Research on the Impact of Virtual Reality Technology Perception on Tourist Engagement in the Context of Smart Tourism

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Abstract—In recent years, virtual reality technology is booming. How to combine VR technology with tourism projects has become an important issue in scenic spots. Previous studies have shown that tourists' acceptance of new technologies or applications will affect their tourism experience, but there is far from enough research on the combination of VR technology and tourism that is gradually emerging, and there is also a lack of research on what driving factors will affect tourists' compatibility under the background of smart tourism. Based on this, this study takes tourists who have experienced VR projects in scenic spots as the research objects. The results show that: (1) all three dimensions of VR technology perception have a direct and significant impact on flow experience; (2) All three dimensions of VR technology perception have a direct and significant impact on tourist engagement; (3) Flow experience has a direct and significant impact on tourist engagement, and flow experience plays a partial mediating effect in the impact of VR technology perception (perceived usefulness, perceived ease of use, perceived entertainment) on tourist engagement. Finally, according to the results, management suggestions are put forward from two aspects of VR project improvement and experience improvement, and at the same time, the shortcomings of this research are pointed out, and the direction for future research is pointed out.

Keywords-Smart tourism; VR technology perception; Tourist engagement; Flow experience

1 INTRODUCTION

With the development of virtual reality (VR) technology, the combination of VR technology and tourism has become a new form for modern tourists to experience the diversity of tourism.

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On the one hand, the application of VR technology can make online travel consumers enjoy virtual travel products and services without time and space restrictions. On the other hand, the introduction of VR technology in tourist attractions can not only enhance the novelty of scenic projects, but also enrich the scenic entertainment facilities. Therefore, how to win the deeper engagement of tourist consumers to the scenic spot through VR technology and strengthen the connection and interaction between tourists and the scenic spot has become an important topic of concern of the scenic spot.

Previous studies have shown that the technology acceptance model (TAM) can better measure the individual's acceptance of emerging technologies. The application of TAM in tourism mainly focuses on tourism e-commerce, focusing on the acceptance of various consumer groups to tourism e-commerce, exploring consumer perception, attitude and behavior tendency. In addition, tourist engagement (TE) is more colorful than the previous research on tourist psychology or behavior, and can better understand the compatibility between tourists and scenic spots from a comprehensive perspective. Therefore, this study uses an extended technology acceptance model to elicit VR technology perception, and explores its impact on tourist engagement based on the S-O-R paradigm, with flow experience (FE) as a mediator.

2 RESEARCH HYPOTHESIS AND MODEL CONSTRUCTION

2.1The relationship between VR technology perception and flow experience

VR technology is a multimedia environment constructed by computer technology. Its outstanding feature is highly interactive, so that consumers can have an immersive experience and realize a breakthrough in simple "hands-off" participation in traditional technological media (Seibert & Shafer, 2018) [20]. Previous studies have shown that the impact of technology perception on the acceptance of emerging technologies mainly focuses on perceived usefulness (PU), perceived ease of use (PEU) and perceived entertainment (PE) three aspects (Zhang Shiying, 2014; Li Zhi, 2019; Zhang Jiaqi et al., 2021) [11, 28, 29]. Therefore, in combination with its own research characteristics and referring to the division of Zhang Shiying (2014) [29] and Gui Yifang (2016) [6], this study introduces the main variables in the extended model. The impact of virtual reality technology on tourist engagement is mainly investigated from the perspective of technology perception, which is summarized as virtual reality technology perception, that is VR technology perception. And it includes three dimensions of perceived ease of use, perceived usefulness and perceived entertainment. Flow experience is defined as the enjoyable experience of being immersed in a certain leisure activity or entertainment project.

In the Internet environment, immersive experience and technological environment stimulation will serve as a response mechanism of consumer experience, and the flow experience environment created by them will bring consumers better consumption experience and good presentation effect (Mollen & Wilson, 2010) [16]. Zhou (2013) [30] pointed out through investigation that the perceived ease of use of emerging technologies has a significant impact on immersion experience. The research of Chen Jie et al. (2009) [3], Liu Yan et al. (2016) [15] also confirmed this point of view, showing that perceived ease of use and perceived usefulness in consumers' online experience are conducive to consumers' flow experience. Liu Dan et al. (2018) [13] on the basis of ease of use, took mobile learning of college students as the research

object, expanded and discussed the driving effect of content quality, perceived relationship and perceived entertainment on flow experience. Therefore, the following hypotheses are proposed in this study:

H1: VR technology perception positively affects tourists' flow experience.

H1a: The perceived usefulness of VR technology positively affects tourists' flow experience.

H1b: The perceived ease of use of VR technology positively affects tourists' flow experience.

H1c: The perceived entertainment of VR technology positively affects tourists' flow experience.

2.2The relationship between VR technology perception and tourist engagement

Tourist engagement refers to the cognitive, emotional and behavioral connections generated through interaction, communication or other non-transactional behaviors with tourism projects on the basis of certain tourism expectations (Wang Fuyuan et al., 2019) [26]. In the context of smart tourism, tourists have deep contact with tourist destinations through playing projects, which will form a close combination in psychology and a deep interaction in action (Prentice, 2001) [18]. As for the relationship between VR technology cognition and tourists, research shows that the perceived ease of use and perceived usefulness of emerging technologies can well explain consumer trust and behavioral intention in the context of the Internet, and also reflect the strength of individual willingness to participate to a certain extent (Chen Minghong et al., 2020; Wang Chao & Gu Xiaoqing, 2022) [4, 25]. Xu Feifei et al. (2018) [27] and Sun Qian (2019) [21] studied consumers' perception of new technology or application software and pointed out that consumers' perceived entertainment or perceived usefulness has a positive effect on tourist engagement. Ahn et al. (2007) [1], Moon and Kim (2001) [17], when studying user groups' propensity to use new technologies or new information systems, all found that individuals' own attitudes and behavioral tendencies would be influenced by perceived entertainment of products. Therefore, the following hypotheses are proposed in this study:

H2: VR technology perception positively effects tourist engagement.

H2a: The perceived usefulness of VR technology positively effects tourist engagement.

H2b: The perceived ease of use of VR technology positively affects tourist engagement.

H2c: The perceived entertainment of VR technology positively affects tourist engagement.

2.3VR technology perception, flow experience and tourist engagement

Flow experience is specifically manifested as the joyful experience of being immersed in a certain leisure activity or entertainment project, which makes people feel that time passes quickly without being aware of it (Ren Jun et al., 2009) [19]. As for the relationship between flow experience and tourist engagement, existing studies show that flow experience positively drives customer engagement and has a positive effect on its formation (Lin Yan & Yu Shasha, 2019) [12]. Hsu and Lu (2004) [7] concluded from the investigation of online shopping that consumers' online flow experience would affect their perception and behavioral intention. The research of Li and Lin (2017) [9] also supports the viewpoint of Hsu and Lu (2004) [7] to some extent. In addition, existing studies have found that the good perception of emerging technologies brings in-depth consumption experience to customers, which further affects

consumer psychology, such as user engagement and trust. For example, Liu Dan et al. (2018) [13] studied college students in mobile learning and found that perceived ease of use, content quality, perceived relationship and perceived entertainment would positively affect the occurrence of flow experience, thus improving user engagement of mobile learning. The researches of Liu Jia (2014) [14], Li Ying and Xiao Shan (2019) [10] also prove this viewpoint to some extent. Therefore, the following hypotheses are proposed in this study:

H3: Flow experience positively effects tourist engagement.

H4: Flow experience has a mediating effect between VR technology perception and tourist engagement.

H4a: Flow experience has a mediating effect between the perceived usefulness of VR technology and tourist engagement.

H4b: Flow experience has a mediating effect between the VR technology perceived ease of use and tourist engagement.

H4c: Flow experience has a mediating effect between the VR technology perception of entertainment and tourist engagement.

The theoretical model of this study is shown in Figure 1.

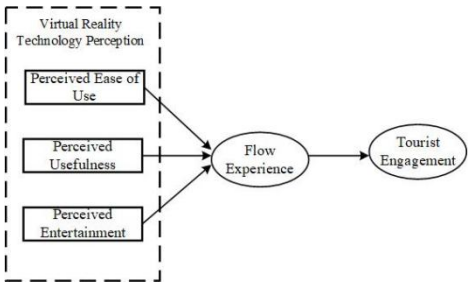

Figure 1 Theoretical model

3 METHODS

3.1 Research methods

This study mainly discusses the relationship between VR technology perception, flow experience and tourist engagement. Therefore, the research objects are tourists who have experienced VR projects in scenic spots. Due to epidemic prevention and control, the questionnaire survey was conducted in the form of on-site distribution and online collection. The questionnaire survey involves subjective evaluation of tourists, so in the process of on-site questionnaire distribution, we communicate with the VR project leader of the scenic spot and ask him to assist us. Finally, a total of 420 questionnaires were distributed through field visits and online surveys, 411 were recovered, and 384 valid questionnaires were eliminated with effective recovery rate of 89.33%.

3.2Research tools

This study mainly includes the measurement of three variables, which are VR technology perception, flow experience and tourist engagement. The Likert 5-point scoring method is adopted in the scale.

VR technology perception (Cronbach's α=0.855) includes three dimensions, namely, perceived ease of use, perceived usefulness and perceived entertainment. Perceived ease of use and perceived usefulness mainly refer to the scale developed by Davis (1989) [5]. Perceived entertainment mainly refers to the scale compiled by Terry (2001) [22] and Venkatesh (2000) [23], with a total of 9 items.

Flow experience (Cronbach's α=0.853) was measured using the scale developed by Koufaris (2002) [8], including five items in total, including "When experiencing VR projects, I am highly focused (immersed in it)" and "When experiencing VR projects, I will ignore what is happening around me".

Tourist engagement (Cronbach's α=0.912) was measured by referring to the scale developed by Vivek (2009) [24], which included 10 items in total, such as "I will be interested in things about this scenic spot" and "I am willing to learn more things about this scenic spot".

4 STATISTICAL ANALYSIS AND RESULTS

4.1Confirmatory factor analysis

In this study, confirmatory factor analysis (CFA) was used to test the discriminant validity between variables. In the comparison of single-factor model, two-factor model and three-factor model (Table 1), it can be seen that the three-factor model shows a good fit among the comparison models (χ^2/df=3.264; RMSEA=0.077; GFI=0.841; AGFI=0.808). These results indicate that the three variables are really different constructs and have ideal discriminative validity.

TABLE 1 CONFIRMATOTY FACTORY ANALYSIS

Model	Factor	χ^2/df	RMSEA	CFI	AGFI
single-factor	VR+FE+TE	5.784	0.112	0.683	0.621
two-factor	VR; FE+TE	5.002	0.102	0.739	0.686
two-factor	VR+FE; TE	3.562	0.082	0.825	0.790
three-factor	VR; FE; TE	3.264	0.077	0.841	0.808

Note: VR: VR technology perception; FE: Flow experience; TE: Tourist engagement.

4.2 Correlation Analysis

Table 2 shows the mean values, standard deviations, and correlation coefficients of variables. The results show that there is a significant correlation between each variable quantum dimension, which provides a necessary premise for the analysis of the relationship between the variables.

TABLE 2 CORRELATION ANALYSIS

Variable	M	SD	PU	PEU	PE	FE	EM	CP	SI
PU	4.086	0.593	1						
PEU	3.861	0.597	0.410**	1					
PE	4.068	0.580	0.649**	0.379**	1				
FE	3.927	0.557	0.625**	0.456**	0.660**	1			
EM	4.027	0.562	0.518**	0.405**	0.473**	0.547**	1		
CP	3.937	0.570	0.475**	0.418**	0.469**	0.466**	0.648**	1	
SI	4.160	0.525	0.491**	0.350**	0.483**	0.481**	0.674**	0.718**	1

Note: ** $p<0.01$; *$p<0.05$.

4.3 Hypothesis testing

4.3.1 Regression analysis of VR technology perception to flow experience

This study tested the relationship between the three dimensions of VR technology perception and flow experience, and the regression analysis results are shown in Table 3: It can be seen from Model 1 that only occupation has significant influence on flow experience among the control variables. After adding perceived usefulness, perceived ease of use and perceived entertainment, it can be seen from Model 2 that perceived usefulness has a positive influence on flow experience (β=0.281, $p<0.001$), and perceived ease of use has a positive influence on flow experience (β=0.190, $p<0.001$), perceived entertainment had a positive effect on flow experience (β=0.401, $p<0.001$), and the explanatory R^2 increased from 0.025 to 0.537, thus supporting the hypothesis of H1a, H1b and H1c. That is, the perceived usefulness, perceived ease of use and perceived entertainment of VR technology have a significant direct effect on tourists' flow experience respectively.

4.3.2Regression analysis of VR technology perception to tourist engagement

This study tested the relationship between the three dimensions of VR technology perception and tourist engagement. The regression analysis results are shown in Table 3: It can be seen from Model 3 that control variables do not significantly affect tourist engagement. After adding the three dimensions of VR technology perception, it can be seen from Model 4 that perceived usefulness has a positive impact on tourist engagement (β=0.303, $p<0.001$), and perceived ease of use has a positive impact on tourist engagement (β=0.224, $p<0.001$). Perceived entertainment has a positive effect on tourist engagement (β=0.250, $p<0.001$), and the explanatory R^2 increased from 0.017 to 0.409, thus supporting the hypothesis of H2a, H2b and H2c.

4.3.3Regression analysis of flow experience to tourist engagement

In the regression analysis of flow experience to tourist engagement, it can be seen from Model 5 that the control variables have no significant effect on tourist engagement. After flow experience is added, it can be seen from Model 6 that flow experience has a significant positive effect on tourist engagement (β=0.561, $p<0.001$), and the explanatory R^2 increases from 0.017 to 0.324. Therefore, hypothesis H3 is supported.

4.3.4Mediating effect analysis of flow experience

In this study, the mediating effect test model proposed by Baron and Kenny (1986) was used to test the mediating effect of flow experience [2].

Firstly, it can be seen from Model 8 in Table 3 that perceived usefulness has a significant impact on tourist engagement. In addition, it can be seen from Model 2 in Table 3 that perceived usefulness has a significant impact on flow experience. According to Model 9, after the addition of the mediating variable (flow experience), flow experience has a significant explanatory power to tourist engagement ($\triangle R^2$ is positive and significant). Therefore, it can be seen from Model 8 and 9 that, with the addition of the mediating variable (flow experience), the predictive power of perceived usefulness decreases from 0.303 (significant) to 0.240 (significant), and the explanatory power R^2 increases from 0.409 to 0.432. Therefore, H4a is assumed to be true. That is, flow experience plays a mediating effect between VR technology perceived usefulness and tourist engagement, and its mediating results belong to partial mediating. In the same way, it can be seen from model 8 and 9 that, with the addition of the mediating variable (flow experience), the predictive power of perceived ease of use decreases from 0.224 (significant) to 0.181 (significant), and the explanatory power R^2 increases from 0.409 to 0.432, so H4b is assumed to be valid. In addition, it can be seen from Model 8 and 9 that, with the addition of the mediating variable (flow experience), the predictive power of perceived entertainment decreases from 0.250 (significant) to 0.160 (significant), and the explanatory power R^2 increases from 0.409 to 0.432. Therefore, H4c is assumed to be true.

TABLE 3 REGRESSION ANALYSIS

	Dependent Variables: FE		**Dependent Variables: TE**						
	Model 1	Model 2	Mode l 3	Model 4	Mode l 5	Model 6	Model 7	Model 8	Model 9
Control Variables									
Gender	0.059	0.044	0.057	0.044	0.057	0.024	0.057	0.044	0.035
Age	0.003	0.027	-0.01 9	0.003	-0.01 9	-0.020	-0.019	0.003	-0.004
Education	0.088	0.006	0.072	0.002	0.072	0.023	0.072	0.002	0.000
Career	-0.143 *	-0.085	-0.10 3	-0.055	-0.10 3	-0.022	-0.103	-0.055	-0.036
Income	0.104	0.029	0.099	0.027	0.099	0.041	0.099	0.027	0.021
Independe nt Variables									
PU		0.281***		0.303* **				0.303* **	0.240* **
PEU		0.190***		0.224* **				0.224* **	0.181* **
PE		0.401***		0.250* **				0.250* **	0.160* *
Mediator									
FE						0.561** *			0.225* **
R^2	0.025	0.537	0.017	0.409	0.017	0.324	0.017	0.409	0.432
Adjusted R^2	0.012	0.527	0.004	0.396	0.004	0.314	0.004	0.396	0.418

$\triangle R^2$	0.025	0.512	0.017	0.392	0.017	0.307	0.017	0.392	0.023
$\triangle F$	1.959	138.042**	1.312	82.759***	1.312	171.458***	1.312	82.759***	15.381***

Note： $*p < 0.05$; $**p < 0.01$; $***p < 0.001$.

4.4 Hypothesis testing

The results show that: (1) all three dimensions of VR technology perception have a direct and significant impact on flow experience; (2) All three dimensions of VR technology perception have a direct and significant impact on tourist engagement; (3) Flow experience has a direct and significant impact on tourist engagement, and flow experience plays a mediating effect in the impact of VR technology perception (perceived usefulness, perceived ease of use, perceived entertainment) on tourist engagement.

5 RESEARCH CONCLUSIONS AND DISCUSSION

5.1Research conclusions

With the help of research and analysis, this study draws the following conclusions: First, VR technology perception is an important factor affecting the formation of tourist engagement. The more useful, easy to use and interesting the VR project experience introduced by the scenic spot is, the more it will touch the tourists' inner enthusiasm for the scenic spot, and then it will drive the tourists to consciously participate in the activities of the scenic spot and carry out in-depth interaction with the scenic spot. Second, flow experience plays an important mediating effect in the relationship between VR technology perception and tourist engagement. The promotion effect of technology perception on flow experience is not a simple one step. The good perception of emerging technology also plays an important effect in the process of influencing tourists' loyalty in attitude and behavior.

5.2Management Suggestions

With the help of the expanded technology acceptance model, this study elicits VR technology perception, and explores its impact on tourist engagement based on the S-O-R paradigm. The following suggestions are put forward focusing on how to improve tourist engagement, in order to promote the application of VR technology in the field of tourism and provide a certain direction for subsequent scenic spots to improve tourist engagement.

Firstly, based on the needs of tourists, focus on improving the perceived usefulness, ease of use and entertainment experience of VR technology. In terms of the usefulness and ease of use of VR projects, scenic spots also need to increase technical input and increase related explanations, reduce the threshold of use, make experience projects more simple, from the perspective of tourists, make the use of scenic spots more user-friendly, so as to improve the quality of tourist experience; In entertaining aspects of the project, the scenic area also need to expand and develop more interesting VR projects, in terms of function, interactivity, interface design should be given more tourist entertainment demand, such as VR projects and related scenario of current popular games, and the combination of popular TV dramas such as picture, thus increasing the tourists travel fun. Secondly, attach importance to emotional experience and

improve the pleasure experience of tourists. Scenic spots can improve the usefulness and ease of use of VR projects by key factors, such as adding interesting explanations of projects, adding warm-up activities of games, and supporting relevant technical guidance, so that tourists can control the play project, dedicated to the VR project, so as to obtain immersive tourism experience.

5.3Limitations and Prospects

There are also some limitations and deficiencies in this study, mainly reflected in:

Firstly, the subjects of the research are mainly young groups under 30 years old. Whether the research conclusions are applicable to tourists of other age groups needs further discussion. Secondly, this study only conducted a survey at a certain point in time, and tourists' psychology and behavior will change over time. Therefore, the universality of the conclusion in time dimension needs to be further confirmed.

In view of the above deficiencies, future research can be carried out from the following two aspects. Firstly, follow-up research should consider expanding the age coverage of the research group accordingly, and give full consideration to whether there are differences in various groups and age stages. Secondly, future studies can be conducted by increasing longitudinal time series surveys. In the longitudinal time series survey of the same group, whether there will be corresponding changes in the degree of technological perception, the degree of immersive experience and the subsequent psychological behavior, etc., so as to deeply analyze the relationship between the VR technology perception of tourists and tourist engagement.

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