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A systematic review of virtual reality in tourism and hospitality: The known and the paths to follow

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ABSTRACT

Virtual reality is currently used to enhance travelers' experience, providing destinations, attractions, and businesses with additional marketing tools, reshaping consumer experiences, and generating a new model of tourism. Our work was motivated by a fast-changing world where virtuality is increasingly becoming the reality in which we live, work, and play. These technologies continuously improve, thus bringing new challenges to tourism and hospitality management. As the VR literature continues to grow, there is an urgent need to synthesize extant evidence in this field. To address this challenge, we systematically reviewed 54 papers selected from high-quality journals on the topic of virtual reality. Results synthesize the available knowledge for research and managerial decision. Our review also provides future research streams and relevant managerial implications based on a nine-step consumer journey that we developed anticipating the growing incorporation of virtual reality in the field.

1. Introduction

In recent years, tourism and hospitality (T&H) have witnessed an exponential growth of high technology adoption, including applications of augmented (AR) and virtual reality (VR). VR has, in particular, impacted T&H (Tussyadiah et al., 2018b) with an increased supply and demand for these experiences (Bogicevic et al., 2019). Past discussions have ranged from whether VR is a threat to the industry (Cheong, 1995) or if it is a reality or a mere fantasy (Williams and Hobson, 1995), while current concerns revolve around the amplification of its potential as a marketing tool (Skard et al., 2021), and as an experience-enhancer for tourists (Flavián et al., 2021).

Immersive digital environments based on AR/VR technologies are currently used to enhance travelers' experience before, during, and after their trip. These technologies are also generating a new model of tourism (Zhang et al., 2022), that of virtual tourism (VT), which is based on real tourism landscapes but in an immersive online environment (Bogicevic et al., 2019). T&H industries' enthusiasm for AR/VR technology adoption is not surprising due to their many advantages (Guttentag, 2010). From the consumers' perspective, AR/VR may make tourism accessible for people with physical disabilities, financial constraints, and time, or other, limitations (Lin et al., 2020). Additionally, for all tourists, it is an opportunity for an enhanced and personalized experience (Spielmann and Mantonakis, 2018).

From the perspective of tourism managers, VR affects policy-making and is fast emerging as an important means of tourism marketing (Lin et al., 2020), with a growing role in supporting attractions' revenue (Zenker and Kock, 2020). VR enables reaching a greater target audience while reducing the carbon footprint or overcrowding (Itani and Hollebeek, 2021), thus contributing to site preservation (Bec et al., 2021). It may also restore the original appearance of a historical destination, contribute to protecting cultural heritage, and be a relevant tool for environmental messaging (Talwar et al., 2022b). VR also provides a new opportunity to develop tourism activities while satisfying new demands, such as physical distancing during the COVID-19 pandemic (Zhang et al., 2022).

Based on AR/VR technologies, VT has become a way to travel in today's society (Zhang et al., 2022), one that has quickly learned to adapt to travel controls following COVID-19 lockdowns. Additionally, the related technologies and applications are evolving rapidly (*e.g.*, Artificial Intelligence (AI), 5G broadband cellular networks). Therefore, any new knowledge on the topic must be gathered, synthesized, and put

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forward for researchers and practitioners. As scholarly interest in AR/VR technologies and their implications in T&H grow, there is a risk of increasing fragmentation and a need for an initial consolidation of 'what is out there.'.

VR/AR technologies have existed for many years and have an important place in T&H. However, AR and VR technologies are improving exponentially (Martínez-Molés et al., 2022). The dramatic interest in the metaverse has spotlighted these technologies, driving much of the metaverse hopes. The metaverse may provide a unique and immersive experience using augmented and virtual reality (Malik et al., 2022). Our work was primarily motivated by a fast-changing environment where virtuality is increasingly becoming the reality in which we live, work, and play. Researchers have been enthusiastically following these changes, leading to a significant increase in publications on the topic from 2021.

Additionally, as AR and VR technologies improve, so do their tourism applications, bringing new managerial challenges. Our research focuses on the T&H managerial and business applications as evidenced by extant research, therefore a step forward from a technological-focused research angle. Questions regarding the overall practicality of the technology, as indicated by Sigala (2020) and Kim et al. (2020), reinforce the need for that distinction. Similarly, Bogicevic et al. (2021) raise the question of whether VR can contribute to brand building and behavioral outcomes beyond offering technical affordances.

To address those concerns, we systematically reviewed 54 papers selected from high-quality journals on the topic of AR/VR in T&H, with over 50% of this literature being published since 2021. We aim to synthesize this recently growing body of knowledge for T&H business research and managerial decision, highlighting gaps and suggesting future research streams.

We contribute to theory by synthesizing the state of the art on VR in the context of T&H and revealing researchers' main methodological choices in empirical studies. Additionally, we inductively determine five main themes that are the focus of extant research, providing a model of how the main questions answered by researchers are articulated with each other and highlighting where it is less focused. Furthermore, we develop a nine-step consumer journey anticipating the growing incorporation of VR in T&H to establish a framework for future developments. By proposing this framework, we offer a broader perspective of VR in T&H, motivating additional research that better illuminates the applicability of VR in T&H.

Although more research is needed in many aspects, this review also brings significant contributions to practitioners, especially those interested in applications of VR in T&H, suggesting it is a very effective tourism marketing tool and its power to enhance tourists' *in-situ* experience. Additionally, this review highlights the underexplored potential for VR technologies in T&H. The nine-step consumer journey framework we developed offers practitioners a complete view of where they may intervene regarding incorporating VR in consumers' journeys in T&H.

The paper is organized as follows. In the next section, we provide a concept clarification that establishes a basis for the rest of the paper and summarizes the current applications of VR in T&H and what technology developments may bring to the field. In the following section, we explain the methodological process for the systematic review. Findings are presented in Section 3, and in Section 4, we discuss the results and offer future research directions. We conclude the paper with theoretical and practical implications and the limitations of the review.

2. Virtual tourism, virtual reality, and augmented reality

2.1. Concept clarification

The concept of VT lacks a generally accepted definition. According to Zhang et al. (2022), VT may be defined broadly or strictly. In the first case, VT refers to "any process of obtaining information and knowledge about tourist attractions using a non-immersive way" (Zhang et al., 2022, p.2). In this broader sense, VT may not even use advanced technology. Historically, it encompassed storytelling and panoramic paintings, providing a 360-degree view.

In the stricter sense, "virtual tourism is a process of experiencing super-real scenes in a three-dimensional virtual environment through various visualization technologies, including virtual reality (VR) and augmented reality (AR)" (Zhang et al., 2022, p.2). In this paper, we will address VT in its narrow sense because, as this review will show, it is in these more advanced technologies that great opportunities lie for T&H.

Some authors state that many VR experiences range from simple (*e.g.*, viewing static images) to more sophisticated (*e.g.*, navigating through high-resolution 360-degree panoramic content) to advanced experiences (*e.g.*, using virtual-reality headsets or full-body suits) (Spielmann and Orth, 2021). Others argue that any device that does not allow for user-controlled navigation would not qualify as VR. In this latter sense, VR is defined by Guttentag (2010, p. 638) as "the use of a computer-generated 3D [three-dimensional] environment – called a 'virtual environment' […] resulting in real-time simulation of one or more of the user's five senses".

A virtual environment (VE) (Guttentag, 2010), or 'mediated environment' (Martínez-Molés et al., 2022), is any virtual three-dimensional (3D) environment (*e.g.*, a hotel lobby) that a user can navigate and possibly interact with. 'Navigate' refers to the ability to move and explore in the VE. 'Interact' refers to the selection and movement of objects by the user. A VE combines visual, auditory, tactile, and vestibular sensory information while also enabling gustatory and olfactory cues (Williams and Hobson, 1995).

Currently, there is a device for every customer's pocket, from more affordable smartphone add-ons to more elaborate, interactive, and low-latency devices (Bogicevic et al., 2021), with consequences on the level of immersion, which is defined as the degree to which the user feels isolated from the real world (Guttentag, 2010; McLean and Barhorst, 2021). Head-mounted displays (HMD), which may be a helmet, goggles, or glasses (Guttentag, 2010), are highly immersive systems; they enable complete isolation from the physical world. It also allows the user to physically move around and interact with the VE as they would in the physical world (Flavián et al., 2019). However, in semi-immersive systems (360° content with surround sound), the user maintains contact with the physical world, and non-immersive systems (desktop-based) are the simplest way of providing and accessing VR.

Contrary to non-immersive VR, immersive technologically-advanced VR facilitated by HMD typically generates higher user-perceived telepresence than more basic applications (H. Lee et al., 2020; M. Lee et al., 2020). Presence, or telepresence, is the psychological state in which, subjectively, a user feels immersed in a mediated environment (Tussyadiah et al., 2018b); the higher the degree to which an individual feels they have shifted from a physical environment to an alternate VE, the higher the level of presence (Wei et al., 2019).

Augmented reality (AR) is the projection of computer-generated images onto a real-world view. Some scholars have proposed that AR is a type of VR (Guttentag, 2010), specifically, a type of mixed reality where the real environment is overlayed in a digital context (Bec et al., 2021). Mixed reality (MR) is a subclass of VR-related technologies that merges real and virtual worlds (Bec et al., 2021). Following this approach, it is "quite valid to consider the two concepts [AR and VR] together" (Milgram et al., 1995, p. 283). In this paper, we follow Guttentag's (2010) approach to the definitions of VR and AR. Therefore, unless we specifically wish to refer to AR / MR technologies, we will implicitly include AR / MR technologies when referring to VR.

2.2. Current applications of VR in T&H and new developments in the field

Although VR has many applications in T&H (*e.g.*, in management, marketing, and heritage preservation, to name a few; Guttentag, 2010), recent studies stress the potential of VR as a marketing communication tool (Kim et al., 2020; Leung et al., 2020; Skard et al., 2021) and as a way to enhancing tourists' experience (Flavián et al., 2021).

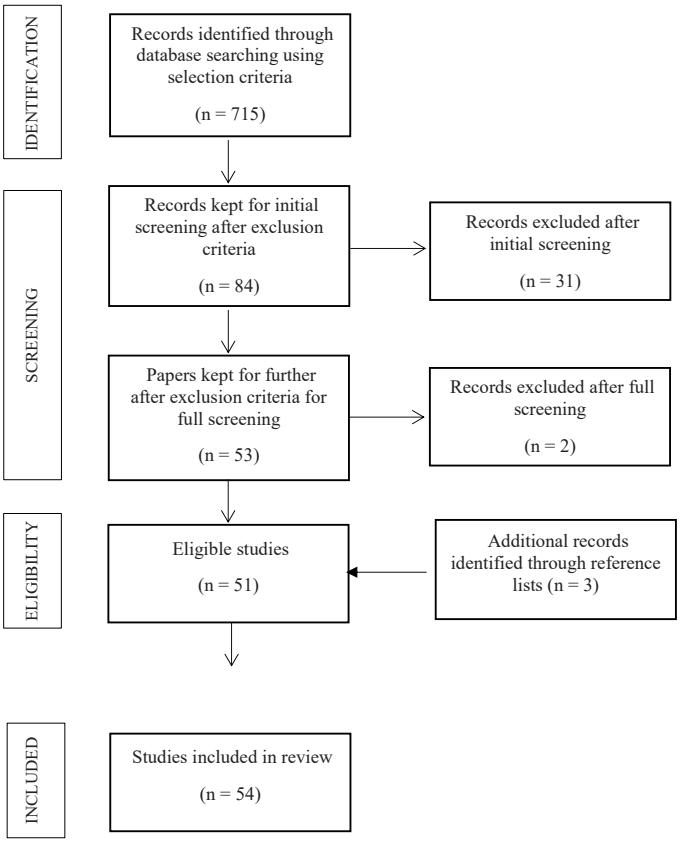

Fig. 1. Selection and exclusion process.

Many hotels, attractions, and destinations offer virtual tours on their websites, although often not genuine VR, because they are frequently panoramic photographs that do not permit free navigation (Guttentag, 2010). However, VR possibilities are being offered in a growing number of cases. Hospitality brands, such as Airbnb, Best Western, Carlson, Hilton, Hyatt Regency, and Marriot, as well as airline companies (*e.g.*, Emirates and Virgin), utilize VR.

Other areas where VR is used are tourist attractions such as theme parks (*e.g.*, Disney) and other entertainment facilities, offering, for instance, simulated motorcycle or car rides. One may also find VR in Zoo exhibits (*e.g.*, Edinburgh Zoo) and aquariums (*e.g.*, Georgia Aquarium).

VR may also be used to enhance learning. For instance, many museums, such as the Louvre Museum, Guggenheim Museum, the British Museum, the Museum of Modern Art, the Rijksmuseum, and the Van Gogh Museum, have adopted VR so anyone can experience their collections anywhere in the world. NASA, too, offers digital space experiences.

Natural sites (*e.g.*, Hawaii Volcanoes National Park) and city destinations (*e.g.*, Central Park, NY), too, are increasingly offering VR experiences. World-famous attractions, like the Great Wall of China and the Great Pyramid of Gize, may also be explored virtually. VR is even being used to recreate sites that no longer exist - such as the destroyed Buddha figure in Afghanistan (Toubekis et al., 2017), or are inaccessible – such as that created by the Arvia'juaq National Historic Site in Nunavut, Canada (Bec et al., 2021). VR also generates opportunities for new business models and jobs, such as VT-based tour guides (Ramachandran et al., 2020).

Beyond its current applications, VR can potentially be a disruptive technology for T&H. Newer technologies must be incorporated into the process to achieve that. Drones, 3D printing, robotics, and other technologies are already employed to record and construct virtual experiences (Kidd, 2015). VR also requires synchronous connectivity and a large transmission capability (for instance, using 5G). Big data, AI, and IoT are indispensable to enabling VR to become a disruptive technology (Abdel-Basset et al., 2021). As this review will reveal, extant research suggests that tourism managers must consider VR's disruptive potential and its potential impact on their businesses, attractions, or destinations.

3. Method

This study used a systematic approach to map and review existing studies concerning VR applications in T&H. A systematic review allows mapping the knowledge base by counting and charting what is known, thus shedding light on what is not yet known (Pickering et al., 2015).

For our systematic review, a protocol was developed regarding the search terms, the database used, and screening criteria. Two groups of search terms were applied in the title, abstract, or keywords of articles to capture research that addresses VR applications in T&H. One group included "augmented reality", "virtual reality", "virtual touris* ", and "mixed reality"; the other group included "touris* ", "hospitality", "hotel* " and "destination marketing". The search terms were informed by previous reviews on the topic (Loureiro et al., 2020), to which we added "mixed reality" in the first group and 'hotel' in the second group. Mixed reality (MR) has been gaining relevance and popularity in the literature, and 'hotel' was added because not all authors use the term hospitality to refer to the hotel sector. No timeframe was applied to the search.

For our review sample, we opted to focus on the quality of the articles rather than the quantity. To assure quality, we: (1) only selected articles, thus assuring peer review; and (2) only used one online library - Web of Science (WoS) - because it is regarded as the most useful and trustful database of publications in scientific journals (Mikki, 2009).

Table 1
Literature profiles and publication years.

Subject area[a]	Subject category	No. of studies per category	< 2001	2001–2005	2006–2010	2011–2015	2016–2020	> 2020
Business, Management, and Accounting	Tourism, Leisure, and Hospitality Management	38	2		1	2	15	18
	Marketing	7				1	3	3
	Management Information Systems	3					2	1
	Management of Technology and Innovation	3						3
Computer Science	Computer Networks and Communications	2					1	1
	Computer Science Applications	1						1
	Total	54	2		1	3	21	27

[a]According to SCIMAGO

Additionally, for quality reasons, we excluded papers not published in journals classified with 3 or 4 in the Academic Journal Guide[1] (AJG), a prestigious rating published by the Chartered Association of Business Schools (ABS). By reducing the search to high-quality journal outlets, we were able to conduct a systematic literature review in a meaningful way. Furthermore, focusing the article search on top-rank journals is a practice in recent literature reviews in business/management (*e.g.*, Ciuchta et al., 2021) and T&H journals (*e.g.*, Khanra et al., 2021).

As of July 2023, our literature search resulted in 715 records screened against the selection criteria. Articles not published in ABS3 or 4 journals were excluded, rendering 84 papers. After a screening based on the abstracts, and full texts when necessary, papers that were editorial pieces, reviews, or did not focus on AR/VR/MR technologies were also excluded. Some studies used terms included in the first group of search words, but the focus was on a broader view of technology or other technological devices. For instance, Jarratt (2021) mentions in the abstract *"virtual portals to connect to nature, the outdoors, and places that they associated with happy memories pre-lockdown*" but are, in fact, referring to webcam travel. As a result, only 53 studies were identified as eligible. Full texts were retrieved and further reviewed for appropriateness for the final analysis. Two studies were discarded at this stage. In one case, the expression 'virtual tourist' was used as an online tourist community, not specifically a VR community. On the other, virtual tours were used for marketing wine.

The reference lists of the articles were then cross-checked to identify papers that might have been overlooked, which led to the inclusion of three additional articles. The screening process yielded a total of 54 records. Fig. 1 outlines the number of studies screened and excluded at different review stages.

A summary table was created in Microsoft Excel software, where the bibliographic details of the 54 studies were tabulated. In the final analysis of the selected papers, information regarding the research topics, the research aims, methodological issues, findings, and explanations were extracted from each study and recorded. A content analysis was conducted on that table, where descriptive information within each category was coded, aggregated, and abstracted into themes. The patterns of themes were explored and quantified, with gaps identified and reported.

4. Findings

4.1. Profiles of the studies

The profiles of the extracted studies are depicted in Tables 1 and 2. As shown in Table 1, the number of research publications on VR in T&H has significantly increased since 2021, revealing that this is an emerging research topic. However, the topic is not yet the concern of mainstream business and management journals since most articles (38 out of 54; 70.4%) were published in Tourism, Leisure, and Hospitality Management journals.

Table 2 reveals that the journals leading this emergent stream of research in T&H are Tourism Management (18 articles), Journal of Travel Research (eight articles), International Journal of Hospitality Management (four articles), and International Journal of Contemporary Hospitality Management (four articles). In the general management area, the Journal of Business Research has six publications on the topic.

4.2. Methodological choices

Of the total 54 papers analyzed, 43 are empirical studies. Concerning the methodologic aspects of these studies (Table 3), it is relevant to highlight that many were conducted in a laboratory setting (22), and 16 had students and/or academic staff as participants. Only in eight of these studies were the participants tourists who had experienced VR while visiting a tourist attraction.

The content of the VR experiences in this set of studies was mainly concerned with cultural/historical attractions (16), lodging facilities (10), nature-related sites and activities (10), or cities as destinations (seven). Most empirical studies (41) used some type of VR experience followed by a questionnaire as their research design.

4.3. Main research themes

Table 4 reveals that many articles (16) were concerned with the determinants of the effectiveness of the VR experience. Another theme that attracts researchers' interest is the expected effects from the tourism managers' perspective (15). These are also the themes where the latest research papers have focused. One paper, by Cranmer et al. (2021), was classified under 'other topics'. It proposes an AR business model that tourism SMEs can implement to exploit AR potential. Therefore, the paper addresses the other topics in many aspects simultaneously. Other papers also address more than one of the five main topics. However, for clarity and conciseness, we opted to classify each under the topic where the paper's main or differentiated contributions are.

The five main themes that emerged from this literature review are related to researchers' attempt to answer basic questions regarding VR in T&H: '*What* and *what for*?' (What is VR, and what are its applications in T&H); '*Why* would *tourist managers* make it available?' (Expected effects); '*Why* would *tourists* adopt it?' (Consumers' motives to adopt); '*Who* would enjoy it the most?' (Individual antecedents of satisfaction and intention to reuse/recommend); and '*How* can the VR experience be enhanced?' (Determinants of the effectiveness of the experience).

Interestingly, the emerging themes are related to the 5 W+H approach, which is helpful for theory development (Whetten, 1989). According to Whetten (1989), 'what' and 'how' questions are useful for describing phenomena. The 'why' explains it, and the 'who', 'where', and 'when' establish limitations and set boundaries.

[1] Available at https://charteredabs.org/academic-journal-guide-2021/

Table 2
Journals publishing on VR in T&H.

Journal	No. of studies	%
Tourism Management	18	33.3
Journal of Travel Research	8	14.8
International Journal of Hospitality Management	4	7.4
International Journal of Contemporary Hospitality Management	4	7.4
Journal of Sustainable Tourism	2	3.7
Annals of Tourism Research	2	3.7
Journal of Business Research	6	11.1
Technological Forecasting and Social Change	3	5.6
Information & Management	2	3.7
ACM Transactions on Multimedia Computing Communications and Applications	1	1.85
European Journal of Marketing	1	1.85
Information Systems Frontiers	1	1.85
Information Technology & People	1	1.85
Journal of Advertising Research	1	1.85
Total	54	100,0%

Those fundamental questions researchers have been answering also highlight the questions that have been less of a concern for researchers. These questions are – '*Where* and *When* is VR used?', which we will return to in the discussion section. For now, we will focus on what one knows regarding the five main themes that emerged in this literature review.

Fig. 2 (from the top to the bottom) suggests that there is sequential reasoning in the way researchers have been answering these questions and highlights the unanswered questions.

4.3.1. *What is VR, and what are its applications in T&H?*

Earlier papers addressed the debate on whether VR would be a logical progression in the incorporation of technology or a threat to T&H (Cheong, 1995) and if VR could ever deliver the potential it promised at the time (Williams and Hobson, 1995). However, at that time, software capabilities hindered the realistic representation of reality, while the hardware devices did not lend themselves to mass consumer adoption (McLean and Barhorst, 2021). As the technology evolved, scholars started to debate what constituted VR (still ongoing; *e.g.*, Bec et al., 2019) as many types of digital experiences became available. Despite arguing for a more restricted definition of VR, where a 3D virtual environment that allows for user-controlled navigation is a requirement, Guttentag (2010) presents a compilation of the main applications of VR in T&H at the time, highlighting six main areas where VR could be of value: planning and management, marketing, entertainment, education, accessibility, and heritage preservation.

Since Guttentag (2010), it is only very recently that one finds research addressing the applications of VR. Bec et al. (2019) reinforce the usefulness of VR for heritage preservation, offering a conceptual model for integrating heritage into VR experiences. Similarly, Bec et al. (2021) study the usefulness of VR in preventing the deterioration of attractions, landmarks, artifacts, and destinations but also highlight how VR may create new tourism opportunities. These scholars introduce the concept of second chance tourism, "an approach that gives a second 'life' to destinations, attractions, sites or artifacts that have been destroyed or severely deteriorated" (Bec et al., 2021, p. 2). Allal-Chérif (2022) also points out how VR may be used to preserve heritage sites while giving the possibility for 'visitors' to access these inaccessible sites from "the comfort of their homes" while keeping the intensity of the *in-situ* experience.

Hofman et al. (2022) reveal other opportunities VR may bring, in their case, concerning nature-related experiences. In their study, Hofman et al. (2022) uncover the potential of VR to be as effective as a real-life experience when influencing conservation behaviors, generating similar reactions to those evoked when the consumer is present in the actual environment. Therefore, any limitations to real nature experiences can be largely overcome with virtual experiences. Those limitations may be related to cost, time availability, travel restrictions, or physical ability (Hofman et al., 2022).

Table 3
Methodological dimensions (of the 43 empirical studies).

		No. studies[a]
Type of participants		
	Attraction's stakeholders	2
	Attraction's visitors	8
	Invited participants from a database (with or without snowballing)	6
	Recruited participants[b] (with or without snowballing)	15
	Students / Faculty / Staff	16
	Tourists	3
	Website Visitors	2
	Other / Secondary data / Not specified	6
Setting for data collection		
	Laboratory	22
	Online	21
	In-situ / Face-to-face	15
	Not specified	1
Tourist setting of AR/VR content		
	City as destination	7
	Country as destination	2
	Cultural/historic attraction	16
	Lodging facilities	10
	Nature-related	10
	Theme Park	3
	Other / Not specified	8
	Not applicable	4
Technology used		
	AR app/device	9
	PC-based 360 tour	18
	PC-based simulation/example of AR or VR	3
	PC-based static images or video	10
	VR app	4
	VR HMD	16
	Website	4
	Other	1
	Not applicable	6
Design		
	Experience → Questionnaire	41
	Questionnaire	6
	Questionnaire →Experience → Questionnaire	5
	Other	7

[a]This is higher than the number of articles, because some articles included more than one empirical study or used more than one approach.
[b]By recruited participants we mean participants that were offered any tangible benefit (*e.g.*, travel voucher) for participating in the study.

Virtual events have gained traction since the COVID-19 crisis. Following the growing use of virtual events, Yung et al. (2022) address the role of VR in that context, offering a typology of events based on three dimensions: location, social presence, and virtuality of the environment.

Table 4
Research topic and years of publication.

	< 2001	2001–2005	2006–2010	2011–2015	2016–2020	> 2020
VR applications in T&H	2		1			5
Expected effects from tourism managers' perspective					9	6
Tourism consumers' motives for adopting VR						5
Individual antecedents of satisfaction and intention to reuse/recommend VR in T&H				2	2	5
Determinants of the VR experience effectiveness				1	9	6
Other topics						1
Total	2	0	1	3	20	28

4.3.2. *Expected effects of VR from the tourism providers' perspective*

The expected effects of VR concern T&H researchers and managers because the investment in VR is only warranted if its positive results overcome those of optimized assets such as websites (McLean and Barhorst, 2021). Articles that address the expected effects of VR in T&H mainly focus on its effects as a marketing tool, namely those related to consumers' perceptions, attitudes, and behavior.

Research on this theme highlights the important role of the perception of authenticity (McLean and Barhorst, 2021; Spielmann and Orth, 2021) and low manipulative intent (Spielmann and Orth, 2021) that VR as marketing communication generates. VR has positive effects on cognition (Fan et al., 2022; Kim et al., 2020; Leung et al., 2020) - namely mental imagery (Bogicevic et al., 2019; McLean and Barhorst, 2021; Skard et al., 2021; Zheng et al., 2021), and influences consumers' appraisal and patronage intention toward accommodations - *via* cognitive engagement (Fan at al, 2022). Affective responses (Kim et al., 2020; Lin et al., 2020), enhanced brand attitude and experience (Bogicevic et al., 2019; Leung et al., 2020), and management of consumer expectations (McLean and Barhorst, 2021; Skard et al., 2021), have also been reported. VR is also expected to impact approach/avoidance behavior positively (Spielmann and Orth, 2021) and boost visit intention (Kim et al., 2020; H. Lee et al., 2020; M. Lee et al., 2020; Lin et al., 2020; McLean and Barhorst, 2021; Skard et al., 2021), impact purchase decisions (Leung et al., 2020; Skard et al., 2021; Zeng et al., 2020), favor the willingness to pay more (He et al., 2018), influence overall satisfaction (Wei et al., 2023), boost individuals' hedonic and eudiamonic wellbeing during the 'drop-down process' post-vacation (Aldossary and McLean, 2022), increase revisit intention (McLean and Barhorst, 2021; Wei et al., 2023) as well as the intention to recommend (Wei et al., 2023).

Despite all these positive effects that extant research has confirmed, Deng et al. (2019) call attention to one unintended effect. VR may decrease interest in visiting the actual destination when the digital experience and the real-world experience are perceived as too similar because the VR experience is enough to satiate some consumers.

4.3.3. *Consumers' motives to adopt VR in T&H*

This theme lacks development, with only five papers addressing why tourism consumers would adopt VR, all related to the pandemic and revealing mixed results on the long-term effects on VR motivation. Itani and Hollebeek (2021) found that, during the pandemic, social distancing boosted demand for advanced VR and its advocacy intentions, also finding that those consumers exhibiting lower threat protection behaviors during the pandemic (and maybe, we add, in other risky contexts) are likely to continue taking in-person tours for as long as possible. They primarily use VR to bridge the riskier period.

Wong et al. (2023) propose a model with four virtual travel needs based on data collected from social media posts from virtual tourists during the COVID-19 pandemic. Those four motives are the need for pleasure, need for mindfulness, need for gathering, and need for growth. These scholars concluded that the online experience also fosters transformative outcomes: hedonic wellbeing, environmental-mastery wellbeing, social wellbeing, and eudaimonic wellbeing.

Itani and Hollebeek (2021) conclude that despite the growing demand for VR, it will not replace *in-situ* visitation in a post-pandemic era. Similarly, Zhang et al. (2022) found that the overall sentiment concerning VT was positive in the context of the pandemic, although diminishing over time as the crisis gradually disappeared.

Interestingly, Zhang et al. (2022) apply the push-pull theory to forming virtual tourists' sentiments. Travel motivation, travel convenience, and travel costs are the push factors. In contrast, VT project design and destination attractiveness are pull factors, and the quality of the experience is a key mediating factor (Zhang et al., 2022). Contrary to Itani and Hollebeek (2021) and Zhang et al. (2022), Talwar et al. (2022b) found that consumers are willing to use VR as a first choice following the pandemic because consumers see VR as a sustainable option and are willing to sacrifice *in-situ* touristic travel for VR to protect the environment. Similarly, Talwar et al. (2022a) identified variables, such as goal difficulty, accomplishment, and willingness to sacrifice, as practical reasons that tourists may make a sustainability-oriented choice, such as an *ex-situ* VR tourism solution.

4.3.4. *Individual antecedents of satisfaction and intention to reuse/recommend VR in T&H*

Literature suggests that user-related variables, such as personal innovativeness (Jung et al., 2015), cultural traits (Jung et al., 2018), age (Bogicevic et al., 2021; Park and Stangl, 2020), gender (Martínez-Molés et al., 2022; Park and Stangl, 2020), sensation-seeking trait (Park and Stangl, 2020) and technology predisposition (Bogicevic et al., 2021; Huang et al., 2013; Yuen et al., 2022), might explain differences regarding satisfaction with VR and intention to reuse and recommend it.

Jung et al. (2015) found that users' satisfaction and intention to recommend AR differed between high- and low-innovativeness groups. Personal innovativeness refers to the willingness of an individual to experiment with new services and products. Jung et al. (2015) conclude that the content quality of AR has stronger effects on the satisfaction of low personal innovativeness users and system quality on the satisfaction of high personal innovativeness individuals. Less innovative users prefer AR applications that provide relevant, clear, easy-to-understand information. On the contrary, highly innovative users require easy-to-use, visually appealing AR applications that allow easy access to relevant information (Jung et al., 2015).

Jung et al. (2018) studied cultural traits (Ireland's *vs.* South Korea's) and their effect on AR acceptance, focusing on the characteristics of applications. These authors concluded that for the high-power distance, collectivist, and high uncertainty avoidance type of culture (such as South Korea's), the relationship between perceived enjoyment and behavioral intention towards AR was stronger, revealing a stronger dependence on social influence. This work opens the need for further studying cultural differences and their impact on VR acceptance and experience.

Park and Stangl (2020) applied the concept of sensation-seeking to segment travelers and better understand their AR experiences. Sensation-seeking reflects a quality of seeking intensity and novelty in a sensory experience. Of the four sensation-seeking elements (experience-seeking, boredom-susceptibility, thrill- and adventure-seeking, and disinhibition), experience-seeking and boredom-susceptibility discriminated between travel groups in the context of AR applications. The scholars identified four clusters of online travelers regarding sensation-seeking (High, Moderate, Ambivalent, and Low). High and

Fig. 2. Sequence of questions researchers have been answering and the still unanswered questions concerning VR in T&H.

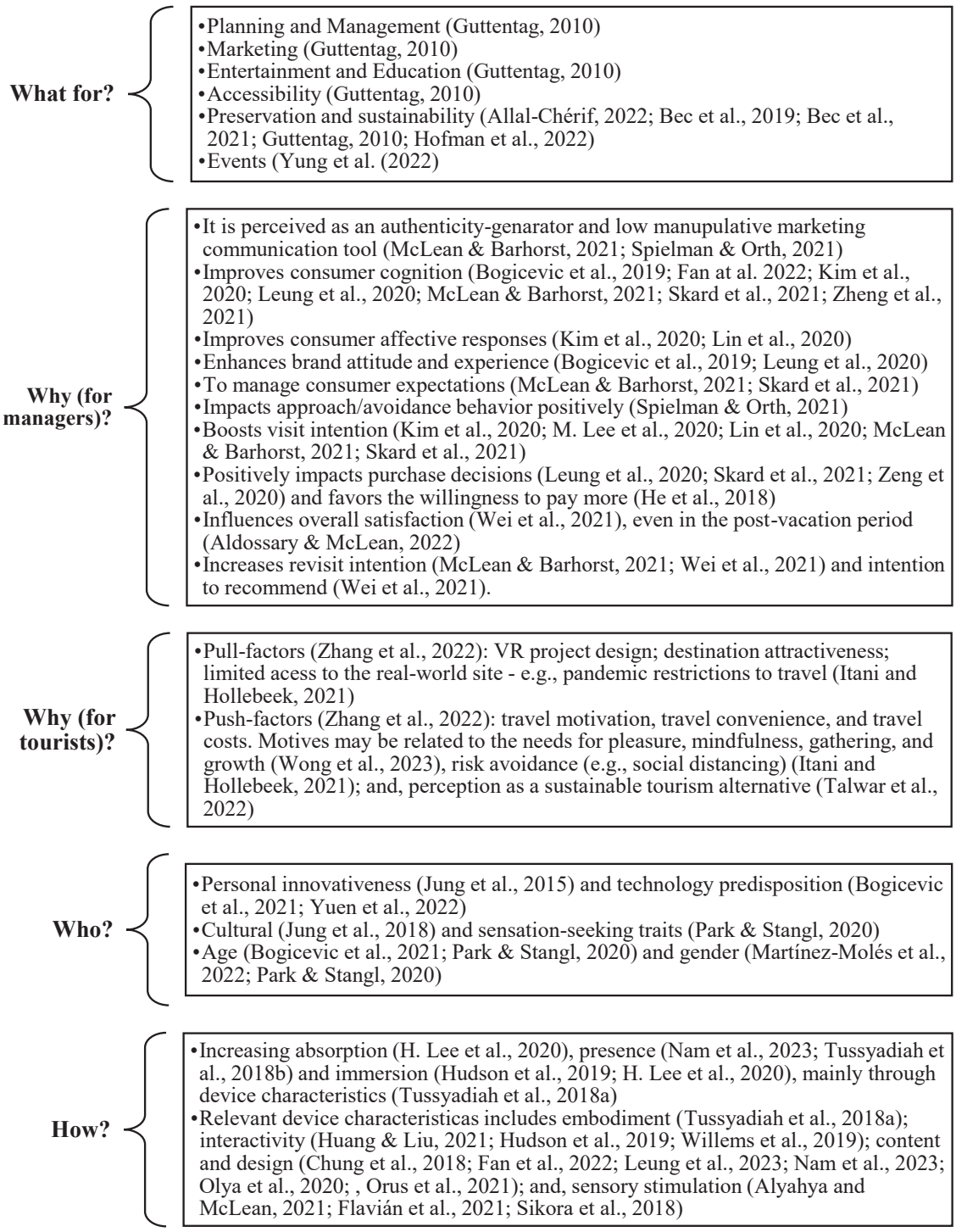

Fig. 3. Syntheses of main results.

ambivalent sensation-seekers reported the highest positive AR experiences, which led the authors to conclude that experience-seeking (similar in both clusters) is the most relevant element.

Gender might be relevant when considering who benefits the most from VR. Contrary to Park and Stangl (2020), who observed that high sensation-seekers who have the most positive experiences with AR are mostly young males, Martínez-Molés et al. (2022) found that VR improves presence, enjoyment, and tourists' learning in a more pronounced way for women. Additional research is needed on the effect of gender on VR experiences.

Huang et al. (2013) examined the applicability of the technology acceptance model. More recently, Yuen et al. (2022) studied how consumers' behavioral intention towards VT in the context of marine ecotourism depended on technology acceptance variables. The authors found that perceived usefulness and perceived ease of use positively impact behavioral intention to use VT. They also found that perceived usefulness mediated the relation between the individuals' motives (in this case, concerning environmental issues) and their behavioral intention.

Table 5
Purposes and intended outcomes of each step in the complete consumer journey – VR + real-world experience.

Phases of the consumer journey in regards to the VR experience		Before	During	After
	After	*Step 3* **Purpose:** Influence attitudes and behavior towards the *in situ* and VR experience **Intended outcome:** consumer decides to purchase a trip to the *in-situ* destination and is willing to reuse and recommend the VR experience	*Step 6* **Purpose:** Foster the creation of positive memories of the full experience **Intended outcome:** Consumer's intention to return *in-situ* and re (use) VR, as well as recommend the full experience	*Step 9* **Purpose:** Sustain the positive memories of the full experience **Intended outcome:** Sustain consumer's intention to return *in-situ* and re (use) VR, as well as recommend the full experience
	During	*Step 2* **Purpose:** Influence attitudes and behavior towards the *in-situ* destination and provide a memorable VR experience **Intended outcome:** Create a positive image of the *in-situ* destination and consumer satisfaction with the VR experience	*Step 5* **Purpose:** Enhance the full experience, virtual and real-world, and manage *in-situ* behavior **Intended outcome:** Higher levels of satisfaction than if the consumer only experienced VR or real-world tourism	*Step 8* **Purpose:** Sustain the positive memories of the *in-situ* experience and provide a memorable VR experience **Intended outcome:** Sustain consumer's intention to return *in-situ* and recommend it, and consumer satisfaction with the VR experience
	Before	*Step 1* **Purpose:** Influence attitudes and behavior towards VR (of targeted segments) **Intended outcome:** Consumers willing to experience VR *ex-situ*	*Step 4* **Purpose:** Influence attitudes and behavior towards the use of VR *in-situ* (when available) **Intended outcome:** Consumers willing to experience VR *in-situ*	*Step 7* **Purpose:** Influence attitudes and behavior towards VR and sustain the positive memories of the real-world experience **Intended outcome:** Consumers willing to experience VR *ex-situ* and sustained consumer's intention to return *in-situ* and to recommend it
		Before	**During**	**After**
		Phases of the consumer journey in regards to the *in-situ* experience		

Similarly, Bogicevic et al. (2021) examined whether consumers' brand and behavioral responses depend on their predisposition toward new technologies, namely technology innovativeness - the trait that captures a consumer's tendency to be a technology pioneer and an early adopter. Results show that technology-innovative consumers respond to VR marketing by forming an enhanced self-brand connection that elevates their visit intention. Technology innovativeness is also related to age, with Bogicevic et al. (2021) suggesting that VR could be particularly effective for Generation Z (born after 1996) as a marketing tool.

Under this theme, most researchers focus on how VR applications can positively influence the tourist consumer experience. The exception is Merkx and Nawijn (2021). They suggest VR might negatively affect some individuals, uncovering the sense of isolation and the addictiveness of virtual reality as hidden themes within VR tourism experiences.

4.3.5. *Determinants of the effectiveness of VR experience*

Generally speaking, our reviewed papers seem to suggest that the effectiveness of VR experiences depends on the interaction between the VR system's characteristics and users' psychological and physiological mechanisms with the fundamental goal of leading the user to a sense of absorption (H. Lee et al., 2020; M. Lee et al., 2020), presence (Nam et al., 2023; Tussyadiah et al., 2018b) and immersion (Hudson et al., 2019; H. Lee et al., 2020; M. Lee et al., 2020). Absorption is when the consumer is provided with an experience from a certain distance; it is considered an antecedent of immersion (H. Lee et al., 2020; M. Lee et al., 2020). Some authors do not distinguish presence from immersion, using the concepts as synonymous (*e.g.*, Flavián et al., 2019; Tussyadiah et al., 2018b). Others argue that immersion is a broader concept than presence. Immersion implies that the user loses self-consciousness and experiences a modified sense of time. Immersion relates to the concept of flow, which is an extreme version of immersion (Hudson et al., 2019).

The relevance of presence, immersion, and flow in VR experiences has been the main focus of several researchers (Hudson et al., 2019; Hyun and O'Keefe, 2012; Spielmann and Mantonakis, 2018; Tussyadiah et al., 2018b; Willems et al., 2019; Ying et al., 2021) in different content contexts, such as destinations, attractions, and hotels. Others have studied how to achieve those states during the VR experience. These studies highlight the role of device characteristics and embodiment (Huang and Liu, 2021; Orús et al., 2021; Tussyadiah et al., 2018a), VR content and content design (Chung et al., 2018; Hyun and O'Keefe, 2012; H. Lee et al., 2020; M. Lee et al., 2020; Olya et al., 2020; Orús et al., 2021), and sensory stimulation (Alyahya and McLean, 2021; Flavián et al., 2021).

According to Hyun and O'Keefe (2012), presence acts as a mediator in a VE and is positively influenced by the information provided. Presence directly affects conation - the intention to act based upon a destination image. The sense of presence has also been proven to create more memorable brand experiences (Spielmann and Mantonakis, 2018) since it acts as a mediator between user-driven interactivity and attitudes toward the advertisement of a destination. Tussyadiah et al. (2018b) found that presence increases the enjoyment of the VR experience and elicits a stronger liking and preference for a destination, be it faraway tourism destinations (international tourism) or local attractions (domestic tourism). This positive attitude change leads to a higher visitation intention (Tussyadiah et al., 2018b). Ying et al. (2021) elucidate how telepresence and social presence interplay to influence users' cognition, affection, and (re)visit intentions. Social presence refers to the degree to which others (living or synthetic beings) exist in the VE. Their study showed that VR commercials with higher telepresence elicited stronger (re)visit intention. However, this effect is stronger in contexts with lower levels of social presence, leading Ying et al. (2021) to suggest that human elements disrupt users' attention and immersion in the tourism destination context. This conclusion is similar to Hudson et al.'s (2019) - although in their case, the authors found a positive effect of social interaction with satisfaction and loyalty. The negative effect of social interaction on immersion contrasts with results from studies in multi-player gaming environments, where the presence of others enhances users' experiences. Contrarily, Nam et al. (2023) found that presence only indirectly affects satisfaction with VR at heritage sites; presence is related to satisfaction only through activity-related authenticity, and it is not associated with satisfaction at all at non-heritage sites.

In the case of T&H contexts, as long as VR experiences do not involve achieving group or social goals (Hudson et al., 2019), social presence might be less relevant, but more research is needed to explore the topic.

Concerning device characteristics, Tussyadiah et al. (2018a) study the importance of wearable technology in T&H. The authors start by elucidating the symbiosis of humans and technology in embodiment

Table 6
Future research lines on VR in T&H.

Areas of research	Research questions	Description of the areas of research	Research contexts and methodology
VR and the nine-step tourism consumer journey	What and what for? Where? When?	The role of VR in each step of the consumer journey, both *ex-situ* and *in-situ*	Differences across industries, tourism products, travel motives, and other relevant research contexts Research designs in settings closer to real experiences and, when appropriate, with large-scale experiments and/or neuromarketing measurement processes Longitudinal studies
Consumer acceptance and intention to use VR	Why (consumer)? Where? When?	How to stimulate consumers to use VR, *ex-situ* and *in-situ* VR usefulness and easiness User segmentation variables	
The VR experience, from the user's perspective	Why (consumer)? Who? How?	Factors leading to positive experiences, such as enjoyment, emotions, senses, cognitive processes Factors leading to negative experiences, such as physical sickness or a sense of isolation Physical and sensory stimulations	
VR and *in-situ* behavior	What and what for? Why (tourism manager)? How? When? Where?	VR as a tool to manage tourists' behavior while visiting a real-world location: - Space use (*e.g.*, diverting visitors from more crowded areas) - Time use (*e.g.*, diverting visitors from more soughed-after hours) - Preservation goals (VR as a substitute for real-world sites that need to be preserved) VR as a tool to enhance the *in-situ* experience. For instance, providing experiences without physical limitations or expanding learning opportunities.	
VR after the *in-situ* visit	What and what for? When? Where?	VR as a tool to reactive memories and sustain the intention to revisit VR as a brand management tool	
VR *ex-situ* as a stand-alone tourist product	What and what for?	Comparison of VR with real-world experiences New business models and jobs Trade-offs between VR as a product and real-world visiting Potential for market segments that have travel restrictions	
VR investment decisions	What? Why (tourism manager)?	Technological options and their effectiveness Cost-benefit analysis	

relations. Embodiment is formed by three factors representing the feeling of ownership (*i.e.*, technology as part of human bodies), location (*i.e.*, co-presence of humans and technology), and agency (*i.e.*, ability to control the relationship). Tussyadiah et al. (2018a) support that technology worn on the body tends to disappear while the user perceives it as part of their body. These scholars also argue for the existence of technology withdrawal in mediated experiences (*i.e.*, the wearable device disappears, as if users looked directly at their surrounding environment instead of filtered through a screen). Huang and Liu (2021) conclude that advanced devices, namely in terms of interaction ability, are relevant for higher humanization of the experience. Humanization implies anthropomorphism, self-representation, and intimacy. Three features of a 360º AR panorama were studied—active monitoring of online tourists' dynamic behavior, somatosensory manipulation, and environmental embedding - and revealed to be superior to less interactive technology (Huang and Liu, 2021). Similarly, Hudson et al. (2019) and Willems et al. (2019) show that interaction with objects in the VE is essential in increasing presence and immersion.

Chung et al. (2018) validated the post-acceptance model of information systems continuance to VR in T&H. Huang et al. (2013) concluded that the perceived usefulness of VR technology had a direct and positive relationship with behavioral intentions. However, no significant effect was found from perceived ease of use. Chung et al. (2018) conclude that expectation confirmation is positively linked to beliefs (perceived advantage, aesthetic experience, and enjoyment) regarding VR technology. According to the post-acceptance model of information systems continuance, consumers are likely to update their expectations after using a system, which strongly predicts the continuance of the use.

Concerning VR content, Chung et al. (2018) highlighted the role of content design, concluding that an aesthetic experience is a significant predictor of both utilitarian and hedonic attributes of an AR application and of experienced satisfaction with AR. An aesthetic experience depends on the design features of the AR content, namely, the beauty that can be expressed through color, photographs, font style, and layout. Olya et al. (2020) arrived at similar conclusions, finding the role of aesthetics in the high satisfaction and engagement of AR users. Fan et al. (2022) concluded that users find pictures more aesthetic than VR in the context of lodging facilities, which calls for providers to improve VR's aesthetic features. Leung et al. (2023) studied perceived aesthetics, education, escapism, and entertainment VR experiences. They found that VR entertainment experience was the strongest predictor of perceived positive mood enhancement and negative mood reduction. Additionally, positive mood enhancement and negative mood reduction predict visit intention and VR stickiness (*i.e.*, repeated use of tourism-related VR activities).

Nam et al. (2023) highlight the role of the perception of authenticity (*i.e.*, genuineness, accuracy, and realness) as an essential variable affecting both users' perceptions of presence as well as users' satisfaction with VR. Similarly, Orus et al. (2021) study how different types of contents and embodied devices influence the perception of presence. The authors show that content with high factual realism positively influences presence. Presence then positively influences ease of imagination and visual appeal; these variables mediate the impact of content on booking intentions. These results are stronger when an HMD is used.

Sensory stimulation is another relevant element in generating presence and immersion. Sensory stimulation is dependent on device characteristics and VR content. As Flavián et al. (2021) put it, VR is a sensory-enabling technology that facilitates a multisensory digital experience. Their study focuses on how adding pleasant and congruent ambient scents to VR affects the user's experience. They confirmed that embodied VR devices and scents enhance sensory stimulation, influencing affective and behavioral reactions.

Similarly, Alyahya and McLean (2021) and Sikora et al. (2018) confirm the role of different levels of sensory information in VR

experiences. A greater combination of sensory cues (including visual and tactile), appealing to consumers' multiple senses, stimulates consumers' thinking. It enables them to imagine a rich experience, transporting them into the VE while blocking out other competing stimuli from the physical world (Alyahya and McLean, 2021). Sikora et al. (2018) found how an AR soundscape enhances the user experience, namely achieving higher levels of arousal, making the experience more exciting.

Building on Fig. 2, Fig. 3 provides a model of how the questions and answers provided by extant research articulate with each other.

5. Discussion and future research directions

As presented in the previous section, we inductively organized the 54 papers around five main themes that emerged from the content analysis and that, as we propose, answer fundamental questions regarding VR in T&H, but not the '*Where* and *When* is VR used?' questions.

To answer the question '*When*' consumers use VR in the context of T&H, researchers should consider the different moments in the consumer's journey. Most studies focus on the moment before the visit to the real-world location when VR is intended to promote an attraction, a hotel, or a destination. However, VR may be used before, during, or after a site visitation. Additionally, the attitudes and behaviors expected from consumers may differ in the before (*e.g.*, intention to use VR), during (*e.g.*, satisfaction), and after (*e.g.*, intention to recommend) moments of the VR experience. Moreover, there is a need to distinguish the experience that happens *ex-situ* (for instance, at home) from the one that may happen *in-situ* in a mixed-reality setting at the location. Therefore, the question '*when* do consumers use VR' is intertwined with the question '*where*'.

Scholars often treat these different moments and situations interchangeably, which may lead to mixed results. Additionally, tourism managers should aim to provide the best possible experiences to tourism consumers at each point of their journey. Therefore, we find it helpful that future research states which step of the complete consumer's journey and which of the use contexts – *ex-situ* or *in-situ*, is the focus of their studies.

We propose nine steps for a complete consumer journey. Customer journey refers to "the processual and experiential aspects of service processes as seen from the customer's viewpoint." (Følstad and Kvale, 2018, p. 197). They can be seen as touchpoints forming customer journeys' building blocks (Meroni and Sangiorgi, 2011). Our proposed framework was derived from previous customer journey models (*e.g.*, Lemon and Verhoef, 2016; that propose a consumer journey in three phases: pre-purchase, purchase, and post-purchase phases) to include the virtual tourism journey. Some of the articles in this review also point to a similar idea of different touchpoints over time. For instance, Nam et al., (2023, p.1219) state that "VR can provide virtual experiences before, during, or in lieu of real-world visits to tourism sites." Kim et al. (2020), Leung et al. (2023), Martínez-Molés et al. (2022), and Tussyadiah et al. (2018b), argue that it may be a way for potential tourists to experience attractions, museums, and festival events before making a visit decision, and shape favorable preferences toward the attraction before visit decisions. Talwar et al. (2020a) state the VR experience may also happen *ex-situ*, Aldossary and McLean (2022) show the role of VR after a real-world experience, and Orús et al. (2021) propose that future research is needed to understand these technologies in all the stages of the consumer journey (before, during and after the experience).

Departing from the idea that tourism experiences may occur *ex-situ* or in the real world (*in situ*) and that for each case, there are before, during, and after the experience phases, we arrive at a 3 × 3 matrix and propose a nine-step consumer journey. Table 5 reveals the nine steps and their focus from the perspective of tourism managers interested in VT. Three of the steps occur *in situ*, and six *ex-situ*, organized in a matrix that crosses three phases of the consumer's VT journey (before, during, and after a VT experience) and three moments of the real-world consumer's journey (before, during, and after the *in-situ* experience), thus pointing the way to answering the '*when*' and '*where*' questions.

Step 1 and *step 2* happen in the pre-purchase phase (or pre-decision to visit the real-life tourist location in our case), *step 3* coincides with the purchase phase, and *steps 4* through *9* with the post-purchase phase. According to Lemon and Verhoef (2016), the post-purchase stage, similar to the pre-purchase stage, could theoretically extend temporally to the end of the customer's life.

Step 1 refers to the moment prior to the VR experience and the *in-situ* experience, where tourism managers may develop actions that should lead the consumer to experience VT, namely *ex-situ*. This step is especially relevant for consumers with a low VR experience and technology innovativeness. Other individual characteristics, such as age, gender, or income, may also be antecedents of the motivation to use VR. These are not variables tourism managers may influence; therefore, in *step 1*, segmentation is relevant. *Step 2* happens while the consumer uses VR and has not yet visited the *in-situ* location. Here, the main goal of VR is to influence attitudes and behaviors toward the real-world destination. VR can aid in managing consumers' expectations by enabling them to familiarize themselves with the location before visiting in the comfort of their own homes (McLean and Barhorst, 2021). *Step 3* happens after the VR experience and before the consumer visits the real-world location. This step focuses on how VR affects decision-making on travel mode and experience.

Step 4 happens *in situ,* where there might be an opportunity for the consumer to experience AR, for instance. In this step, tourism managers may develop actions to lead the consumer to experience VR *in situ* and benefit from a full (VR + real-world; MR) experience in *step* 5. In *step 4*, too, segmentation is relevant. For instance, not all virtual attractions are of interest to all ages. *Step 5* happens when the consumer experiences VR *in situ*. In this step, the main goal is to provide a full, mixed-reality experience. However, this step is also helpful for managing *in-situ* behavior. Mixed reality, where virtual and real worlds coexist (Bec et al., 2021), may help manage tourist load, avoiding booking mix-ups and protecting the ecological balance at environmentally sensitive destinations. *Step 6* happens still *in situ* but after a VR experience. Actions must be taken in this step to foster the creation of positive memories of both the virtual and the real-world experience.

Step 7 happens when a consumer has already visited the real-world location but has not experienced VR. In this step, tourism managers may develop actions to influence the use of VR in the future, *ex-situ*, and sustain the positive memories of the real-world experience so that the consumer is willing to return to the location. Although Skard et al. (2021) have shown that a consumer with previous experience with the destination will be less influenced by VR exposure in terms of intention to revisit, VR may add value and content to those consumers' existing knowledge, established memories, and mental images. Additional research is needed to understand VR's benefits at this step fully. *Step 8* refers to when the consumer experiences VR *ex-situ* but has already visited the real-world location. At this step, the goals are to reactivate the memories of the *in-situ* experience to sustain the intention to return and provide a memorable VR experience. Aldossary and McLean (2022) have shown how VR may boost individuals' wellbeing during the 'drop-down process' post-vacation. Finally, *step 9* is after the visit to the real-world location and after an *in-situ* or *ex-situ* VR experience (*step 8*). At this moment, tourism managers may want to continue to sustain the intention to return to the real-world location and lead consumers to recommend the full experience. We concur with McLean and Barhorst (2021) in that VR plays a critical role in the post-purchase phase of the consumer journey, which in our model would refer to *steps 4* through *9*, in influencing both satisfaction with the *in-situ* experience and further revisiting intention.

Although we sequentially number the steps for practical reasons, that does not mean every customer goes through every step. When adding technology to the consumer's experience, the customer journey does not always follow a linear and sequential pattern (Wolny and Charoensuksai, 2014). That is why we opted for a 3 × 3 table to better represent a non-linear consumer journey, where consumers do not have to follow all

nine steps. For example, a customer who has never used VR technologies *ex-situ* may still be drawn (*step 4*) to use it *in situ* (*step 5*) and then move to step 8. Another customer may have never experienced VR before or during the visit *in situ* but may be attracted to use it afterward (*step 7*).

Table 6 presents the main lines of research that we propose, highlighting how these new lines of research connect to the questions researchers have been focusing on so far, which we presented in Figs. 2 and 3, and the way to move the knowledge on this topic forward.

As we explained above, our main line for future research is linked to the **nine-step consumer journey** we propose since more research is needed on the role of VR in each step of the consumer journey, both *ex-situ* and *in-situ.* However, in Table 6, we also suggest other more focused areas for research, which we explain below.

Based on what we have discussed, research focusing on *steps 1, 4,* and *7* would mainly intend to explain the variables and processes affecting **consumers' acceptance and intention to use VR**. These are relevant steps for now since VR is still relatively unfamiliar to most tourists (Zhang et al., 2022). For instance, some authors have suggested the benefits of incorporating VR in the sales process for travel agencies, destination marketing organizations, and other business firms (Flavián et al., 2019, 2021; Martínez-Molés et al., 2022). In these steps, it is useful to consider the factors, such as how useful or easy to use the VRs are, which will affect the consumer's attitudes toward and intention of using VR in tourism. This idea implies that people from diverse backgrounds and using different devices should be able to use it, as would people with various levels of computer literacy. *Step 7* is also intended to sustain the positive memories of the real-world experience. It may happen that with time and the widespread use of VR, *steps 1* and *4* will decrease in importance. User characteristics have received less attention, including previous technology experience, age, and education level (Martínez-Molés et al., 2022) despite the need to adapt VR experience to the consumers' profile, experiences, and preferences, and not following a one-size-fits-all as argued by Skard et al. (2021). Future research should also consider the effects of personality factors. In the future, it will be even more common for virtual experiences to include virtual robots and avatars interacting with tourists in real-time (Wei et al., 2019), which requires more research on its cost-benefit characteristics.

Research focusing on *steps 2*, *5*, and *8* is relevant because when having a **VR experience, users** can obtain a sense of enjoyment and subjective wellbeing (Tussyadiah et al., 2018b). However, they can also experience physical fatigue, doubts about their authenticity, or even a sense of isolation, which may lead to addiction (Merkx and Nawijn, 2021). Issues such as social presence and VR technology design (Tussyadiah et al., 2018b) and innovation (Zhang et al., 2022) are relevant issues in these steps, as is media content (H. Lee et al., 2020; M. Lee et al., 2020; Olya et al., 2020; Orús et al., 2021). As VR technology continues to evolve, VR systems will improve in their ability to stimulate each of the five senses, leading to the need for more research. Future studies should also further analyze the role of enjoyment, analyzing the consequences of presence to study the emotional aspects of the mediated experience, as suggested by Martínez-Molés et al. (2022).

Research focusing on *steps 4*, *5*, and *6* may not only enhance the tourists' experience but also, from the perspective of tourism managers, may highlight how VR may be used to manage ***in-situ* tourists' behavior** for preservation, operational, or other relevant reasons.

More research focusing on *steps 3, 6,* and *9* is also needed. VT is not limited by real-world physics; tourism managers should make the most of the digital format. Therefore, more research is needed on how VR may provide more information, different types of experiences, and other features that are not possible (or cost-effective) in the real world. Although without prejudice to the intention to visit the real-world site and without creating an expectation that the real world will not meet. Especially more research is needed on the **use of VR after the *in-situ* visit**. As Zhang et al., (2022, p.9) state, "it is difficult to maintain sufficient and sustained attention," suggesting exploring ways to maintain VT tourists' interest in repeating and sharing the VR experience. Therefore, it should be considered how virtual tourism can assist brand management.

On the one hand, as technology evolves, stimulating the visitors to *ex-situ* visits may potentially reduce or eliminate visitation to the original sites. That stimulation may have positive (reducing over-tourism; providing more accessibility) but also negative (reducing conventional direct and indirect revenue from real-world visitation) consequences. On the other hand, *ex-situ* VR may generate new revenue models (Bec et al., 2021). Therefore, research on the possible trade-offs related to VR in T&H is required. On the other hand, *ex-situ* **VR may become a stand-alone tourist product** in itself, namely for some potential consumers with travel restrictions, extending the meanings and value of the *in-situ* products (Zhang et al., 2022). In that case, these steps would remain relevant in the future, although with some modifications. More studies are needed to compare VR experiences with the equivalent real-world experience since not many studies have been done so far (Hofman et al., 2022).

Since there are many technological options regarding VR, from less to more immersive, and the characteristics of the VR systems, as discussed, highly influence its effectiveness, more research is also needed to support managers in their **VR investment decisions**.

Despite the growing interest in VR among academics and practitioners, limited empirical work.

exists to date (notice that our search criteria only led to 43 empirical studies relevant to tourism management), and, therefore, more empirical work is needed. However, to capture all the nuance of the research possibilities we laid above, **methodologic choices** are a concern. Most studies are made in laboratory settings and with a student population. Research in settings closer to real tourists' experiences is needed. Additionally, researchers have relied mostly on self-reported questionnaires, whereas future research could use objective measurements, for instance, from neuromarketing, to confirm the results. Finally, **contexts matter**, and more research is needed to study the specificities of each type of tourism offering since VR effects may differ across each type of tourist product.

6. Conclusion

This paper presents a systematic review of 54 papers published in high-quality journals. Our review aims to characterize the state of the art regarding knowledge useful for T&H management research and managerial decision, highlighting research gaps and suggesting lines of future research.

6.1. Theoretical implications

Our paper contributes to theory in at least four ways. First, it synthesizes the state-of-the-art literature on VR in the context of T&H. This synthesis includes the profiles of the main articles and the journals where they were published. From the seminal papers in 1995 to the research published as of July 2023, substantial publication growth has been registered from 2021 onwards.

Second, we reveal the researchers' main methodological choices in the empirical studies. Characterizing the methodological choices is useful for future research, especially because we highlight the main issues with the most common research designs, done mostly in laboratory contexts, with students, and based on self-reported questionnaires.

Third, we inductively determined the five main themes that are the focus of extant research. These themes are applications of VR in T&H, expected effects of VR for T&H, motives for consumers to adopt VR, satisfaction and intention to reuse/recommend VR, and determinants of the effectiveness of the VR experience. Based on the results, we relate the themes with fundamental questions regarding VR in T&H, providing a model of how the main questions answered by researchers are articulated with each other, and highlight the questions where extant research is less focused on – '*Where* and *When* is VR used?'.

Fourth, we develop a nine-step consumer journey anticipating the growing incorporation of VR in consumers' experience in T&H to establish a framework for future developments that highlights the relevance of studying the '*where*' and '*when*', in addition to all the other basic questions. By proposing this framework, we offer a broader perspective of VR in T&H, motivating researchers for additional research. Extant research has mainly focused on VR tourism as a tool to attract tourists to destinations (Talwar et al., 2022b), which roughly coincides with *step 2* of our proposed nine-step framework of the consumer's journey, leaving many steps of that journey where more research is needed.

6.2. Practical implications

Although more research is needed in many aspects outlined above, this review brings significant contributions to practitioners interested in applications of VR in T&H based on the research and technology available so far. Our review suggests that VR is a more effective tourism marketing tool than current optimized assets such as websites. It could become an integral part of marketing communications processes with the intention that consumers will use the technology during travel planning decision-making to help them imagine experiences they would have at a real-life location. VR is also a powerful tool to enhance the *in-situ* experience. Managers may study how to enhance their offering by providing experiences without physical limitations (*e.g.*, flying over a volcano) or expanding learning opportunities (*e.g.*, showing how the location looked like 2000 years before).

Additionally, there is an underexplored potential for VR technologies in T&H. For instance, even beyond COVID-19, VR systems are helpful during any temporary closure due to renovation, weather, or other circumstances. Managers concerned with sustainability issues should see VR as an environment-protecting tool. More importantly, there is huge potential for VR as a stand-alone product. This development would eventually generate additional revenue streams to attend to the needs of a large chunk of the potential consumers that, due to some limitations, may not travel and could see VR as a viable alternative.

Tourism managers should consider the advantages of more immersive VR technology when deciding which VR tools to invest in, which yields more favorable outcomes regarding user evaluations and advocacy. To ensure the investment meets the needs of a larger number of consumers, tourism managers should consider using platforms that enable viewing through either a desktop computer in the form of a 360° VR tour or *via* a VR HMD. Additionally, the vividness and authenticity of VR content are also something that tourism managers should ensure.

The nine-step consumer journey framework we developed offers practitioners a complete comprehension of where they may intervene in the consumer journey regarding the incorporation of VR in consumers' experience in T&H. It proposes the intention of each step and what outcomes they should work for.

6.3. Limitations

Any systematic review has limitations because of its retrospective, observational, and selective nature (Petticrew and Roberts, 2006). We used only one database, which can be seen as a limitation. However, WoS gathers the most relevant articles in the area. Additionally, to enhance the precision of our search, we restricted it to title, abstract, and keywords because the terms 'tourism' and 'hotel' are sometimes mentioned as examples, not being the focus of that research. As a result, studies that have addressed VR in T&H may have been overlooked. Finally, while the systematic nature of the method has been explained, the interpretation of the data is inevitably subjective. Nevertheless, the clear reporting practice makes future follow-up studies possible. Despite these few limitations, this is the first study to systematically review VR literature in T&H with a management stance, to the best of our knowledge.

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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.

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