



The use of 360-degree virtual tours to promote mountain walking tourism: stimulus–organism–response model

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Abstract

Based on the stimulus–organism–response (S–O–R) theory, this study attempts to investigate how the use of 360-degree virtual mountain walking tours can motivate audiences' intention to take a real walking in the mountains. The survey results from 320 samples after watching a 360-degree virtual video reveal the positive influence of vividness (stimulus) on presence, emotional involvement, flow state, and enjoyment (organism), leading to the intention to take mountain walking tourism (response). This study also examines the interrelationship between four organism variables to explain the underlying mechanism of 360-degree virtual travel experience in stimulating audiences' visit intention. It shows how technology helps the development of nature-based tourism. It also offers implications for developers to develop influential 360-degree virtual tourism and destination marketers to promote mountain walking tourism.

Keywords Mountain walking tourism · Vividness · Presence · Emotional involvement · Flow state · Enjoyment · Stimulus–organism–response (S–O–R) theory

1 Introduction

Since the outbreak of COVID-19, outdoor walking, such as walking in the mountains, has become a big attraction for people to keep away from the crowds and enjoy nature (Clark 2020). Walking is an outdoor recreation activity in diverse tourism settings (Nordh et al. 2017). With slowness, walking enables more conscious

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engagement with the local environment, culture, and people (Kato and Prozano 2017). For tourists, walking tourism meets the need of most tourists regardless of age, gender, and so on for physical and health activities as well as to provide emotional benefits (Zurawik 2020), such as relaxation, stress reduction, control, excitement, and freedom (Anable and Gatersleben 2005). For tourist destinations, walking tourism is a kind of sustainable tourism with relatively low investment. Regarding the benefits of walking tourism to both tourists and destinations, UNWTO has made great efforts to promote its development (UNWTO 2019). Subsequently, some researchers started to take research on walking tourism. For example, Vural Arslan et al. (2018) studied the factors impacting the walkability of the shopping street in the historic city centre of Bursa, Turkey. They identified that accessibility, comfort and use, traffic safety, crime security, and connectivity are the most influential factors of walking tourism in urban cities. The low-altitude mountain is suitable for developing walking tourism. Compared with walking in an urban environment, walking in natural environments offers more physical and mental benefits (Zurawik 2020). Mountainous scenery creates a pleasant walking environment for walkers, where they can closely watch the trees, flowers, birds, and insects. Mountain walking tourism in this study is defined as walking in the low-altitudes mountainous areas, which is a simple, low-cost, informal leisure outdoor activity for all ages. The COVID-19 pandemic has created high tourist demand for health and relaxation (Li et al. 2021). Mountain destinations provide good quality air (Arcaro et al. 2018), which is increasingly rare in the urbanised world. Mountains are also, at least temporarily, places to escape from uncomfortable climates (McCool 2002). Mountain walking is an ideal recreational outdoor activity for people during COVID-19 because it benefits walkers physically and mentally. It thus has excellent potential for development during this time. On the other hand, because 24% of the land surface is mountains, thus, there is a need to have a way to promote it (Río-Rama et al. 2019).

For promoting tourism, destination marketers have started to apply virtual reality (VR) as a marketing tool to show the environment of the destinations (Lo and Cheng 2020; Willems et al. 2019). VR provides users with visualising experience to explore the virtual world by responding to the visual, motion, and audio prompts. A 360-degree virtual video is a spherical video that makes people feel like participating in activities at the destination (Griffin et al. 2017). Therefore, researchers claimed that 360-degree virtual videos could be used to strengthen people's awareness of a destination (Yung and Khoo-Lattimore 2017) and consequently motivate a real visitation (Jung et al. 2017). Furthermore, a 360-degree video is particularly useful for large-scale scenes and distant objects (Slater and Sanchez-Vives 2016). Therefore, it is possible that the experiences mediated by a 360-degree virtual mountain walking tour may enhance audiences' intention to conduct walking in a mountain area in the real world. However, the question of how the use of 360-degree virtual tours can motivate audiences' travel intentions is still under investigation.

VR is thought to convey a sense of presence in terms of vividness (i.e. the representational richness of a mediated environment) and interactivity (i.e. the extent to which users can participate in modifying the form and content of a mediated environment in real-time (Steuer 1992; Yeh et al. 2017). However, there are two types of VR. Since a 360-degree virtual tour provides limited interactivity, only vividness

is considered for influencing a sense of presence in this study. Sightseeing in a virtual tour leads to a sense of presence which refers to a sense of 'being there' in the virtual environment (Steuer 1992). Emotional involvement is a type of experience that influences users' feelings of reality (Holsapple and Wu 2007). Some researchers stated that a flow state is also a type of experience that predicts users' behaviours in a virtual tour (Willems et al. 2019). Furthermore, Huang et al. (2016) pointed out that enjoyment is a type of experience that drives people to visit the destination depicted in a 3D tourism environment. Although several studies have been taken to study how VR motivates potential audiences to visit a destination, no studies have considered how the presence of 360-degree virtual tours could affect audiences' intention to take a real visit through emotional involvement, flow state, and enjoyment.

The stimulus–organism–response (S–O–R) theory is a useful framework for understanding the relationships between environmental input (stimulus), emotional status (organism), and post-consumption behaviour (response) (Surovaya et al. 2020). It has been widely used to study the connections among inputs, processes, and outputs in various settings (Wu et al. 2020) and in the context of VR tourism marketing (e.g. Kim et al. 2020). Recently, Kim et al. (2020) extended the S–O–R model to test a theoretical framework that investigates users' emotional and behavioural responses toward VR tourism. Their research demonstrated the relationship among authentic experience (stimulus), cognitive and affective responses (including enjoyment, emotional involvement, and flow state) (organism), and attachment and visit intention (response). However, they did not consider the significant role of presence, a powerful stimulus in affecting VR experience and shaping audiences' behaviour. In addition, they ignored the possible links among emotional involvement, flow state, and enjoyment. They also did not test the direct effect of these three response factors on audiences' behaviour.

To fill the research gap, this study aims to investigate, after audiences undergo a 360-degree virtual mountain walking tour, how the vividness of a 360-degree virtual tour influences the audiences' sense of presence; how the sense of presence influences emotional involvement, flow state, and enjoyment; and then how these four responses influence audiences' intention to take a real walking in the mountains. This study is embedded within the S–O–R framework that vividness is a stimulus; presence, emotional involvement, flow state, and enjoyment are organisms; and audiences' intention to take mountain walking tourism is a response. This study contributes to VR tourism marketing research in clarifying the underlying mechanism of 360-degree virtual tour experiences in shaping audiences' psychological, emotional, and behavioural responses. Furthermore, this study explores people's emotional and psychological states in (virtual) mountain walking. It also shows how innovative technology helps the development of nature-based tourism. The results also provide insights for destination marketers to invest in edge-cutting technology to promote nature-based tourism and for virtual tour developers to improve their design in more influencing content.

2 Literature review

2.1 Mountain walking tourism

Walking is not just a physical movement but also is a form of exercise, a social activity, and a family memory (Karupiah and Bada 2018). It is a passive, pleasurable, and therefore a popular form of outdoor recreation (Kay and Moxham 1996). Given the growing interest in walking tourism, there is significant literature on urban walking tourism (Ram and Hall 2018) and natural walking tourism (Davies 2018) in Western countries.

Besides, the studies in urban walking tourism, researchers also studied mountain walking in terms of climbing, hiking, and Nordic walking in Western countries (Kling et al. 2020). Researchers usually discussed the benefits of taking mountain walking such as well-being (e.g. Zurawik 2020), sustainability issues such as senses of responsibility (e.g. Rickly and Vidon 2017) and sustainability perceptions (Bonadonna et al. 2019), and soft adventure motivation (e.g. Bichler and Peters 2021). Comparatively, the studies focused on marketing and promotion of mountain walking tourism were few, especially in Asian countries.

Mountain walking tourism is related to wellness tourism (Seraphin and Dosquet 2020). Low-altitude mountains are ideal for walking. Mountain walking tourism is suitable and accessible by almost all the sections of the tourism market. Mountain walking tourism is recognised as relaxing, leisure and sociable, low cost, capable of spontaneous participation individually or by groups of mixed-ability (e.g. kids and elder people). Therefore, it is meaningful research to investigate how to promote walking in the mountains.

2.2 360-Degree virtual tour

A virtual tour represents a real scenic spot and destination virtually; it aims to serve as a prelude to visiting or the extension of consumers' previous experience (Kim and Hall 2019). It allows potential visitors to experience and feel a destination presented in the virtual environment (Huang et al. 2016). A 360-degree virtual video is a type of virtual tour. It is filmed in a real place that allows users to turn around at any angle and navigate the video by choosing any direction they wish to view. The visual images are supplemented with real audio so that audiences can receive rich sensory information to understand better the spatial, factual, and experiential aspects of a destination (Disztinger et al. 2017). By using a VR headset, users can experience the mediated environment. Such experience arouses audiences' interest and impacts their behavioural intention (Flavián et al. 2020).

Currently, some researchers studied virtual tours as an effective destination promotion tool because it provides tourists with a pre-purchase 'trial' experience (Kim et al. 2020). On the other hand, some researchers studied virtual tours as a substitute for the actual site visit for someone (El-Said and Aziz 2021). This

study supports the former, so it focuses on the study of virtual tours acting as a marketing tool to arouse users' interest in mountain walking.

Empirical research has demonstrated that the interactive 3D tourism experience shapes users' behaviour in a simulated virtual environment (Marchiori et al. 2018; Tussyadiah et al. 2018). However, few tourism studies have investigated users' experience of a 360-degree virtual tour using a head-mounted display (HMD) to display the real tourist attraction (An et al. 2021). Since filmed 360-degree real images with synchronised audio represent the better environment of mountains. Furthermore, the photographer's moving pace can make the audiences have the feeling like walking on the mountain. Therefore, the mechanism of a 360-degree virtual video that generates audiences' emotional and psychological states may vary from interactive 3D tourism. 360-degree video is the photographer's dominant travel speed, and interactive 3D tourism is the user's dominant. So, there is a need to investigate how 360-degree virtual videos could stimulate audiences' intention to take walking on the real mountain.

2.3 Stimulus–organism–response (S–O–R) theory

The S–O–R theory states that environmental aspects (stimulus) evoke individuals' psychological states (organism), which, in turn, undergoes an internal process to shape their behavioural responses (respond) (Mehrabian and Russell 1974). According to the S–O–R model, the behavioural intention of a consumer is formed by the stimuli from the external environment as well as their internal psychology and physiology (Mehrabian and Russell 1974). Since environmental psychology is often used to explain the interaction between humans and the environment, the S–O–R theory is widely adopted in different contexts, such as marketing and tourism (Wu et al. 2020).

Recently, researchers used the S–O–R theory to explain the psychological process of a virtual tourism experience (e.g. An et al. 2021; Kim et al. 2020). For example, An et al. (2021) examined the influence of sense and quality of information on evoking flow and producing satisfaction and visit intention. Their findings confirmed that the psychological process through which the sense and quality of the information in virtual tours induce flow, which further leads to satisfaction and intention to visit. Thus, the S–O–R theory provides an appropriate framework for studying the relationship among virtual stimuli, participants' emotional and behavioural responses in a virtual tour context. As a result, this study employs the S–O–R model to investigate how the technical aspect of 360-degree virtual tours stimulates audiences' intention to conduct mountain walking tourism through psychological processes.

2.4 A sense of presence and vividness

Presence, also known as telepresence, refers to a subjective experience of being there in the technology-mediated environment (Slater 1999). Presence can be aroused by a medium in a virtual environment, such as the feeling of being in a mediated space, the interpersonal relationship perceived through mediated communication,

and the psychological connections with others (Nowak and Biocca 2003). The sense of ‘being there’ is the most significant experiential dimension of the experience of viewing virtual tours (Steuer 1992).

Vividness is a driver of presence (Steuer 1992). Researchers found that vividness is the primary determinant of presence, as it is three times more influential than interactivity (Cheng et al. 2014). Vividness, similar to media richness, refers to the number (i.e. sensory breadth) and quantity and quality (i.e. sensory depth) of the message (Klein 2003). In VR research, Van Kerrebroeck et al. (2017) found that a high level of vividness leads to richer sensory representations, which results in a high sense of presence. In VR theme park research, Wei et al. (2019) found that vividness is one of the key drivers of a sense of presence in experiencing a VR rollercoaster. Therefore, vividness is considered as a ‘stimulus’, and a sense of presence is an ‘organism’. When the images provided by the 360-degree virtual walking tour are visually vivid, audiences may feel more engaged and ‘being there’ in the virtual environment. Thus, it is proposed that:

H1. The vividness of a 360-degree mountain walking tour has a positive impact on the audience’s sense of presence.

2.5 Emotional involvement and flow state

The virtual environments can attract feedback from tourists and produce a sense of involvement (Stamboulis and Skayannis 2003). Emotional involvement refers to ‘the degree to which an individual is emotionally engaged in a behaviour’ (Holsapple and Wu 2007, p. 87). Since presence often involves sensory outputs such as visual, aural, or olfactory (Choi et al. 2016), such perceived appeal leads to the emotional involvement of users. Individuals who have a higher sense of presence when watching a 360-degree virtual mountain walking video may be emotionally involved in the virtual environment.

H2a. The sense of presence of a 360-degree mountain walking tour has a positive impact on the audiences’ emotional involvement of the 360-degree mountain walking.

Kim et al. (2017) defined the flow state in digital tourism technology as fascinated, immersed, deeply involved, and focused on the use of technology. When people experience flow in a virtual tour, they experience time distortion and feel that time passes faster than normal (Sherry 2004). Flow is considered as the phase of the organism in the context of the computer-mediated environment (Ali 2016) and the study of VR travel (An et al. 2021). Willems et al. (2019) confirmed that the sense of ‘being there’ perceived in VR positively impacts to flow and enjoyment in studying millennials. When watching a 360-degree virtual mountain walking video, individuals who have a higher sense of presence may experience a deeper flow in the virtual environment.

H2b. The sense of presence of a 360-degree mountain walking tour has a positive impact on the audiences’ flow state of the 360-degree mountain walking.

On the other hand, Kim and Ko's (2019) study in VR spectatorship pointed out that sports fans' involvement with sport positively impacts flow experience due to their enhancing engagement. Specifically, the audiences' emotional involvement with the 360-degree mountain walking tour positively influences their concentration, leading to a flow experience.

H3a. The emotional involvement of a 360-degree mountain walking tour has a positive impact on the audiences' flow state of the 360-degree mountain walking.

2.6 Enjoyment

Enjoyment is often seen as an important intrinsic motivation (Hew et al. 2018). Enjoyment in the computer-mediated environment refers to 'the extent to which the activity of using a specific system is perceived to be enjoyed in its own right aside from any performance consequence resulting from system use' (Venkatesh 2000, p. 351). Tussyadiah et al. (2018) found that a sense of presence during VR experience positively impacts the enjoyment of VR experience in studying Hong Kong and U.K. tourists. Koufaris (2002) studied online consumer behaviour and stated that consumers' emotional involvement with a product has a positive influence on enjoyment and concentration. Weibel and Wissmath's (2011) study on computer games found that flow has a positive effect on enjoyment. When watching a 360-degree virtual mountain walking video, audiences may enjoy the virtual tour more if they experience a higher sense of presence, are more emotionally involved in the virtual tour, and are in a deeper flow state.

H2c. The sense of presence of a 360-degree mountain walking tour has a positive impact on the audiences' enjoyment of the 360-degree mountain walking.

H3b. The emotional involvement of a 360-degree mountain walking tour has a positive impact on the audiences' enjoyment of the 360-degree mountain walking.

H4a. The flow state of a 360-degree mountain walking tour has a positive impact on the audiences' enjoyment of the 360-degree mountain walking.

2.7 Intention to take mountain walking

Skadberg and Kimmel (2004) suggested that flow experience positively affects customers' understanding of a place displayed in a virtual environment when viewing a website, thus, in turn, affecting their intentions to visit. For emotional involvement, Kim et al. (2020) found that emotional involvement positively influences audiences' intention to visit the destination shown in VR tourism. Marasco et al. (2018) empirically confirmed that emotional involvement enabled by HMD positively impacts tourists' behavioural intentions to visit sites and attractions. For enjoyment, Tussyadiah et al. (2018) suggested that enjoyment plays an important role in VR tourism, resulting in the intention to real visit attractions displayed in VR. In this study, flow state, emotional involvement, and enjoyment are treated as the 'organism' factors of

the audiences in the S–O–R framework, while the intention to take mountain walking is a ‘response’. Therefore, these three organism factors may influence audiences’ intention to take mountain walking.

H3c. The emotional involvement of a 360-degree mountain walking tour has a positive impact on the audiences’ intention to take mountain walking.

H4b. The flow state of a 360-degree mountain walking tour has a positive impact on the audiences’ intention to take mountain walking.

H5. The enjoyment of a 360-degree mountain walking tour has a positive impact on the audiences’ intention to take mountain walking.

Based on the hypotheses, an S–O–R research model is proposed in Fig. 1. The vividness is the stimulus. Presence, emotional involvement, flow state, and enjoyment are organisms. The intention to take mountain walking is the response.

3 Methods

3.1 The stimuli—the 360-degree virtual videos

Due to the strict restriction on tourism activity after the outbreak of COVID-19 (Chen et al. 2020) and perceived risks in cross-provincial travel (Abdullah et al. 2020), people in China prefer to travel within the province. Dinghu Mountain (Chinese: 鼎湖山) is located in Zhaoqing City, Guangdong Province, Greater Bay Area of China and is composed of more than ten low-altitude mountains. It is one of the four famous mountains in Guangdong province and a famous tourist attraction. Dinghu Mountain, known as ‘Emerald on the Tropic of Cancer’, is famous for its ancient trees, waterfalls, fresh air, various animals, and abundant plants species. The Dinghu Mountain National Nature Reserve, founded in 1956, is the first nature reserve in China. Dinghu Mountain is also regarded as the ‘gene repository’ and ‘living natural museum’ of South China biological species. In 1979, it became one

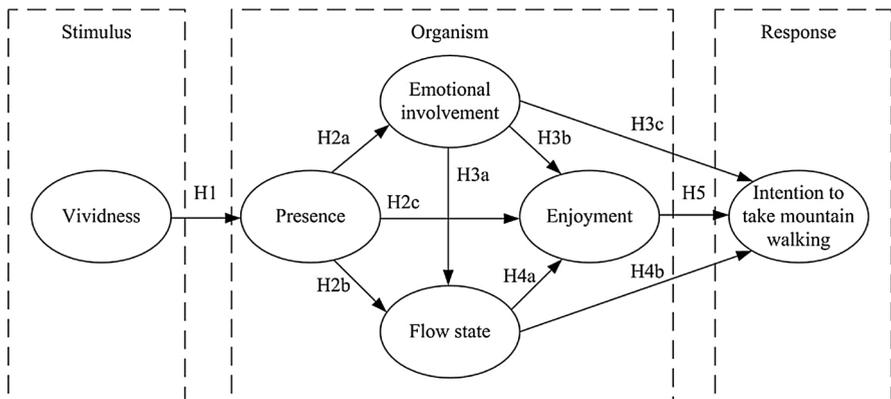


Fig. 1 Proposed research model

of the first designated scientific research stations of UNESCO's Man and Natural Biosphere Program. Dinghu Mountain is a popular tourist destination for people in the Greater Bay Area of China. Given its easy access, diverse tourism attractions, and comfortable environment, Dinghu Mountain is suitable for mountain walking. Therefore, Dinghu Mountain was chosen as the place for the study.

Unlike other VR tourism marketing studies, this study filmed 360-degree virtual videos rather than using existing VR videos downloaded from online video platforms. In order to provide respondents with a full virtual experience of mountain walking, the research team visited Dinghu Mountain in October 2020. It used an Insta360 One X camera to shoot five 360-degree virtual tour videos. In order to capture the real experience of mountain walking, the film crew tested three different paces and finally decided to use the slowest one. It is because the walking process should be casual and slow, so that audiences have enough time to experience the scenery next to them.

An et al. (2021) pointed out that the research based on a single VR tourism content limited the generalisation of the research results and called for the research based on various VR tourism contents, which provides different levels of types of technical and informational attributes of destination. Therefore, this study used five 360-degree virtual tour videos. These five 360-degree virtual tour videos displayed the walking of different landscapes of Dinghu Mountain in different lengths of time (ranging from 1 to 5 min). Participants were randomly assigned to watch one video. Through the use of various virtual contents, participants could have different virtual experiences. If there is only one source, respondents have similar experiences and may potentially place similar rates on the same question. Therefore, this setting reduces the bias from a single source of the 360-degree virtual video. The contents of the five 360-degree virtual videos are shown in [Appendix](#).

3.2 Measurement items

The measurement items were derived from literature and modified for the study setting. Given the study context, three items of vividness were adopted from Kim and Ko (2019). Seven items of presence were adopted from Bogicevic et al. (2019). Moreover, three items of emotional involvement, four items of flow state, four items of enjoyment, and four items of the intention to take mounting walking were derived from Kim et al. (2020). Unlike Kim et al.'s (2020) study that measured audiences' intention to visit the place shown in the tourism-related VR activity, this study measures the intention to take mountain walking where is not limited to Dinghu Mountain. So, items were revised as an example: I intend to take a walk in a mountain in the near future. Furthermore, Kim et al. (2020) measured the responses from using the tourism-related VR activity, and this study measures the experience from the 360-degree virtual tour. So, items were revised, as an example, from 'Using the tourism-related VR activity is enjoyable for me' to 'Experiencing the 360-degree mountain walking virtual tour was enjoyable for me'. The list of measurement items was presented in Table 1.

Table 1 Measurement items, mean, standard deviation, and factor loading

Construct	Abbreviation	Items	Mean	Standard deviation	Factor loading
Vividness	V11	When I am viewing the 360-degree mountain walking virtual tour, I thought the sensory information provided by the HMD was highly vivid	4.506	1.728	0.857
	V12	When I ... was highly rich	4.572	1.598	0.857
	V13	When I ... was highly detailed	4.594	1.651	0.844
Presence	PR1	When I finished the 360-degree mountain walking virtual tour, I felt like I came back to the "real world" after a journey	5.216	1.667	0.824
	PR2	The 360-degree mountain walking virtual tour created a new world for me, and the world suddenly disappeared when I finished the preview	4.900	1.773	0.855
	PR3	The world generated by the 360-degree mountain walking virtual tour seemed to me like "somewhere I visited" rather than "something I saw."	4.869	1.358	0.798
	PR4	While I was viewing the 360-degree mountain walking virtual tour, I felt I was in the mountain	5.072	1.687	0.801
	PR5	While I ..., I sometimes forgot that I was in the middle of an experiment	5.131	1.678	0.815
	PR6	While I ..., my body was in the room, but my mind was inside the world created by the mountain	5.131	1.658	0.852
	PR7	While I ..., the world generated by the mountain was more real or present for me compared to the "real world."	5.181	1.653	0.845
Emotional Involvement	E11	I was completely involved in the 360-degree mountain walking virtual tour	4.966	1.648	0.891
	E12	I was deeply impressed by the 360-degree mountain walking virtual tour	5.119	1.567	0.864
	E13	I felt total empathy with the 360-degree mountain walking virtual tour	5.122	1.644	0.885
Flow State	FS1	While I was experiencing the 360-degree mountain walking virtual tour, I felt totally captivated	4.453	1.565	0.827
	FS2	While I ..., time seemed to pass very quickly	4.781	1.471	0.823
	FS3	While I ..., I forget all concerns	4.716	1.429	0.799
	FS4	Experiencing the 360-degree mountain walking virtual tour often made me forget where I am	4.719	1.480	0.761

Table 1 (continued)

Construct	Abbreviation	Items	Mean	Standard deviation	Factor loading
Enjoyment	EN1	Experiencing the 360-degree mountain walking virtual tour was enjoyable for me	4.966	1.656	0.855
	EN2	Experiencing ... was pleasurable for me	5.259	1.591	0.823
	EN3	Experiencing ... was fun for me	4.653	1.617	0.810
	EN4	Experiencing ... kept me happy	5.134	1.653	0.789
Intention to take mountain walking	IN1	I am planning to take a walk in a mountain	4.691	1.656	0.853
	IN2	I intend to take a walk in a mountain in the near future	4.884	1.714	0.845
	IN3	I am willing to take a walk in a mountain soon	4.863	1.707	0.837
	IN4	I intend to invest money and time to take a walk in a mountain	4.788	1.664	0.881

The questionnaire was comprised of three sections. In the first section, one screening question (Have you been to any mountain during the past three months?) was used to qualify the respondents. Only the respondents who answered 'no' to the screening question were qualified for the next section. The second section was to score 22 measurement items of the six constructs in the model through a seven-point-Likert scale, ranging from 1 (strongly disagree) to 7 (strongly agree). The last section was the demographic background of the respondents. These measurable questions were originally written in English and were translated into Chinese by one translator who was proficient in both Chinese and English, then translated back into English by another professional translator to verify consistency. To ensure content validity, a pilot test with 30 samples was conducted in Macao in December 2020. Some amendments were made according to the results of the pilot test.

3.3 Sample collection

This study used a time-based systematic sampling method to collect data at fixed periodic intervals (every 15 min). As a type of probability sampling method, time-based systematic sampling is widely used in tourism studies (e.g. Bruwer et al. 2018; Lai 2020). In the absence of a list of all subjects (i.e. the sampling frame is not available), time-based systematic sampling can be effectively applied to obtain the desired sample size from a large population (Sayed and Ibrahim 2018). In addition, it reduces the potential bias of convenience samplings, such as interviewer-selection bias, unrepresentative samples, under-coverage bias, and non-response bias (Etikan et al. 2016).

A survey was taken in three cities of the Greater Bay Area of China, including Macao, Zhuhai, and Zhongshan from December 20, 2020, to January 10, 2021. Since shopping malls provided a comfortable environment for respondents to view the 360-degree virtual tour videos (Yang et al. 2021), four research assistants intercepted people in the shopping malls every 15 min. At the beginning of the survey, research assistants asked the respondents the screening question. They explained the necessary information of the research to participants who passed the screening question. Most of the invited people were very interested in the 360-degree virtual tour videos. However, some people refused because they did not have free time. The rejection rate was about 50%. Once the participants confirmed their understanding and willingness to participate, they were provided with a Xiaomi all-in-one VR headset and invited to view one 360-degree virtual tour video. Participants can move their heads and see any direction by wearing HMD during the previewing process. After viewing the video, participants were invited to fill out the questionnaire. Most participants showed great interest in watching the 360-degree virtual videos. They generally spent around 3–5 min watching the videos. Then, they took around 10 min to complete the questionnaire.

A total of 350 samples were collected. Due to incomplete or identical question scoring, thirty questionnaires were deleted. The remaining 320 valid data were used for data analysis. Table 2 contained the demographic background of the samples.

Table 2 Sample profile (n = 320)

	Frequency	Percentage
Gender		
Male	146	45.6
Female	174	54.4
Age		
18–30	110	34.4
31–40	99	30.9
41–50	91	28.4
51–60	12	3.8
> 60	8	2.5
Education		
Secondary school or below	57	17.8
Diploma	103	32.2
University degree	115	35.9
Postgraduate degree	45	14.1
VR usage experience before this time		
Never	120	37.5
Occasionally	175	54.7
Frequently	25	7.8
Mountain walking experience		
Never	30	9.4
Occasionally	181	56.6
Frequently	109	34.1

4 Findings

4.1 Sample profile

As presented in Table 2, there were 54.4% female respondents and 45.6% males. The age of the respondents was between 18–30 (34.4%), 31–40 (30.9%), 41–50 (28.4%), 51–60 (3.8%), and above 60 (2.5%). Most of the respondents completed a university degree (35.9%) and held a diploma (32.2%). Regarding prior experiences, 54.7% of the respondents reported occasional VR experience, 37.5% had no VR experience, and 7.8% used VR frequently. More than half of the participants (56.6%) walked in the mountain occasionally, 34.1% walked in the mountain frequently, and 9.4% of respondents had no mountain walking experience.

4.2 Reliability, convergent, and discriminant validity

Table 1 presented the mean, standard deviation, and PLS factor loading of all the measurable items. Table 3 showed the values of reliability, validity, and correlation of the constructs. All the factor loadings were greater than 0.70 (range from 0.761 to

Table 3 Reliability, validity, and correlation of the constructs

	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)	Fornell-Larcker criterion				Heterotrait-Monotrait ratio (HTMT)								
				EI	EN	FS	IN	PR	VI	EI	EN	FS	IN	PR	VI	
Emotional involvement (EI)	0.854	0.911	0.774	<i>0.880</i>												
Enjoyment (EN)	0.838	0.891	0.672	0.458	<i>0.820</i>							0.534				
Flow state (FS)	0.816	0.879	0.645	0.393	0.508	<i>0.803</i>						0.468	0.599			
Intention to take mountain walking (IN)	0.876	0.915	0.730	0.638	0.559	0.551	<i>0.854</i>					0.733	0.640	0.649		
Presence (PR)	0.921	0.937	0.680	0.488	0.695	0.550	0.719	<i>0.824</i>				0.547	0.783	0.630	0.798	
Vividness (VI)	0.812	0.889	0.727	0.282	0.451	0.432	0.455	0.690	<i>0.853</i>			0.336	0.546	0.529	0.540	0.798

The italicised values represent the square root value of each AVE

0.891), indicating all items were considered to have sufficient loading from the constructs (Hair et al. 2010). The values of Cronbach’s alpha and composite reliability (CR) were above 0.70 (range from 0.812 to 0.921 and from 0.879 to 0.937, respectively) (Table 3), indicating the measurable scales were reliable (Hair et al. 2010). The values of average variance extracted (AVE) were greater than 0.50 (range from 0.645 to 0.774). Hence convergent validity was achieved (Hair et al. 2010). Table 3 also showed the result of the Fornell–Larcker criterion and Heterotrait–Monotrait Ratio (HTMT). The value of the square root of each AVE was greater than its construct correlations and the values of HTMT were lower than 0.85 (Hair et al. 2017), confirming the discriminant validity of the scales.

4.3 Hypothesis testing

Partial least squares structural equation modelling (PLS-SEM) was conducted to test the research model because PLS can deal with a small sample and has less restrictive assumptions on the normality of data (Hair et al. 2017). SmartPLS v.3.2.6 package (Ringle et al. 2015) was used and bootstrapping with 5000 samples was performed to assess the path coefficients.

Figure 2 presented the result of hypothesis testing. Hypothesis 1 stated the positive influence of vividness on presence. H1 was supported ($\beta_{\text{vividness} \rightarrow \text{presence}} = 0.690, p < 0.001$). Hypotheses 2a–c stated the positive influence of presence on emotional involvement, flow state, and enjoyment. The results indicated that presence has a significant influence on emotional involvement ($\beta_{\text{presence} \rightarrow \text{emotional involvement}} = 0.488, p < 0.001$), flow state ($\beta_{\text{presence} \rightarrow \text{flow state}} = 0.470, p < 0.001$), and enjoyment ($\beta_{\text{presence} \rightarrow \text{enjoyment}} = 0.545, p < 0.001$). Thus, H2a–c were supported. Hypotheses 3a–c stated emotional involvement has a positive influence on flow state, enjoyment, and intention, respectively. Hypotheses 3a–c were supported ($\beta_{\text{emotional involvement} \rightarrow \text{flow state}} = 0.164, p = 0.013$; $\beta_{\text{emotional involvement} \rightarrow \text{enjoyment}} = 0.130, p = 0.007$; $\beta_{\text{emotional involvement} \rightarrow \text{intention}} = 0.429, p < 0.001$ respectively). In addition,

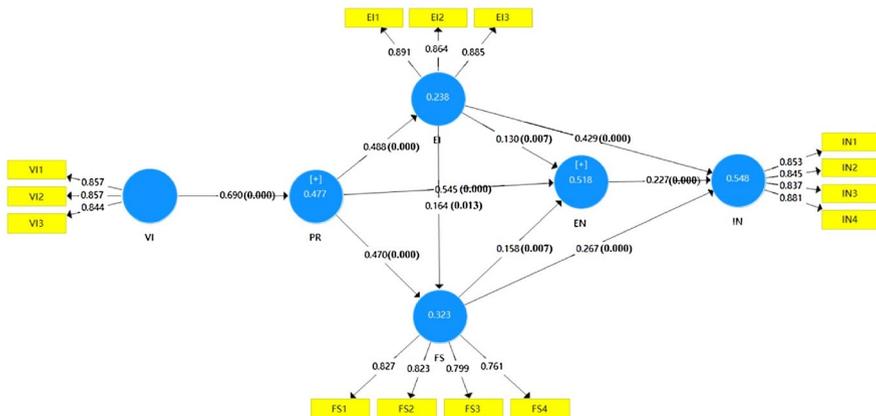


Fig. 2 Result of PLS-SEM

flow state positively influences enjoyment ($\beta_{\text{flow state} \rightarrow \text{enjoyment}} = 0.158$, $p = 0.007$) and intention ($\beta_{\text{flow state} \rightarrow \text{intention}} = 0.267$, $p < 0.001$), which supported H4a–b. Similarly, enjoyment has a significant influence on intention ($\beta_{\text{enjoyment} \rightarrow \text{intention}} = 0.227$, $p < 0.001$), supporting H5. Therefore, all hypotheses were supported. The variance explained (R-square) by presence, emotional involvement, flow state, enjoyment, and intention to take mountain walking were 0.477, 0.238, 0.323, 0.518, and 0.548, respectively.

Insert Fig. 2

5 Conclusions and implications

5.1 Conclusions

This research focuses on using 360-degree virtual tours to promote audiences' intention to conduct mountain walking tourism through developing and testing a theoretical framework for elaborating the relationships among vividness (stimulus), presence, emotional involvement, flow state, and enjoyment (organism), and intention to conduct mountain walking tourism (response) based on an extension of S–O–R theory. The results show that the vividness of a 360-degree virtual tour has a positive influence on audiences' sense of presence, which is consistent with the literature that supports vividness as a key determinant of sense of presence (e.g. Wei et al. 2019). In addition, a virtual feeling of being walking in the mountain leads to emotional involvement, flow state, and enjoyment. It is in line with the literature supporting the critical role of presence in understanding VR experience (e.g. Choi et al. 2016; Tussyadiah et al. 2018; Willems et al. 2019) and explains the findings of previous research in how VR influences users' behaviour intention (e.g. Kim et al. 2020; Tussyadiah et al. 2018). Furthermore, this study identifies that emotional involvement leads to a flow state and enjoyment. Furthermore, a flow state is also a vehicle for creating user's enjoyment. Finally, emotional involvement shows the greatest impact on audiences' intention to walk in a real mountain, followed by flow state and enjoyment.

5.2 Theoretical contributions

The result contributes to the literature of VR research in tourism marketing. Kim et al. (2020) considered emotional involvement, flow state, and enjoyment as the organism variables but did not include a sense of presence. However, researchers in VR research in tourism commonly agreed that presence is a key factor in influencing audiences' experience in a VR environment (Tussyadiah et al. 2018). In Kim et al.'s (2020) study, they treated these three organism variables independently and did not test the relationship among them. However, in Weibel and Wissmath's (2011) study, they found that flow state is an antecedent of enjoyment. In addition, Kim and Ko's (2019) study in VR spectatorship also confirmed that involvement significantly impacts flow state due to enhancing engagement. Furthermore, many

previous studies have confirmed that a sense of presence induced by VR has a positive effect on emotional involvement, enjoyment, and flow state (Huang et al. 2013; Willems et al. 2019). In order to explain how 360-degree virtual tours promote mountain walking tourism, this study reconstructs the S–O–R research model. This study considers vividness as the stimulus to investigate its consequences; a sense of presence, emotional involvement, flow state, and enjoyment as the organism variables to the 360-degree virtual video; and visit intention as the response to the 360-degree virtual video. The results of this study indicate the relational flow from VR presence to user behavioural intention via emotional state (emotional involvement and flow state), psychological state (enjoyment), and behavioural state (visit intention). Some researchers have used the S–O–R theory to explain the processes that influence tourists' behaviours in the virtual environment. However, they only considered the organismic emotional state (e.g. positive emotions and positive surprise) in their research models (e.g. Surovaya et al. 2020). This study extends the applicability of the S–O–R theory by embedding both emotional state and psychological state as internal organismic states. In this study, the emotional state is placed on the ascending position of the psychological state. This structure helps to explain the internal organismic processes. By enhancing a sense of presence through a vivid 360-degree virtual tour, audiences are more likely to involve and experience a flow state, which further evokes enjoyment and ultimately leads to their intention to walk in a real mountain. This study greatly extends the findings of Kim et al. (2020), who only treated flow state, enjoyment, and emotional involvement as first-order factors of affective response. The results show that the S–O–R theory is an effective framework that can explain the linkages between the mediated environment, viewers' emotional and psychological processes, and behavioural intentions in the 360-degree virtual tour context. This study supports the generalisability of using the S–O–R theory in studying VR research in tourism.

In addition, Kim et al. (2020) did not test the direct effect of emotional involvement, flow state, and enjoyment on the visit intention. They instead constructed a higher-order research model where these three organism factors (as the first-order factors) reflectively form the affective response (as the second-order factor). The factor loadings of emotional involvement, flow state, and enjoyment are 0.862, 0.807, and 0.904, respectively. Therefore, Kim et al. (2020) told us that enjoyment has the greatest indirect effect on visit intention. However, this study indicates that emotional involvement has the greatest direct effect on the intention to take mountain walking. Kim et al. (2020) tested the visit intention (a place that audiences saw), and this study tests the intention to take mountain walking (a type of tourism). The respondents for Kim et al. (2020) study were audiences who had any experience with tourism-related VR activities in the past 12 months. This study examines the audiences who have a fresh experience after using a Xiaomi all-in-one VR headset to have a 360-degree virtual tour. Since HMD provides visual isolation from the surrounding, it may enhance audiences' responses, especially the involvement. Thus, the effects of three organism factors in different research settings may vary. It raises questions for researchers further investigate (1) whether these three organism factors should formatively or reflectively form the affective response, (2) their effects under different tourism research settings, and (3) their effects under different types

of VR equipment. This study points out the research gaps for future VR research in tourism.

The study also provides a new insight to bridge the innovative technology with the promotion of nature-based tourism. Existing literature focused on using VR to promote a specific destination (e.g. Kim et al. 2020). However, with the outbreak of COVID-19 and the widespread of the variant virus, long-distance travelling was ceased due to travel restrictions and border closures. By providing benefits to tourists, mountain walking tourism, as a type of walking tourism, deserves more research attention, especially during the COVID-19 pandemic (De Vos 2020). This study shows how the use of 360-degree virtual videos can promote mountain walking tourism. Thus, this study investigates tourists' intention to go walking in the mountains instead of visiting only Dinghu Mountain. The results of the study support the possibilities of using 360-degree virtual tours to promote any kind of nature-based tourism. For developing mountain walking tourism, evaluating what visitors perceive during the trip is important. By using 360-degree virtual videos to simulate mountain walking, audiences can obtain an experience similar to real mountain walking when viewing the videos. This study simulates and explores visitors' emotional and psychological states during mountain walking. After filling out the questionnaire, the interviewers have asked respondents' experience with virtual mountain walking. They mentioned that the environment of the mountain landscape leads them to be completely involved in the walking pace. They felt that they slowly walked on the mountain path, enjoying the breeze, listening to the birds singing, and the sound of the running water made them intoxicated. People like to experience nature and wilderness. Thus, mountain walking provides opportunities for people to touch nature, so the respondents were happy with the virtual tour. However, fewer respondents provided a special argument that they would not go to Dinghu Mountain in case they have watched all the virtual videos, but they would visit other mountains. It is because they do not need to have a 'second' visit to Dinghu Mountain. So, some researchers argued that VR is a double-edged sword (Li and Chen 2019). However, this study empirically proves that 360-degree virtual tours can help to promote mountain walking tourism. Although audiences obtained the experience from virtual videos, they may go through similar emotional and psychological states during a real mountain walking. Therefore, the use of 360-degree virtual tours can not only promote mountain walking but also allow researchers and marketers to predict visitors' emotional and psychological responses in experiencing real mountain walking. The study provides evidence to show how innovative technology helps the development of nature-based tourism.

5.3 Practical contributions

This study also provides meaningful practical implications for destination marketers, virtual tour developers, and managers of mountain parks. A well-designed virtual tour is a good way to present mountain walking products, including location, walkways, attributes, culture, and people. In addition, virtual tours provide the opportunity for potential tourists to 'walk in a mountain' by visiting virtually

before the real visit. Therefore, for enhancing the sense of presence, destination marketers are suggested investing in the newest high-performance HMDs, such as VR-3 headset delivering 2880×2720 resolution per eye, to foster users to a vivid 'feel' of the mountain walking in a virtual tour.

For virtual tour developers, developing immersive 360-degree virtual tour content which induces presence is important. More appealing sensory devices, such as high-quality visual elements (e.g. green trees, bloom flowers, clean water, sun-rise, and mountain shrouded in mist), audio elements (e.g. sounds of birds, fish, water, rain, and tourists in the mountains), and/or different sensory stimulation (e.g. blowing wind), should be integrated into the mountain walking virtual tour. In addition, when shooting 360-degree virtual videos, the directors should design involving, entertaining, and enjoyable content.

In order to promote mountain walking, the general manager of the mountain parks should create a walking-friendly environment to enhance walkability. It is important to maintain walking tracks, rambling trails, toilets, and gazebos in good condition. In addition, referring to the feedback of audiences on the 360-degree virtual tourism experience, mountain park managers can manipulate various natural landscapes, smells, and sounds, which allow visitors to experience the natural environment. Planting lush trees and colourful flowers create an ecological circle favourable to the life of birds and insects. With the singing of birds and the calls of insects, tourists can immerse themselves in the beauty of nature to evoke their physical, emotional, and psychological pleasure. It matches audiences' experiences in 360-degree virtual tours.

5.4 Limitations

Some limitations of this study should be addressed. First, all 360-degree virtual videos were filmed in a single tourist destination (Dinghu Mountain). Thus, the generalisation of the results may be limited. The future study may examine the influence of virtual tours captured from diverse tourism sites. In addition, during the COVID-19 pandemic, the samples were limited to the Greater Bay Area of China. Future studies may test the model in different regions and countries to generalise the results. Second, this study only considers presence, emotional involvement, flow state, and enjoyment as the organism to the 360-degree virtual video. Future studies can include more emotional and psychological measures. Also, researchers can include more antecedents of VR presence to construct a more comprehensive research model. Since audiences' experience in virtual mountain walking should be different from the experience in real mountain walking, it is recommended to conduct further research to understand the emotional and psychological states of visitors in real mountain walking. Finally, this study only evaluated the use of 360-degree virtual tours in HMD. However, 360-degree virtual videos can be viewed on a computer screen. Further study is recommended to verify any difference between using these two types of devices.

Appendix



Video 1



Video 2



Video 3



Video 4



Video 5

Declarations

Conflict of interest We have no conflict of interest to declare.

References

- Abdullah M, Dias C, Muley D, Shahin M (2020) Exploring the impacts of COVID-19 on travel behavior and mode preferences. *Transp Res Interdiscip Perspect* 8:100255
- Ali F (2016) Hotel website quality, perceived flow, customer satisfaction and purchase intention. *J Hosp Tour Technol* 7(2):213–228

- An S, Choi Y, Lee CK (2021) Virtual travel experience and destination marketing: effects of sense and information quality on flow and visit intention. *J Destin Mark Manag* 19:100492
- Anable J, Gatersleben B (2005) All work and no play? The role of instrumental and affective factors in work and leisure journeys by different travel modes. *Transp Res Part A* 39:163–181
- Arcaro A, Gorla G, Zublena M (2018) What are the benefits of clean air for alpine destinations? *Worldwide Hosp Tour Themes* 10(2):172–184
- Bichler BF, Peters M (2021) Soft adventure motivation: an exploratory study of hiking tourism. *Tour Rev* 76(2):473–488
- Bogicevic V, Seo S, Kandampully JA, Liu SQ, Rudd NA (2019) Virtual reality presence as a preamble of tourism experience: the role of mental imagery. *Tour Manag* 74:55–64
- Bonadonna A, Giachino C, Truant E (2019) Sustainability and mountain tourism: the millennial's perspective. *Sustainability* 9:1219
- Bruwer J, Prayag G, Disegna M (2018) Why wine tourists visit cellar doors: segmenting motivation and destination image. *Int J Tour Res* 20(3):355–366
- Chen H, Huang X, Li Z (2020) A content analysis of Chinese news coverage on COVID-19 and tourism. *Curr Issue Tour* 4:1–8
- Cheng LK, Chieng MH, Chieng WH (2014) Measuring virtual experience in a three-dimensional virtual reality interactive simulator environment: a structural equation modeling approach. *Virtual Real* 18:173–188
- Choi J, Ok C, Choi S (2016) Outcomes of destination marketing organization website navigation: the role of telepresence. *J Travel Tour Mark* 33(1):46–62
- Clark BE (2020) Looking for a socially distanced vacation? Try a walking tour. *Los Angeles Times*. <https://www.latimes.com/travel/story/2020-07-30/walking-tours-are-made-for-traveling-during-the-pandemic>
- Davies N (2018) Who walks, where and why? Practitioners' observations and perspectives on recreational walkers at UK tourist destinations. *Ann Leis Res* 21(5):553–574
- De Vos J (2020) The effect of COVID-19 and subsequent social distancing on travel behavior. *Transp Res Interdiscip Perspect* 5:100121
- Disztinger P, Schlogl S, Groth A (2017) Technology acceptance of virtual reality for travel planning. In: Roland S, Brigitte S (eds) *Information and communication technologies in tourism 2017*. Springer, Cambridge, pp 255–268
- El-Said O, Aziz H (2021) Virtual tours a means to an end: an analysis of virtual tours' role in tourism recovery post covid-19. *J Travel Res* 00:1–21
- Etikan I, Musa SA, Alkassim RS (2016) Comparison of convenience sampling and purposive sampling. *Am J Theor Appl Stat* 5(1):1–4
- Flavián C, Ibáñez-Sánchez S, Orús C (2020) Impacts of technological embodiment through virtual reality on potential guests' emotions and engagement. *J Hosp Mark Manag*. <https://doi.org/10.1080/19368623.2020.1770146>
- Griffin T, Giberson J, Lee SH, Guttentag D, Kandaurova M (2017) Virtual reality and implications for destination marketing. In: 48th Annual Travel and Tourism Research Association (TTRA), International Conference
- Hair JF, Black WC, Babin BJ, Anderson RE (2010) *Multivariate data analysis*, 7th edn. Prentice-Hall Inc., Englewood Cliffs
- Hair JF, Hult GTM, Ringle CM, Sarstedt M (2017) *A primer on partial least squares structural equation modeling (PLS-SEM)*, 2nd edn. Sage, Thousand Oaks
- Hew JJ, Leong LY, Tan GWH, Lee VH, Ooi KB (2018) Mobile social tourism shopping: a dual-stage analysis of a multi-mediation model. *Tour Manag* 66:121–139
- Holsapple CW, Wu J (2007) User acceptance of virtual worlds: the hedonic framework. *ACM SIGMIS Database* 38(4):86–89
- Huang YC, Backman SJ, Backman KF, Moore D (2013) Exploring user acceptance of 3D virtual worlds in travel and tourism marketing. *Tour Manag* 36:490–501
- Huang YC, Backman KF, Backman SJ, Chang LL (2016) Exploring the implications of virtual reality technology in tourism marketing: an integrated research framework. *Int J Tour Res* 18(2):116–128
- Jung TH, tom Dieck MC, Moorhouse N, tom Dieck D (2017). Tourists experience of virtual reality applications. In: *IEEE international conference on consumer electronics, Las Vegas*
- Karupiah P, Bada AB (2018) A qualitative study on walking in the Penang botanical gardens, Malaysia. *Ann Leis Res* 21(2):199–214

- Kato K, Prozano RN (2017) Spiritual (walking) tourism as a foundation for sustainable destination development: Kumano-Kodo pilgrimage, Wakayama, Japan. *Tour Manag Perspect* 24:243–251
- Kay G, Moxham N (1996) Paths for whom? Countryside access for recreational walking. *Leis Stud* 15(3):171–183
- Kim MJ, Hall CM (2019) A hedonic motivation model in virtual reality tourism: comparing visitors and non-visitors. *Int J Inf Manag* 46:236–249
- Kim D, Ko YJ (2019) The impact of virtual reality (VR) technology on sport spectators' flow experience and satisfaction. *Comput Hum Behav* 93:346–356
- Kim MJ, Bonn M, Lee CK (2017) Seniors' dual route of persuasive communications in mobile social media and the moderating role of discretionary time. *Asia Pac J Tour Res* 22(8):799–818
- Kim MJ, Lee CK, Jung T (2020) Exploring consumer behavior in virtual reality tourism using an extended stimulus–organism–response model. *J Travel Res* 59(1):69–89
- Klein LR (2003) Creating virtual product experiences: the role of telepresence. *J Interact Mark* 17(1):41–55
- Kling KG, Margaryan L, Fuchs M (2020) (In) equality in the outdoors: gender perspective on recreation and tourism media in the Swedish mountains. *Curr Issue Tour* 23(2):233–247
- Koufaris M (2002) Applying the technology acceptance model and flow theory to online consumer behavior. *Inf Syst Res* 13(2):205–233
- Lai IKW (2020) An examination of satisfaction on word of mouth regarding Portuguese foods in Macau: applying the concept of integrated satisfaction. *J Hosp Tour Manag* 43:100–110
- Li T, Chen Y (2019) Will virtual reality be a double-edged sword? Exploring the moderation effects of the expected enjoyment of a destination on travel intention. *J Destination Mark Manage* 12:15–26
- Li Z, Zhang X, Yang K, Singer R, Cui R (2021) Urban and rural tourism under COVID-19 in China: research on the recovery measures and tourism development. *Tour Rev* 76(4):718–736
- Lo WH, Cheng KLB (2020) Does virtual reality attract visitors? The mediating effect of presence on consumer response in virtual reality tourism advertising. *Inf Technol Tour* 22(4):537–562
- Marasco A, Buonincontri P, Van Niekerk M, Orlowski M, Okumus F (2018) Exploring the role of next-generation virtual technologies in destination marketing. *J Destin Mark Manag* 9:138–148
- Marchiori E, Niforatos E, Preto L (2018) Analysis of users' heart rate data and self-reported perceptions to understand effective virtual reality characteristics. *Inf Technol Tour* 18(1–4):133–155
- McCool S (2002) Mountains and tourism: meeting the challenges of sustainability in a messy world. In: *Celebrating mountains: proceedings of an international year of mountain conference*, Jindabyne, pp 311–318
- Mehrabian A, Russell JA (1974) *An approach to environmental psychology*. MIT Press, Cambridge
- Nordh H, Vistad OI, Skar M, Wold LC, Bærum KM (2017) Walking as urban outdoor recreation: public health for everyone. *J Outdoor Recreat Tour* 20:60–66
- Nowak KL, Biocca FA (2003) The effect of the agency and anthropomorphism of users' sense of telepresence, copresence, and social presence in virtual environments. *Presence Teleoperators Virtual Environ* 12(5):481–494
- Ram Y, Hall CM (2018) Walkable places for visitors: assessing and designing for walkability. In: Hall CM, Ram Y, Shoval N (eds) *The Routledge International Handbook of Walking*. Routledge, Abingdon, pp 311–329
- Rickly JM, Vidon ES (2017) Contesting authentic practice and ethical authority in adventure tourism. *J Sustain Tour* 25(10):1418–1433
- Ringle CM, Wende S, Becker JM (2015) *SmartPLS 3*. SmartPLS GmbH, Boenningstedt
- Río-Rama D, Maldonado-Eraza CP, Durán-Sánchez A, Álvarez-García J (2019) Mountain tourism research. A review. *Eur J Tour Res* 22:130–150
- Sayed A, Ibrahim A (2018) Recent developments in systematic sampling: a review. *J Stat Theory Pract* 12:290–310
- Seraphin H, Dosquet F (2020) Mountain tourism and second home tourism as post covid-19 lockdown placebo? *Worldwide Hosp Tour Themes* 12(4):485–500
- Sherry JL (2004) Flow and media enjoyment. *Commun Theory* 14(4):328–347
- Skadberg YX, Kimmel JR (2004) Visitors' flow experience while browsing a web site: its measurement, contributing factors and consequences. *Comput Hum Behav* 20(3):403–422
- Slater M (1999) Measuring presence: a response to the Witmer and Singer presence questionnaire. *Presence* 8(5):560–565
- Slater M, Sanchez-Vives MV (2016) Enhancing our lives with immersive virtual reality. *Front Robot AI* 3:1–47

- Stamboulis Y, Skayannis P (2003) Innovation strategies and technology for experience-based tourism. *Tour Manag* 24(1):35–43
- Steuer J (1992) Defining virtual reality: dimensions determining telepresence. *J Commun* 42(4):73–93
- Surovaya E, Prayag G, Yung R, Khoo-Lattimore C (2020) Telepresent or not? Virtual reality, service perceptions, emotions and post-consumption behaviors. *Anatolia* 30(4):620–635
- Tussyadiah IP, Wang D, Jung TH, Dieck MCT (2018) Virtual reality, presence, and attitude change: empirical evidence from tourism. *Tour Manag* 66:140–154
- Van Kerrebroeck H, Brengman M, Willems K (2017) When brands come to life: experimental research on the vividness effect of virtual reality in transformational marketing communications. *Virtual Real* 21(4):177–191
- Venkatesh V (2000) Determinants of perceived ease of use: integrating control, intrinsic motivation, and emotion into the technology acceptance model. *Inf Syst Res* 11(4):342–365
- Vural Arslan T, Durak S, Dizdar Gebesce F, Balcik B (2018) Assessment of factors influencing walkability in shopping streets of tourism cities: case of Bursa, Turkey. *Int J Tour Cities* 4(3):330–341
- Wei W, Qi R, Zhang L (2019) Effects of virtual reality on theme park visitors' experience and behaviors: a presence perspective. *Tour Manag* 71:282–293
- Weibel D, Wissmath B (2011) Immersion in computer games: the role of spatial presence and flow. *Int J Comput Games Technol* 2011:1–14
- Willems K, Brengman M, Van Kerrebroeck H (2019) The impact of representation media on customer engagement in tourism marketing among millennials. *Eur J Mark* 53(9):1988–2017
- World Tourism Organization (2019) Walking tourism—promoting regional development, executive summary. UNWTO, Madrid. <https://doi.org/10.18111/9789284420520>
- Wu SH, Huang SCT, Tsai CYD, Sung CL (2020) As loyal as migratory birds: analyzing event revisit intention with dramaturgy and environmental psychology theories. *Asia Pac J Tour Res* 25(8):841–857
- Yang T, Lai IKW, Fan ZB, Mo QM (2021) The impact of a 360° virtual tour on the reduction of psychological stress caused by COVID-19. *Technol Soc* 64:101514
- Yeh CH, Wang YS, Li HT, Lin SY (2017) The effect of information presentation modes on tourists' responses in internet marketing: the moderating role of emotions. *J Travel Tour Mark* 34(3):1–15
- Yung R, Khoo-Lattimore C (2017) New realities: a systematic literature review on virtual reality and augmented reality in tourism research. *Curr Issue Tour* 22(1):1–26
- Zurawik MA (2020) Socio-environmental influences on Nordic walking participation and their implications for well-being. *J Outdoor Recreat Tour* 29:100285

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