

# *Research on the Impact Mechanism of Augmented Reality Technology on Tourist Experience*

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**Abstract:** With the rapid development of new media technology, augmented reality technology, known as the next universal technology of human-computer interaction, is being widely used in various fields, and also provides new possibilities for intelligent construction. Based on the technical acceptance model and task-technology adaptation model, in Luoyang Longmen grottoes scenic area as a case, using fuzzy set comparative analysis method, discusses the sense of use, perceived usefulness, perceived interest, task characteristics, technical characteristics, task-technology matching degree and personal characteristics of augmented reality applied in tourism to improve the linkage effect of use intention and its path selection. It can be considered that the impact on tourists' augmented reality technology use behavior is multi-dimensional and multisynergistic. Among them, there are three main influence paths, corresponding to the three development modes of augmented reality technology in the field of tourism: The influence path with perceptual usefulness as the core, corresponding to the technical tool mode; The influence path with the perception of interest as the core, corresponding to the technical tourism mode; The influence path with high task-technology matching degree as the core, corresponding to the resource upgrade mode.

## 1. Introduction

In the 1960s, the virtual reality-based headset display (HMD) appeared, when the user turns the head, the HMD display content changed with the angle, and eventually superimposed the display content on the real scene. This is considered by many scholars as the beginning of augmented reality technology (AR)<sup>0</sup>. Later, in the 1970s, philosophy-based augmented reality technology discussion began to appear, but due to technical limitations, relevant research was paid no attention until 2010-2015, when augmented reality technology based on holographic projection was gradually applied in mobile devices and other mobile phones. On the basis of technological progress, the application research of augmented reality technology is more extensive. Therefore, even if the earliest literature dates back to 1995, research on the application of augmented reality in tourism was only conducted on a large scale after 2010<sup>00</sup>.

Today, visitors are more involved in using VR and AR to experience destinations, hotels or museums<sup>00</sup>. Therefore, the research and commercial applications of augmented reality technology have flourished in tourism, and have prompted scholars to study the drivers of the success of using virtual technology in tourism<sup>00</sup>. In the 21st century, the research on augmented reality in computer

science has been increasing year by year<sup>0</sup>, and important progress has been made in the application of augmented reality technology in tourism. Researchers in the field of heritage tourism have tried to simulate the ancient Greek cultural heritage from the threats of pollution, disasters and war<sup>00</sup>. In 2010, Guttentag became the first scholar to conceptualize extended reality (including virtual reality and augmented reality) in tourism, and his research played an important role in pioneering research in this field<sup>0</sup>. After that, the number of relevant papers published in top journals has increased rapidly, and the researchers' perspectives have become more diverse. For example, the related research on the technical acceptance model (TAM) of augmented reality technology has appeared in wine tourism, historical tourism, heritage tourism and other fields, which has an important inspiration for the research of tourist experience research in the background of augmented reality technology application. During the same period, research on tourism and new technologies based on the SOR (stimuli-organism-response) framework was developed. In this framework, stimulation affects the visitor's mood and cognition, resulting in behavior (proximity or attachment and avoidance).

## 2. Research Case

The Longmen Grottoes World Cultural Heritage Tourism Area, located in the southern suburb of Luoyang City, was awarded as a World Historical and Cultural Heritage Site by UNESCO in 2000. Longmen Grottoes World Cultural Heritage Park is in the forefront of similar scenic spots in the application of modern technology. In 2019, the virtual recovery technology combining online AR display and offline 3D printing was officially released. Visitors only need to use their mobile APP to scan the restored AR images to the screen with the remaining images in the cave<sup>0</sup>.

## 3. Research Model

The technical acceptance model (TAM) is a kind of attitude image behavior designed to explain and predict how the user accepts the use of the new technology after a period of interaction with the system<sup>00</sup>. The application of technical acceptance model (TAM) in tourism is mainly used to study the individual behavior attitude and behavior intention of tourists, based on the comparison between costs and benefits between subjects. The traditional TAM model mainly includes two factors: perceived usefulness and perceived ease of use.

In 1995, the TTF (Task Technology Fit) model proposed by Goodhue and Thompson was derived from the Technical Performance Chain (TPC), based on the theory of perceptual suitability and revealed the task performance mechanism of information technology through the analysis of individual cognitive psychology and behavior<sup>0</sup>. It includes task characteristics, technical characteristics, task-technology matching, use behavior, personal performance and other core elements.

On the premise of meeting the theoretical core requirements of "technology acceptance model" and "task-technology matching model", the measure of the level of tourist experience.

The Fuzzy set qualitative comparative analysis (fsQCA) approach is considered an effective way to explore "joint effects" and "interactive relationships", The core logic of the basis is the collective theory of thought, Its founder Ragin argued that many propositions of social science research can be interpreted as affiliations between collections<sup>0</sup>. Therefore, the proposed method observes the relation of conditions and results from the perspective of set theory, and the Boolean algebra algorithm is used to formalize the logical process of analyzing the problem, Emphasize the continuous dialogue with relevant theories through empirical materials, The causal relationship of the research issues was constructed from the small sample data, Focus on how multiple different conditional variables lead to the occurrence of results in the formation of combinations. Therefore, the above model can

be simplified to the influence model of 8 factors on tourist behavior in two categories: technology user factors and technology factors.

## **4. Selection of Reason Conditions**

### **4.1 Visitors' Cognitive Level of Augmented Reality Technology**

In practice, visitors often choose technical forms that are easy to master and promote the level of experience, described by TAM models as the perceived ease of use and usefulness of the technology.

(1) Perceptual ease of use is the perception of the difficulty of the new technology when adopting the new technology<sup>0</sup>.The higher the level of awareness of the new technology, the stronger the intention to accept the new technology.The additional workload and adaptive investment that tourists pay when using a new technology is the main criteria for measuring the ease of use of the new technology.

(2) This study describes perceptual usefulness as a cognitive judgment of whether the use of new technology helps to improve the level of experience.Only when tourists recognize the internal connection between the application of new technology and improving the level of experience, the useful cognitive tendency of new technology is established, and the attitude and intention of using new technology are formed.In tourism, different aesthetic objects, different requirements and restrictions on new technologies, different aesthetic objects affect whether a certain technical form will be applied, in what level and scope will be applied, and how to be applied.

### **4.2 Tourist Knowledge**

The process of tourists to accept the new technology is in fact a process of taking the new technology as the medium, calling the knowledge system and experience system related to the tourism attraction, and carrying out the aesthetic experience.

### **4.3 Relevant Experience**

In the view of psychology and organizational behavior, an individual's past behavior will have a strong prediction and influence on their future behavior.Tourists will choose some successful use of experience of technology products based on their previous experience.

### **4.4 Technical Characteristics**

At present is an era of rapid development of information technology. The technology that can achieve a certain function is no longer single, but often exists in the form of a technology cluster.That is to say, in many new technology for tourism product quality improvement, compared with holographic projection technology, virtual reality technology, naked eye 3D technology, etc., augmented reality technology only when in the technology group has irreplaceable function or has a relative advantage in operation, will produce positive correlation with individual use intention effect.

### **4.5 The Extent to Which Augmented Reality Matches Specific Tasks**

The degree of adaptation of new technology and tasks reflects the internal logical relationship between technology application and task requirements, and it is possible to use it when individuals perceive that technical functions and task characteristics match well. When any new technology

enters the practice field, it still needs to follow the path of finding problems, finding technical solutions, and explore the effective application of technology from the perspective of demand.

## 5. Data, Processing

### 5.1 Data Calibration

In fsQCA, calibration means giving cases a membership score. In set theory, each condition and outcome are treated as an independent set, where each case has membership scores<sup>0</sup>. This paper adopts the direct calibration method, according to the common calibration standard and the actual situation of the case, with 0.5 as the calibration standard, 0.05 as completely not subordinate to the calibration standard, 0.95 as completely subordinate to the calibration standard, the calibration information of the conditions and results is shown in the table 1:

Table 1: Calibration of the Conditions and Results

Conditions and Results		calibration		
		Fully subordinate	cross point	Not subordinate at all
Perceived usefulness	PU	5.75	4.5	3.3875
Perceive ease of use	PEO	4.5	3.5	2.5
Tourist knowledge	TK1	6	3	1
relevant experience	EA1	1	0	0
Technical characteristics	TYC	5.67	4.67	3.33
Technology-Task matching degree	PEOU	5.33	4.33	3
behavior disposition	BI	5.71399177	5.15534979	4.59855967

### 5.2 Qualitative Comparative Analysis

This paper abandons the traditional statistical analysis method based on the binary relationship of “independent variable-dependent variable”, and uses the qualitative comparative analysis (QCA) method based on set theory, trying to analyze the multiple and complex action mechanism of the application of augmented reality technology on tourist experience based on the perspective of configuration. This is mainly due to the following considerations: First, in the path of augmented reality technology affecting tourists' experience, the independent role or multiple combination of tourist cognitive level, tourist knowledge, related experience, technical characteristics and technical-task matching degree are difficult to be clearly shown in conventional statistical analysis. The QCA analysis believes that the interdependence and different combinations of cause conditions constitute multiple concurrent and causal relationships, which helps to understand the interaction between multiple cause conditions. Therefore, the QCA method is more suitable to explore the influence mechanism on tourist experience under the combination of multiple dimensions of augmented reality technology from the overall relationship.

## 6. Da

### 6.1 Necessity Analysis of the Individual Conditions

Before performing the conditional configuration analysis, it is necessary to test the “necessity (Necessity)” of each condition separately. This paper, combined with the mainstream QCA study, and first tests whether a single condition (including its non-set) constitutes a necessary condition to affect the behavior intention of tourists.

In QCA, a condition always exists when the result occurs, and then it becomes necessary for the

result .Agreement is an important detection criterion for essential conditions and is necessary for the results when the consistency is greater than 0.9 .The following table 2 shows the results of the necessary conditional tests for high and non-high level behavioral intentions analyzed using fsQCA 3.0 software.It is seen that the level of agreement for all conditions was less than 0.9. Therefore, in the multi-dimensional elements applied by augmented reality in tourism, there is no necessary condition for the non-high level and the high level of tourists' behavior intention.

Table 2: an Analysis of the Necessary Conditions

condition variable	High behavioral intention		Non-high behavioral intent	
	consistency	coverage	consistency	coverage
High perceived usefulness	0.800780	0.738195	0.584557	0.539824
Non-high-perceived usefulness	0.500810	0.546147	0.716500	0.782745
High perception of ease of use	0.757801	0.755854	0.540626	0.540189
Non-high perceived ease of use	0.539005	0.539442	0.755656	0.757605
High tourist knowledge	0.711290	0.679820	0.605201	0.579447
Non-high tourist knowledge	0.559979	0.586074	0.665589	0.697836
High relevant experience	0.826759	0.595495	0.837937	0.604613
Non-high related experience	0.451059	0.735332	0.439391	0.717575
High technology characteristics	0.730571	0.761507	0.514178	0.536898
Non-high technology characteristics	0.555711	0.533112	0.771599	0.741528
High technology-task matching degree	0.809832	0.753028	0.555906	0.517826
Non-High Tech-task matching degree	0.481454	0.519743	0.734866	0.794709

## 6.2 Sufficiency Analysis of the Conditional Configuration

Table 3: Table of the Histomational Analysis Results<sup>1</sup>

Condition configuration	configuration ①	configuration ②	configuration ③	configuration ④	configuration ⑤
Perception of usefulness PU	●	●	∞		
Perceptual-ease-of-use, PEO			∞	●	●
Visitor Knowledge TK1		∞	●	●	∞
Related Experience EA1	●	●	●	●	●
Technical Features: TYC	●		●	∞	●
Technology-Task Match-PEOU	●	∞		●	●
consistency	0.95	0.861494	0.832061	0.917325	0.950323
Original coverage	0.471225	0.303945	0.288784	0.350309	0.346335
Unique coverage	0.0510009	0.0114807	0.030836	0.09111	0.0239918
The coverage of the solution	0.659479				
Concordance of solutions	0.850593				

Unlike the above analyses of the necessary conditions, the configuration analysis attempts to reveal the adequacy of the results induced by different groups composed of multiple conditions.From the set theory perspective, we explore whether a set represented by configurations composed of multiple conditions is a subset of the resulting set.Concordance is also used to measure the adequacy of configurations, but the acceptable minimum criteria and computational methods are different from analyses with necessary conditions.The frequency threshold shall be determined based on the sample size, for small and medium samples, and be greater than 1 for large samples. In specific studies, the

<sup>1</sup> ∞● indicates that the condition exists and that the condition does not exist.The blank indicates that the condition may or may not exist.

distribution of the cases in the true value table and the familiarity of the researchers should also be considered. The final consistency threshold determined in this study was 0.80 and a frequency number threshold of 3. The following table 3 shows the configuration analysis results of applying various dimensional conditions to influence tourist behavior intention in tourism<sup>0</sup>.

The five configurations presented in the table, both the single solution (configuration) and the overall solution consistency levels are above the acceptable minimum standard of 0.75, where the overall solution consistency is 0.850593 and the overall solution coverage is 0.659479. The five configurations in the table can be viewed as sufficient combinations of conditions capable of creating high tourist behavior intentions. The high experience elements of the five formations appear, indicating that tourists who have experienced AR technology will be more sensitive to the application of AR technology in tourism.

## 7. Finding

(1) On the whole, technical user factors, technical factors, technology-task matching degree and other factors cannot be used as the necessary conditions for augmented reality technology to affect the tourist experience level alone, indicating that individual elements will not constitute a bottleneck for the application of augmented reality technology in tourism.

(2) Enhanced reality that can cause the high behavior intention of tourists in tourism has three driving paths, namely three adaptation modes. Among them, the new tourism resource mode takes augmented reality technology as the core, high perceived usefulness, the technical tool mode, high perceived ease of use and high task-technology matching, the parallel development mode develops in parallel, and the dependence on the technology users.

## 8. Conclusion

This paper uses fsOCA method to conduct conditional configuration analysis on the application of augmented reality technology in Longmen Grottoes World Cultural Heritage Park, and finds that there are three paths to promote the high use behavior of augmented reality among tourists, and each path is composed of multiple elements. The three influence paths also correspond to the three development modes of augmented reality technology in the field of tourism. First, the influence path with perceived usefulness as the core corresponds to the technology tool mode. Its core point is to give play to the inherent tool properties of augmented reality technology and provide convenience for tourists in scenic spots. Second, the influence path with perceived fun as the core corresponds to the technological tourism model. Its core point is to explore the attraction of augmented reality technology, to develop augmented reality technology as a special tourist attraction, and to create new tourism resources with augmented reality technology as the core on the basis of extracting the original tourist cultural symbols. Third, the influence path with high task-technology matching as the core corresponds to the resource upgrade mode. Its core idea is to use augmented reality technology to realize the transformation and upgrading of tourism products and enhance the tourism attraction of original tourism resources on the basis of maintaining the core status of the original tourism attractions.

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