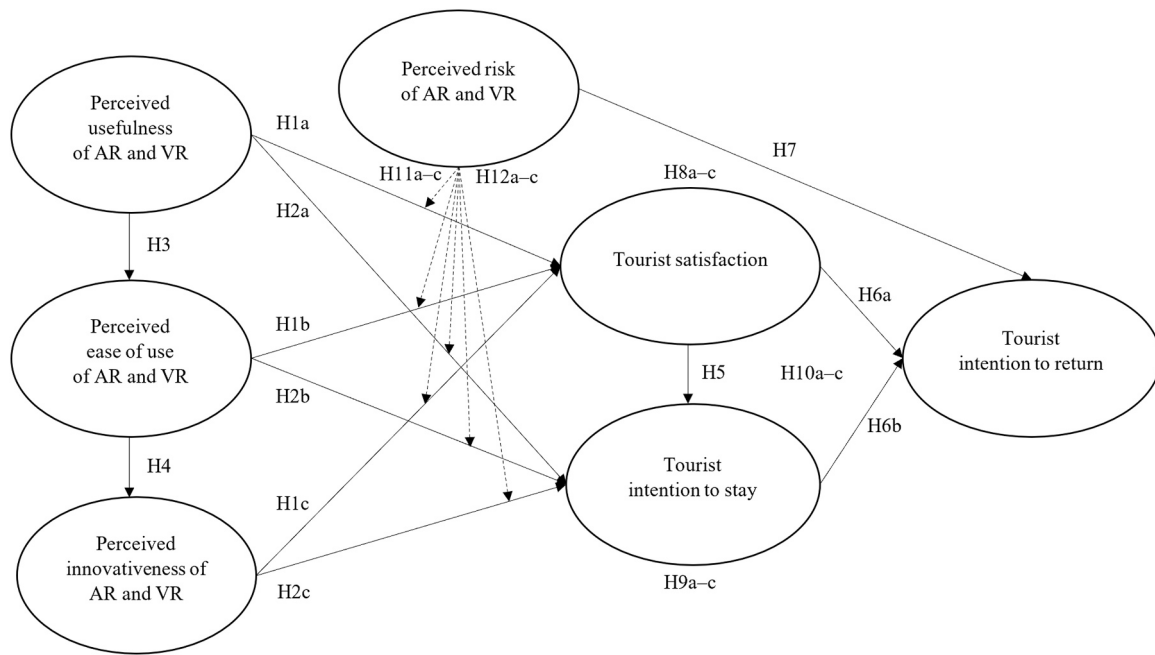
Fig. 1. Conceptual model.

3. Methods

Our study aims to examine the intention to stay and repeat stays in hotels among tourists who have experience staying at star hotels. We conducted an online survey using a structured questionnaire due to its advantages of wider geographical coverage, low cost, and rapid responses (Green et al., 2003). To minimize proximity effects, the items for each variable were presented separately in the questionnaire.

3.1. Instrumentation

The questionnaire was developed to achieve the research objectives and was divided into two sections. The first section contained four questions to collect the participants' demographic profiles, while the second section consisted of 31 questions measuring seven variables on a 5-point Likert scale, ranging from "5 – Strongly agree" to "1 – Strongly disagree". The items for the seven variables were obtained from existing literature, with some modifications to the statements to align with our research objectives. Perceived usefulness, consisting of five items, and perceived ease of use, with four items, were adapted from Davis (1989). Perceived innovativeness, comprising five items, was adapted from Agarwal, Prasad (1997), while the perceived risk construct, containing four items, was adapted from Featherman and Pavlou (2003). Similarly, the items for satisfaction were adapted from Bhattacherjee (2001), intention to stay from Kim et al. (2012), and intention to repeat a stay or return, which includes five items, from Goldsmith et al. (2005).

The questionnaire was first subjected to a pre-test involving five academic experts to ascertain content validity. Subsequently, a pilot study was conducted with 30 respondents, all of whom had prior experience using AR and VR for hotel bookings, to establish face validity. These steps to establish content validity and face validity are in line with Lim et al. (2023). Feedback from these respondents primarily centered on enhancing the clarity and format of the questionnaire. These suggestions were duly incorporated before the questionnaire was disseminated to the primary sample for this study.

3.2. Data collection

To obtain a sufficient number of participants for conducting structural equation modeling, 1500 online questionnaires in Google Forms were distributed to tourists through emails, WhatsApp, and social media platforms. Given the specific nature of our research, we employed purposive sampling—a non-probability sampling technique where participants are selected based on particular characteristics that serve the study's objectives (Kamboj et al., 2022). In this context, our research was primarily aimed at tourists who had prior experience of using AR and VR for hotel bookings, a feature predominantly available in hotels within the 4-star, 5-star, or 5-star deluxe categories. Thus, the use of purposive sampling ensured that the participants were from the specific demographic group that met this criterion, thus enhancing the relevance and specificity of our collected data.

Critics might argue that purposive sampling can introduce bias, as it does not offer every individual an equal chance of selection. However, given the specialized nature of our research topic, employing a random sampling method might have resulted in a low incidence rate of respondents with the requisite experience, potentially diluting the validity of the findings. Purposive sampling, in this scenario, provides a focused approach to target the exact subset of the population that can offer rich and relevant insights, thereby making it an appropriate choice for this study.

Consequently, to further refine the sample, participants were screened through a dichotomous rating scale ("Yes" or "No") regarding their prior experiences with AR and VR in the aforementioned hotel categories. Only those who responded affirmatively proceeded to the survey's subsequent sections. A total of 486 responses were collected, yielding a response rate of 32.4%. From this pool, 14 responses (equivalent to 2.9% of non-usable responses received) were excluded due to issues of incompleteness or invalidity. This left us with a robust sample of 472 responses (constituting 97.1% of usable responses) for in-depth analysis.

3.3. Data analysis

In this research, structural equation modeling (SEM) was the chosen technique to examine and validate the conceptual model of our study. SEM allows for the simultaneous examination of multiple dependent relationships and the assessment of latent constructs, making it particularly fitting for our investigation.

Our analysis began with an assessment of the measurement model, which ensured the reliability and validity of the constructs we introduced. Reliability pertains to the consistency of the measurements—ensuring that the instruments used produce consistent results over time. Validity, on the other hand, ensures that the constructs measure what they are intended to. By validating the measurement model, we ensured that the observed variables rightly represented their underlying latent constructs.

Following this, we proceeded to analyze the structural model, where the primary objective was to evaluate the proposed hypotheses. This allowed us to discern the strength and direction of relationships between the latent constructs. The Lavaan package in R was employed for this analysis. Lavaan is a robust tool that provides a range of functionalities needed for SEM, facilitating both the development and refinement of models.

Our choice to utilize covariance-based SEM (CB-SEM) was intentional and strategic. CB-SEM is predominantly favored when the research's objective leans towards theory building and development. This differs from partial least squares SEM (PLS-SEM), which, being a component-based approach, is more tailored for theory testing and prediction. Given that our study is situated in the realm of understanding and constructing relationships (rather than just testing them), CB-SEM presented as the more suitable analytical method.

4. Results

4.1. Profile of participants

The participants' demographic information is presented in Table 2. Of the 472 participants, 311 were male and 161 were female. The majority of participants were aged between 21 and 30 years (46.8%). Most participants held undergraduate degrees (75%). Furthermore, 45% had stayed in a hotel once in six months, followed by 40% stayed once a year.

4.2. Measurement model

The measurement model was assessed by reliability, convergent validity, and discriminant validity. Cronbach alpha values are greater than 0.70, indicating reliability of the measurement model (Table 3). Convergent validity was observed by three threshold limits: (i) factor loadings should be greater than 0.7, (ii) composite reliability (CR) values of above 0.7, and (iii) average variance extract (AVE) of above than 0.5. All factor loadings are above 0.7, CR values range from 0.865 to 0.966, and AVE values are 0.562–0.877, indicating convergent validity of the measurement model (Table 4). Similarly, discriminant validity is assessed by examining whether the square root of the AVE of each variable is greater than the correlations with other variables. As evidenced, all square root values of AVE are greater than the off-diagonal

values in the correlation matrix, indicating discriminant validity of the measurement model (Table 4). These tests and interpretations are in line with Anderson and Gerbing (1988), Fornell and Larcker (1981), and Hulland (1999).

4.3. Structural model

The structural model had a good fit (Relative chi-square ($\chi 2//df$) = 4.21 < 5; Root Mean Square Error of Approximation (RMSEA) = 0.014 < 0.08; Comparative Fit Index (CFI) = 0.924 > 0.9; Normal Fit Index (NFI) = 0.915 > 0.9; Root Mean Square Residual (RMSR) = 0.022 < 0.5; Tucker Lewis Index (TLI) = 0.971 > 0.9) as all goodness-of-fit measures satisfy the criteria (Kline, 2005; Tabachnik and Fidell, 2007).

4.3.1. Direct effects

Consistent with earlier studies on intention to stay in hotels adopting advanced technologies like service robots, smart hotel technology, and virtual employee (lma Çallı et al., 2023; Dewi et al., 2022), this study reveals that all direct effects are significant except between (i) tourists' satisfaction of AR and VR experience of hotels and their intention to return for a subsequent stay (H6a: $\beta = 0.14$, $p > 0.05$) and (ii) tourists' perceptions of risk and their intention to return for a subsequent stay (H7: $\beta = 0.11$, $p > 0.05$). Specifically, tourists' perceptions of usefulness (H1a: $\beta = 0.177$, $p < 0.05$), ease of use (H1b: $\beta = 0.328$, $p < 0.05$), and innovativeness (H1c: $\beta = 0.193$, $p < 0.05$) of experiencing AR and VR of hotels have a significant positive influence on their satisfaction (Table 5). Similarly, tourists' perceptions of usefulness (H2a: $\beta = 0.475$, $p < 0.05$), ease of use (H2b: $\beta = 0.17$, $p < 0.05$), and innovativeness (H2c: $\beta = 0.103$, $p < 0.05$) of experiencing AR and VR of hotels have a significant positive influence on their intention to stay. In addition, tourists' perceptions of usefulness has a significant positive influence on their perceptions of ease of use (H3: $\beta = 0.083$, $p < 0.05$), which, in turn, exert the same effect on their perceptions of innovativeness (H4: $\beta = 0.115$, $p < 0.05$) of experiencing AR and VR of hotels. Last but not least, there is also a significant positive relationship between tourists' satisfaction and their intention to stay (H5: $\beta = 0.142$, $p < 0.05$), which, in turn, exert the same effect on their intention to return for a subsequent stay (H6b: $\beta = 0.173$, $p < 0.05$). Therefore, H1a, H1b, H1c, H2a, H2b, H2c, H3, H4, H5, and H6b are supported, but not H6a and H7.

4.3.2. Mediating effects

The results of the mediating analysis reveal several noteworthy observations. To begin, tourists' satisfaction, on its own, does not mediate the perceptions of usefulness (H8a: $\beta = 0.052$, $p > 0.05$), ease of use (H8b: $\beta = -0.002$, $p > 0.05$), and innovativeness (H8c: $\beta = -0.025$, $p > 0.05$) of experiencing AR and VR of hotels on the intention to return for a subsequent stay. This is contrary to tourists' intention to stay, which, on its own, positively mediates the perceptions of usefulness (H9a: $\beta = 0.145$, $p < 0.05$), ease of use (H9b: $\beta = 0.034$, $p < 0.05$), and innovativeness (H9c: $\beta = 0.171$, $p < 0.05$) of experiencing AR and VR of hotels on the intention to return for a subsequent stay (Table 6).

Nonetheless, tourists' satisfaction does matter when their intention to stay is also considered, as seen through their positive serial mediation influence on the perceptions of usefulness (H10a: $\beta = 0.165$, $p < 0.05$), ease of use (H10b: $\beta = 0.151$, $p < 0.05$), and innovativeness (H10c: $\beta = 0.049$, $p < 0.05$) of experiencing AR and VR of hotels with the intention to return for a subsequent stay. Therefore, H9a, H9b, H9c, H10a, H10b, and H10c are supported, but not H8a, H8b, and H8c.

4.3.3. Moderation effects

The results of the moderating analysis show several interesting observations consistent with the mediation analysis. Though tourists' perceptions of risk does not moderate the mediating effect of their satisfaction on the direct effect of their perceptions usefulness (H11a: $\beta = -0.027$, $p > 0.05$), ease of use (H11b: $\beta = 0.048$, $p > 0.05$), and

Table 2
Profile of participants.

Demographic		Frequency	Percentage
Gender	Male	311	65.9
	Female	161	34.1
Age	< 21 years	28	5.9
	21–30 years	221	46.8
	31–40 years	127	26.9
	41–50 years	74	15.7
	> 50 years	22	4.7
Educational qualification	School	44	9.3
	Undergraduate	354	75.0
	Postgraduate	74	15.7
Frequency of staying in hotel	Once in a week	12	2.5
	Once in a month	56	11.9
	Once in six months	214	45.3
	Once in a year	190	40.3
Total		**472**	**100.0**

Table 3
Descriptive statistics and correlation matrix.

Variable	Mean	SD	A	Kurtosis	Skewness	PU	PEU	PI	PR	TS	TIS	TIR
PU	3.21	0.14	0.81	1.247	0.943	0.86						
PEU	3.45	0.25	0.85	1.223	0.864	0.13	0.86					
PI	3.32	0.33	0.88	0.432	0.833	0.09	0.24	0.85				
PR	3.71	0.43	0.78	1.134	0.802	0.15	0.04	0.04	0.85			
TS	3.56	0.22	0.86	0.345	0.835	0.21	0.11	0.15	0.17	0.94		
TIS	3.72	0.24	0.74	0.376	0.922	0.03	0.14	0.16	0.08	0.13	0.90	
TIR	3.66	0.36	0.83	0.783	0.734	0.22	0.13	0.23	0.04	0.12	0.11	0.75

Notes: PU = Perceived usefulness. PEU = Perceived ease of use. PI = Perceived innovativeness. PR = Perceived risk. TS = Tourist satisfaction. TIS = Tourist intention to stay. TIR = Tourist intention to return for a subsequent stay. Diagonal values are square roots of AVEs and off-diagonal values are correlations.

innovativeness (H11c: β = −0.008, p > 0.05) of experiencing AR and VR of hotels on their intention to return for a subsequent stay, it does moderate the mediating effect of their intention to stay on the direct effect of their perceptions usefulness (H12a: β = 0.173, p < 0.05), ease of use (H12b: β = 0.167, p < 0.05), and innovativeness (H12c: β = 0.153, p < 0.05) of experiencing AR and VR of hotels on their intention to return for a subsequent stay (Table 7). The results of these moderating effects are sensible as they are consistent with the non-significance and significance of mediating effects of tourists' satisfaction and intention to return for a subsequent stay, respectively. Therefore, H12a, H12b, and H12c are supported, but not H11a, H11b, and H11c.

5. Conclusion

5.1. General discussion

The present study offers valuable insights into how tourists' perceptions of the usefulness, ease of use, and innovativeness of AR and VR experiences in hotels influence their satisfaction and intentions regarding future stays.

Firstly, findings indicate that tourists' perceptions of usefulness, ease of use, and innovativeness exert a positive effect on their satisfaction and subsequent intentions to stay. This underlines the criticality of these attributes for the successful deployment of AR and VR technologies in the hotel sector.

Secondly, our study identifies a robust positive linkage between tourists' satisfaction and their intention to stay. This relationship is further observed to enhance their propensity to return for subsequent stays. The nuance here lies in understanding that tourists' satisfaction, when considered outside the purview of the intention to stay, does not serve as a mediating factor.

Thirdly, we underscore the moderating function of perceived risk. This moderating role becomes evident in the relationship between tourists' perceptions of AR and VR experiences in hotels and their inclination to revisit. The takeaway here is the indispensable need to manage and address tourists' risk perceptions if the aim is to bolster their behavioral intentions.

Fourthly and *finally*, this research sheds light on the pivotal role played by the intention to stay. It acts as a bridge or mediator between tourist' perceptions of AR and VR experiences in hotels and their intention to embark on a return stay. This suggests a clear trajectory: by enhancing tourists' satisfaction and intention to stay, hotels can amplify the chances of securing repeat visits. The ramifications of these findings will be elaborated upon in the subsequent sections.

5.2. Theoretical implications

This study offers several significant theoretical implications for the literature on AR and VR applications in the hospitality and tourism sector, particularly in the context of hotels.

Firstly, the findings herein enrich the understanding of the factors influencing tourists' decisions to use AR and VR for hotel bookings and

their likelihood of becoming repeat users. This deepened understanding contributes to bridging knowledge gaps and enriching insights in the literature (e.g., McLean and Barhorst, 2022; Yoon et al., 2021) and helps researchers better understand the underlying mechanisms of AR and VR adoption in the hotel industry.

Secondly, the application and expansion of the TAM, expectation-confirmation theory, and value-percept theory in the context of AR and VR adoption in the context of hotels enable the study to demonstrate the theories' versatility and relevance in explaining technology adoption and loyalty behaviors across different contexts (e.g., Huang et al., 2019; Sancho-Esper et al., 2022). This supports the idea that these theories, when integrated, can serve as a valuable theoretical framework for investigating the adoption of emerging technologies and the ensuing loyalty behavior in various sectors (Lim, 2018).

Thirdly, the introduction and examination of perceived innovativeness and perceived risk as extensions to the TAM showcase the need for considering additional factors when investigating the adoption of novel technologies such as AR and VR. This theoretical implication encourages future research to explore other potentially relevant constructs and their relationships to better understand the unique peculiarities of AR and VR adoption in different contexts (e.g., Wei, 2019).

Fourthly, the examination of the direct relationships between tourists' perceptions of usefulness, ease of use, and innovativeness, satisfaction, intention to stay, and intention to return for a subsequent stay amounts to a comprehensive understanding of the factors influencing tourists' behavioral intentions in the context of AR and VR experiences, thereby answering the call by past scholars for additional research in this space (e.g., Han, 2019; Wei, 2019).

Fifthly, the study also extends the current knowledge on the role of perceived risk in the adoption of AR and VR technologies by investigating its moderating effect on the relationships between tourists' perceptions, satisfaction, and intentions, highlighting the significance of considering risk perceptions in studies focusing on technology adoption in the hospitality and tourism sector, especially in the hotel industry (Dayour et al., 2019; Wu and Cheng, 2018).

Sixthly, the mediating role of intention to stay in the relationship between tourists' perceptions of AR and VR experiences of hotels and their intention to return for a subsequent stay contributes to the literature by establishing a strong connection between these factors, thereby emphasizing the importance of tourists' intention to stay in understanding their future behavior (Lai and Hitchcock, 2017).

Overall, the theoretical implications of this study underline the importance of considering the unique characteristics of AR and VR technologies and their effects on tourists' adoption behaviors in the hospitality and tourism sector, including the hotel industry. This can pave the way for future research to further investigate and refine the understanding of the adoption of AR and VR technologies.

5.3. Managerial implications

The findings of this study offer valuable managerial implications for destination marketers, hoteliers, and hotel booking service providers who seek to leverage AR and VR technologies.

Table 4
Factor analysis and reliability analysis.

Variable	Item	Item description	Loading	Average variance extracted	Composite reliability
Perceived usefulness (PU)	PU1	Augmented and virtual reality for hotels would be useful in my life.	0.911	0.733	0.932
	PU2	Augmented and virtual reality for hotels would allow me to access information more quickly.	0.887		
	PU3	Augmented and virtual reality for hotels would increase my productivity.	0.785		
	PU4	Augmented and virtual reality for hotels would enhance my effectiveness.	0.804		
	PU5	Augmented and virtual reality for hotels would enable me to search for information rapidly.	0.885		
Perceived ease of use (PEU)	PEU1	Accessing hotels using augmented and virtual reality does not require significant mental effort.	0.933	0.743	0.920
	PEU2	Accessing hotels using augmented and virtual reality could be done without the help of an expert.	0.805		
	PEU3	Accessing hotels using augmented and virtual reality would be easy for me.	0.887		
	PEU4	Accessing hotels using augmented and virtual reality seems to be user-friendly.	0.816		
Perceived innovativeness (PI)	PI1	If I heard about a new augmented and virtual reality application, I would seek ways to experiment with it.	0.885	0.717	0.927
	PI2	I am usually the first to try out new augmented and virtual reality technologies among my peers.	0.834		
	PI3	I am hesitant to try out new augmented and virtual reality applications.	0.857		
	PI4	I enjoy experimenting with new augmented and virtual reality technologies.	0.844		
	PI5	I would shop using augmented and virtual reality even if I did not know anyone who had done it before.	0.811		
Perceived risk (PR)	PR1	Augmented and virtual reality for hotels might not perform well and could process information incorrectly.	0.874	0.726	0.914
	PR2	Augmented and virtual reality for hotels might introduce significant uncertainty.	0.844		
	PR3	Augmented and virtual reality for hotels might not have strong enough security systems to provide protection.	0.826		
	PR4	Augmented and virtual reality for hotels might be susceptible to hackers who could access my information.	0.863		
Tourist satisfaction (TS)	TS1	I am satisfied with my decision to use augmented and virtual reality for hotels.	0.995	0.877	0.966
	TS2	I am confident that my decision to use augmented and virtual reality for hotels is a wise one.	0.974		
	TS3	I am unhappy with decision to use augmented and virtual reality for hotels.	0.944		
	TS4	I am not satisfied with my experience of using augmented and virtual reality for hotels.	0.823		
Tourist intention to stay (TIS)	TIS1	I would use augmented and virtual reality to evaluate hotel services before I make bookings.	0.922	0.808	0.944
	TIS2	I would use augmented and virtual reality to help me decide on which hotels to book.	0.927		
	TIS3	I would use augmented and virtual reality for hotels to make bookings.	0.916		
	TIS4	I would book a stay at hotels that provide augmented and virtual reality experiences.	0.826		
Tourist intention to return for a subsequent stay (TIR)	TIR1	I would be happy to consider subsequent stays after experiencing augmented and virtual reality for hotels.	0.773	0.562	0.865
	TIR2	I would be happy to stay longer after experiencing augmented and virtual reality for hotels.	0.801		
	TIR3	I would be less willing to engage in subsequent stays after using augmented and virtual reality for hotels.	0.743		
	TIR4	I would be willing to use augmented and virtual reality to decide on my subsequent stays at hotels.	0.726		
	TIR5	I would be willing to use augmented and virtual reality to decide whether or not to return to hotels.	0.703		

Firstly, tourists' perceptions of usefulness, ease of use, and innovativeness play a significant role in their satisfaction and intention to stay based on the findings of this study. In this regard, destination marketers, hoteliers, and hotel booking service providers should focus on designing user-friendly and appealing AR/VR applications that cater to tourists' needs and preferences. Additionally, enhancing the design of hotel rooms to better align with tourists' expectations should lead to more satisfying experiences and increased repeat visits.

Secondly, perceived innovativeness and perceived risk are important factors to consider in the adoption of AR and VR technologies based on

the outcomes of this study. Hence, destination marketers, hoteliers, and hotel booking service providers should consider these factors when crafting marketing strategies. Noteworthily, emphasizing the innovative aspects of AR/VR applications and mitigating the perceived risks associated with their use should increase the likelihood of adoption and repeat use. Moreover, destination marketers, hoteliers, and hotel booking service providers should explore different communication channels to convey the benefits of AR and VR technologies effectively and increase awareness of their offerings.

Thirdly, understanding the factors that drive tourists' satisfaction and

Table 5
Direct effects.

Hypothesis	Relationship	Path coefficient	t-statistic	p-value	Outcome
H1a	PU → TS	0.177	3.88	< 0.05	Supported
H1b	PEU → TS	0.328	7.258	< 0.05	Supported
H1c	PI → TS	0.193	5.11	< 0.05	Supported
H2a	PU → TIS	0.475	14.462	< 0.05	Supported
H2b	PEU → TIS	0.17	5.083	< 0.05	Supported
H2c	PI → TIS	0.103	4.301	< 0.05	Supported
H3	PU → PEU	0.083	2.074	< 0.05	Supported
H4	PEU → PI	0.115	3.523	< 0.05	Supported
H5	TS → TIS	0.142	5.034	< 0.05	Supported
H6a	TS → TIR	0.043	1.836	> 0.05	Not supported
H6b	TIS → TIR	0.173	4.278	< 0.05	Supported
H7	PR → TIR	0.027	1.058	> 0.05	Not supported

Notes: PU = Perceived usefulness. PEU = Perceived ease of use. PI = Perceived innovativeness. PR = Perceived risk. TS = Tourist satisfaction. TIS = Tourist intention to stay. TIR = Tourist intention to return for a subsequent stay.

Table 6
Mediation effects.

Hypothesis	Relationship	Path coefficient	t-statistic	p-value	Outcome
H8a	PU → TS → TIR	0.052	1.407	> 0.05	Not supported
H8b	PEU → TS → TIR	-0.002	0.053	> 0.05	Not supported
H8c	PI → TS → TIR	-0.025	1.038	> 0.05	Not supported
H9a	PU → TIS → TIR	0.145	5.007	< 0.05	Supported
H9b	PEU → TIS → TIR	0.034	3.442	< 0.05	Supported
H9c	PI → TIS → TIR	0.171	4.087	< 0.05	Supported
H10a	PU → TS → TIS → TIR	0.165	5.045	< 0.05	Supported
H10b	PEU → TS → TIS → TIR	0.151	3.82	< 0.05	Supported
H10c	PI → TS → TIS → TIR	0.049	4.196	< 0.05	Supported

Notes: PU = Perceived usefulness. PEU = Perceived ease of use. PI = Perceived innovativeness. PR = Perceived risk. TS = Tourist satisfaction. TIS = Tourist intention to stay. TIR = Tourist intention to return for a subsequent stay.

Table 7
Moderation effects.

Hypothesis	Relationship	Path coefficient	t-statistic	p-value	Outcome
H11a	PU × PR → TS → TIR	-0.027	1.041	> 0.05	Not supported
H11b	PEU × PR → TS → TIR	0.048	1.271	> 0.05	Not supported
H11c	PI × PR → TS → TIR	-0.008	1.716	> 0.05	Not supported
H12a	PU × PR → TIS → TIR	0.173	4.102	< 0.05	Supported
H12b	PEU × PR → TIS → TIR	0.167	5.042	< 0.05	Supported
H12c	PI × PR → TIS → TIR	0.153	3.829	< 0.05	Supported

Notes: PU = Perceived usefulness. PEU = Perceived ease of use. PI = Perceived innovativeness. PR = Perceived risk. TS = Tourist satisfaction. TIS = Tourist intention to stay. TIR = Tourist intention to return for a subsequent stay.

intention to stay and return for a subsequent stay can help hoteliers and service providers create more engaging, immersive, and personalized experiences for their customers. This, in turn, can foster long-term relationships with tourists and lead to increased customer loyalty and repeat business.

Finally, hoteliers and hotel booking service providers can drive innovation and contribute to the overall growth of the hospitality and tourism sector, particularly the hotel industry, by adopting AR and VR technologies in their operations and marketing strategies, whereby embracing these cutting-edge technologies should help them to differentiate themselves from competitors and attract a wider range of tourists.

Overall, the managerial implications of this study highlight the need for destination marketers, hoteliers, and hotel booking service providers to consider the factors influencing tourists' adoption of AR and VR technologies and use this knowledge to enhance their product offerings, marketing strategies, and customer engagement initiatives, as doing so should lead to more successful and sustainable businesses in the ever-evolving hospitality and tourism sector of which the hotel industry is a part of and plays a key role.

5.4. Limitations and future research directions

Notwithstanding its contributions, this study has several limitations, which, when taken positively, provides a foundation for future research on the adoption of AR and VR technologies in the hospitality and tourism industry.

Firstly, this study is limited in the set of variables that it considered and tested. Though a large set of hypotheses was present, future research is encouraged to explore other factors influencing tourists' perceptions of AR and VR experiences, which may include but not limited to cultural differences, demographic variables, and the role of trust in technology adoption. Understanding these factors should provide valuable insights into tailoring AR and VR experiences to specific target groups.

Secondly, this study is limited to cross-sectional insights, and thus, longitudinal studies could be conducted to examine the long-term effects of AR and VR on tourists' satisfaction and intention to stay and return for a subsequent stay. Such studies should contribute to shedding light on how AR and VR experiences influence repeat visits and loyalty over time.

Thirdly, this study is limited to a macro-overview of hotels. Hence, future studies might investigate the role of AR and VR across different segments of the hospitality and tourism industry, including but not limited to boutique versus luxury hotels or tours versus vacation rentals, which, in turn, would allow for a more comprehensive understanding of the potential impact of AR and VR technologies across various hospitality and tourism settings.

Last but not least, future research could also focus on the development of best practices for implementing AR and VR experiences in hotel settings alongside other settings in the hospitality and tourism sector, drawing from successful case studies and exploring innovative approaches to enhance tourist experiences.

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The authors declare no interests that might appear to affect their ability to present the study objectively.

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