AN ANALYSIS OF TOURIST EXPERIENCE AND BEHAVIOR INTENTION OF THE AUGMENTED REALITY TOURISM OF MOGAO CAVES IN CHINA

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AN ANALYSIS OF TOURIST EXPERIENCE AND BEHAVIOR INTENTION OF THE AUGMENTED REALITY TOURISM OF MOGAO CAVES IN CHINA

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AN ANALYSIS OF TOURIST EXPERIENCE AND BEHAVIOR INTENTION OF THE AUGMENTED REALITY TOURISM OF MOGAO CAVES IN CHINA

BY

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This study aims to enhance theoretical research on how AR tourism influences tourist behavioral intentions, specifically the examining factors impacting tourist travel experiences and intentions at the Mogao Caves. It provides an overview and detailed analysis of variables including stimulating factors, tourist experiences, and behavioral intentions. Through a questionnaire survey, empirical analysis was conducted on 400 tourists who had experienced AR tourism in Mogao Caves. The sample demographics show a balanced gender distribution, with men accounting for 49.75% and women for 50.25%. The largest age group was 26-35 years old. PLS analysis was used to investigate the relationships between AR tourism experience and behavioral intentions, while also analyzing the structural model and the mediating effects among variables. The results indicate that in AR tourism, content quality, system quality, and interactive quality positively influence tourist experiences. AR tourism experiences significantly affect behavioral intentions. It was particularly surprising that the impact of tourist experiences on behavioral intentions exceeded expectations, underscoring its significance in AR tourism. This finding highlights the potential of AR technology in enhancing tourist experiences. The research advances digital cultural heritage tourism and supports sustainable development in Dunhuang tourism while preserving cultural heritage.

Keyword : AR Tourism, Tourist Experience, Behavior Intentions, Mogao Caves

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CHAPTER 1
INTRODUCTION

1.1 Background

The Dunhuang culture, represented by the Buddhist art of the Mogao Caves and relics from the Library Cave, has spanned nearly 2000 years. It is a shining gem in the river of world civilizations, blending Chinese culture with influences from Indian, Greek, Persian, and other foreign cultures (Liu & Qiao, 2023). According to the statistics, the total number of Cultural Sites in Dunhuang reached 265, including 3 World Heritage Sites and 4 National Key Cultural Heritage sites (Ministry of Culture and Tourism, 2023). The Mogao Caves, a Silk Road World Heritage Site, dates from the 4th to the 14th century and has 492 painted cave temples dug into 1.6 kilometers of cliff face (Agnew et al., 2014). It holds a revered historical position in the realm of cave art and offers tourists a rare cultural experience and historical exploration (Agnew & Neville, 1997). In recent years, the Dunhuang government has actively seized the opportunities of the “Belt and Road” initiative. It continues to explore cultural and tourism resources, improve supporting services, and further advance the policies of creating a “Great Dunhuang Cultural and Tourism Economic Circle”. The city aspires to be a well-known international cultural and tourism destination (Jiuquan Goverment, 2023). Dunhuang City’s tourism industry emerged with the Mogao Caves as one of its core resources and the local government adopted tourism as a pillar industry to stimulate the city’s economy. According to the Dunhuang Municipal Government statistics, in 2023, Dunhuang city received 16.8293 million tourists, marking a 427.05% increase compared to 2022, and generating tourism revenue of 15.622 billion yuan (China News, 2024). Six major attractions including the Mogao Caves and Crescent Lake in Mingsha Mountain received a combined total of 7.0018 million visitors for the first time, a 497.23% increase from 2022, setting new historical records (Dunhuang Municipal Committee Propaganda Department, 2023). These figures reflect the crucial role that the Mogao Caves play in the economic development of Dunhuang City. The Dunhuang Academy oversees this

significant heritage, which is recognized globally through major collaborations, including with the Getty Conservation Institute, aimed at conservation efforts.

With the rising “Digital Age”, people have realized they are living in a world where computers are ubiquitous, and scientists are beginning to use new technology in the study of social science fields (Ackland, 2013). The application of AR in tourism is flourishing and promising. As early as the year 2000, tourism researchers and industry elites keenly foresaw the tremendous potential of AR technology in the industry. This discovery gave rise to a new and dynamic research field (Jingen et al., 2021). AR offers innovative ways for tourists to explore unknown environments (Cranmer et al., 2018). Various VR and AR applications help practitioners attract more tourists and enhance service experiences (Wei, 2019). AR allows tourism enterprises to unpredictably integrate computer-based digital worlds into the immersive realm of the physical world (Çeltek, 2020). AR applications have opened a window for tourists, enabling them to delve deeper into and explore unfamiliar environments. This makes AR invaluable in the tourism industry, emerging as a significant trend in digital transformation and experience innovation of tourism destinations (Qiji & Chensi, 2022). AR is increasingly utilized for marketing, information dissemination, and enhancing experiences in the tourism industry (Cranmer et al., 2023). The tourism industry has faced tremendous pressures since the global COVID-19. The digitization of the tourism business necessitates the ongoing development of value in an ever-changing consumer experience. In the Forbidden City in Beijing, AR technology allows visitors to interact with artifacts, understanding their production techniques and historical significance. In Xi’an’s Terracotta Warriors and Horses Museum, AR technology enables visitors to see the original colors and equipment of the warriors, providing a more vivid experience of ancient military grandeur. At West Lake in Hangzhou, AR technology recreates ancient poets’ verses left by the lake, offering visitors a deeper insight into the cultural richness of West Lake. In Jiuzhaigou Valley in Sichuan, AR technology simulates potential natural disasters such as earthquakes and landslides, enhancing tourists’ awareness of disaster prevention. In Guangzhou, AR technology reconstructs historical buildings along the Pearl River,

allowing visitors to gain a deeper understanding of the city's historical and cultural heritage. The Chinese government implements a number of laws to encourage cultural heritage units, tourist attractions, and other entities to use cultural resources to create immersive experiential projects, digital exhibition halls, virtual scenic places, and other services. The State Council's "The 13th Five-Year National Informatization Plan" emphasizes the need to significantly improve the development and frontier layout of artificial intelligence, network technology, and augmented reality (National Development and Reform Commission, 2017). The digitalization of cultural heritage has been elevated to the status of national strategy in the 14th Five-Year Plan (2021-2035), which was published in 2021. For example, the Chinese Government (2023) envisions online digital experience products for museums, immersive experiences for tourist sites, and new cultural tourism services such as AR exhibition halls. New digital technologies, such as AR, have become the foundation for the tourism industry's high-quality development (Xinhua News, 2022).

As one of China's earliest cultural heritage conservation units, the Mogao Caves began digital exploration as early as the 1980s, opening up a new path for the protection and inheritance of Dunhuang Mogao Caves (Lu & Pan, 2011). To ensure that cultural heritage remains "Youthful Forever" and is spared from destruction. After three decades of research and investigation into digital technology, the Dunhuang Academy has developed a comprehensive solution for digitizing the cultural treasures of caves and vast amounts of associated data (Yu et al., 2022), and has created a number of scenario-based and immersive cultures to satisfy the needs of visitors seeking a more in-depth understanding of Dunhuang culture and experiences (Yang et al., 2023). In recent years, the Digital Dunhuang project has achieved significant milestone progress. Leveraging advanced virtual simulation technology, the project successfully restored precious religious art and historical cultural heritage, contributing greatly to the preservation and conservation of the caves. Since the launch of Digital Dunhuang, accessibility to and tourism practices at the Mogao Caves have significantly improved, striking a good balance between cultural heritage preservation and tourism industry

development. In 2016, the “Digital Dunhuang” AR resource library was launched, spanning 10 dynasties. Visitors have the opportunity to engage in interactive activities such as voiceover recording and immersive tours. These innovative methods enhance user engagement and promote the dissemination of Dunhuang culture. The application of digital technology enables tourists to feel the magnificence of Mogao Caves even from thousands of miles away. Additionally, Digital Dunhuang facilitates data access for academic research, fine arts, and education. Because of featuring diverse, representative, and immersive content, it has gained widespread acclaim at home and abroad. By the end of 2022, it had attracted over 20 million global visits from users in 78 countries, becoming an authoritative platform for international academia and the public to share Dunhuang culture (Dunhuang Municipal People's Government, 2023). AR tourism has effectively revitalized the utilization of Dunhuang culture, unleashing the profound power of its heritage.

AR tourism has effectively revitalized the utilization of Dunhuang culture, unleashing the profound power of its heritage. However, the application of AR technology in the Mogao Caves still faces multiple challenges. There are numerous English translation issues in the system, especially regarding the accuracy of terminology related to grottoes. For English tourists who rely on precise information, this may hinder the AR experience (Qiu et al., 2020). In addition, the Mogao Caves are composed of 492 uniquely shaped caves, each with specific technical requirements that necessitate highly customized research and development work. However, the murals in these caves generally have defects, and current AR technology struggles to fully replicate the complex details of these murals, which limits the depth of experience that tourists seek when exploring the Mogao Caves. Technical issues have further exacerbated these challenges. Users often encounter delays when opening the AR interface, and the interaction provided by the current system is relatively simple. The lack of responsiveness and depth of interaction reduces tourist satisfaction (Liu et al., 2022). More importantly, the escalating number of tourists has exacerbated the conservation pressures on the Mogao Caves. Apart from the scheduled 6,000 visitors,

as many as 12,000 tourists flood into the Mogao Caves daily, often queuing under the scorching sun in anticipation of entering the caves (CCTV News, 2022). Due to protection needs and space limitations, many tourists can only visit within limited areas, unable to experience up close the detailed murals and historical ambiance inside the caves. It is prompting experts, scholars, and tourism practitioners to reassess its impact. If AR tourism enhance the experience for tourists, and if it can address issues such as the relatively short duration of visitors' stays at Mogao Caves, as well as the significant fluctuations in visitor numbers between peak and off-peak periods.

To address these research gaps and considering the Mogao Caves' significant role in global cultural exchange and the current development of AR tourism, this study selects the Mogao Caves as an empirical research case. The aim is to expand the theoretical research on the influence mechanism of AR tourism on tourists' behavioral intentions, investigate the factors influencing tourists' travel experience and behavioral intentions in AR tourism at the Mogao Caves. By enhancing the research outcomes of digital cultural heritage tourism, providing empirical references for stakeholders in the tourism and cultural heritage fields. This will support the enhancement of AR tourism projects, improve tourist experiences, and promote mutually beneficial outcomes for cultural heritage preservation and sustainable tourism development.

1.2 Research Objectives

1.2.1 To study and understand tourists' augmented reality tourism quality, tourist experience, and behavioral intentions while virtually exploring the Mogao Caves.

1.2.2 To analyze the stimulate factors influence tourists' experiences and behavioral intentions of the augmented reality tourism of Mogao caves.

1.3 Significance of the Research

At the theoretical level, this study will broaden and deepen theoretical research on the influence mechanisms of digital cultural heritage tourism on tourists' behavior intentions, as well as enrich the theoretical system of the cultural heritage tourism experience. Based on SOR theory, a model will be developed to examine the elements

influencing tourists' experiences and behavioral intentions, thereby enhancing research achievements in digital cultural heritage tourism and offering theoretical references for the integration of culture and tourism. At the practical level, this study provides empirical research references for tourism firms and cultural heritage scenic locations, as well as improvements to Dunhuang's tourism difficulties. It will assist them in designing and improving AR tourism programs from the standpoint of visitors' emotional experiences in order to completely meet tourists' need for cultural tourism experiences and raise their knowledge of the importance of cultural heritage protection.

1.4 Definition of Terms

1.4.1 Augmented Reality Tourism

Augmented reality tourism is defined as a form of tourism that integrates AR technology into the tourism experience, creating interactive and immersive experiences for users. This provides tourists with a deeper understanding of the history, culture, and significance of Dunhuang and the Mogao Caves.

1.4.2 Tourist Experience

Tourist experience is defined as a deep integration of tourists with the surrounding environment, leading to a sense of oneness between body and mind. This integration is the outward manifestation of the inner interaction between tourists and the surrounding environment during a series of activities like appreciation, communication, imitation, and consumption in the Mogao Caves.

1.4.3 Behavior Intention

Behavior intention is defined as the possibility and inclination of individuals to travel to Dunhuang in a specific manner under the joint influence of internal psychological factors and the external environment.

1.4.4 SOR

SOR is the process of human behavior. In this context, Stimulus can be any external events, situations, objects, or internal physiological states that trigger an individual's perception and attention. "Organism" refers to the internal psychological state, encompassing the individual's emotions, motivations, values, beliefs, and

cognitive processes, among others. “Response” demonstrates how individuals adapt and regulate themselves in relation to external and internal factors.

1.5 Scope of Research

1.5.1 Population

The research focuses on Chinese tourists who have visited Mogao Caves of Dunhuang, experienced Augmented Reality (AR), and are at least 18 years old.

1.5.2 Area

The research area is a world cultural heritage site, the Mogao Caves tourist attraction in Dunhuang City, Gansu Province in China.

1.5.3 Time Period

The survey questionnaires were distributed to the target tourists who traveled to Dunhuang between February to April 2024 through online to offline questionnaires.

1.5.4 Research Substance

This research focuses on Mogao Caves in Dunhuang, using tourists’ experience and behavioral intention as entry points. AR tourism is categorized into three dimensions: system quality, content quality, and interactive quality. Drawing upon the SOR theory, tourism experience theory, and behavioral intention theory, the research analyzes factors influencing tourist experience and behavioral intentions. A theoretical framework is constructed for AR tourism, tourism experience, and behavioral intentions. Utilizing the Partial Least Squares Structural Equation Modeling (PLS-SEM), the study examines the impact mechanisms and pathways of AR tourism at the Mogao Caves on tourism experience and behavioral intentions.

CHAPTER 2
LITERATRUE REVIEW

The main purpose of this study is to investigate the factors influencing the impact of AR tourism on tourists' travel experiences and behavioral intentions. This chapter reviews literature related to augmented reality and tourism experiences as follows.

2.1. SOR Theory

2.2. Stimulus Factor

2.3. Tourist Experience

2.4. Behavior Intention

2.5. Augmented Reality in Dunhuang

2.6. Research related to Augmented Reality

2.1 SOR Theory

The SOR theory, also known as the Stimulus-Organism-Response theory, is a psychological framework (Mehrabian & Russell, 1974). It is often used to understand and analyze consumer behavior and how various factors interact to shape individuals' reactions and actions. The theory explains how external stimuli (S) influence internal psychological processes (O), which, in turn, leads to behavioral responses (R) (Li, 2022; Rummel, 1975). The SOR theory is defined as the "Stimulus-Organism-Response" process, which describes how an organism undergoes a process from receiving stimuli from the external world, processing these stimuli internally, and eventually generating a response. "Stimulus" refers to any factor in the external environment that attracts the attention of an organism and potentially triggers a response. "Organism" denotes a living being capable of perception, thought, and action. "Response" is the organism's reaction or response to the stimulus (Elaine et al., 1997). In this framework, stimulus is the starting point for triggering responses, and organisms being the entity that receives, interprets the stimulus, while responses are the adaptive responses that organisms make to stimulus (Rogers, 1975).

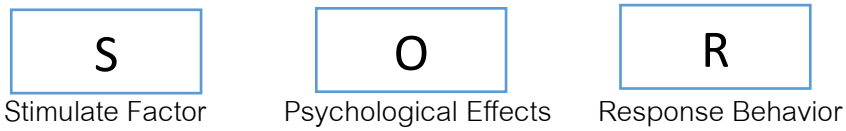

FIGURE 1 SOR Model

Source: (Mehrabian & Russell, 1974)

The “SOR theory” has become one of the key theories used to study and explain individuals’ emotional and behavioral responses to environmental stimuli (Chen et al., 2018; M. J. Kim et al., 2020). It has been applied in various fields, contributing to a wide range of research.

In the tourism industry, SOR theory is widely applied in studying tourists’ emotional and behavioral reactions to the tourism environment. It is used to explain the tourism impact of the destination environment on tourists internal emotion and behavior (Chen et al., 2021; Nian et al., 2023). The SOR model includes intervening variable, antecedent variable and outcome variable. Antecedent variables encompass attributes of the external environment. Tourists engage their psychological states through sensory perception. Intervening variables encompass internal psychological processes triggered by external stimuli, which manifest as tourists’ emotional states. Outcome variables represent tourists’ behavioral responses, influenced by emotions that may encourage or deter specific behaviors (Jeong et al., 2020). In the context of emerging digital technologies such as virtual reality (VR), augmented reality (AR), and artificial intelligence (AI). The SOR theory posits that external stimuli affect an individual’s psychological state, which in turn influences their behavior (Song et al., 2021). This theory is particularly relevant in the context of AR tourism. When travelers use digital technologies like VR, AI, and AR, the stimuli provided by these immersive environments influence their perceptions and emotions.

In AR tourism, stimuli (S) refer to the digital experiences offered to tourists, such as exploring virtual environments or using AI-driven guides to enhance the travel experience (Kim et al., 2020). These digital experiences not only include visual immersion but also significantly enhance tourists' perception of cultural experiences (Han et al., 2020). AR can provide personalized guidance and narration, helping tourists to gain a deeper understanding of the destination's history, culture, and landscape features, further enriching their leisure experience (Ghandour et al., 2021).

The stimuli activate the organism (O), representing the individual's psychological effects, which may manifest as increased curiosity, engagement, or emotional responses to the quality of AR content, system reliability, and interactivity (Xu et al., 2024). The quality of content, system, and interactivity in AR tourism directly influences tourists experience and virtual attachment. These factors significantly shape tourists' intentions and behaviors during their travels (Do et al., 2020; Morrison et al., 2024; Trunfio et al., 2022). Tourists are more likely to express an intention to visit a location physically if their virtual experience proves compelling. This is especially relevant when considering the use of AR to virtually explore destinations before making travel decisions. Thus, Content quality, system quality, and interactive quality are critical factors influencing tourists' virtual exploration of destinations or experiences in AR tourism (Jung et al., 2015; Moon et al., 2019; Stylidis et al., 2022).

The organism influences the individual's response behavior (R). From a consumer behavior perspective, approach behavior refers to positive behavioral responses triggered by stimuli in the external environment, such as staying in a specific environment, exploring, and desiring social interaction. In contrast, avoidance behavior refers to negative behavioral responses after accepting environmental stimuli, with a relatively lower willingness to stay in the environment (Mehrabian & Russell, 1974). Approach behavior includes actual actions taken and the intentions behind those actions (Peng et al., 2014). For example, visitors to theme parks perceive higher value and express greater willingness to revisit based on their perception of the natural environment's realism (Chang et al., 2014).

In summary, the SOR theory is a comprehensive framework that provides a structured approach to understanding how environmental factors mediated by user experience influence tourists' internal psychological states and subsequent behaviors. It is used to study and explain tourists' emotional and behavioral responses to various environmental stimuli in the tourism industry. The key elements of the SOR model include stimuli (S), which are the AR experiences provided to the tourists; Organism (O), representing the tourists' psychological effects manifested as emotional, leisure, and cultural experience responses to the quality of AR content, system, and interactive quality; The response (R), which refers to how these psychological states influence tourists' behavioral responses. Behavioral responses can be categorized into approach behaviors (positive behaviors, such as staying, revisiting, recommending, and paying a premium).

The SOR theory is used as a foundational research framework in this study for a comprehensive exploration of the impact of AR tourism at the Mogao Caves on tourists' experiences and behavioral intentions. The study variables are categorized into three groups: AR tourism, internal psychological effects, and reaction, leading to the construction of a conceptual model. The first category, the stimulation factor, encompasses elements crucial to AR tourism. Drawing on the SOR theory and researchers' studies on AR tourism experiences, this factor comprises three major components: content quality, system quality, and interactive quality. The second category, rooted in cognitive psychology, is the tourist experience. It includes the emotional, leisure, and cultural dimensions individuals undergo during AR tourism, which are crucial in shaping tourists' psychological effects. The third category focuses on tourists' reaction, particularly their behavioral intentions. It includes various dimensions such as stay intention (indicating tourists' inclination to extend their stay after the AR experience), revisit intention (reflecting the likelihood of tourists returning to physically visit the Mogao Caves), recommendation intention (measuring the willingness of tourists to recommend the destination based on their AR tourism experience), and

premium payment intention (showcasing the willingness to invest in premium services or experiences, indicating perceived value and satisfaction derived from the AR encounter).

2.2 Stimulus Factor

The “stimuli” refers to environmental signals that influence an individual's mental state (Jung et al., 2021). A stimulus is defined as an entity or occurrence capable of arousing or prompting human actions. In the context of tourist decision-making, a stimulus is an external factor that motivates tourists to formulate travel intentions (Chan et al., 2017). In this scenario, AR serves as the primary technological stimulus. AR overlays digital assets onto users' real environments, allowing them to access compelling digital content while maintaining interactions with others, thus introducing a social dimension to the stimulus (Suh et al., 2018). By providing unprecedented sensory stimulation through immersive and interactive experiences, AR significantly enhances tourists’ engagement and enjoyment (Chunhui et al., 2022).

Prior research has identified various factors influencing stimuli, with content quality being a significant determinant. Content quality affects the relevance, accuracy, currency, and usability of information and media on a website, acting as a stimulus for online customers. It plays a pivotal role in encouraging website engagement and shaping user behavior (Liu et al., 2023). Representing the external environmental factors of a website, content quality encompasses the information and media present. It profoundly influences how customers perceive and interact with the website’s content. In the context of stimuli, high-quality content leads to positive experiences, while low-quality content results in negative customer perceptions (Yadav et al., 2022). In the context of travel decision-making, high-quality, reliable, and accurate content contributes to forming a positive user experience. This encourages users to interact more actively with the website, such as reading relevant information, watching videos, or making purchases. In the realm of AR tourism systems, the system provides accurate, up-to-date, and valuable information covering tourist attractions, guide services, cultural interpretation, travel planning, and guides (Kim et al., 2020). The content quality of an AR tourism system directly influences the value and usability of the user experience,

making it an indispensable factor in stimulating tourist interest, encouraging active responses, and fostering engagement with the website (Trunfio et al., 2022). Therefore, content quality is a key variable in the SOR model, regarded as a crucial stimulus factor. It plays a stimulating role in the interaction between users and the website, generating positive psychological and emotional responses (Mehrabian & Russell, 1974; Song et al., 2021).

The concept of authenticity has become a focal point in the research of tourism motivation and experiential sociology, garnering significant attention in the field of tourism studies (Ahmed et al., 2021). When tourists make travel decisions, the quality of AR system plays a crucial role in influencing their level of interest in specific destinations. Because it directly impacts users' experiences and perceptions. High system quality ensures smooth performance, quick loading times, accurate information, and seamless interactions, which are essential for maintaining user engagement and satisfaction. For instance, a well-functioning AR system that offers high-resolution graphics, responsive controls, and reliable information enhances the user's sense of immersion and enjoyment, thus acting as a positive stimulus (Kim et al., 2020). The system quality is another key variable in the SOR model. Factors such as performance, reliability, and technical functionality contribute to the overall perceived quality of the system (Jayadi et al., 2022).

The content, personalized services, and system quality of AR technology directly impact tourists' overall experiences, consequently influencing their satisfaction (Jung et al., 2015). The SOR model explores the relationships between external stimuli and internal responses, asserting that the interface of AR applications can elicit specific reactions from users through emotional and cognitive processes. In this model, system quality is a critical component, determining the smoothness and enjoyment of users' AR application experiences. System quality serves as a vital intermediary in the internal processes triggered by external stimuli, especially the interface design in AR applications. A high-quality system ensures that users find the application easy to use, intuitive, and stable, fostering positive emotional experiences. This positive experience,

in turn, stimulates users' willingness to further engage with AR applications, elevating their level of participation and interest. Conversely, low system quality may lead to challenges or issues, resulting in negative emotional experiences that hinder user engagement and reduce interest levels. In the field of AR tourism, system quality is crucial for determining the effectiveness of user experiences. It influences users' willingness to engage and their responses to stimuli, making it a critical stimulus variable (Guo et al., 2024).

The investigation reveals a close correlation between user satisfaction and the likelihood of recommending AR applications with the content, personalized services, and system quality of such applications (Jung et al., 2015). In the realm of tourist experiences, AR technology aims to heighten on-site engagement, aligning with the prevailing trend in activities and destinations to support augmentation rather than replacing it with virtual reality (Neuhofer et al., 2021). Accessing and exploring AR tourism involves human-machine interaction. Research indicates that integrating AR guide systems significantly enhances tourists' learning abilities and sense of direction, cultivating a positive attitude towards these systems (Chang et al., 2015). In contrast, poor interactive quality in a website or system can pose challenges for users, leading to frustration, confusion, and disengagement. For instance, slow response times or cumbersome navigation menus can cause impatience, driving users to seek alternative interactive platforms. In the context of enhancing AR tourism experiences, the essence of interactive quality lies in proficiently utilizing digital technology to discern user needs and preferences, providing personalized information to tourists. Interactive quality becomes crucial in enabling tourists to make informed and prudent decisions about their activities and destinations during their visit. In the SOR model, stimuli involve external triggers, such as the interface of AR applications, inducing specific responses through internal processes like emotional and cognitive reactions. Interactive quality, as a component of these internal processes, directly influences users' experiences and perceptions of AR applications. Recent literature suggests that in the field of AR tourism,

interactive quality is a key determinant of user satisfaction and engagement, making it a crucial stimulus variable in the SOR model (Bird et al., 2023; Huang et al., 2023).

In summary, the stimulation process in AR tourism is significantly influenced by three key factors: content quality, system quality, and interactive quality. These factors shape the user experience and exhibit complex interactions among themselves. In the SOR model, these three variables collectively impact the user's internal psychological processes, thereby affecting their behavioral responses. Content quality stimulates user interest by providing relevant, accurate, and useful information. System quality ensures the stability and fluidity of the user experience, preventing negative emotions caused by technical issues. Interactive quality enhances user engagement and satisfaction through personalized information delivery and human-machine interaction. This study recognizes the interdependence among these factors and categorizes the stimulation process into three distinct variables: content quality, system quality, and interactive quality. A comprehensive understanding of the intricate and dynamic relationships between these variables contributes to a holistic comprehension of the stimulation process within the realm of AR tourism. Each variable influences various aspects of the overall user experience, collectively shaping the captivating and interactive features of AR tourism.

2.2.1 Content Quality

Content quality refers to the high standard exhibited by information or content across various aspects, encompassing uniqueness, depth and breadth of information, accuracy, and authority (Carlson et al., 2018; Dabbous & Barakat, 2020). Content quality is defined as the degree to which information or content meets users' needs and expectations during the processes of delivery, understanding, and application (Arif et al., 2020; Gummerus et al., 2012). In the dynamic landscape of AR tourism, content quality emerges as a central facet of the tourist experience (Shi et al., 2016). It encapsulates the tourists' unique perspective on the information woven into the AR tapestry. As tourists embark on their exploratory journeys facilitated by AR applications, the quality of the content assumes a pivotal role in shaping their

understanding and enjoyment of the destination. It is the very bedrock upon which tourists build their immersive, informative, and memorable experiences while navigating their surroundings.

Content quality is a fundamental factor that significantly impacts the stimulation process of AR applications. In the realm of AR, content quality pertains to the attributes and characteristics of the digital or augmented elements (Heller et al., 2021). It involves the richness, relevance, accuracy, and engagement of the content within the AR environment (Vretos et al., 2019). Richness refers to the depth and diversity of information presented within the AR application, offering users a comprehensive and immersive experience through detailed 3D models, informative textual information, audiovisual elements, and other multimedia components. Relevance ensures that the content meets the user's context and needs, such as historical facts, local attractions, real-time data, and personalized recommendations in the tourism industry. Accuracy is paramount, as users rely on AR applications for precise and trustworthy information, and any inaccuracies can erode trust and diminish the overall user experience. Engagement captivates users, encouraging them to explore and interact further through gamification elements, storytelling, or interactivity that enhance the overall appeal and entertainment value of the AR experience (Ajanki et al., 2011; Bugeja et al., 2020; Jia et al., 2023).

In the tourism industry, content quality encompasses a wide range of information, media, and materials curated by various stakeholders, including tourist destinations, travel agencies, websites, and platforms, all with the common goal of informing, engaging, and enhancing the tourist experience. The Mogao Caves leverage high-quality smart tourism technology to enrich AR tourism content, thereby increasing tourism efficiency (Su et al., 2023). The synergy between content quality and AR technology helps create immersive and memorable tourism experiences. As the tourism industry continues to embrace AR, focusing on content quality becomes imperative to meet the evolving demands of modern travelers. In the era of AR tourism, content quality plays a crucial role in shaping the travel experience (Loureiro et al., 2021). AR seamlessly integrates content quality into the real world, providing tourists with an

innovative and immersive way to explore destinations (Bird et al., 2023). Through AR applications, tourists can access accurate and authentic information about their surroundings, from historical landmarks to local attractions, enriching their understanding and enabling them to make informed choices (Cranmer et al., 2020). The relevance of AR content is tailored to the specific interests and needs of different tourist groups, ultimately enhancing the effectiveness and user satisfaction of the applications. The comprehensiveness of AR content surpasses traditional travel materials, offering travelers multimedia resources, historical context, and real-time information, deepening their connection to the destination. The quality of content in AR applications sparks user interest and curiosity by providing valuable, meaningful, and immersive experiences (Tu et al., 2024).

In summary, content quality in AR applications involves providing rich, relevant, accurate, and engaging digital content that not only captures users' attention but also guides them toward exploration and interaction within the augmented environment. When content quality is high, it complements system and interaction quality to create a more enjoyable and satisfying AR experience.

In this study, content quality refers to the information presented, visual effects, and the authenticity of perception within the augmented reality tourism of Mogao Caves. The synergy between content quality and AR technology enhances the tourist experience, offering immersive and memorable interactions that are tailored to the specific interests and needs of different tourist groups. This comprehensive approach to content quality enriches users' understanding and connection to the destination, ultimately fostering higher levels of engagement and satisfaction.

2.2.2 System Quality

System quality refers to the overall effectiveness and reliability of an information system, encompassing various aspects that together determine its capability to serve its intended purpose and deliver a positive user experience (Gorla et al., 2010). System quality is defined as the ability of a system to meet its predefined requirements and standards, encompassing aspects such as internal security, stability, and reliability

(Seddon, 1997). System quality encompasses key aspects such as functionality completeness, security, stability, reliability, compatibility, and more (DeLone et al., 2003). System quality can be defined as a set of standards and characteristics that measure the ability of system to meet user needs and expectations (Sedera et al., 2004). System quality involves the stability, usability, and performance effects of AR tourism applications (Ye et al., 2022).

The principles of system quality originate from DeLone and McLean's Information Systems Success Model (DeLone et al., 2003). In this model, Information and system quality are two indispensable dimensions that together form the basis of user interaction with the platform (Cheng, 2019). Scholars often regard information quality as the core value provided by social media platforms, which collectively determine users' satisfaction and trust in platform information (Yen et al., 2018). They serve as the drivers that influence users' internal states and shape their subsequent behavior. Extensive research has explored how technological attributes influence users' internal states and subsequent behaviors (Cao et al., 2020). This foundational understanding of system quality continues to be instrumental in unraveling the intricacies of user interactions in the digital landscape and is pivotal in shaping the design and improvement of information systems.

In the framework of the SOR model, research on system quality in the realm of AR tourism focuses on the profound impact of information systems and technological solutions on the tourist experience, particularly emphasizing the technical intricacies of these systems within the tourism industry and how they shape user behavior and satisfaction (Li et al., 2024). Researchers investigate the effects of AR applications and systems on the overall tourist experience, assessing factors such as ease of use, system performance, and the quality of AR content in influencing tourists' perceptions and behaviors (Jingen et al., 2021). User satisfaction, including reliability and user-friendliness, is evaluated, and high system quality generally leads to greater user satisfaction, encouraging repeated usage and positive word-of-mouth recommendations (Anand et al., 2023). Scholars examine how AR applications and

systems either enhance or diminish the overall tourism experience. They scrutinize factors like the ease of use and the capability of system performance, including the system's ability to shape tourist perceptions and behaviors. System quality is assessed based on performance indicators, including the speed and responsiveness of AR applications. Technical challenges affecting system quality in AR tourism include connectivity issues, device compatibility, and data accuracy. Addressing these challenges is crucial for enhancing system quality. As the tourism industry increasingly emphasizes sustainability, system quality in AR applications contributes to eco-friendly tourism practices and minimizes environmental impacts (Rane et al., 2023; Sia et al., 2023; Yoo, 2020). These research areas provide robust support for understanding how improving system quality can enhance the tourist experience, increase visitor numbers, and facilitate sustainable destination management.

In summary, System quality refers to the overall effectiveness and reliability of an information system, encompassing aspects such as ease of use, system performance, and integration, which collectively determine its capability to deliver a positive user experience. In this study, system quality is defined as the technical performance of the Mogao Caves AR tourism system, including application stability, user-friendliness, and performance responsiveness, among others.

2.2.3 Interactive Quality

Interaction refers to the psychological state that users undergo during the entire process of engaging with a digital interface or system (Park et al., 2020). Interactive quality encompasses the effectiveness and efficiency of this user engagement, focusing on aspects such as responsiveness, intuitiveness, and satisfaction (Pelau et al., 2021). In AR and VR tourism research, interaction is recognized as a crucial factor (Jiang et al., 2023). Interactive quality refers to the ability to provide personalized information, understand user needs and preferences, and facilitate personalized interactions (Ye et al., 2022). Interactivity, as part of AR unique attributes, is an important factor in how digital technology influences user experience perception (Nikhashemi et al., 2021). It signifies the system's ability to allow users to

modify the form and content of the mediated environment in real-time, fostering dynamic and responsive engagement where users can actively interact with the interface, content, or features.

In the tourism field, interactive quality holds a paramount position, significantly influencing the perceived ease of use of online destination marketing and booking systems (Herrero et al., 2012; Park et al., 2007). It extends beyond passive consumption and actively encourages users to become participants who can control and shape their experiences based on their preferences and choices. This concept underscores the dynamic and reciprocal nature of the interaction between users and AR tourism platforms, where user actions and inputs yield immediate responses and changes within the environment. Interactive quality is readily apparent in how easily users can navigate, explore, and interact with various elements of the AR tourism experience. Ultimately, it contributes to an enriched sense of immersion, engagement, and satisfaction. AR technologies that promote the active participation of tourists have been shown to stimulate travel-related product purchases, facilitate efficient tourism information searches, and aid tourists in making informed travel decisions (Yoo et al., 2015). Tourists engage with smart tourism technology environments by creating, searching, and sharing information, including destination evaluations, travel-related product assessments, and the sharing of their travel experiences. This interaction not only provides emotional and informational value to tourists but also instills a sense of reciprocity, where they feel compelled to offer valuable information to their peers (Bhuiyan et al., 2022; Zhang et al., 2014).

AR technology with high interactivity reshapes the landscape of tourism experiences. It empowers tourists with the tools to engage with their surroundings in a dynamic and personalized manner. These immersive and interactive capabilities open doors to numerous possibilities for travelers (Mishra, 2024). Tourists can customize their itineraries according to their interests. They can access real-time information about historical landmarks, cultural facts, or nearby attractions, thereby gaining a more personalized exploration experience (Torres et al., 2020). Interactive AR adds an

element of entertainment to travel. It can turn an ordinary city stroll into a treasure hunt, reveal hidden stories about landmarks, or even transport tourists into fictional worlds or historical events. In terms of decision-making, tourists can efficiently plan their trips by accessing real-time travel information, checking availability, and directly booking accommodations, activities, or transportation from their AR devices. High-quality interactive AR establishes an emotional connection with the destination. Users can participate in local traditions, share cultural experiences, or interact with the environment in ways that foster deeper emotional bonds. Interactivity enhances the travel experience in various ways, empowering tourists to explore, learn, engage, and connect with their surroundings and fellow travelers, making tourism more immersive, efficient, and enjoyable. By catering to various needs and preferences, interactive AR contributes to the fulfillment of travelers' enjoyment and social goals, ultimately leaving them with unforgettable and satisfying journeys (Huang, 2021; Yu et al., 2024).

In summary, Interactive quality refers to the effectiveness and efficiency of user engagement with digital interfaces, focusing on responsiveness, intuitiveness, and satisfaction. In AR tourism, it enables personalized interactions, allowing users to shape their experiences dynamically, fostering immersion and satisfaction in the travel journey. In this study, interactive quality is defined as the degree to which the AR tourism experience of Mogao Caves allows users to engage with the platform's content and features actively and meaningfully. It encompasses the flexibility for users to actively shape and customize their real-time interactions within the AR environment to match their preferences and interests. This concept highlights the dynamic and personalized nature of user engagement within the AR experience.

2.3 Tourist Experience

Experience is often seen as a deeply rooted, elusive, continuously evolving, and highly personalized phenomenon (Cutler et al., 2010). Experience reflects the context and sensations a person assimilates while interacting with a specific place or environment (Sixsmith, 1986). Tourism experience encompasses the personalized perception and understanding individuals form through their sensory, tactile, and

cognitive responses to specific stimuli and tourism environments (Packer et al., 2016; Xie et al., 2000). It encompasses the dynamic interaction between tourists and destinations, where the destination serves as the stage for the experience, and tourists are indispensable participants in this process (Zhang et al., 2023). Tourism experience is a multidimensional blend that integrates elements of leisure, culture, and escapism. Within the framework of the experience economy, tourists tend to deepen their understanding and perception of tourism destinations through active engagement (Mehmetoglu et al., 2011). These definitions collectively suggest that a tourism experience is not a one-size-fits-all concept. It varies from person to person and can encompass a wide range of sensory, emotional, and cognitive aspects, making it a highly individualized and diverse phenomenon. People embark on journeys and vacations with distinct sensory perceptions, emotional responses, and cognitive engagements, making it a rich tapestry of personal encounters with the world. As travelers venture into the realm of tourism, they weave together their unique tapestries of experiences, shaped by the sensory, emotional, and cognitive threads that make up their journeys.

Scholars in the field of tourism have explored theories and models related to tourism experience from different theoretical perspectives, aiming to understand, explain, and enhance tourism experience. like the experience economy model, the emotional dimension of tourism, and the four realms of an experience model.

Experience Economy Model suggests that experiences have become the new economic offering, with tourism businesses shifting from providing mere services to staging memorable experiences. It emphasizes the importance of consumer participation in co-creating experiences (Mehmetoglu et al., 2011). Experience Economy Model has had a profound influence on how businesses approach customer engagement and value creation. It underscores the need for businesses to transition from providing products and services to delivering meaningful, personalized, and memorable experiences (Vesci et al., 2020). In the context of tourism, this model encourages destinations and travel-related businesses to focus on creating unique and

participatory experiences that resonate with modern travelers' desires for authenticity and personalization (Lorenzo et al., 2023).

The Emotional Dimension of Tourism, this theory focuses on the emotional aspect of the tourism experience. It suggests that emotions play a crucial role in shaping how tourists perceive and remember their experiences (Cutler et al., 2010). Researchers explore how positive emotions can lead to increased satisfaction and loyalty (Jepson et al., 2018). Positive emotions, in particular, are seen as catalysts for satisfaction, loyalty, and memorable travel experiences (Ali et al., 2016). This theory guides researchers and businesses in the tourism industry to recognize the significance of emotional engagement and strive to create emotionally resonant and authentic encounters for travelers.

The Four Realms of an Experience Model, in the process of constructing theories of tourism experience, it typically encompasses four key areas: emotional resonance and impressions, knowledge acquisition and learning outcomes, enhancement and development of practical skills, and personal growth transformation and influence (Aho, 2001). Joseph Pine and James Gilmore introduced this model, which categorizes experiences into four realms: entertainment, educational, esthetic, and escapist. It helps businesses understand how to design experiences that align with these realms to meet customer expectations (Pine et al., 2011).

These theories offer various perspectives and frameworks for understanding the complexities of the tourism experience. Researchers and practitioners use these theories to inform their strategies for designing, managing, and enhancing tourism experiences. Tourism experience has been widely discussed and applied in diverse research contexts.

In the realm of tourism, people seek diverse experiences that not only offer cultural feasts, aesthetic pleasures, and adventurous thrills but also satisfy their emotional needs distinct from daily life (Zhang et al., 2012). These diverse tourism experiences enrich travelers and have profound value impacts on destination stakeholders and policymakers (Karayilan et al., 2016). To understand tourists'

behaviors, research delves into the dimensions of their experiences. These experiences encompass multiple dimensions including learning new knowledge, enjoying pleasures, and seeking escapism from reality (Cutler et al., 2010). Learning experiences involve acquiring new insights about the destination's history, culture, or natural environment (Korn, 1992). Enjoyment experiences extend beyond utility, encompassing emotional and sensory gratification derived from travel (Zhao et al., 2024). Escape experiences allow tourists to detach from daily stressors, seeking tranquility and novelty (Fan et al., 2019). Recent studies explore emotional solidarity's impact on volunteer tourists, revealing its significant influence on learning, enjoyment, and escape experiences (Jiang et al., 2022). These dimensions reflect travelers' motivations to gain knowledge, derive pleasure, and seek respite from daily routines. Tourism experience encompasses all the feelings and experiences during travel, influenced by individual, social, and service factors. The physical aspect involves specific spaces and locations, the social aspect includes social relationships and interactions, and the service aspect depends on service quality, recreational activities, and the richness of tourism products (Cutler et al., 2010). Understanding and catering to these dimensions are vital for enhancing the overall tourism experience and meeting the needs of tourists and stakeholders in the industry. AR technology has significantly transformed tourism experiences, offering immersive and interactive encounters with destinations (Roodposhti et al., 2024).

In summary, tourism experience is a highly personalized and subjective phenomenon shaped by interactions with the environment through sensory, emotional, and cognitive engagement, encompassing elements of knowledge acquisition, emotional satisfaction, and escapism. These experiences involve personalized perceptions and responses to specific stimuli, including elements of entertainment, education, and detachment from reality, and are influenced by various factors such as destination attributes, social interactions, and service quality, ultimately contributing to overall satisfaction and value for both tourists and stakeholders in the tourism industry.

In this study, the tourism experience is defined as the comprehensive manifestation of tourists' perceptions, emotions, and cognitions during their visit to the

Mogao Caves. This includes their feelings and knowledge related to the historical and cultural significance, artistic value, and tourism services of the Mogao Caves. The tourism experience is not only influenced by the objective factors of tourist resources but also by subjective factors such as individual differences among tourists, their travel experiences, and the environment. AR technology offers new possibilities for enhancing the tourism experience at the Mogao Caves. By combining virtual information with the real world, tourists can have richer and more in-depth experiences during their visits.

2.3.1 Emotional Experience

Emotion is a psychological and physiological state produced by individuals or groups in response to specific stimuli (Niedenthal et al., 2012). Its notable feature involves intense emotional fluctuations closely associated with specific behavioral responses (Hosany et al., 2013). The formation and expression of emotions encompass multiple dimensions, including subjective experiences within individuals, outward expressive actions or expressions, physiological arousal responses, cognitive evaluations of stimuli, and resulting behavioral tendencies (Frijda, 1986). In essence, emotion represents the sum of an individual's subjective feelings, expressed behavioral responses, and accompanying physiological changes when confronted with internal and external stimuli. Emotional experience is defined as an individual's psychological response to meaningful events (Vishkin et al., 2023). Scholars reviewed over 100 definitions of emotions and found consensus on three core components: subjective experience (internal feelings and their intensity and duration), expressive components (expressing emotions through language, facial expressions, body language, and vocal cues), and physiological arousal (associated physiological changes like heart rate, respiration, skin responses, and hormone levels). This comprehensive definition provides valuable insights into the role of emotions and their expressions in human behavior and experiences (Kleinginna Jr et al., 1981). In the context of tourism, emotional experiences are defined as the emotional and emotional experiences that occur during travel and tourism. These emotions can encompass tourists' feelings and

emotional reactions to aspects such as the destination, tourism activities, cultural experiences, and interpersonal interactions.

The importance of emotional theorization has received unprecedented prominence and attention in tourism industry, reflecting a growing recognition of the importance of emotions in shaping tourist behavior and experiences. These theories provide different perspectives and approaches to explain the origins and mechanisms of emotional experience, offering valuable frameworks for the study of the role of emotions in tourist behavior and experiences.

Cognitive Appraisal Theory drawing inspiration from Lazarus' cognitive appraisal theory, scholars within the field of tourism have conducted in-depth explorations into how tourists engage in the evaluation and interpretation of their travel experiences. This theoretical framework posits that emotions emerge because of individuals' cognitive appraisals of specific events. Essentially, tourists assess whether the events they encounter align with or deviate from their personal goals and values. In the context of tourism, the cognitive appraisal theory provides valuable insights into how tourists appraise and subsequently react to various facets of their journeys, ranging from the initial selection of destinations to the interactions they have with service providers. This approach has offered a nuanced understanding of how emotional responses are intricately linked to the different phases and elements of the travel experience (Bagozzi et al., 1999; Johnson et al., 2017). Consequently, the cognitive appraisal theory has proven to be an invaluable tool for understanding the intricate interplay between tourists' cognitive assessments and their emotional reactions, contributing to a richer comprehension of the tourist experience within the field of tourism studies (Talebzadeh et al., 2024).

Affective Events Theory suggests that emotions are triggered by specific events or encounters during the tourism experience. Researchers in tourism have applied this theory to understand how various events, such as a positive interaction with a resident or a negative encounter with a service provider, influence the overall emotional experience of tourists. In this theoretical framework, it's recognized that the

tourism experience is punctuated by a myriad of events, each capable of inducing distinct emotional reactions (Stylos et al., 2022). For instance, rich cultural interactions might evoke feelings of joy and connection, thereby enhancing the overall emotional well-being of a traveler. Conversely, a negative encounter with a service provider, such as a disappointing experience at a hotel, may lead to emotions like frustration or disappointment. By identifying the key events and their emotional consequences, destination marketers and service providers can work towards curating more positive and emotionally fulfilling travel experiences, thereby ensuring higher levels of satisfaction and loyalty among tourists (Zhou et al., 2023). This theory offers a dynamic perspective on how emotions evolve and respond to various triggers within the ever-changing landscape of tourism.

Positive psychology has gained traction in tourism research, emphasizing the role of positive emotions in enhancing well-being during travel (Zhang et al., 2024). Researchers explore how experiences like awe, gratitude, and flow contribute to tourists' overall happiness and life satisfaction, offering insights into the emotional aspects of travel that lead to lasting positive effects (Sin et al., 2009). When individuals are confronted with breathtaking natural landscapes, awe-inspiring historical sites, or remarkable cultural events, emotions often occur, triggering a sense of wonder and amazement that can lead to a transformative experience, broadening the traveler's perspective (Chirico et al., 2018). The application of positive psychology in tourism research provides valuable insights into the emotional dimensions of travel.

These theories collectively provide a framework for analyzing the multifaceted nature of emotional experiences in tourism. They help researchers and practitioners understand how emotions intricately weave into the fabric of tourist behavior and the overall quality of their travel experiences, offering practical insights for destination marketing, service design, and enhancing visitor satisfaction.

Empirical research clearly indicates that emotions play a pivotal role in customer decision-making, shaping their overall attitudes towards service products (Jang et al., 2015; Song et al., 2017). However, it is noteworthy that certain motivational

factors do not significantly influence tourists' emotions (Lin et al., 2020). In consumer contexts, researchers generally believe that emotions related to consumption are predominantly positive, such as feelings of happiness and leisure (Han et al., 2013; Jani et al., 2015). In psychology, there are two main categorizations of emotions: categorical and dimensional analyses. Categorical approaches view emotions as distinct states, such as joy (Sharma et al., 2019). Dimensional analysis, on the other hand, conceptualizes emotions as complex constructs consisting of continuous underlying dimensions like pleasure and arousal (Bradley, 2014). In tourism research, dimensional approaches to emotion conceptualization are more popular. Tourists' emotional responses are seen as critical determinants of their post-consumption behaviors. Emotions not only influence tourists' satisfaction, trust, and loyalty but also directly relate to their behavioral intentions, such as willingness to revisit or recommend to others (Gnoth, 1997; Goossens, 2000). Understanding the emotional dimension of tourist experiences helps in designing and managing tourism services to enhance visitor satisfaction and loyalty, ultimately benefiting destination marketers and stakeholders.

In summary, emotional experience is a psychological response to meaningful events, characterized by subjective feelings, expressive behavior, and physiological changes. In the tourism industry, emotional experience is defined as emotions and feelings that tourists experience when participating in augmented reality tourism activities. These experiences encompass tourists' emotions and reactions to destinations, activities, cultural experiences, and interactions, significantly influencing their behavior, satisfaction, and loyalty. In this study, tourists' emotional experiences act in the mediating role of the S-O-R model. This includes the emotional experiences that tourists have when interacting with the virtual reality content of the Mogao Caves, viewing the murals, and learning about the historical background. These emotional elements are intertwined with the technology-enhanced experiences, impacting tourists' engagement and their overall perception on AR tourism experience.

2.3.2 Leisure Experience

Leisure is the subjective feelings and psychological states individuals acquire during leisure activities (Hosany et al., 2022). Usually interpreted as a specific psychological state that encompasses deep engagement in an activity, pure enjoyment, relaxation of mind and body, positive emotions, a brief escape from reality, and a range of other positive and uplifting experiences (Ellis et al., 1994; Hull et al., 1995). In the realm of social sciences, various standard definitions of leisure exist, each offering a unique perspective on its nature. The first definition, fundamental in its essence, portrays leisure as quantifiable free time, categorized as residual or discretionary, providing individuals with the freedom to choose how to spend it. The second definition emphasizes leisure as the activity one selects at a specific time and place, with the quality of the activity itself determining its classification as leisure. Taking a more subjective stance, the third definition views leisure as a state of being attained through the pursuit of freely chosen experiences driven by intrinsic motivation (Kelly, 2019). Leisure experience encompasses individuals freely exploring and enjoying a wide range of activities based on personal preferences. This includes travel, outdoor adventures, entertainment, cultural exchanges, and relaxation-oriented experiences (Bloch et al., 1984; Henderson et al., 2004; Mannell et al., 1987; Neal et al., 1999). These experiences typically evoke positive emotions and a sense of satisfaction, contributing to individuals' relaxation, fulfillment, and overall enjoyment.

It is widely acknowledged that a primary motivation for travel is the pursuit of positive and enjoyable leisure experiences. As a crucial pillar of the global economy, the tourism industry's core activities often revolve around offering various leisure activities to meet peoples relaxation needs (Cooper, 2008). Undoubtedly, tourism is a significant branch of leisure activities, where leisure experiences and travel experiences intertwine in many aspects (Leiper, 1989). To gain a deeper understanding of leisure experiences and their relationship with tourism, researchers and scholars have proposed various leisure theories.

The Serious Leisure Perspective (SLP), proposed and developed by Robert Stebbins, is a framework for classifying leisure activities. Since its inception in 1974, it has evolved into an ongoing research project aimed at exploring the diversity and richness of leisure activities (Stebbins, 2017). This theory suggests that people engage in serious leisure activities for the intrinsic rewards, personal development, and satisfaction they offer. Serious leisure activities require commitment, effort, and skill-building (Tripathi et al., 2023). It is valuable in understanding why individuals invest their time and energy in activities that may appear as leisure to an observer but are deeply meaningful and personally rewarding. It highlights the complex motivations behind engaging in serious leisure pursuits and how they contribute to an individual's personal development and satisfaction (Elkington et al., 2014). This theory has found applications in various fields, including sports, arts, and hobbies, shedding light on the profound experiences associated with these activities.

Leisure Satisfaction Theory examines the factors that contribute to an individual's satisfaction with leisure experiences. It considers elements like leisure activity choice, the environment, social interactions, and personal expectations (Sirgy, 2010). One key component examined by this theory is the choice of leisure activities. It recognizes that people have different preferences and motivations when it comes to how they spend their leisure time (Ragheb et al., 1980). Whether someone enjoys reading, hiking, watching movies, or participating in sports can significantly impact their leisure satisfaction. Understanding the role of activity choice can provide insights for tailoring leisure options to better meet individual preferences. Additionally, the theory highlights the importance of the environment where leisure activities take place (Yoo, 2022). The setting, whether it's a natural park, a bustling urban area, or a quiet retreat, can have a significant influence on the satisfaction of the leisure experience. Factors like ambiance, accessibility, and comfort all affect an individual's leisure satisfaction. The Leisure Satisfaction Theory provides a comprehensive framework for understanding the subtle factors that contribute to an individual's contentment and enjoyment in their leisure pursuits. It helps researchers and practitioners customize leisure travel products

to better meet the diverse needs and preferences of individuals seeking satisfying leisure experiences (Kuykendall et al., 2018).

In recent years, the field of leisure studies has undergone significant transformation. The concept of “leisure experience” has become increasingly central in academic discussions, gradually replacing more traditional terms such as “leisure activities” or “leisure patterns” (Mannell et al., 1987; Tinsley et al., 1986). Modern research has revealed the multidimensional nature of leisure experiences, including their unique emotional, cognitive, and physical dimensions (Patterson et al., 2013). For instance, (Lee et al., 1994) emphasized the transient, complex, and dynamic qualities of leisure experiences, which collectively enrich their meaning. For most individuals, leisure represents a state that integrates various enjoyable experiences. To deepen the understanding of how leisure experiences contribute to personal well-being, contemporary researchers have begun applying theories from social psychology to leisure studies (Ellis et al., 1994; Patterson et al., 2013). Key concepts from these theories, such as locus of control, intrinsic motivation, perceived freedom, and flow, play crucial roles in defining leisure experiences. With the integration of these social psychological insights, research focus has shifted towards exploring attitudes, motivations, and emotions behind individual participation in leisure and tourism activities. This shift indicates that assessing the diversity, frequency, and quality of leisure and tourism experiences has become a significant indicator of life satisfaction, no longer confined to specific types of activities (Grant, 2007; Smith et al., 1991). These changes not only reflect the evolution of the leisure studies field but also herald new directions for the future development of the leisure and tourism industries. It prompted tourist agencies to reconsider their view of customers and adapt to their evolving needs and desires. It signifies a transition from a product-centered perspective to a customer-centered one, emphasizing the delivery of remarkable experiences.

In summary, leisure experiences are the subjective feelings and psychological states individuals gain from freely chosen activities, characterized by deep involvement, enjoyment, relaxation, and a sense of escape. These experiences

can include a variety of pursuits such as travel, outdoor adventures, entertainment, cultural activities, and moments of relaxation, typically evoking positive emotions and satisfaction. In the context of AR tourism, AR technology enhances tourists' leisure experiences by integrating virtual elements with real-world environments. This approach deepens tourists' appreciation of the Mogao Caves' cultural heritage, understanding of art and culture, awareness of historical context, and perception of the tourist environment. Therefore, in this study, leisure experience is defined as the sensations and experiences tourists acquire while touring the Mogao Caves, particularly those obtained through interactions with tourist attractions and activities using AR technology during the travel process.

2.3.3 Cultural Experience

Cultural experience refers to tourists satisfy their desire for cultural knowledge and seek self-identity by engaging with and experiencing the cultural significance inherent in tourist attractions or other cultural elements (Zhang et al., 2023). Tourists gain an understanding of the new culture through interactions with local people, visiting cultural attractions, participating in local traditional activities, and other means. This experience is unique and valuable because it provides cultural insights and enriches the travelers' journey, while also promoting cultural exchange and understanding (Ning, 2017). For tourists, the value of experiences is the foremost motivation for traveling. Cultural experiences, in particular, attract an ever-larger share of tourists (Throsby, 2003). Cultural experiences and all tourism a cultural experience. The tourism industry not only provides opportunities for travelers to explore new places but also serves as a platform for learning about and appreciating different cultures. Through tourism, people can enhance their understanding of diverse cultures, fostering cultural exchange and mutual learning. This cultural experience not only enriches the essence of travel but also adds more depth and meaning to people's lives (Cetin et al., 2016; Kay, 2013).

Cultural experiences are a central focus of cultural studies and related fields, and various theories have been developed to understand and analyze the ways individuals engage with and make meaning from culture.

Cultural consumption theory explores how individuals consume and engage with cultural products and experiences, such as literature, art, music, and film. It examines how people's choices and interactions with cultural content reflect their social identities, tastes, and cultural capital (Jafari et al., 2013). In the Cultural Consumption Theory, the way individuals engage with culture is not solely a matter of personal choice or intrinsic appreciation. Instead, it is deeply connected to their social position, cultural capital, and habitus. This theory suggests that cultural experiences are influenced by the larger social structures and power dynamics in which they occur. Cultural consumption is not a passive act but a means of participating in and shaping one's own cultural identity within a larger social context (Bourdieu, 2018).

Cultural Capital Theory, as developed by Pierre Bourdieu, is a key concept in understanding how individuals' social backgrounds and educational experiences shape their ability to appreciate and engage with cultural experiences (Davies et al., 2018). This theory sheds light on the profound influence of cultural capital on an individual's preferences and interpretations of cultural products and practices. Individuals from different social classes are exposed to distinct forms of cultural capital during their upbringing. Cultural capital significantly influences an individual's cultural experiences (Hashemi et al., 2018). It shapes their preferences and interpretations of cultural products and practices. This theory underscores the importance of recognizing that cultural experiences are not solely a matter of personal choice or intrinsic appreciation but are deeply rooted in the social and educational context in which individuals are situated (Emirbayer et al., 2008). It is a valuable framework for understanding how social inequalities are reflected in cultural practices and experiences.

Aesthetic experience theory goes beyond merely acknowledging the aesthetic appeal of cultural artifacts and activities. It delves into the profound impact of

aesthetic elements on the overall cultural experience (Casey, 2010). According to this theory, when individuals engage with culture, they do so not only for the intellectual or informational aspects but equally for the sensory and emotional dimensions (Dickie, 1974). One of the key facets of this theory is the recognition of how art, design, and other aesthetic qualities embedded in cultural expressions can elicit powerful emotions and deep sensations (Menninghaus et al., 2019). Aesthetic experience theory highlights that cultural experiences can be profoundly transformative. This connection transcends the rational and enters the realm of pure emotion and sensory delight (Albers et al., 2019). It highlights the power of aesthetics to leave a lasting imprint on an individual's memory, making cultural experiences not just informative but deeply moving and memorable.

These theories provide diverse lenses through which scholars and researchers analyze the multifaceted nature of cultural experiences. In tourism studies, cultural experiences are analyzed through various theoretical lenses, reflecting the multifaceted nature of such experiences. The concept of the “experience economy” highlights a shift from providing mere products or services to offering unforgettable experiences that deeply engage customers. Cultural experiences are pivotal in this transformation, driving changes in the modern economy by being inherently immersive and captivating; the more immersive the experience, the greater its contribution to the experience economy (Radder et al., 2015). Tourism is not just about visiting attractions but also about cultural exchange. Tourists, seen as temporary members of the host country’s culture, interact in ways that shape the essence of their cultural experiences. The balance between authenticity and adaptability is crucial in crafting these experiences (Cetin et al., 2016). In contemporary society, people increasingly seek meaningful and culturally enriching experiences during their leisure time. Consumption has evolved from acquiring material wealth to gaining memories and emotions. Cultural experiences are now viewed as valuable assets that contribute to overall happiness and life satisfaction. People invest in cultural experiences as leisure activities that bring meaning, fulfillment, and a sense of connection to their lives (Stebbins, 2017). Tourists

consume culture through visual gazing, a concept emphasizing that tourists are not just passive observers but active participants who shape and influence the culture of the destination. This notion of “the gaze” underscores tourists’ roles in understanding and experiencing cultural elements of destinations through their visual perception (Layang, 2015). The book “Critical Issues in Tourism: A Geographical Perspective” provides a comprehensive examination of the tourism industry from a geographical standpoint, offering valuable insights into the complex relationship between culture and tourism. It gathers expert perspectives on various aspects of cultural experiences in tourism (Shaw et al., 1994). These studies and theoretical frameworks offer diverse perspectives on the definition and significance of cultural experiences in tourism, leisure, and consumer behavior.

In summary, cultural experience refers to a profound and enriching travel experience where tourists deeply understand and engage with the unique essence of different cultures through interactions with locals, visiting cultural attractions, and participating in traditional activities. This experience aims to satisfy cultural needs, enhance self-identity, and promote cultural exchange and understanding.

In this study, cultural experience is defined as the process through which tourists, utilizing AR technology, perceive, engage, and immerse themselves in the unique culture and history of the Mogao Caves during their visits and explorations. The key characteristics of such a cultural experience encompass immersive engagement, interactivity and participation, knowledge dissemination and educational qualities, personalization, and autonomy, as well as emotional resonance and affective involvement. Cultural experiences play a pivotal role in the research of AR tourism in the Mogao Caves. They not only enable tourists to better understand and appreciate the cultural heritage of the Mogao Caves but also offer opportunities for profound engagement and learning, enriching their overall tourism experiences. This definition provides both tourists and researchers with a framework for comprehending and analyzing the role and impact of cultural experiences in tourism.

2.4 Behavior Intention

"Intention" is a psychological concept referring to a decision made within one's inner self before a particular behavior occurs (Eagly et al., 1993). The term "Behavior Intention" originates from the theory of attitudes and is considered a closer predictor of actual behavior than factors like attitude and feelings (Ajzen, 1991). Behavior intention refers to an individual's willingness and determination to perform or avoid performing a specific action (Warshaw et al., 1985) and reflects the likelihood of an individual completing a particular task (Venkatesh et al., 2003). Behavioral intention represents the degree of willingness or inclination of individuals to adopt specific behaviors in a given context (Siribowonphitak, 2024). In consumer behavior and psychology, understanding behavioral intention is crucial for predicting how individuals will respond to various stimuli, products, or services. This understanding helps researchers and businesses anticipate consumers' actions, enabling more effective strategies and decision-making. Whether it involves evaluating the likelihood of customers making a purchase, adopting new technology, or engaging in a specific behavior, behavioral intention provides valuable insights into human decision-making processes. While researchers and scholars offer various definitions of behavioral intention, there is a consensus on its significance in shaping consumer choices and actions. By understanding behavioral intention, businesses and researchers can better predict and influence consumer behavior, leading to more targeted and effective outcomes.

In the S-O-R model, customer behavioral responses are referred to as approach-avoidance behaviors, representing the consumer intentions to approach or avoid a given setting (Tang et al., 2020). Behavioral intention is the core driver determining whether individuals take action, occupying a pivotal role in multiple theoretical frameworks in psychology and sociology such as the Theory of Reasoned Action (TRA), Theory of Planned Behavior (TPB), and Interpersonal Behavior Model. These theories consistently emphasize that, when predicting future behavior, behavioral intention far surpasses mere attitudes. The development of these theoretical frameworks

has been significantly influenced by (Wicker, 1969) review, which highlighted that simple attitudes often fail to accurately predict specific behaviors. To explain this discrepancy, the attitude-behavior relationship model attempts to measure attitudes and behaviors at the same specificity level and reveals how attitudes combine with other factors to collectively influence behavior. The Theory of Reasoned Action (TRA) introduced the concept of social pressure, positing its joint influence with individual attitudes on forming behavioral intentions. Therefore, when measuring attitudes, the influence of subjective norms must also be considered (Montano et al., 2015). TRA further suggests that attitudes and subjective norms collectively promote the formation of behavioral intentions, which directly determine the occurrence of behavior (Kim et al., 2013). Within the TRA framework, intention becomes the bridge connecting attitudes, subjective norms, personal traits, external factors, and eventual behavior, emerging as the most direct and crucial predictor of behavior. Building upon TRA, the Theory of Planned Behavior (TPB) incorporates the concept of Perceived Behavioral Control (PBC), enriching the theoretical model. TPB argues that PBC, along with attitudes and subjective norms, influences the formation of behavioral intentions, and when PBC accurately reflects the actual level of control, it can also directly predict behavior or moderate the relationship between intention and behavior (Ajzen, 1985). These theories illustrate that behavioral intention is a critical factor shaping individual choices and actions. It is influenced by individual attitudes, social expectations, and perceived control, directly determining whether behaviors occur. Therefore, understanding and predicting individual behavior necessitates a thorough consideration of the importance of behavioral intention.

In the field of tourism research, tourists' planning and anticipation of future travel activities are referred to as "visit intentions", a concept directly linked to tourist loyalty (Chin et al., 2023). The core objective of tourist travel is to obtain enriching and memorable travel experiences. Therefore, the relationship between tourism experiences and tourists' visit intentions has received significant attention and has been widely supported by empirical research. Numerous quantitative studies indicate that the

experiences tourists gain during their travels significantly influence their behavioral inclinations (Choi et al., 2022; Kim et al., 2020; Lehto et al., 2004). Behavioral intentions include the intention to revisit, spread positive word-of-mouth, and make purchases (Gholipour et al., 2018). Scholars generally believe that tourists' behavioral intentions directly predict whether they will actually visit a particular tourist destination in the future (Duong et al., 2022). Positive behavioral intentions typically manifest as tourists willing to spread positive word-of-mouth about the destination, exhibit high levels of loyalty, and express a strong willingness to revisit. Conversely, when tourists have negative experiences, they may develop negative behavioral intentions, such as spreading negative word-of-mouth or turning to competitors in search of better travel experiences (Zeithaml et al., 1996). Tourists' travel experiences play a crucial role in shaping their behavioral intentions, meaning that employees of tourism businesses profoundly influence the overall travel experience (Barnes et al., 2020).

In tourism research literature, behavioral intentions are typically described as revisit intention and recommendation intention (Kaur et al., 2020). The intention to revisit signifies a commitment to return, indicating strong satisfaction and loyalty. Equally valuable is the intention to recommend, as it reflects the tourist's satisfaction and has the potential to attract new visitors through positive word-of-mouth. Research reveals that user satisfaction with AR applications and their willingness to recommend such applications are primarily influenced by three key factors: content quality of the AR application, provision of personalized services, and overall system quality (Jung et al., 2015). The novelty and fashion of AR devices create a stronger sense of enjoyment for users, impacting first-time users more significantly compared to experienced users. This heightened enjoyment may be due to the excitement and willingness to explore new services or value propositions (Nam et al., 2023). Compared to traditional online product demonstrations, AR technology offers users unprecedented novel experiences, deep immersion, enjoyable interactions, and practical value due to its outstanding capabilities. This unique experience fosters a more positive emotional attitude towards AR media and stimulates higher willingness to pay among users (Yim et al., 2017).

In summary, behavioral intentions are influenced by a variety of factors and encompass several key variables: length of stay intention, revisit intention, recommendation intention, and premium payment intention. These variables are widely used in tourism research to understand tourists' attitudes and tendencies and to assess the attractiveness and sustainability of destinations. In this study, behavioral intention is defined as the inclinations or intentions displayed by tourists after their AR tourism experience at the Mogao Caves. These intentions include the desire to stay longer, re-visit, recommend, and express a willingness to make premium payments. Understanding these behavioral intentions is crucial for the management and sustainable development of AR tourism at the Mogao Caves.

2.4.1 Stay Intention

In the context of tourism and destination management, stay intention refers to a tourist’s intention or willingness to extend their stay or visit for a longer period at a particular destination (Do Valle et al., 2006). It reflects the tourist’s desire to prolong their visit beyond their originally planned duration (Alén et al., 2014). Stay intention is often considered a positive indicator of a tourist's satisfaction with the destination and their level of engagement with the local attractions, culture, and experiences (Adruce et al., 2021). The willingness of tourists to stay is often influenced by various factors, such as the attractiveness of tourist destinations, the quality of tourist experiences, the quality of tourist facilities and services, and the safety and health of tourist destinations (Lee et al., 2011). High tourist satisfaction with a destination is a key driver of stay intention. When tourists have a highly satisfying experience, they are more likely to develop a stronger willingness to stay and engage in more consumption, exploration, and deeper cultural experiences (Zhou, 2013).

Stay intention, often referred to as the intention to extend one’s stay at a destination, is a concept explored in the field of tourism and destination management. Several theories and models are related to the understanding of stay intention. These theories help researchers and practitioners identify the factors that influence tourists' decisions to prolong their stay.

The push-pull theory is a valuable framework in the field of tourism and destination management, which reveals the factors that affect tourists' willingness to stay (Uysal et al., 2009). For example, tourists feeling stressed and at a loss at home may have an incentive to extend their stay at peaceful and picturesque destinations. When the driving factors from the family environment are offset or exceeded by the driving factors from the destination, tourists are more inclined to consider extending their stay time (Said et al., 2018). Pull factor, which is a destination-specific factor that attracts tourists and makes the destination more attractive (Carvache et al., 2023). These factors can include the quality of the attraction, hospitality, cultural experience, and the overall attractiveness of the destination. When tourists discover that a destination provides them with a unique and enjoyable experience, they are more likely to feel pulled to extend their stay. For example, extraordinary natural landscapes, vibrant local culture, and enthusiastic hospitality may be powerful driving factors that make tourists reluctant to leave.

In the field of tourism, scholars typically study issues related to tourists' length of stay at tourist destinations, spending behavior, satisfaction levels, and loyalty.

Destination image significantly influences tourists' choices, length of stay, and spending behaviors. A tourist destination that integrates natural beauty, rich historical and cultural heritage, and unique local customs often attracts visitors to extend their stay (Tu et al., 2017). For tourism destinations, visitor length of stay is crucial as it directly correlates with increased tourism revenue (Barros et al., 2010; Martinez et al., 2008). Longer stays enable tourists to explore more attractions, thereby energizing the local economy. Tourists' length of stay is intertwined not only with other aspects of the tourism experience (such as accommodation types and destination features) but also constrained by various factors like economic capability, time constraints, and family responsibilities (Dellaert et al., 1998). Attributes of the destination play a pivotal role in determining the length of stay. Cultural attractions, historical landmarks, and unique events can attract tourists and encourage them to extend their visits, fully immersing themselves in the local culture (Loureiro, 2014). Specialized experiences, such as

cultural festivals, virtual tourism, and AR tourism, can also extend tourists' stays. Effective destination marketing and promotional strategies highlighting these attractions further encourage longer stays. The quality of services and accommodations is crucial, as tourists who enjoy high service levels and diverse accommodation options may extend their visits (Encalada et al., 2022). Positive reviews and recommendations from previous tourists, as well as the perceived safety and security of a destination, also play significant roles in influencing the length of stay (Cui et al., 2018).

In summary, the length of stay is a multifaceted variable influenced by a combination of factors, including destination attributes, available activities, service quality, and safety perceptions. Understanding and managing the factors that impact the length of stay is essential for destination managers to enhance economic sustainability and tourism appeal. In this study, stay intention is defined as the intention or desire of tourists to extend their stay at the destination after the conclusion of their AR tourism experience in the Mogao Caves. This signifies that tourists wish to prolong their time at the Mogao Caves to further explore, appreciate, and engage in the local culture and attractions, allowing them to fully experience the range of activities and experiences offered by the destination. This directly relates to their satisfaction with the destination and their willingness to revisit, reflecting their loyalty.

2.4.2 Revisit Intention

Revisit Intention refers to tourists' strong inclination and expectation to revisit a particular tourism destination. In the current highly competitive tourism market, intention to revisit has become a crucial gauge for assessing the development potential of a tourism destination. It not only reflects tourists' satisfaction with their previous tourism experiences but also predicts their likelihood of returning to the destination in the future (Baker et al., 2000). Revisit Intention serves as a key indicator not only for evaluating the attractiveness and competitiveness of a tourism destination but also for reflecting tourists' satisfaction with tourism and hotel experiences, as well as their potential inclination to revisit in the future. This intention often stems from tourists' positive impressions and experiences at the destination, including its unique charm,

high-quality services, comprehensive facilities, and innovative tourism products. Revisit Intention reflects tourists' loyalty to the destination. If tourists express a strong desire to revisit after their trip, it indicates a deep emotional connection to the destination and a willingness to continue investing time and effort to experience and enjoy its attractions (Gyte et al., 1989). It is worth noting that even if previous travel experiences were not entirely satisfactory, tourists may still choose to revisit due to specific factors such as the destination's unique landscapes, cultural characteristics, historical heritage, or the special significance the destination holds for the tourists' personal experiences and emotions (Han et al., 2010). Revisit intention is playing an important role in the sustainable development and enhancement of competitiveness for destinations.

For a long time, intention has been regarded as a bridge connecting behavioral determinants and actual behavior. This concept largely originates from the Theory of Reasoned Action (TRA) and the Theory of Planned Behavior (TPB), which have been widely applied in social behavior research (Ajzen, 1980; Armitage et al., 2001; Conner et al., 2005). In the context of the tourism industry, revisit intention represents a specific manifestation of this intention, directly related to tourists' intention to revisit a specific destination. The TRA model emphasizes the central role of attitudes and subjective norms in shaping individual behavioral intentions (Sheppard et al., 1988). For tourists, their positive attitude towards a destination is enhanced by past pleasant experiences, thereby increasing their revisit intention. However, TPB provides a more comprehensive framework for predicting behavioral intentions (Fielding et al., 2008). TPB suggests that individual behavioral intentions are influenced not only by attitudes and subjective norms but also by perceived behavioral control (Ajzen, 1985; Lam et al., 2004). This means that even if tourists have a positive attitude towards a destination and are encouraged by friends and family, if they perceive barriers to revisiting or feel they lack control over their decision to revisit, they may choose not to revisit. In the context of revisit intention, TPB offers an insightful tool. It helps us understand that tourists' revisit intention is influenced not only by their attitude towards the destination and recommendations from friends and family but also by their perception and evaluation of

barriers they may encounter during the revisiting process. This comprehensive perspective assists destination managers and marketers in formulating more precise strategies to attract and retain tourists, ensuring the sustainable competitiveness and growth of the tourism industry (Ashraf et al., 2020).

In discussing the factors influencing tourists' revisit intention, extensive research has clearly indicated that attracting repeat customers is crucial for the sustained success of the tourism industry, yielding benefits far beyond merely attracting new customers (Chen et al., 2007; Li et al., 2018). Researchers in the hotel and tourism fields have delved into customer value formation and decision-making processes, emphasizing the close connection between perceived value and revisit intention (Huang et al., 2009). Understanding the antecedents and mechanisms of revisit intention is crucial for tourism scholars and industry practitioners alike because it directly relates to formulating effective marketing and management strategies. Studies on consumer loyalty often measure loyalty through revisit intention and positive word-of-mouth (Virto et al., 2019). In the context of festivals or special events, research on revisit intention reveals how various aspects of these events influence tourists' intention to revisit through their experiences (Grappi et al., 2011; Mason et al., 2012). In the pursuit of experiential economy focused on enjoyment and pleasure, the quality of tourists' experiences is directly linked to their likelihood of revisiting (Drengner et al., 2008; Tsai, 2016). Various studies have identified multiple determinants influencing revisit intention, including tourists' past behavior, perceived value, satisfaction, service quality, socio-psychological motives, destination image, and information sources (Baker et al., 2000; Baloglu et al., 2004). Particularly, a survey on the relationship between travelers' vacation behavior, satisfaction, perceived value, and revisit intention leisure destinations revealed the strong predictive power of past behavior, satisfaction, and perceived value on revisit intention (Petrick et al., 2001). It is worth noting that while traditional research often examines revisit intention within the context of traditional marketing, some studies have explored it from other perspectives. For example, research has delved into the cultural determinants of tourists' revisit intention and found that culture and nationality

have a more significant impact on whether tourists decide to return to a destination than age or gender (Caneen, 2003). Therefore, revisit intention is a key driver of success in the tourism industry, with significant implications for tourism enterprises and destination managers aiming to develop effective marketing strategies, enhance customer satisfaction, and loyalty.

In summary, tourist revisit intention is a highly discussed topic in the field of tourism research. Researchers have conducted extensive studies to explore the factors that influence whether tourists are willing to revisit a destination. This is because attracting existing tourists to return to a destination is often more cost-effective and efficient than attracting new ones. Literature indicates that several factors can affect tourists' revisit intention, including past behavior, satisfaction, perceived value, culture, and nationality. These factors not only contribute to understanding tourists' behavioral intentions but are also crucial for formulating effective tourism marketing and management strategies. Therefore, in this study, revisit intention is defined as tourists' positive intentions and expectations to revisit the Mogao Caves. This signifies that tourists wish to spend more time exploring, appreciating, and engaging in local culture and attractions at the Mogao Caves to fully experience the range of activities and experiences offered at the destination.

2.4.3 Recommendation Intention

Tourist loyalty holds a central position in tourism research, typically assessed through tourists recommend destinations (Litvin et al., 2008). Tourists' behavioral intentions specifically refer to their judgment on whether they are likely to revisit a tourism destination and their positive attitude in recommending it to family and friends (Chen et al., 2007). Among these, recommendation intention is particularly crucial as a core indicator of assessing customer loyalty, reflecting tourists' deep endorsement of a tourism destination or service. Recommendation intention is a strong desire within tourists, motivating them to actively recommend tourism destinations or services they find worth experiencing to their family, colleagues, and friends (Prayag et al., 2017). When tourists actively recommend a destination within their social circles, it

not only shares their enjoyable experiences but also expresses the expectation that others can have similar or even better experiences (Chen et al., 2020). Recommendation intention, as an indirect manifestation of loyalty, often emerges after tourists experience a high level of satisfaction with the destination or service. In the context of the tourism industry, destination loyalty is tangibly reflected in tourists' willingness to recommend the destination to others and their plans to revisit it (Kusdibyo, 2022).

In the realm of theoretical research, when customers have a positive and delightful experience with a product or service, they are more inclined to recommend it to others. This inclination is considered a key variable in measuring service quality in behavioral studies (Wirtz et al., 2002). Such behavior not only impacts business performance but also serves as a critical factor in attracting new customers and increasing market share (Hutchinson et al., 2009). For loyal customers who have established long-term relationships with service providers and derive pleasure from them, there is greater motivation to recommend these companies, thereby positively impacting their profitability (Muskat et al., 2019). Recommendation intention fundamentally involves informal sharing where consumers express positive evaluations of a product, brand, or service through various channels, often without any commercial intent (Chang et al., 2018). With the rapid development of mobile internet and social media, the influence of word-of-mouth recommendations has greatly increased, attracting widespread attention from academia and industries alike. Consumer's positive recommendations can bring significant benefits to businesses, such as increasing revenue by attracting new customers or reducing marketing costs. In the tourism industry, the willingness of loyal customers to recommend is particularly crucial, especially among those with experience in international travel. Their positive recommendations help overseas tourism businesses attract more potential customers, thereby achieving higher profits. Therefore, the tourism industry has deeply recognized that enhancing customers' willingness to recommend is a key strategy to ensure sustained growth and competitiveness. This strategy not only integrates theoretical

research on recommendation intentions but also provides robust support for the practical development of the tourism industry.

In summary, recommendation intention is a crucial metric for assessing service quality. It not only represents customer satisfaction and loyalty to products or services but also reflects their recognition and trust in them. In the tourism industry, recommendation intention helps businesses better understand customer needs and behavioral characteristics, thereby gaining more business opportunities and a competitive edge. Positive recommendations enable tourism companies to attract potential customers, increase market share, and enhance their reputation.

In this study, recommendation intention is defined as the extent to which tourists, after experiencing the Mogao Caves AR tourism, are willing to recommend this innovative way of touring to others. This indicates that tourists wish to share and endorse their enriching experiences at the Mogao Caves, which include activities such as exploration, appreciation, and engagement with the local culture and attractions. By understanding tourists' recommendation intention, researchers can gain insights into their behaviors and expectations, further improving the Mogao Caves AR tourism experience, meeting customer needs, and enhancing customer loyalty.

2.4.4 Premium payment Intention

The premium payment intention, also known as "premium payment willingness" or "extra payment willingness", refers to the extent to which consumers are willing to pay an additional fee for a particular product or service, exceeding its standard or market price, in exchange for added value, unique features, personalized services, brand reputation, or other factors that enhance their satisfaction or perceived value. It is important to note that definitions of premium payment intention may vary in the literature. A premium price is paid over a fair price (Park et al., 2018) and imparts credibility to products or services when presented to customers (Ba et al., 2002). It may also be perceived as a way to entice customers to explore interesting products (Tellis et al., 1987; Yang et al., 2016). (Kotler et al., 2010) define premium payment intention as consumers' willingness to pay an additional fee for a product or service that exceeds its

listed price. Premium payment intention as the willingness to pay a fee higher than the market price for a product or service to meet personalized needs or obtain additional value (Varki et al., 2003). They emphasized the correlation between the willingness to pay a premium and consumers' perceived value of a product or service, defining it as the willingness to pay additional fees beyond the listed price to acquire a product or service that aligns with their needs and expectations (Erdem et al., 2001). Premium payment intention involves consumers' readiness to incur extra costs for high quality, unique features, or personalized services that enhance their satisfaction or perceived value, so that to consumers' willingness to pay more for products and services that meet their specific needs and expectations.

The theory of reasoned action emphasizes the importance of behavioral intention in understanding individuals deliberate decision-making processes (Fishbein et al., 1977). Behavioral intention is regarded as the most accurate predictor of actual behavior (Han et al., 2009). It directly reflects consumers' inclination to perform a specific behavior and often foreshadows the occurrence of actual behavior. This concept is pivotal in understanding consumer actions and choices (Ajzen et al., 2008). Behavioral intention is not only fundamental to understanding consumer behavior but also a key component of brand loyalty. Indicating the extent to which a consumer expresses their willingness to engage in a specific behavior related to a product, service, or brand. This willingness is shaped by their attitudes, beliefs, and expectations regarding a particular object (Boulding et al., 1993; Yoo et al., 2022). Researchers investigating customer behavioral intentions have explored several key dimensions, including positive word of mouth, recommending products or services to others, fostering emotional attachment or affection toward a brand, expressing a willingness to revisit with others, and readiness to pay a premium for a specific offering (Wilson et al., 2016). These dimensions provide a comprehensive framework for understanding how behavioral intentions manifest across different industries and contexts.

Within the context of consumer behavior, "premium payment intention" is a specific aspect of interest. This term refers to consumers' willingness to pay a

premium or an additional amount for a product or service, typically above its standard or market price (Sun et al., 2022). Premium payment intention involves a deliberate decision by consumers to invest extra money in exchange for added value, unique features, or the satisfaction of specific needs. Such as high-quality products, personalized services, or products associated with a particular brand's reputation. By examining premium payment intention, businesses can tailor their strategies to meet consumer demands and enhance customer satisfaction) (Saleem et al., 2022). The Theory Reasoned Action provide a solid theoretical framework for studying such intentions and how they influence consumer behavior and choices.

Brand loyalty (BL) is interpreted as consumers' deep emotional attachment to a particular brand, rooted in their satisfaction with that brand (Carroll et al., 2006). This concept encompasses multiple dimensions within the framework of the brand-consumer relationship, such as positive behaviors exhibited towards the brand, strong emotional bonds, resonance with the brand's values, and a positive attitude towards paying a premium for the brand (Ghorbanzadeh, 2021; Sousa et al., 2017). For managers, brand loyalty holds significant value because it not only strengthens the connection between consumers and the brand but also provides crucial momentum for the brand's long-term success (Chaudhuri et al., 2001). On a relational level, people are often willing to make sacrifices for each other. Similarly, after consumers establish a strong emotional connection with a brand, they are more inclined to pay a premium for that brand's products or services (Castro et al., 2022; Vaz, 2019). Therefore, brand loyalty is closely linked to consumers' willingness to pay a premium, demonstrating the direct impact of consumer emotional attachment on the brand's economic value.

The premium payment intention is a complex psychological and economic phenomenon that is influenced by multiple factors. Scholars have explored the formation mechanism of premium payment willingness and the application of marketing strategies from different perspectives. These studies are of great significance for enterprises to understand consumer demand and behavioral characteristics and improve market competitiveness.

Behavioral intention encompasses various expressions, including consumers actively spreading word-of-mouth, enthusiastically recommending, and being willing to pay premium for a brand's products or services that exceed the market average (Wilson et al., 2016). When making purchasing decisions, consumers assess how much they are willing to spend on a product (You et al., 2012). Consumers who perceive added value confidently choose higher-priced items, securing desired products and deriving perceived value from their purchases (Ba et al., 2002). They are willing to pay higher prices anticipating superior service quality. Premium payment intention develops during the evaluation of a product's or service's value, influenced by external cues like price and brand (Yeoman et al., 2006). Premium payers invest in the psychological and economic advantages of a product or service, even when facing financial constraints, seeing these expenses as indicators of economic utility and brand value (Choi, 2017). Consumers' emotional attachment to a brand, manifesting as brand loyalty, suggests they might be willing to pay a premium for that brand (Thomson et al., 2005). True loyalty cannot be achieved solely through discounts, as demand for higher-priced, non-discounted products persists when purchasing decisions are based solely on price (Cheverton, 2002). The fundamental measure of loyalty, a key component of brand equity, is the amount a customer is willing to pay for a specific brand, even when other brands offer similar benefits. This willingness to pay a premium can be assessed by the price customers are willing to pay for a particular brand (Aaker, 1996). In this context, trust and innovativeness are among the factors influencing the price consumers are willing to pay for a product or brand.

In summary, the premium payment intention is a complex concept closely intertwined with factors such as brand loyalty, brand image, product quality, and consumer psychology. In the tourism industry, the premium payment intention is a reflection of tourists' desires for unique, high-quality, and emotionally resonant experiences. It underscores the importance of brand loyalty, trust, and the overall value perceived by tourists when making their travel choices.

In this study, premium payment intention is defined as the extent to which tourists are willing to pay a higher price after experiencing AR tourism at the Mogao Caves to re-experience this innovative form of travel. Tourists may pay additional fees for customized experiences, such as using advanced AR equipment for more immersive virtual travel or accessing unique features like interacting with historical figures. They might also pay a premium for high-quality services, including professional tour guides, better facilities, and superior food. AR tourism at the Mogao Caves can evoke emotional resonance, such as admiration for cultural heritage, prompting tourists to pay more for these unique experiences. Understanding these factors can help tourism businesses enhance customer satisfaction and maintain a competitive edge in a dynamic industry.

2.5 Research related to Augmented Reality in Dunhuang

2.5.1 Augmented Reality

Augmented reality is a new interface technology that integrates software and hardware technologies such as positioning, presentation, and interaction. Its purpose is to enable users to perceive the spatial and temporal correlation and fusion of virtual and real spaces, thereby enhancing their perception and cognition of the real environment (Sungkur et al., 2016; Syed et al., 2022). Since emerging in the late 1990s as a nascent field within virtual reality and computer technology, augmented reality has continuously evolved, with its applications expanding increasingly across various domains (Pagani et al., 2016). Various experts have defined augmented reality differently.

TABLE 1 An Overview of Definition of Augmented Reality by Various Scholars

Title	Key Findings	Country	References
Exploring the value of augmented reality for tourism	AR is an innovative interface technology that integrates computer-generated virtual environments with the real-world surroundings for user.	UK	Cranmer et al. (2020)

TABLE 1 An Overview of Definition of Augmented Reality by Various Scholars (Continue)

Augmented reality technologies, systems and applications	View AR as the creation of a direct or indirect representation of the true world environment by enhance computer-generated information.	USA	Carmigniani et al. (2011)
Augmented Reality: A Comprehensive Review	AR is an inspiring and attractive medium that allows the real world to integrate rich information elements in real-time and dynamically.	India	Dargan et al. (2023)
Classifying different types of augmented reality technology	AR is an experience where sensory input enhances computer-generated elements, creating either direct or indirect perspectives within the physical and real world.	USA	Edwards et al. (2016)
Current Status and Development Trends of Augmented Reality Technology Research	AR technology is an imaginative interaction that enhances, enriches, and extends users' perception of the real world.	China	Wang et al. (2018)
Augmented Reality: Characteristics, Key Technologies, and Applications	AR is an intelligent means intertwined with optoelectronic display technology, interacting technology, and various sensor technologies.	China	Qi et al. (2004)
A survey of augmented reality technologies, applications and limitations	AR is the way people perceive and process various digital information and has become a research hotspot in global information technology.	China	Shi et al. (2021)
A review of research on AR unlabeled tracking and registration methods	AR is a technology that seamless merging virtual objects or information into true world scenes without the need for manually added markers in the environment.	China	Cao et al. (2023)

The literature summarized the development, applications, and theoretical frameworks of AR globally. It consistently highlights AR's core feature of seamlessly integrating computer-generated virtual elements with the user's real-world environment, providing unprecedented interactive experiences and integrated information capabilities. The studies emphasize AR's interactivity, enabling real-time interaction with virtual elements, greatly enriching perception of the real world. Additionally, AR dynamically integrates rich information elements into real-world settings, offering users comprehensive and immersive experiences. However, studies from different regions show slight variations in understanding and application of AR technology. European research focuses more on detailed classification and technical exploration of different types of AR technologies, reflecting Europe's rigor and depth in technological innovation and academic research. In contrast, studies from India and China emphasize comprehensive reviews and development trends of AR technology in specific application fields, demonstrating Asia's sensitivity and foresight in technology application and market development. Overall, the literature uniformly recognizes AR as a research hotspot in the global information technology field, attracting widespread attention and research from around the world. With advancing technology and expanding applications, the prospects of AR are increasingly promising. The Mogao Caves of Dunhuang, a cultural landmark with millennia-old history, it is not merely a precious cultural heritage of China but also a world-class tourist destination. The introduction of AR technology has transformed the traditional flat tourism experience into a vivid and immersive encounter with the cultural relics and sites. Upon entering the site, visitors can activate a virtual tour guide system by scanning a QR code at the entrance using their smartphones or AR glasses. This virtual guide offers multilingual services and provides real-time historical and mural stories based on the visitor's location. When visitors scan designated spots on the cave murals, AR technology reproduces the original appearance of the murals on their screens. The implementation of AR technology at the Mogao Caves significantly enhances visitor experiences and improves cultural dissemination effects. This innovative application not only demonstrates the

potential of technology in preserving and promoting traditional culture but also provides new avenues for sustainable development of other cultural heritages.

2.5.2 Augmented Reality Tourism in Dunhuang

The Mogao Caves in Dunhuang, renowned as the Thousand Buddha Caves, are situated along the ancient Silk Road and serve as a sacred site carrying rich religious and cultural heritage. These spectacular caves span from the 4th to the 14th century, witnessing the splendor of religious art and history in China and throughout Asia. However, with the passage of time, these precious cultural relics are facing serious decay issues, making it challenging for archaeologists to reconstruct history. To address these challenges, virtual simulation technology has emerged as a feasible and effective method for the digital display and preservation of cultural heritage. AR tourism offers a way to create immersive tourist experiences without causing damage to the physical site. This technology can accurately restore the cultural heritage, allowing tourists to deeply engage with and appreciate the historical culture of the Mogao Caves. By integrating AR tourism, it is possible to enhance the preservation of the site while providing an enriched and educational experience for visitors. To address these urgent issues and better preserve and inherit this precious cultural heritage, virtual simulation technology offers a completely new solution. Specifically, AR breaks the limitations of traditional tourism, promoting the transformation and upgrade of the cultural tourism industry, and providing visitors with a more enriching and diverse cultural experience.

To meet the growing demands of tourists, the Dunhuang Academy initiated the “Digital Dunhuang” project. In 2003, Mr. Fan Jinshi, the honorary director of the Dunhuang Academy, proposed using modern technology to enhance the conservation and development of the Mogao Caves. Under his leadership and through long-term exploration, the “Digital Dunhuang” initiative has made initial progress with the support of digital technology (Dunhuang Academy, 2021).

The application of digital technology in the protection of the Mogao Caves murals has enabled the permanent storage of mural data as digital images. An important aspect of this project is the application of AR technology. AR allows for the 3D

reproduction of layered murals with high fidelity, effectively recreating the original scenes of the Mogao Caves murals (Du, 2022). This technology is a crucial part of the “Digital Dunhuang” initiative. The Dunhuang Research institute collaborated with domestic and international research institutions to create 3D models of the caves using AR technology. By September 2014, digital exhibition centers, such as the Dunhuang Tourist Reception Hall and the Digital Cinema, were officially opened to the public. These centers serve a dual purpose: they help manage visitor flow by allowing tourists to watch movies before their visit, reducing the time spent inside the caves and thus aiding in the protection of the murals. Additionally, these centers offer tourists 4D movies and other digital experiences that provide a comprehensive view of the caves’ interiors, enhancing their understanding and appreciation of the Mogao Caves (Zhao, 2023). Replicas of the murals reproduced in the digital exhibition center provide visitors with clearer details. Due to the immersive, interactive, and imaginative nature of AR technology, it significantly enhances the overall satisfaction for tourists (Cai et al., 2015). Furthermore, the digitization efforts extend beyond the Mogao Caves to include six major cultural heritage sites managed by the Dunhuang Academy and the neighboring area of Dunhuang City. The Electronic Dunhuang Database, an online free resource, is a significant breakthrough in the digitization of Dunhuang's cultural heritage (Dunhuang Academy, 2021). It offers high-definition photos and virtual tours of 30 caves, and contributes to creating impressive digital exhibitions using the latest technologies such as 3D dome screens, IMAX screens, holographic projection, embedded applications, and immersive exhibitions (Hu et al., 2017). These new exhibition forms have drawn public attention and offered different ways to appreciate the rich culture of Dunhuang. The digitization efforts have significantly enhanced public awareness of heritage preservation provided valuable data for academic research. AR technology offers tourists a more diverse and immersive travel experience. Through AR-guided tours and interactive displays, visitors can gain a deeper understanding of the history, culture, and art of the Mogao Caves, increasing the enjoyment and participation of the tour, and enhancing their overall satisfaction and experience value. The application of AR

technology not only helps popularize the culture of the Mogao Caves but also addresses the challenges of protecting and managing these cultural relics. The digitization of the Mogao Caves murals represents a significant step toward the goal of “sustainable use and permanent preservation”.

In recent years, Dunhuang has fully tapped into its rich cultural and tourism resources, actively exploring new tourism models, scenes, and formats. Continuously introducing tourism products that blend ancient with modern, traditional with fashionable elements, it promotes the deep integration of cultural tourism industries, enriches tourism product offerings, enhances tourism consumption experiences, and drives high-quality development in the tourism sector (Pengpai News, 2024). In the first quarter of 2024, Dunhuang’s tourism market showed strong growth momentum, with a total of 438,600 visitors received, marking a 63.85% increase compared to the same period in 2023. Within Dunhuang’s six major scenic areas, such as Mogao Caves, Mingsha Mountain, Yardan Landforms, Jade Gate Pass, Yangguan Pass, and Dunhuang Ancient City, all exhibited vibrant tourism vitality. Specifically, Mogao Caves received a total of 140,000 visitors, a year-on-year increase of 52.17% (CCTV Finance, 2024). As a landmark attraction in Dunhuang, Mogao Caves has introduced a new interactive experience for visitors. In March 2023, it pioneered the “Dunhuang AR Smart Guide” system, a groundbreaking initiative in China’s cultural tourism industry. This system utilizes AR glasses guided by an AR virtual guide named “Dundun”, allowing visitors to immerse themselves in the millennia-long history of Mogao Caves. While experiencing the vivid and awe-inspiring revitalized murals, visitors can gain a more precise and clearer understanding of the profound content of each cave, enhanced by virtual reality and digital technology, thereby enjoying an immersive exhibition experience (Dunhuang Academy, 2024).

The development of AR tourism in Dunhuang has received strong support and promotion from the Chinese government. In the “14th Five-Year Plan” (2021-2035), there is a significant increase in the proportion of content related to cultural heritage and relics. Priority has also been given to digital content, and there has been a

focus on the digital development of museums. The digitization of cultural heritage and institutions has risen to the level of a national strategic priority. This plan mentions various specific application areas, including online digital experiences in museums, immersive experiences at tourist sites, and virtual exhibition halls, which represent new forms of cultural tourism services. In the “13th Five-Year National Science and Technology Innovation Plan”, there is a strong emphasis on the development of human-computer interaction technology, particularly in the fields of VR and AR. It explicitly calls for breakthroughs in key technologies, rendering techniques, true three-dimensional representation, real-time positioning and registration, and user-oriented virtual reality technology. These advancements are essential for enhancing the overall user experience and engagement in AR tourism. Furthermore, in specific subfields, the government expects AR/VR technologies to stimulate new productivity and address existing challenges in education, cultural tourism, healthcare, and industry. For example, these technologies can offer more immersive and interactive learning experiences, improve medical training through realistic simulations, and enhance industrial processes and efficiency (Ministry of Culture and Tourism, 2023).

In summary, the Chinese government’s strong policy support and emphasis on digitalization and AR/VR technologies have provided a solid foundation for the development of AR tourism in Dunhuang. This support has led to technological innovations and the application of AR/VR in various sectors, contributing to the thriving development of this field.

2.6 Research related to Augmented Reality

Research on AR in tourism has gained significant attention in recent years due to its potential to enhance the tourist experience and transform the way people engage with travel destinations. This emerging field has explored various aspects of AR technology in the context of tourism, leading to valuable insights and findings. Scholars have debated and discussed the potential barriers and user demands for application of AR technology in the tourism field for many years and multiple topics around AR have emerged.

TABLE 2 Research Related to Augmented Reality in China and Aboard.

Title	Key Findings	Country	References
A systematic review of augmented reality tourism research: What is now and what is next?	AR is revolutionizing tourism with promising research. Unlike virtual reality, it enhances real-world interaction, especially in user acceptance studies, forming a maturing research field with distinct clusters.	China	Liang et al. (2020)
Research on the Design and Application of Digital Navigation System for Scenic Spots Based on User Needs	AI+AR has stronger interactivity, immersion, and experience. It should complement traditional guidance systems and cannot be completely replaced. This is an important issue to consider for the rapid integration and development of the cultural and tourism industry.	China	Fan (2021)
Application Practice of 5G Metaverse in Cultural Tourism Industry	Amid COVID-19's impact, China's cultural and tourism sectors are speeding up digital transformation, shaping a "cultural tourism universe". Leveraging VR/AR, 5G, cloud computing, and big data, this initiative aims to innovate online models integrating culture, scenery, and consumption.	China	Qian (2022)
Augmented reality and the enhancement of memorable tourism experiences at heritage sites	AR technology has profoundly revolutionized the way experiences are perceived in the tourism industry, creating an interactive platform for visitors to deeply engage with unique cultures. When evaluating visitor participation in cultural heritage sites, significant differences in experiential intensity have been observed.	China	Jiang et al. (2023)

TABLE 2 Research Related to Augmented Reality in China and Aboard (Continue)

Exploring the value of augmented reality for tourism	AR is increasingly employed as an information, experiential, and marketing channel in the tourism industry. Studies have identified marketing value as a newly defined dimension of AR value, gaining consensus among stakeholders.	UK	Cranmer et al. (2020)
VR and AR Technologies for Accessibility and Marketing in the Tourism Industry	AR enhances knowledge and experiences but faces drawbacks like high costs and security concerns. Its benefits include cost reduction, tourist attraction through gamification, easy brand promotion, building loyalty, data collection, and design product development.	Portugal	Ozdemir (2021)
Augmented Reality for Geospatial in E-Tourism: Current Status, Research Trends, and Future Directions	AR stands out among current technologies as a potential innovation capable of enhancing the tourism sector when utilized optimally. AR enables users enjoy enriched travel experiences through interactive maps.	Indonesia	Kamang et al. (2022)
Augmented Reality for Cultural Heritage	AR is widely used to enhance perspectives by displaying both current and historical views of landmarks and archaeological sites. Future applications may include accessing diverse information formats about ancient relics simply by viewing them.	Italy	Fanini et al. (2023)

The above literature collectively reveals the multifaceted applications and potential of AR in the tourism industry. All studies highlight the challenges faced by AR technology in tourism, such as technical costs, user acceptance, and safety issues, while also recognizing opportunities such as innovative service models and enhanced user experiences. They emphasize the interactive nature, immersion, and experiential

aspects of AR, crucial for improving service quality and visitor satisfaction in tourism. Due to differences in cultural backgrounds, market environments, and policy support, foreign research tends to focus more on the development and innovation of AR technology itself, as well as its widespread application and effectiveness evaluation in tourism. Conversely, Chinese research places greater emphasis on the practical application and outcomes of AR technology in specific tourism scenarios, and how to leverage its maximum potential while integrating with the country's unique tourism market characteristics and cultural backgrounds.

To gain a deeper understanding of how users perceive, evaluate, and interact with AR-based tourism experiences, scholars have employed various theoretical frameworks and models. These include the SOR model, process theory, Technology Acceptance Model (TAM), Technology Readiness (TR), Pleasure-Arousal-Dominance (PAD) model, User Experience Model, and Experience Economy Theory. These emerging research areas provide crucial perspectives for understanding the complex interactions between users and AR tourism experiences, thereby offering robust support for the further development of AR technology within the tourism industry.

In summary, As AR technology continues to evolve and integrate into the tourism landscape, this area of research will remain pivotal in ensuring that AR applications meet the needs and expectations of users, providing them with engaging and satisfying experiences while contributing to the growth and enhancement of the tourism sector.

This study employs the SOR theory to understand the relationship between tourists' AR tourism experiences and behavioral intentions at the Mogao Caves. AR tourism serves as the stimulus (S), with its content quality, system quality, and interactive quality directly influencing tourists’ perceptions and experiences (O), Ultimately leading to tourist behavioral intention (R). These experiences involve tourists’ psychological states and cognitive evaluations, such as emotions, cognitions, and attitudes. When tourists feel emotional pleasure, relaxation, and cultural inspiration during AR tourism, their experiences and behavioral intentions may be positively affected, including their

willingness to stay, revisit, recommend, or pay a premium. High-quality AR content can offer richer and more vivid experiences, enhancing tourists' engagement and satisfaction (Agustini et al., 2023; Cheng et al., 2023). The stability and usability of AR technology are crucial for enhancing tourist experiences. Stable, user-friendly, and aesthetically pleasing system designs can increase tourists' willingness to use and satisfaction, thereby positively influencing tourism experiences (Anand et al., 2023; Jiang et al., 2023). Additionally, robust interactive features can facilitate the integration of tourists with the virtual environment, enhancing immersion and engagement, thus enhancing tourism experiences (Su et al., 2023). Based on these findings, this study adopts a quantitative assessment approach and proposes the following hypotheses:

H1: The content quality of augmented reality tourism positively influences the tourist experience.

H2: The system quality of augmented reality tourism positively influences the tourist experience.

H3: The interactive quality of augmented reality tourism positively influences the tourist experience.

H4: Tourist experience influences behavioral intentions.

These hypotheses are proposed to explore the complex relationship between various aspects of AR tourism quality and tourists' experiences and behavioral intentions. Based on the above literature analysis, the conceptual framework is derived as follows:

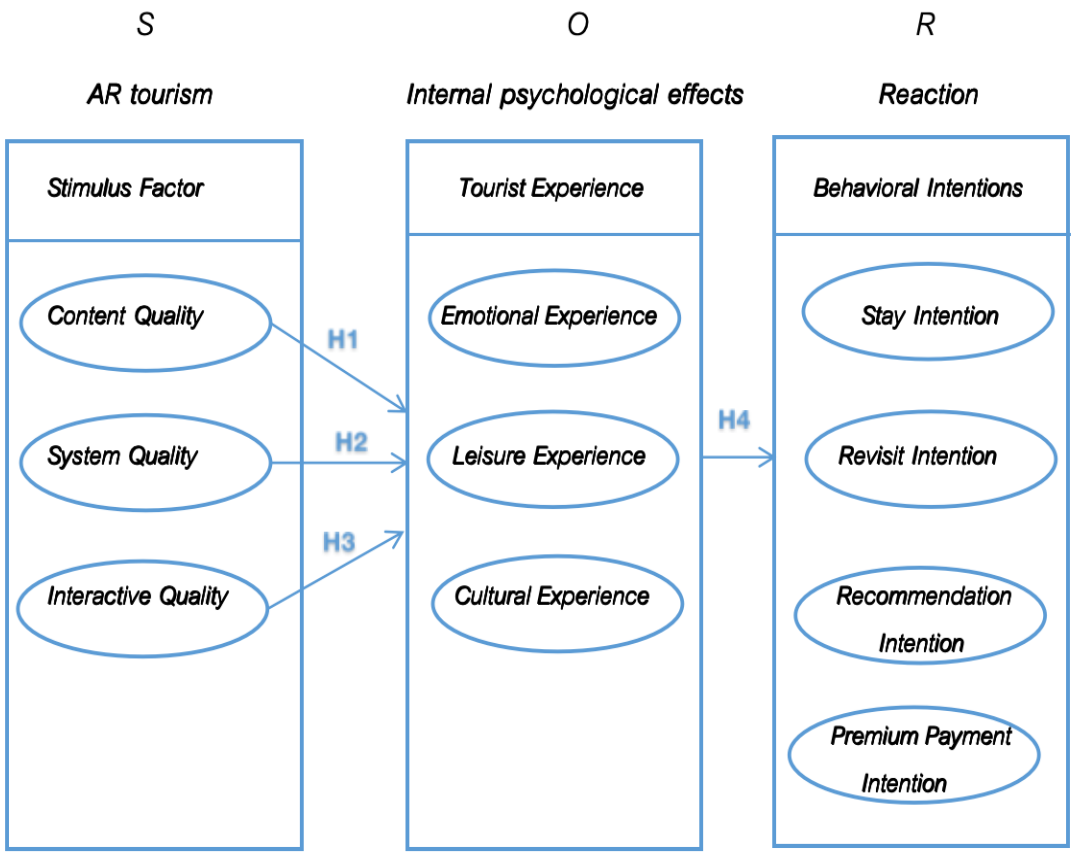

FIGURE 2 Conceptual Framework

CHAPTER 3
METHODOLOGY

This study aims to analyze of tourist experience and behavior intention of the augmented reality tourism of Mogao Caves in China. Based on literature research, this chapter describes the participants, sample, research instruments, and the procedures for data collection and data analysis. This chapter is structured as follows:

3.1 Participants

3.2 Research instruments

3.3 Data collection

3.4 Data analysis

3.1 Participants

3.1.1 Populations

Chinese tourists who have visited the Mogao Caves of Dunhuang, have prior experience with AR, and are at least 18 years old constitute the research population. According to the data from Dunhuang Tourism Bureau as of October 2023, visitors have visited six major scenic spots in Dunhuang, including the Mogao Caves. Among these visitors, the number of individuals who have utilized AR amounts to 5 million (Pengpai News, 2023).

3.1.2 Samples

This study employs convenience sampling. According to the Taro Yamane's formula, the following steps were taken to calculate the sample size:

Formula:

$$n = \frac{N}{1+N(e)^2}$$

Determine the total number of visitors with AR experience (5 million). Where “n” is the sample size. “N” is the population size, and “e” is the level of precision or sampling of error.

Substituting into the equation:

$$n \approx \frac{5000000}{1+5000000 \times 0.05^2}$$

As a result, the sample size of this study is 400.

3.2 Research Instruments

This study conducted quantitative research through a questionnaire survey. The data was collected from 400 tourists who have visited Dunhuang. The survey was conducted in Dunhuang from February to April 2024, during which questionnaires were randomly distributed to participants. The steps to test the reliability and validity of the questionnaire are as follows:

Step1: Literature analysis. Definition of research concepts and questions from the perspectives of SOR theory, tourism experience, behavioral intention, Dunhuang AR tourism, and related studies. By reviewing the development trajectory of AR technology, its application in the tourism industry, and academic research related to AR in the tourism industry, explore the concept of AR tourism. Then, review the origin, concept, characteristics, and application fields of the SOR theory, provide an overview and in-depth analysis of variables such as stimulus factors, tourism experience, and behavioral intention, conceptualize the relationships between these variables, and guide questionnaire construction based on research objectives and theoretical frameworks.

Step2: Questionnaire Design. The questionnaire was validated through consultation with an advisor. The questionnaire comprises four parts: tourist demography, AR tourism in the Mogao Caves of Dunhuang, tourist experience, and tourist behavioral intentions.

The first part includes five items: gender, age, occupation, education level, and region.

The second part involves tourists' use of AR applications in the Mogao Caves of Dunhuang, covering issues related to stimulation (content quality, system quality, interactive quality).

The third part focuses on the tourist experience scale, encompassing emotions, leisure, and culture.

The fourth part of tourist behavioral intentions covers stay intention, revisit intention, recommendation intention, and premium payment intention. All items were based on the grounded theory results, using a Likert 5-point scale with responses ranging from “disagree” to “agree” obtain a Summated Rating Score or Likert Scale value for each respondent (Likert, 1932). Each response was assigned a value from 1 to 5 points, allowing tourists to score and judge their tourism experiences.

Step3: The Index of Consistency (IOC) test. All of research questionnaires were officially examined of content validity by three experts. It was found that the IOC of the questionnaires was higher than 0.5, with an average score of 0.92. This indicates that all questions were relevant to the content and objectives of the study, validating their use for data collection (Rovinelli et al., 1977). Any questions scoring below 0.5 would have been excluded, but none met this criterion. Therefore, the questionnaires were deemed suitable for data collection.

Step4: Conduct a reliability test. Select 30 tourists with a sample size other than 400 to carry out preliminary testing of the survey questionnaire. The reliability test of questionnaire was used a pilot test with the proposed survey questionnaires. Commonly, pilot test was analyzed using Cronbach’s alpha coefficient (Ghozali et al., 2008). It was found that the Cronbach’s α coefficient was 0.974 and all questions had values greater than 0.7. Therefore, it can be used for data collection.

3.3 Data Collection

This survey adopted an offline approach to ensure access to rich and comprehensive information. The survey form was distributed through face-to-face interactions on WeChat, a widely popular social media platform in China, with links to the digital Dunhuang website. This approach allowed users to provide feedback after

experiencing “Cloud Tour Dunhuang” and “Digital Dunhuang Immersion Exhibition”. Efforts were made to conduct the survey efficiently while allowing participants enough time to provide thoughtful responses. Throughout the data collection process, ethical principles were followed. Participants were provided with detailed explanations of the survey’s purpose and assured of the strict confidentiality of their personal information and survey responses. Their full understanding and consent to participate in the survey were ensured. However, the face-to-face WeChat distribution method may introduce demographic biases among users, potentially limiting the diversity of the respondent pool. Therefore, surveys were conducted at different locations in this study to attract various participants, aiming to mitigate these limitations.

TABLE 3 Date Collection Process

Serial Number	Process Description	Time
1	Activity description	5 min
2	Users can select tour modes via touch control in immersive AR technology. Such as navigate through real surroundings, interactively clicking on each scenic spot to switch between them and receive explanations.	10 min
3	users can add voiceovers to their favorite Mogao Grotto mural stories. Afterwards, they can rotate images to fully observe the caves and appreciate the diverse styles of its sculptures.	5 min
4	Based on user activities, the AR system intelligently recommends personalized tour routes and experience content, ensuring users achieve the most satisfying visit within a limited timeframe.	5 min
5	Complete a questionnaire after the virtual tour.	5 min

3.4 Data Analysis

The basic statistical data for this study includes mean values, percentages, frequencies, and standard deviations.

3.4.1 Personal Data

General information about respondents is computed using frequencies and percentages to display participants' frequencies in variables such as gender, age, occupation, education level, and region.

3.4.2 Questionnaire Data

To calculate the tourists' experiences and behavioral intentions towards the AR tourism of the Mogao Caves in Dunhuang from the four sections of the questionnaire, including stimulus-related aspects (content quality, system quality, interactive quality), emotional experience, leisure experience, culture experience, and tourist behavioral intentions encompassing stay intention, revisit intention, recommendation intention, and premium payment intention. The results were described using mean and standard deviation (S.D.). Calculate the average value of each question to report responses' overall perceived personal relevance. Average scores obtained from SPSS interpret data using a Likert scale divided into five levels, ranging as follows (Likert, 1932):

Score Range	Satisfaction Level	
Above 4.50	means	"Agree Strongly"
3.50 – 4.49	means	"Agree"
2.50 – 3.49	means	"Neutral"
1.50 – 2.49	means	"Disagree"
Below 1.50	means	"Disagree Strongly"

3.4.3 Structural Model Evaluation

This study utilized the Smart PLS software, which is based on the calculation principles of Partial Least Squares (PLS), for the path analysis of the structural equation model. Based on literature review, theoretical analysis, research hypotheses, and the characteristics of factors influencing tourist experience and behavioral intentions in Mogao Caves AR tourism that cannot be directly measured, this study employs Structural Equation Modeling (SEM) to analyze tourists' experience and behavioral intention.

The complete structure of the PLS-SEM model consists of two main parts: the outer model (measurement model) and the inner model (structural model). The measurement model allows indirect measurement of latent variables through observed variables, while the structural model reveals causal and dependency relationships among these latent variables.

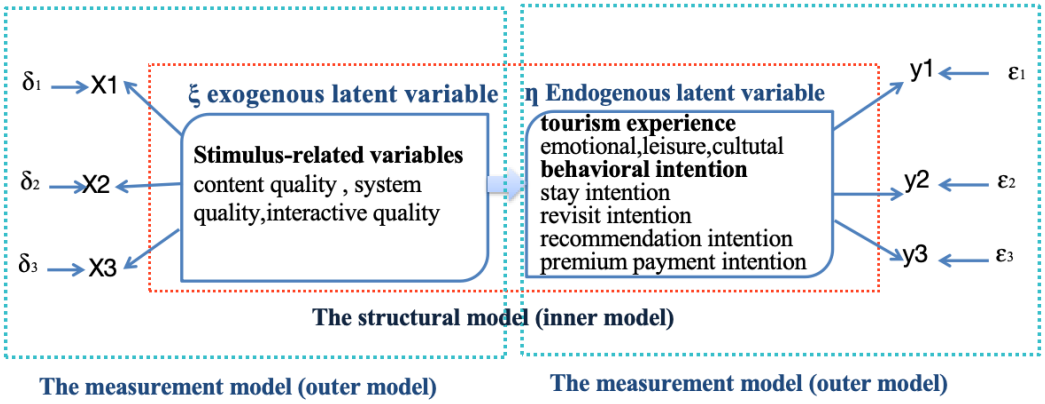

FIGURE 3 Measurement Model

Measurement Model (Outer Model)

The testing procedures for the measurement model include validity testing and reliability testing

Validity Test

Validity testing is used to evaluate whether a questionnaire is effective. If the questions in the survey can accurately measure the content intended to be measured by the questionnaire, then the questionnaire is considered valid. Validity testing applies to all items within each variable.

Reliability Test

Reliability testing is used to measure the consistency of a measurement tool in assessing a concept, or the consistency of respondents in answering statements or items in a questionnaire.

Structural Model (Inner Model)

The internal model, also known as the structural model, is a more central part of the model. It describes the causal relationships between latent variables. The goal of the internal model is to test hypotheses about the relationships between latent variables. By analyzing the significance and effect size of path coefficients, it is possible to assess whether the hypotheses proposed in the model are supported (Edwards et al., 2000).

Measurement Model Evaluation

Formative

Formative models are evaluated based on content validity, collinearity, and item significance. In the Formative Model, the latent variable is viewed as being formed or influenced by its indicators, making it a consequence of the observed variables rather than a cause (Diamantopoulos et al., 2008). In certain situations, it is more reasonable to consider that variations in indicators lead to variations in latent variables. This is known as a Formative Model (FM), and its corresponding indicators are termed formative indicators (Blalock Jr, 2018). These indicators may represent distinct aspects or dimensions contributing to the overall construct.

Content validity

Content validity is the first and most critical criterion for evaluation, assessing how well formative indicators measure various aspects of the structure (Hair et al., 2014). Due to the potential significant impact of any omitted items on the nature of the formative structure, redundancy analysis must be conducted to ascertain convergent validity, with higher redundancy values indicating stronger models. The better the overall predictive ability of the model (Ringle et al., 2012).

Multicollinearity

Multicollinearity is tested using the Variance Inflation Factor (VIF) among indicators. As the reciprocal of tolerance, VIF represents the square of the increase in standard error caused by collinearity (Hair et al., 2011). Any VIF values above 1.0 suggests some degree of multicollinearity, while values exceeding 5 suggest severe multicollinearity (Henseler et al., 2009).

Item Significance

Bootstrapping evaluation forms a formative model to assess the statistical significance of parameters. The significance level criterion is a critical t-value of 1.96, where all parameters are significant ($p < 0.5$) (Hair et al., 2014).

Reflective

In the measurement model, the relationship between indicators and latent variables is a linear function, representing the model proposed by Spearman in factor analysis. This model is known as a Reflective Model (RM), and the corresponding indicators are referred to as reflective indicators. The standard for reflective indicators is to ensure that they can effectively measure the corresponding latent variables and have a certain degree of stability and consistency between them (Bollen, 1989). Reflective indicators are obtained through questionnaire survey data. Reflective indicators are assessed through Indicator Reliability, Convergent Validity, Discriminant Validity, and Cross Loadings to evaluate reliability.

Indicator Reliability

The indicator reliability can be assessed through Cronbach's α. Cronbach's α is greater than 0.7, These criteria indicate the ideal reliability of observed variables on the latent variable measures (Bujang et al., 2018).

Convergent Validity

Convergent validity refers to the degree of correlation between responses obtained from different methods measuring the same underlying construct or concept. It is typically assessed using the Average Variance Extracted (AVE). The value should be 0.5 or higher for this validity to achieve (Cepeda et al., 2004).

Discriminant Validity

The Fornell-Larcker criterion is a commonly used standard for assessing discriminant validity in structural equation modeling. The criterion states that the square root of the AVE of a latent variable must be greater than its correlations with any other latent variables in the model (Henseler et al., 2015).

Cross Loadings

During the process of path modeling, when conducting PLS estimation, a matrix of loading coefficients between manifest variables (indicators) and latent variables is generated, known as the cross-loading coefficient matrix. In the cross-loadings matrix, this is reflected in the loading coefficients between the observed variables and their corresponding latent variables positioned on the diagonal, which must be higher than other values in the same row, and the loading coefficients are generally higher than 0.7 (Sarstedt et al., 2021).

Inner Model Evaluation

In PLS-SEM, internal model evaluation is the evaluation of the structural model. The inner model evaluates the relationships between latent variables and examines the overall fit of the proposed theoretical framework. This evaluation involves various criteria to ensure the reliability and validity of the structural model. Though the following steps to assess the structural model: Coefficient Determination R^2, Validated Redundancy(Q^2), Effect Size(f^2), Effect Analysis.

Coefficient Determinant

The coefficient determinant, also known as the coefficient of determination or R^2, is a crucial metric in structural equation modeling (SEM). R^2 is primarily used to measure the explanatory power of the structural model, indicating the degree to which internal latent variables are explained by external latent variables. A higher R^2 value suggests better fit of the internal model in the PLS path model. The models with coefficients of determination R^2 of 0.67, 0.3, or 0.19 are classified as strong, medium, or weak based on the extent to which they explain the variance of the endogenous constructs relative to all relevant exogenous constructs associated with them (Hair et al., 2014; Henseler et al., 2015).

Cross Validated Redundancy

Cross-validated redundancy, typically denoted as Q^2 (Q square), provides an intuitive understanding of the model's ability to predict or replicate variance in the endogenous variable structure (Fornell et al., 1993). To estimate cross-validated redundancy, typically a leave-out distance of 5-10 samples is used for cross-validation.

When Q^2 exceeds 0.5, the model is generally considered to have sufficient predictive capability (Chin et al., 2010). A higher Q^2 value indicates better predictive relevance, suggesting that the model has a good ability to predict the endogenous constructs. Conversely, a lower Q^2 value may indicate that the model's predictive performance is limited (Cohen, 2013).

Effect Size (f^2)

In PLS-SEM, Effect Size, often denoted as f^2(f-squared), is a measure used to assess the practical significance or importance of a particular path or relationship in the model. The f^2 value ranges from 0 to 1. A larger f^2 indicates a stronger effect, suggesting that the predictor has a more substantial impact on the dependent variable (Cohen, 2013).

Effect Analysis

During the process of PLS path modeling, while calculating other values, a path diagram is simultaneously generated. This path diagram allows for easy identification of which latent variables in the model have direct relationships. However, for those latent variables with zero path coefficients, it is impossible to determine whether there is a relationship or a definite lack of relationship. Therefore, with the help of the model's effects table, one can intuitively observe the total effect between two latent variables. The magnitude of the effect values can be used to assess the degree of mutual influence between latent variables. Total effects are categorized into direct effects and indirect effects. "Total effect= direct effect + indirect effect" (J. F. Hair et al., 2011). The effect size (magnitude) of path coefficients is considered. Larger path coefficients indicate a stronger relationship between variables.

Path Coefficients and Significance Levels

Path coefficients measure relationships between latent variables, reflecting the direct influence of one latent variable on another within a structural equation model. These coefficients act as weights along model paths, quantifying the effect in the construct between variables. In PLS analysis, the path coefficient's standard estimate determines the significance level of the relationship hypothesis among model constructs. It signifies the expected variance in endogenous constructs due to the

exogenous variant. Higher path coefficient values indicate a more substantial effect on the endogenous latent structure (Chin, 1998).

Significance levels assess the statistical importance of path coefficients, gauging whether they significantly differ from zero. In hypothesis testing, p-values, typically set at 0.05, determine significance. A path coefficient is deemed significant if its p-value is below this threshold, indicating a meaningful direct relationship (Hair et al., 2021). The validity of PLS-estimated path coefficients is examined using asymptotic t-statistics, derived through resampling methods (Yoo et al., 2018). For standard t-tests, significance levels of 10%, 5%, and 1% correspond to 1.65, 1.96, and 2.57, respectively. In PLS-SEM, significance levels are determined through resampling or bootstrapping. Multiple iterations yield the distribution of path coefficients, enabling p-value calculation. If the p-value is less than the significance level, the null hypothesis is rejected, indicating the path coefficient's significance (Chin et al., 2010).Based on all research, the structural model evaluation is summarized as follows:

TABLE 4 Structural Model Evaluation

Step	Evaluation Content	Evaluating Indicator	Evaluation Criterion
1	Structural Model Assessment	Outer Model Equation	To assess the reliability and validity of the measurement variables.
		Inner Model Equation	To test hypotheses about the relationships between latent variables.
2	Measurement model evaluation	Convergent Validity	Redundancy analysis for each construct. The higher the redundancy value, the greater the modulus. The better the overall predictive ability of the model.
	Formative Indicators	Multicollinearity	Variance Inflation Factor (VIF) >1.

TABLE 4 Structural Model Evaluation (Continue)

		Item Significance	Bootstrapping to evaluate the statistical significance of the model parameters. All formative indicators are signifcant at a 5% level, T>1.96.
		Indicator Reliability	Cronbach's alpha, CA>=0.7
3	Measurement model evaluation	Convergent Validity	AVE>0.5
		Discriminant Validity	The square root of AVE for each latent variable in the model should be greater than the maximum correlation between that latent variable and all other latent variables.
	Reflective Indicators	Cross Loadings	The loading coefficients must be lower than the loading coefficients between the observed variable and its corresponding latent variable.
4	Inner Model Evaluation	Coefficient Determinant(R^2)	R^2 >=0.67 is better, 0.33 Moderate, < 0.19 Poor.
		Validated Redundancy(Q^2)	Q^2>0, observation reconstruction is good, and the model has predictive correlation. Q^2<0, model lacks predictive correlation.
		Effect Size(f^2)	Q^2>=0.35 is relatively large, 0.15 is moderate, <0.02 is very small. >=0.35 is relatively large, 0.15 is moderate, <0.02 is very small.
		Effect Analysis	The indirect impact is obtained by multiplying the coefficients of each path.
5	Interpret the results	Path Coefficients and Significance Levels	P<0.05, T-statistic>1.96.

CHAPTER 4
RESEARCH RESULTS

This chapter presents the research findings, which are divided into three sections: demographic characteristics, questionnaire survey data analysis and Structural Model Evaluation

4.1 Demographic Characteristics

The demographic information includes gender, age, education level, occupation, and region. The data are shown below.

TABLE 5 Descriptive Statistics of Participants

Demographic Characteristics		Frequency	Percentage (%)
Gender	Male	199	49.75
	Female	201	50.25
Age	18-25	79	19.75
	26-35	128	32.00
	36-45	104	26.00
	46-55	89	22.25
Education	Junior high school and below	32	8.00
	High school	75	18.75
	Junior College	130	32.50
	College/bachelor's degree	118	29.50
	Master's degree and above	45	11.25
Occupation	Government officer	56	14.00
	Private Company employee	125	31.25
	State enterprise employee	85	21.25
	Teachers and other technical personnel	92	23.00
	Students	42	10.50

TABLE 5 Descriptive Statistics of Participants (Continue)

Region	South China	18	0.23
	Central China	25	0.31
	Southwest China	15	0.19
	Northwest China	286	0.36
	North China	12	0.15
	Northeast China	6	0.08

As shown in Table 5, the descriptive statistical data of the sample showed a balanced gender distribution, reducing the potential impact of gender bias on the research results. Men account for 49.75% and women account for 50.25%. Many participants (32.00%) belong to the 26-35 age group, followed by 26% in the 36-45 age group and 22.25% in the 46-55 age group. The age range of 26 to 35 years old is a critical stage for career development and family life, indicating a higher interest and acceptance of emerging technologies such as travel experiences and AR. In terms of education level, most participants have an associate or bachelor's degree, accounting for 32.50% and 29.50% respectively. Indicates that they have a deeper understanding of AR tourism. From a professional perspective, a higher proportion of participants are employed by private companies, teachers, or professionals, accounting for 31.25% and 23.00% respectively. These occupational groups typically have stable income and higher social status, which may indicate that they are more willing to pursue and pay for tourism experiences. From a geographical perspective, participants from the northwest region have the highest proportion, accounting for 36.00%.

4.2 Questionnaire Survey Data Analysis

4.2.1 Descriptive Analysis

This section analyzed four components of the questionnaire, including aspects related to the stimulus factor (content quality, system quality, interactive quality), tourist experience (emotional experience, leisure experience, cultural experience), tourist behavioral intention (stay intention, revisit intention, recommendation intention,

premium payment intention), and AR tourism satisfaction. The results were described using mean values and standard deviations. Descriptive statistical analysis of each variable item is presented in Table 6.

TABLE 6 Descriptive Statistical Analysis of Various Variable Items

	Variables	Items	N	Mean	Standard Deviations
Stimulus Factor	Content Quality	A1	400	4.215	1.145
		A2	400	4.282	1.177
		A3	400	4.058	1.092
	System Quality	B1	400	4.235	1.170
		B2	400	4.157	1.209
		B3	400	4.178	1.210
	Interactive Quality	C1	400	4.018	1.166
		C2	400	4.067	1.201
		C3	400	4.103	1.151
Tourist Experience	Emotional Experience	D1	400	4.205	1.158
		D2	400	4.247	1.133
		D3	400	4.053	1.128
	Leisure Experience	E1	400	3.998	1.129
		E2	400	3.953	1.206
		E3	400	3.985	1.117
	Cultural Experience	F1	400	4.005	1.137
		F2	400	4.120	1.220
		F3	400	4.095	1.174

TABLE 6 Descriptive Statistical Analysis of Various Variable Items (Continue)

Tourist Behavioral Intention	Stay Intention	G1	400	4.005	1.128
	Revisit Intention	G2	400	3.993	1.190
	Recommendation Intention	G3	400	4.043	1.115
	Premium Payment Intention	G4	400	3.915	1.037
Tourist satisfaction		Q1	400	4.152	1.026

Descriptive analysis indicates that all four components of the questionnaire aspects related to the stimulus factor, tourist experience, tourist behavioral intention, and AR tourism satisfaction, have received positive responses from the respondents. Within the SOR theory framework, the average score for content quality was 4.185, system quality was 4.190, interactive quality was 4.062, emotional experience was 4.168, leisure experience was 3.979, and cultural experience was 4.073. This reflects generally high average scores across these indicators, with relatively small standard deviations, indicating high satisfaction among visitors in these aspects. This suggests that AR tourism excels in content design, system stability, and interactive experiences, providing visitors with rich, seamless, and enjoyable experiences.

In terms of tourist experience, emotional experience has received high recognition from visitors, with average ratings ranging from 4.053 to 4.247 and standard deviations from 1.128 to 1.158. This indicates that tourists feel pleasure and satisfaction during their AR tourism experience. Leisure experience (M=3.953—3.998) and cultural experience (M=4.005—4.120) are also positively evaluated, albeit with slight fluctuations. This may reflect varying preferences and expectations among different visitors regarding leisure and cultural activities.

Regarding tourist behavioral intentions, tourists demonstrate a positive attitude towards their behavioral intentions, with relatively high average ratings for intentions to stay, revisit, recommend, and willingness to pay a premium, ranging from

3.915 to 4. 043.This further demonstrates the effectiveness of AR tourism in attracting and retaining visitors.

Regarding AR tourism satisfaction, the overall satisfaction among visitors is high, with an average score of 4.152 and a standard deviation of 1.026. This indicates that tourists are satisfied with the overall AR tourism experience and consider it a recommended and repeatable tourism product. These results preliminarily suggest that tourists in the sample hold a positive attitude towards the overall experience of the Mogao Caves AR tourism and are satisfied with the services provided. It is worth noting that while most scores are at a high level, there are still some particularly high or low scores. For example, some tourists may give particularly high ratings to specific AR content or interactive activities because they resonate strongly with their interests or expectations. Conversely, some tourists may feel less satisfied with certain aspects, possibly due to technical glitches, inconvenient operations, or unappealing content. These particularly high or low scores provide clues and directions for improving and optimizing the AR tourism experience.

In conclusion, tourists generally have positive attitudes toward dimensions such as content quality, system quality, interactive quality, emotional experience, leisure experience, cultural experience, behavioral intention, and satisfaction, with average scores around 4 points. The small standard deviations indicate a consensus among tourists. Despite this positive feedback, outliers suggest areas for improvement, such as addressing technical issues or enhancing content attractiveness. These findings affirm the positive reception of Mogao Caves AR tourism and provide insights for further enhancement.

4.2.2 Reliability Analysis

The reliability of the questionnaire indicates the consistency of measurements. Cronbach's α coefficient is commonly used as an indicator of the reliability of measurement scales. When the α coefficient is high, it indicates that the items in the questionnaire are strongly correlated when measuring the same concept, less susceptible to random errors, and accurately reflect the true situation of the

respondents. This enhances the credibility of the study and provides strong support for subsequent analysis. As shown in Table 3, the Cronbach's α coefficients are 0.917, 0.922, 0.896, 0.914, 0.893, 0.902, and 0.912, all of which exceed 0.7. This indicates that the scale has high reliability and can be used for subsequent analysis.

TABLE 7 Variable Reliability Test

Variables	Items	Cronbach's α
Content Quality	3	0.917
System Quality	3	0.922
Interactive Quality	3	0.896
Emotional Experience	3	0.914
Leisure Experience	3	0.893
Cultural Experience	3	0.902
Tourist Behavioral Intention	4	0.912

4.2.3 Validity Analysis

This study employed Exploratory Factor Analysis (EFA) to examine the validity of questionnaire items. The results indicate that the questionnaire has a clear and reasonable factor structure with good discriminant validity among the factors, demonstrating its structural validity.

TABLE 8 KMO and Bartlett Sphere Tests

KMO	0.943	
Bartlett sphericity test	Approximate chi-squared value	7397.080
	df	231
	P Value	0.000*

*p<0.001

KMO and Bartlett's sphere tests were conducted separately for each variable. The results of the KMO and Bartlett tests are shown in Table 8. The KMO result

is 0.943, with all variables having KMO values greater than 0.7, indicating that the sample adequacy reached a good level. In this scenario, Bartlett's sphere test yielded an approximate chi-squared value of 7397.080 with 231 degrees of freedom and a p-value of 0.000 ($p<0.001$), indicating the presence of correlated factors among the variables. This suggests that the questionnaire is suitable for factor analysis.

This study categorized and numbered different influencing factors and corresponding items according to different dimensions for ease of statistical analysis. See Table 9 for details.

TABLE 9 Variable Classification Numbers

	Items	N.
1. Content Quality	1.1 Are you satisfied with the accuracy, depth, and visual appeal of the content delivered by the Mogao Caves AR system?	A1
	1.2 Were the specific features or information in the AR content intriguing or engaging for you?	A2
	1.3 Did the AR content enhance your understanding of the artistic and historical culture associated with the Mogao Caves?	A3
2.System Quality	2.1 How would you rate the overall performance and responsiveness of the AR system during your virtual tour of the Mogao Caves?	B1
	2.2 Is the operation of the AR system smooth for you, without any interruptions or technical problems?	B2
	2.3 How satisfied are you with the ease of navigation within the AR system during your virtual tour?	B3
3.Interactive Quality	3.1 How would you rate the responsiveness of the AR system to your interactions and commands?	C1
	3.2 Assess the level of interactivity provided by the AR system during your virtual tour. Did it meet your expectations?	C2
	3.3 Were you able to control and manipulate the AR features effectively during your visit to Mogao Caves?	C3

TABLE 9 Variable Classification Numbers (Continue)

1.Emotional Experience	1.1 Did the AR technology contribute to an emotionally enriching experience at Mogao Caves?	D1
	1.2 Did you feel a sense of wonderment while exploring Mogao Caves through AR?	D2
	1.3 Did the AR experience evoke any feelings of nostalgia for the cultural heritage of Mogao Caves?	D3
2.Leisure Experience	2.1 How much did the AR tour of the Mogao Caves contribute to your sense of relaxation? (e.g., Very relaxing, somewhat relaxing, Neutral, somewhat engaging, very engaging)	E1
	2.2 Did the use of AR technology add a fun element to your visit to the Mogao Caves?	E2
	2.3 Did the AR features provide opportunities for engaging in leisure activities during your visit to Mogao Caves?	E3
3.Cultural Experience	3.1 Did the AR experience enhance your appreciation for the cultural diversity showcased at Mogao Caves?	F1
	3.2 How much did the AR experience at Mogao Caves improve your understanding of the cultural significance of the site?	F2
	3.3 Did you learn new information about the cultural significance of Mogao Caves through the AR features?	F3
1.Stay Intention	1.1 How likely are you to extend your stay in the Mogao Caves after experiencing augmented reality tourism?	Q1
2.Revisit Intention	2.1 Would you contemplate returning to the Mogao Caves in the future based on your current experience?	Q2
3.Recommendation Intention	3.1 Would you recommend the Mogao Caves AR tourism to others?	Q3
4.Premium Payment Intention	4.1 Are you willing to pay extra for an enhanced or extended AR experience for the Mogao Caves?	Q4

To assess the quality of the factor structure and explain the variance of questionnaire items, the maximum variance method was employed. Table 10 presents the factor loadings and cumulative explained variance for each factor.

TABLE 10 Table of Factor Load Coefficients After Rotation

Measurement Items	Factor loading coefficient						
	F1	F2	F3	F4	F5	F6	F7
A1	0.208	**0.827**	0.158	0.177	0.152	0.200	0.178
A2	0.197	**0.765**	0.259	0.186	0.220	0.181	0.244
A3	0.215	**0.789**	0.209	0.189	0.212	0.167	0.148
B1	0.245	0.159	0.136	**0.809**	0.208	0.216	0.157
B2	0.238	0.154	0.251	**0.804**	0.176	0.216	0.099
B3	0.251	0.256	0.203	**0.779**	0.130	0.152	0.232
C1	0.189	0.189	0.148	0.213	0.172	0.181	**0.802**
C2	0.194	0.121	0.208	0.116	0.211	0.114	**0.817**
C3	0.229	0.242	0.212	0.124	0.164	0.252	**0.755**
D1	0.198	0.224	0.196	0.193	**0.767**	0.258	0.209
D2	0.206	0.206	0.220	0.156	**0.790**	0.165	0.228
D3	0.222	0.148	0.134	0.159	**0.832**	0.161	0.145
E1	0.256	0.143	0.173	0.216	0.173	**0.781**	0.180
E2	0.175	0.201	0.160	0.141	0.173	**0.811**	0.136
E3	0.239	0.174	0.125	0.205	0.203	**0.772**	0.212
F1	0.205	0.199	**0.791**	0.190	0.201	0.134	0.190
F2	0.172	0.189	**0.772**	0.175	0.219	0.229	0.203
F3	0.238	0.201	**0.812**	0.190	0.117	0.115	0.180
Q1	**0.768**	0.175	0.184	0.212	0.174	0.202	0.122
Q2	**0.780**	0.162	0.167	0.238	0.197	0.158	0.194
Q3	**0.747**	0.193	0.188	0.208	0.170	0.178	0.224
Q4	**0.791**	0.156	0.163	0.138	0.162	0.215	0.166

TABLE 10 Table of Factor Load Coefficients After Rotation (Continue)

KMO value	0.943
Bartlett sphericity value	7397.080
df	231

According to the factor loading coefficient criteria, the data were divided to 7 factors: Factor 1 represents tourist behavioral intentions, encompassing four variables related to tourists' willingness and loyalty toward AR tourism experiences. Factor 2 signifies content quality, influencing tourists' overall evaluation of AR tourism experiences. Factor 3 represents cultural experience, focusing on tourists' cultural perceptions during AR tourism. Factor 4 denotes system quality, measuring the stability and reliability of AR tourism systems. Factor 5 represents emotional experience, encompassing feelings of pleasure, excitement, and immersion. Factor 6 represents leisure experience, particularly significant for tourists seeking relaxation. Factor 7 represents interactive experience, evaluating the degree of interaction between tourists and AR tourism content. The cumulative variance is 84.031%, indicating a high explanatory power. It suggests that the extracted factors adequately represent the original data. Moreover, all factor loadings exceed 0.5, indicating good questionnaire validity and providing a solid foundation for subsequent analysis and discussion.

4.3 Structural Model Evaluation

Based on the literature review, theoretical analysis, research hypothesis framework, and the characteristics of AR tourism (stimulating factors), Internal psychological effects (tourism experience), and Reaction (behavioral intention) indicators in the evaluation of tourist experience and behavior intention of the augmented reality tourism of Mogao Caves in China, which cannot be directly measured, this study utilizes the Partial Least Squares (PLS) method and Smart PLS software to evaluate the structural equation model.

4.3.1 PLS-SEM Model Construction

This study utilizes the PLS method and Smart PLS software to evaluate the structural equation model. Figure 4 shows Model of tourist experience and behavior

intention of the AR tourism of Mogao Caves in China. The model comprises three latent variables, including tourist experience (Emotional Experience, Leisure Experience, Cultural Experience), and behavioral intention (Stay Intention, Revisit Intention, Recommendation Intention, Premium Payment Intention), which consist of seven endogenous latent variables. Stimulating factors (content quality, system quality, interactive quality) are represented by three variables as exogenous latent variables. Tourist experiences are regarded as the mediating variables, subdivided into emotional experience, leisure experience, and cultural experience, representing different aspects of experiences that tourists may undergo during their visit to the Mogao Caves. Behavioral intentions, including tourists' intention to stay, revisit, recommend, and willingness to pay a premium, are the ultimate outcomes of interest in this study. The model capable of explaining the complex relationship between tourists' experiences and behavioral intentions.

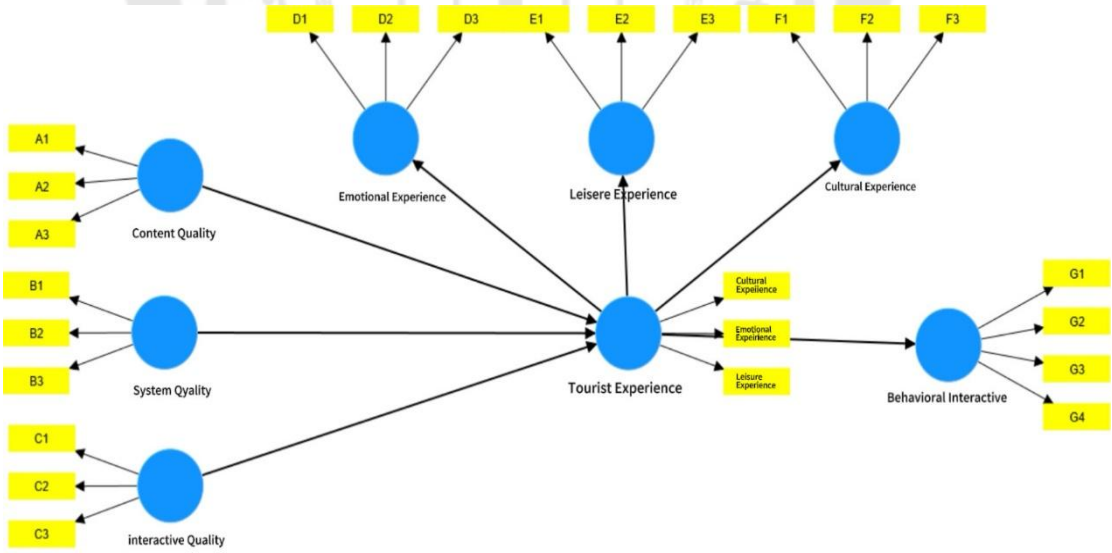

FIGURE 4 PLS-SEM Model of Tourist Experience and Behavior Intention

of the Augmented Reality Tourism of Mogao Caves in China

4.3.2 Measurement Model

Measurement models are assessed based on two core indicators: reliability and validity. Reliability primarily measures the consistency, stability, and the degree of reliability of measurement outcomes. Validity focuses on examining whether measurement outcomes truthfully and accurately reflect the content or variables under study.

Convergent Validity

As shown in Table 11 results, it can be observed that the AVE of each factor is greater than 0.5 and the CR values are greater than 0.7, indicating strong measurement relationships and high validity

TABLE 11 Measurement Model Summary

Variables	Factor Loading	Cronbach's α	CR	AVE
A1 <- A Content Quality	0.927			
A2 <- A Content Quality	0.937	0.918	0.921	0.859
A3 <- A Content Quality	0.917			
B1 <- B System Quality	0.928			
B2 <- B System Quality	0.934	0.922	0.922	0.865
B3 <- B System Quality	0.928			
C1 <- C Interactive Quality	0.912			
C2 <- C Interactive Quality	0.899	0.896	0.900	0.828
C3 <- C Interactive Quality	0.919			
D1 <- D Emotional Experience	0.934			
D2 <- D Emotional Experience	0.930	0.914	0.917	0.854
D3 <- D Emotional Experience	0.908			
E1 <- E Leisure Experience	0.915			
E2 <- E Leisure Experience	0.899	0.894	0.895	0.825
E3 <- E Leisure Experience	0.911			
F1 <- F Cultural Experience	0.914	0.902	0.904	0.837
F2 <- F Cultural Experience	0.916			

TABLE 11 Measurement Model Summary (Continue)

F3 <- F Cultural Experience	0.914			
D Emotional Experience <- G Tourist Experience	0.849			
E Leisure Experience <- G Tourist Experience	0.830	0.782	0.782	0.697
F Cultural Experience <- G Tourist Experience	0.825			
G1 <- H Behavioral Intention	0.883			
G2 <- H Behavioral Intention	0.904			
G3 <- H Behavioral Intention	0.890	0.913	0.913	0.793
G4 <- H Behavioral Intention	0.883			

Multicollinearity Analysis

To analyze the impact of multicollinearity issues on structural equation modeling, this study employs the variance inflation factor (VIF) index to test for multicollinearity among the measurement variables, the results are shown in the table below.

TABLE 12 Measurement Model VIF Value

Item	VIF
A1	3.450
A2	3.549
A3	2.967
B1	3.380
B2	3.522
B3	3.353
C1	2.805
C2	2.591
C3	2.806
D1	3.468
D2	3.386
D3	2.833
E1	2.809

TABLE 12 Measurement Model VIF Value (Continue)

E2	2.535
E3	2.716
F1	2.845
F2	2.791
F3	2.934
G1	2.662
G2	3.127
G3	2.796
G4	2.709
D Emotional Experience	1.709
E Leisure Experience	1.607
F Cultural Experience	1.580

Table 12 displays the VIF values for each measurement variable in the measurement model. From the data, it can be observed that all VIF values for the measurement variables are less than 5, with the maximum value being 3.549 and the minimum value being 1.580. This indicates that in the measurement model, the collinearity between each variable is not particularly severe, as their VIF values are within an acceptable range and do not exceed the threshold of 5. This suggests that there are no significant multicollinearity issues among the variables in the measurement model, making the data reliable in this regard.

TABLE 13 Structural Model VIF Value

	G Tourist Experience	H Behavioral Intention
A Content Quality	1.734	
B System Quality	1.609	
C Interactive Quality	1.607	
G Tourist Experience		1

Table 13 presents the VIF values for each variable in the structural model. In the structural model, tourist experience and behavioral intention are key variables, and they are related to content quality, system quality, and interactive quality.

From the data, it can be observed that the VIF values for tourist experience and behavioral intention are all less than 5, with the maximum value being 1.734 and the minimum value being 1. This indicates that in the structural model, there are no significant issues of multicollinearity among these key variables, making the results of the structural analysis of the model reliable.

Significance Analysis

The significance analysis conducted through bootstrapping provides valuable insights into the relationships between model parameters. In this study, the path from tourist experience to tourist behavioral intention is found to be statistically significant ($p < 0.05$), supporting hypothesis H4. This result suggests that tourists' experiences during AR tourism at the Mogao Caves have a positive influence on their behavioral intentions, such as revisiting, recommending, or paying additional fees. The theoretical implications of this finding underscore the importance of providing high-quality AR tourism experiences to enhance tourists' behavioral intentions. It aligns with the SOR theory, which posits that positive stimulus (tourist experiences) lead to favorable responses (behavioral intentions). The significance testing results offer theoretical insights and practical implications for destination management and tourism development, emphasizing the pivotal role of tourist experiences in driving favorable behavioral intentions in the context of AR tourism at the Mogao Caves.

TABLE 14 Structural Equation Model Coefficients

Items	β	STDEV	T	P
A Content Quality -> G Tourist Experience	0.322	0.052	6.216	0.000*
B System Quality -> G Tourist Experience	0.322	0.048	6.696	0.000*
C Interactive Quality -> G Tourist Experience	0.320	0.044	7.344	0.000*
G Tourist Experience -> D Emotional Experience	0.848	0.021	40.220	0.000*
G Tourist Experience -> E Leisure Experience	0.830	0.024	34.874	0.000*
G Tourist Experience -> F Cultural Experience	0.826	0.023	35.620	0.000*
G Tourist Experience -> H Behavioral Intention	0.692	0.042	16.401	0.000*

*P<0.001

Discriminant Validity

The values on the diagonal represent the AVE scores for each variable, reflecting the proportion of variance explained by the variable. The values off the diagonal represent the correlation coefficients between variables. According to the Fornell-Lacker criterion, if the square root of the AVE for each variable on the diagonal is greater than the correlation coefficients between the corresponding variables, it indicates that these variables have good discriminant validity. As shown in Table 15, it is found that the square root of the AVE scores for each variable is greater than the non-diagonal values correlated with them.

For example, taking content quality (variable A) as an example, its AVE is 0.927, and the corresponding correlation coefficients with other variables are 0.567, 0.566, 0.578, 0.550, 0.589, and 0.571. However, the square root of 0.927 is 0.963, which is greater than the correlation coefficient values with other variables. This indicates that content quality (A) exhibits sufficient differentiation from other variables and possesses good discriminant validity. The same applies to other variables.

Therefore, these results indicate that each variable exhibits sufficient differentiation from others, demonstrating good discriminant validity. This suggests that the measurement tools used in the study can effectively distinguish between different variables, thereby enhancing the reliability and validity of the research.

TABLE 15 Results of the Discriminant Validity Test

Variables	A	B	C	D	E	F	H
Content Quality	**0.927**						
System Quality	0.567	**0.930**					
Interaction Quality	0.566	0.518	**0.910**				
Emotional Experience	0.578	0.542	0.564	**0.924**			
Leisure Experience	0.550	0.568	0.547	0.565	**0.908**		
Cultural Experience	0.589	0.568	0.564	0.556	0.515	**0.915**	
Behavioral Intention	0.571	0.616	0.567	0.573	0.591	0.568	**0.890**

Cross Loadings

The cross-loading matrix reflects the extent to which latent variables explain themselves and other measured variables. In the cross-loading matrix, bold letter combinations typically indicate the latent variable to which each measured variable belongs. This implies a close association between these measured variables and the same latent variable. When analyzing the cross-loading matrix in this study, the focus is primarily on the correlation between each factor and its corresponding latent variable, as well as the correlation between each factor and the measured items of other latent variables.

According to the criteria for judging cross-loading matrices, the aim is to observe factors with relatively high loadings being strongly associated with their respective latent variables' measured items and having lower correlations with measured items of other latent variables. This scenario indicates good discriminant validity for each variable, meaning they can effectively distinguish between different latent variables. Therefore, when analyzing the cross-loading matrix, attention is paid to factors with relatively high loadings, especially those associated with the measured items of their respective latent variables. From Table 16, it can be observed that factors with relatively high loadings are indeed correlated with the respective measured items of the latent variables, consistent with the cross-loading criteria. This indicates that each variable possesses discriminant validity.

TABLE 16 Cross Loading Analysis Scale

Item	A	B	C	D	E	F	H
A1	**0.927**	0.510	0.503	0.500	0.506	0.503	0.518
A2	**0.937**	0.543	0.572	0.567	0.526	0.592	0.542
A3	**0.917**	0.522	0.495	0.536	0.496	0.537	0.526
B1	0.505	**0.928**	0.470	0.517	0.538	0.488	0.569
B2	0.505	**0.934**	0.443	0.502	0.534	0.552	0.566
B3	0.573	**0.928**	0.532	0.492	0.513	0.545	0.585
C1	0.515	0.504	**0.912**	0.509	0.498	0.493	0.510
C2	0.460	0.428	**0.899**	0.505	0.436	0.501	0.486

TABLE 16 Cross Loading Analysis Scale (Continue)

C3	0.565	0.479	**0.919**	0.525	0.553	0.544	0.548
D1	0.571	0.535	0.549	**0.934**	0.576	0.540	0.547
D2	0.547	0.498	0.545	**0.930**	0.508	0.540	0.534
D3	0.479	0.465	0.465	**0.908**	0.477	0.456	0.506
E1	0.493	0.540	0.507	0.515	**0.915**	0.487	0.563
E2	0.494	0.473	0.456	0.490	**0.899**	0.450	0.491
E3	0.512	0.534	0.526	0.533	**0.911**	0.465	0.554
F1	0.541	0.523	0.517	0.518	0.457	**0.914**	0.520
F2	0.544	0.523	0.531	0.541	0.517	**0.916**	0.512
F3	0.530	0.513	0.499	0.463	0.436	**0.914**	0.527
G1	0.505	0.553	0.474	0.504	0.529	0.503	**0.883**
G2	0.512	0.576	0.519	0.529	0.519	0.510	**0.904**
G3	0.530	0.560	0.538	0.519	0.530	0.524	**0.890**
G4	0.487	0.505	0.486	0.487	0.525	0.485	**0.883**

4.3.3 Structural Model

To determine the importance of value and coefficient paths, the structural model is evaluated by the following steps: Coefficient Determination(R^2), Validated Redundancy(Q^2), Effect Size(f^2), Effect Analysis.

Coefficient Determination

R^2 is primarily used to measure the explanatory power of the structural model, indicating the degree to which internal latent variables are explained by external latent variables. A higher R^2 value suggests better fit of the internal model in the PLS path model. The endogenous latent variable R^2 value of tourism experience is 0.651. The tourist behavior intention value is 0.479, indicating that the structural model has good fitting ability.

TABLE 17 R Square

Variables	R-square	R-square adjusted
G Tourist Experience	0.651	0.648
H Behavioral Intention	0.479	0.477

According to Table 17, the R-squared value for tourist experience is 65.1%, and for tourist behavioral intention, it is 47.9%. Both R-squared values exceed the minimum threshold of 10%. Therefore, the constructed model demonstrates a strong explanatory power.

Validated Redundancy

Redundancy serves as an evaluation of the overall predictive level of the model, where the magnitude of its value determines whether the model's predictive effect is good or not. A higher redundancy value indicates stronger predictive capability of the model. When $Q^2 > 0$, observation reconstruction is good, and the model has predictive correlation. When $Q^2 < 0$, the model lacks predictive correlation. $Q^2 >= 0.35$ is relatively large, 0.15 is moderate, and < 0.02 is very small. As seen from Table 18, In this model, the Q^2 for tourist experience (G) is 0.446, indicating that the model can explain 44.6% of the total variance, while for behavioral intention (H), the Q^2 is 0.373, indicating that the model can explain 37.3% of the total variance. Therefore, based on the analysis of Q^2 values, we can conclude that in this SEM, the predictive ability of the model for tourist experience (G) is slightly higher than that for behavioral intention (H).

TABLE 18 Redundancy Analysis

Variables	SSO	SSE	Q^2 (=1-SSE/SSO)
G Tourist Experience	1200	664.897	0.446
H Behavioral Intention	1600	1003.265	0.373

Effect Size (f^2)

According to the data provided in Table 19, the explanatory power of tourist experience (G) on content quality (A), system quality (B), and interaction quality (C) is at a moderate level, with values of 0.171, 0.185, and 0.183 respectively. This indicates that the influence of tourist experience on these dependent variables is not very strong, but also not very weak. However, behavioral intention (H) has a relatively high explanatory power on tourist experience (G), reaching 0.919, indicating a significant impact of behavioral intention on tourist experience.

TABLE 19 Effect Size (f^2)

Variables	G Tourist Experience	H Behavioral Intention
A Content Quality	0.171	
B System Quality	0.185	
C Interactive Quality	0.183	
G Tourist Experience		0.919

4.3.4 Model Path Analysis

The model's fit has been confirmed, indicating strong explanatory power, and laying the groundwork for subsequent analysis. At this stage of path analysis, the core variables are analyzed first, followed by the moderator variables, and finally the mediator variables, to provide support for the validation of the research hypotheses. In this study, using bootstrapping method and Smart PLS software, the path coefficients, T-values, and P-values of the research model were calculated, and further validation of the research hypotheses was conducted as shown in Tables 20. Through empirical analysis of the factors influencing the Dunhuang Mogao Caves augmented reality tourism experience, the following three causal influence paths were identified:

Path 1: Content quality → Tourist experience → Tourist behavioral intention

Path 2: System quality → Tourist experience → Tourist behavioral intention

Path 3: Interactive quality → Tourist experience → Tourist behavioral intention

TABLE 20 Intermediary Testing

Items	β	STDEV	T	P<0.001	Lower Limit	Upper Limit
A -> G ->H	0.223	0.039	5.744	0.000*	0.154	0.307
B -> G -> H	0.223	0.037	6.006	0.000*	0.162	0.312
C -> G -> H	0.222	0.034	6.604	0.000*	0.163	.0297

Table 20 lists the results of the mediation analysis for the effects of tourism experience (G) and behavioral intention (H). These results are crucial for understanding the effects of content quality (A), system quality (B), and interactive quality (C) on tourism experience and behavioral intention. The analysis reveals:

The impact of content quality (A) on tourism experience (G) and its effect on behavioral intention (H) are significant. Specifically, with a coefficient (β) of 0.223, a T-value of 5.744, and a P-value of 0.000, indicating that the influence of content quality on tourism experience and behavioral intention is significant and positive. This suggests that improving content quality may have a positive impact on both tourism experience and behavioral intention. Similarly, the effects of system quality (B) and interactive quality (C) on tourism experience (G) and its effect on behavioral intention (H) are also significant. Specifically, with coefficients (β) of 0.223 and 0.222, T-values of 6.006 and 6.604, and P-values of 0.000 for both, indicating that the effects of system quality and interactive quality on tourism experience and behavioral intention are significant and positive. This implies that enhancing system quality and interactive quality may positively influence both tourism experience and behavioral intention.

4.3.5 Summary of Data Analysis

This study employed a Structural Equation Modeling (SEM) approach to investigating the influence of Dunhuang Mogao Caves AR tourism on tourist experience and behavioral intentions. Firstly, the model's fit and predictive ability were determined through the analysis of coefficient of determination (R^2) and cross-validated redundancy (Q^2). The results revealed that the R^2 values for tourist experience and behavioral intentions were 65.1% and 47.7%, respectively, while the Q^2 values were 0.446 and 0.373, indicating the model's high explanatory and predictive power. Further analysis of effect sizes showed that the influence of tourist experience on content quality, system quality, and interactive quality was moderate, while the impact of behavioral intentions on tourist experience was significant. Through model path analysis, the study identified key factors and their influencing paths affecting the AR tourism experience at Dunhuang Mogao Caves.

TABLE 21 Results of Hypotheses Test

Hypothesized Relationship	β	T	P	Results
H1: The content quality of augmented reality tourism positively influences the tourist experience.	0.223	5.744	0.000*	Valid
H2: The system quality of augmented reality tourism positively influences the tourist experience.	0.223	6.006	0.000*	Valid
H3: The interactive quality of augmented reality tourism positively influences the tourist experience.	0.222	6.604	0.000*	Valid
H4: Tourist experience influences behavioral intentions.	0.602	16.401	0.000*	Valid

*P<0.001

H1 analysis indicates that the coefficient (β) is 0.223, with a T-value of 5.744 and a P-value of 0.000, demonstrating a significant and positive impact of content quality on tourist experience. This suggests that improving content quality may have a positive influence on tourist experience.

H2 analysis reveals that the coefficient (β) is 0.223, with a T-value of 6.006 and a P-value of 0.000, indicate a significant and positive effect of system quality on tourist experience. This implies that enhancing system quality may positively affect tourist experience.

H3 analysis yields a coefficient (β) of 0.222, with a T-value of 6.604 and a P-value of 0.000. This indicates that improving interactive quality may positively influence tourist experience.

H4 analysis shows a coefficient (β) of 0.602, with a T-value of 16.401 and a P-value of 0.000. The impact of tourist experience on behavioral intentions is significant. This suggests that a positive tourism experience may lead to favorable behavioral intentions.

Based on analysis, obtain the structural equation:

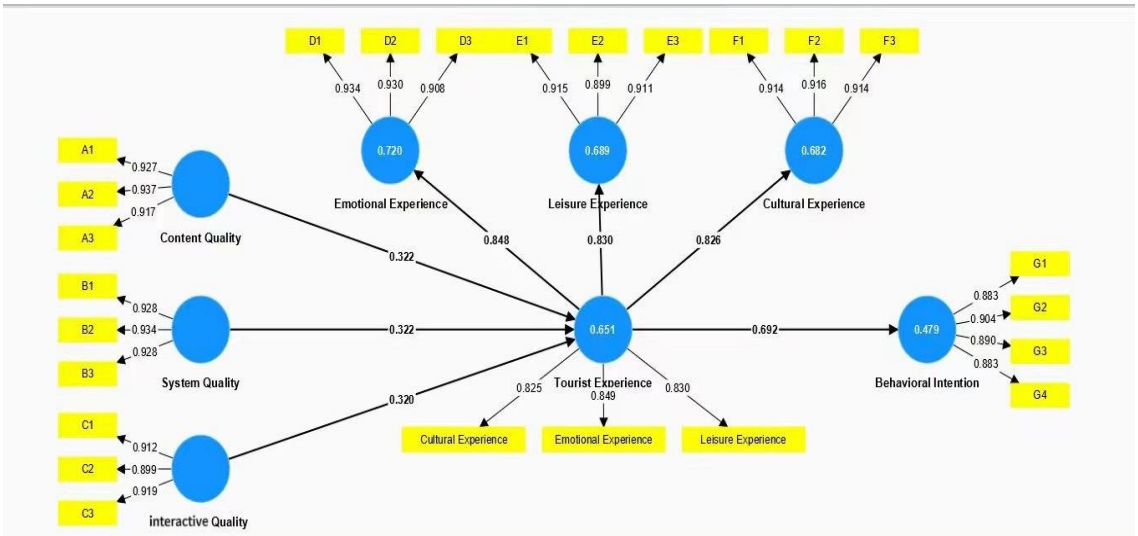

FIGURE 5 Structural Equation Modeling (SEM) Analysis Results

Overall, the statistical results provide support for all hypotheses proposed in the study. The analysis confirms that content quality, system quality, and interactive quality of AR tourism positively influence tourist experience, which, in turn, influences behavioral intentions. These findings align with the research hypotheses, suggesting that improving these aspects of AR tourism can enhance both tourist experience and behavioral intentions.

In summary, this study thoroughly analyzed the relationship between tourist experience and behavioral intentions. The results suggest that the influence of content quality, system quality, and interactive quality on tourist experience is significant and positive, thereby impacting behavioral intentions. These findings provide important insights for the practice and management of AR tourism at the Mogao Caves. By optimizing content quality, system quality, and interactive quality, tourism destinations can enhance the tourist experience, thereby promoting positive behavioral intentions among tourists and further advancing the protection of the Mogao Caves cultural heritage, thus achieving sustainable development in the tourism industry.

CHAPTER 5
CONCLUSION AND DISCUSSION

This chapter presents the summary of finding, discussion, conclusions, limitations of the study, and recommendations for implementation.

5.1 Summary of Finding

5.1.1 Objectives of the Study

To study and understand tourists' augmented reality tourism quality, tourist experience, and behavioral intentions while virtually exploring the Mogao Caves.

The questionnaire comprises four parts: tourist demography, AR tourism in the Mogao Caves of Dunhuang, tourist experience, and tourist behavioral intentions. The demographics section includes five items: gender, age, occupation, education level, and region, providing background for analyzing the responses of the participating tourists and understanding their diverse situations. The second part focuses on tourists' use of AR applications in the Mogao Caves, covering key aspects of AR stimulation such as content quality, system quality, and interactive quality. By examining these factors, the study aims to assess the overall quality of the AR tourism experience. The third section delves into the tourist experience, using subscales to measure emotional, leisure, and cultural aspects. These subscales provide a holistic view of the outcomes of tourists' experiences. The fourth section explores tourist behavioral intentions, including intentions to stay, revisit, recommend, and pay a premium. The data collected through the questionnaire will help identify key trends and insights related to tourists' AR experiences.

To analyze the stimulate factors influence tourists' experiences and behavioral intentions of the augmented reality tourism of Mogao caves.

To explore the complex relationship between various aspects of AR tourism quality and tourists' experiences and behavioral intentions, this study proposes several hypotheses. The hypotheses are designed to analyze how different stimulating

factors of the AR experience at the Mogao Caves influence tourists' overall experiences and subsequent behavioral intentions. Specifically, the study investigates how content quality, system quality, and interactive quality impact tourists' experiences, and how these experiences in turn affect their intentions to stay, revisit, recommend, and pay a premium. By conducting statistical analysis on the collected survey data, the study aims to test these hypotheses and identify which factors most significantly enhance tourists' experiences and drive their behavioral intentions. This analysis will provide a deeper understanding of the key elements that contribute to a successful AR tourism experience at the Mogao Caves and offer insights for further improvement.

5.1.2 Summary of the Study

The study focused on Chinese tourists aged at least 18 who had visited the Mogao Caves in Dunhuang and experienced AR. Based on descriptive statistical analysis, The gender distribution of the sample was balanced, and the age composition aligned with the overall age distribution of Chinese tourists. Participants mainly held associate or bachelor's degrees, and the occupations of participants were primarily from private companies or were teachers/professionals. Geographically, participants from the northwest region were the most represented, particularly from Gansu province. Analysis of questionnaire survey data revealed that tourists tended to highly rate the quality of AR content (M=4.185), systems (M=4.190), and interactive (M=4.062). Emotional experiences during the tourism visit received high recognition (M=4.168, S.D.=1.140), and tourists expressed positive intentions toward behaviors such as stay intention (M=4.005), revisit intention (M=3.993), recommendation intention (M=4.403), and being willing to pay a premium (M=3.915). Overall, tourists were very satisfied with the experiences and services provided (M=4.152).

Empirical analysis indicated that the quality of AR content (β=0.223, T=5.744), system (β=0.223, T=6.006), and interactive (β=0.222, T=6.604) positively influenced tourists' experiences, subsequently affecting their behavioral intentions. The positive impact of AR content, system, and interactive quality on tourist experience underscores the importance of these elements in shaping overall satisfaction and

subsequent behaviors. High scores for AR content quality indicate that tourists value rich, immersive, and informative content. Positive ratings for system quality suggest that stable and user-friendly AR technology is crucial for enhancing the tourist experience. Similarly, high scores for interactive quality highlight the importance of engaging interactive AR features that facilitate deeper immersion into the virtual environment of the Mogao Caves. The findings emphasize that high-quality AR features are essential for shaping the overall tourism experience at the Mogao Caves.

5.2 Discussion

With the rise of the digital age, AR technology has been widely applied in the tourism industry. The Dunhuang municipal government utilizes the “Belt and Road” policy to create the “Great Dunhuang Cultural and Tourism Economic Circle”, placing the Mogao Caves in the spotlight. The rapid development of Dunhuang’s tourism industry poses significant challenges to the protection and management of the Mogao Caves cultural heritage. The main purpose of this study is to investigate the factors influencing tourists’ travel experience and behavioral intentions in AR tourism at the Mogao Caves Heritage. I will present the results of the study based on the predetermined objectives. Each objective will be addressed separately, including any hypotheses proposed. I will explain the consistency or inconsistency of the results with the hypotheses, and then analyze the survey results and the reasons behind their consistency or inconsistency with the hypotheses. Additionally, I will draw upon existing research to support and contextualize the study findings.

5.2.1 Relevance of the Research Questions

Objective 1: To study and understand tourists’ augmented reality tourism quality, tourist experience, and behavioral intentions while virtually exploring the Mogao Caves.

Tourist’s augmented reality tourism quality

Based on an in-depth analysis of the SOR theory, AR tourism quality can be divided into three dimensions: content quality, system quality, and interactive quality. The research results revealed several findings:

The study showed that the quality of AR tourism content has a significant positive impact on the tourist experience and behavioral intentions. As a UNESCO World Heritage Site, the Mogao Caves possess rich historical, cultural, and artistic value, making it an important attraction for tourists. Through high-quality AR content, tourists can deeply experience the historical background, cultural significance, and artistic charm of the Mogao Caves. This immersive experience makes tourists feel as if they have traveled back in time, immersing themselves in a cultural feast from thousands of years ago, significantly enhancing the tourism experience. This finding is unsurprising, as the quality of the tourist experience is directly influenced by the content. Providing content based on the real world can improve the quality of the tourist experience. (Orús et al., 2021) further support this view. They point out that when tourist content is closely related to the real world, tourists can better integrate into the destination, leading to stronger emotional experiences and more satisfying and profound tourism experiences. AR, as a tool to assist tourist attractions, provides immersive experiences with rich content, enhancing the quality of the tourist experience, and allowing visitors to immerse themselves (Cranmer et al., 2023).

The study also found that the system quality of AR tourism significantly impacts the tourist experience. High-quality system performance, stability, and reliability can provide tourists with a smooth and enjoyable user experience, thereby enhancing their cognitive and emotional experiences of the tourist destination. Descriptive statistical analysis shows that the system quality score increased from 4.157 to 4.235, with an average score of around 4, indicating that tourists hold a positive attitude. In AR tourism, whether tourists can smoothly use AR devices, seamlessly switch between different scenes and content, and obtain a coherent and authentic experience while exploring mysterious caves and admiring exquisite murals depends on the performance of the AR system. High-quality system performance plays a crucial role in shaping tourists' experiences in AR tourism. These findings not only demonstrate the importance of system quality in general commercial environments but also highlight the critical role of system quality in improving the tourist experience. A high-quality AR tourism system

can provide tourists with a more enjoyable and seamless experience, enhance their understanding and interest in tourist destinations, thereby improving the overall quality of the tourist experience (Anand et al., 2023). In heritage sites, the quality of AR systems directly impacts the tourist experience and indirectly influences satisfaction by positively affecting the perception of object-based authenticity (Nam et al., 2023).

In addition, the quality of interactive experiences in AR tourism significantly impacts the overall tourist experience. This interactivity enables tourists to actively engage in the exploration and discovery process of places like the Mogao Caves, providing them with a more authentic and personalized journey filled with enjoyment and inspiration. Through interactive maps and other AR applications, tourists can surpass traditional modes of tourism, exploring new locations and experiences, thereby enhancing their overall satisfaction with the tourism experience. These findings underscore the importance of interactive quality in AR tourism, highlighting it as a form of interactive technological engagement (Bec et al., 2021). The service quality of AR applications in tourism environments, through interactive maps that extend beyond traditional locations, enhances the overall tourism experience (Anand et al., 2023). Technologies such as AR have been widely adopted across disciplines to enhance individual interactive experiences (Tsang et al., 2023). These research findings not only advance our understanding of the application of AR technology in tourism but also provide valuable insights for future AR tourism experiences to design and improvement.

Tourist Experience

Based on previous research, tourism experiences are categorized into emotional experiences, leisure experiences, and cultural experiences. Questionnaire analysis reveals that emotional experiences (M=4.168, S.D.=1.140), leisure experiences (M=3.978, S.D.=1.151), and cultural experiences (M=4.073, S.D.=1.177) are positively perceived by tourists, who express high satisfaction with these dimensions of experiences and services. AR tourism experiences stimulate emotional identification among tourists, evoking emotional resonance, allowing for leisurely enjoyment of the travel process. The profound cultural history of the Mogao Caves enriches tourists' travel

experiences, promotes cultural exchange and understanding, and facilitates the inheritance and protection of cultural heritage. AR provides significant opportunities for heritage tourism sites, adding value to the tourism experience while avoiding disruption and damage to sensitive locations (Bec et al., 2021). AR technology overlays the virtual world onto the real world, offering tourists richer and more immersive experiences, thereby aiding the tourism industry in addressing various contemporary challenges (Rane et al., 2023).

Behavioral Intentions

In this study, behavioral intention includes stay intention, revisit intention recommendation intention, and premium payment intention. Empirical analysis has shown that tourists exhibit a positive attitude towards AR tourism at the Mogao Caves, with relatively high ratings in aspects such as stay intention, revisit intention, recommendation intention, and willingness to pay premiums, with an average value of 3.989. The relatively small standard deviation indicates a high level of consistency among tourists in these aspects. Furthermore, from the significance analysis results, all parameters have $p< 0.05$, with a critical value of $t=1.96$, indicating that AR tourism at the Mogao Caves significantly enhances tourists' stay intention, revisit intention, recommendation intention, and premium payment intention. This finding emphasizes the positive impact of AR tourism at the Mogao Caves on tourists' behavioral intentions, further highlighting its importance in the tourism industry. By providing rich and diverse experiences and attractions, AR technology effectively stimulates tourists' interest and engagement, thereby enhancing their behavioral intentions. This not only helps attract more tourists and increase revenue for the scenic area but also lays a solid foundation for its sustainable development. The emergence of AR enriches and further enhances the tourism experience, influencing tourist behavior (Zhu et al., 2023). More and more tourist attractions and historical sites are designing and implementing AR and VR technologies and services to enhance tourists' experiences and promote revisits (Wen et al., 2023). Tourists' satisfaction with the use of AR significantly affects their behavioral intentions towards key heritage sites. Some studies examine tourists' intentions to

protect heritage sites by assessing economic factors such as willingness to pay (Xiao et al., 2020). AR tourism applications include three quality dimensions that all affect tourist satisfaction and recommendation willingness, including content quality, interactive quality and system quality (Du et al., 2022).

5.2.2 Discussion on Research Hypotheses

Objective 2: To analyze the stimulate factors influence tourists' experiences and behavioral intentions of the Augmented reality tourism of Mogao caves.

This study comprehensively explores the impact of Mogao Caves AR tourism on tourists' experience and behavioral intentions based on the SOR theory framework. The study found that the stimulating process of AR tourism is significantly influenced by factors such as content quality, system quality, and interactive quality. These factors not only shape individual user experiences but also exhibit complex interactions among them.

The impact of content quality on the tourists' experiences and behavioral intentions of the Augmented reality tourism of Mogao caves.

The findings of this study indicate that the impact of content quality, system quality, and interaction quality on tourist experience is significant, thereby influencing behavioral intentions. The statistical analysis results (β=0.223, *p<0.001, T=5.744) confirm Hypothesis 1. The quality of content in AR tourism plays a crucial role in attracting and motivating tourists. Well-designed AR content enables tourists to gain deeper insights into the historical and cultural significance of destinations, enriching their tourism experiences. When tourists perceive the AR content to be realistic and engaging, they are more inclined to prolong their stay intention, revisit intention recommendation intention, and premium payment intention. This finding aligns with existing research in the field, further emphasizing the importance of content quality in AR tourism (Chen et al., 2021; Mohanty et al., 2020). Recent studies have indicated a direct correlation between content quality and visitors' experiences using AR applications. This convergence with our findings further underscores the central role of content quality in AR tourism (Jiang et al., 2023). AR users seek contextually relevant, rich, and high-quality information. Therefore, tourists expect AR tourism content to

provide them with accurate and engaging destination information to enhance their travel experiences (Trunfio et al., 2022). From a theoretical perspective, the study results provide new empirical support for the application of the SOR theory in heritage tourism environments and expand the applicability of this theory in the context of emerging technologies.

The impact of system quality on the tourists' experiences and behavioral intentions of the Augmented reality tourism of Mogao caves.

System stability is crucial for ensuring a seamless and enjoyable user experience. The analysis results (β=0.223, *p<0.001, T=6.006) confirm Hypothesis 2. High-quality AR system quality, characterized by excellent performance and rapid responsiveness, influences tourist experience, thereby increasing their intention to revisit. These findings not only affirm the positive impact of system quality on tourism experience but also support previous research (Fan et al., 2022). Furthermore, scholars have utilized the Technology Acceptance Model (TAM), immersion theory, and Information Systems (IS) success model to conduct a series of studies examining the impact of AR quality on various dimensions. This study reaffirms that high-tech devices such as VR or AR can improve the satisfaction of customer tourism experiences (Cheng et al., 2023).

The impact of interactive quality on the tourists' experiences and behavioral intentions of the Augmented reality tourism of Mogao caves.

The analysis results (β=0.222, *p<0.001, T=6.604) validate Hypothesis 3. The quality of interaction directly influences user experience when using AR applications. In the cultural heritage of the Mogao Caves, AR technology not only provides rich visual experiences but also enhances visitor interaction and immersion through high-quality interaction design. This viewpoint is supported by previous research (Chen et al., 2020). Engaging in virtual environments increases personal immersion, as individuals feel more present in virtual reality due to increased interaction. This aligns with the assertions of (Arghashi et al., 2022), who emphasize that the experience of AR applications should enhance immersion through triggered interaction. Recent studies have shown that AR combines immersion, fluidity, engagement, and enjoyment, creating a holistic user

experience that promotes interaction between tourists and immersive environments (Barhorst et al., 2023).

The impact of tourist experience on behavioral intentions.

According to the path analysis results, the standardized coefficients of tourism experience for content quality, system quality, and interactive quality are quite similar, with values of 0.223, 0.223, and 0.222 respectively. The corresponding T-values are 5.744, 6.006, and 6.604. However, the explanatory power of tourism experience on behavioral intentions is highly significant, with a coefficient (β) of 0.602, a T-value of 16.401, and a P-value of 0.000. The research results validate Hypothesis 4, indicating that tourist experience significantly influences behavior and is a key variable affecting tourists' behavioral intentions. Existing literature also confirms that AR tourism experiences can enhance tourists' sense of engagement, interaction, and immersion, thereby stimulating their desire for on-site tourism (Ercan, 2020). The experiential value of AR tourism may be an essential premise for tourists' understanding of destinations and their future visitation behavior (Zeng et al., 2022). For potential tourists, authentic experiences with VR activities related to tourism significantly influence their cognition and emotional responses to destinations, thus affecting their behavioral intentions (Rasoolimanesh et al., 2022). Tourists' virtual attachment and experience are key factors influencing tourists' willingness to travel and are also critical variables in whether a tourist destination attracting more tourists (Barhorst et al., 2023). This empirical analysis reveals that tourist experience positively influences tourists' willingness to travel. A comprehensive understanding of the complex and dynamic relationships among these variables contributes to an overall understanding of the stimulating process within the AR tourism field.

5.3 Conclusions

This study aims to explore the quality of AR tourism, tourist experiences, and behavioral intentions when tourists virtually explore the Mogao Caves. It analyzes the stimulating factors that influence the AR tourism experience and behavioral intentions at the Mogao Caves. The research found that content quality, system quality,

and interactive quality are stimulating factors that significantly and positively influence the tourist experience and behavioral intentions of AR tourism at the Mogao Caves. Additionally, we expanded their meanings within the scope of AR tourism. Content quality enhances tourists' cognition and appreciation of cultural heritage, thereby increasing satisfaction with the tourism experience. System quality plays a crucial role in providing a smooth and stable AR experience. Interactive quality acts as a bridge between tourists and the system, influencing the tourist experience. With these boundaries, this study constructed a relationship model, expanded the theoretical understanding of AR tourism, analyzed the relationships between variables, and validated hypotheses. Particularly surprising is that the impact of tourism experiences on behavioral intentions exceeds expectations, demonstrating its importance in AR tourism. This finding highlights the potential of AR technology in enhancing tourist experiences and provides new development opportunities for tourism destinations. The Mogao Caves, as an important cultural heritage site along the Silk Road, hold profound historical and cultural significance. The application of AR technology not only provides tourists with a novel way to explore but also offers new possibilities for the protection and inheritance of cultural heritage. By bridging the gap between historical heritage and modern technology, AR technology enables tourists to gain deeper insights into and appreciation of the charm of the Mogao Caves, while also paving the way for the protection and sustainable development of cultural heritage.

This study emphasizes the importance of stimulating factors in shaping tourist experiences and behavioral intentions, providing valuable insights for the development of tourism in Dunhuang and promoting a deeper understanding and appreciation of the unique cultural heritage of the Mogao Caves on the Silk Road. More importantly, the study results reveal the enormous potential of AR technology in cultural heritage protection and tourism development. Through AR technology, tourists can explore world cultural heritage sites in a new way, experiencing their profound historical and cultural heritage. This not only helps to enhance tourists' awareness and

appreciation of cultural heritage but also provides new avenues for the protection and inheritance of cultural heritage.

5.4 Limitations of the Study

This study has expanded and deepened the theoretical research on the mechanism of tourist behavior intention in digital cultural heritage tourism, making theoretical contributions to the field of AR tourism. It also offers practical suggestions for tourism enterprises and cultural heritage sites to enhance the value of tourist experiences and promote sustainable development in the tourism industry. However, the study has several limitations. AR tourism experience is a dynamic process. This research captures real-time psychological reactions using user memories from digital museums rather than experimental methods. Due to the homogeneity of tourist experiences, individual differences in tourist preferences, backgrounds, and prior experiences may lead to variations in their responses to AR tourism, which our study may not fully capture. Additionally, the conclusions of the study may be limited to the specific cultural heritage site——Mogao Caves, and the generalizability to other cultural heritage sites needs further exploration. While the hypotheses proposed in this study aim to investigate the relationship between AR tourism quality, tourist experience, and behavioral intention, it is important to acknowledge the potential assumptions and limitations of our research methods. By recognizing these factors, we can ensure a cautious interpretation of our findings and provide insights for future research in the emerging field of AR tourism.

5.5 Recommendations for Implementation

5.5.1 Implications for Research Practice

This study makes theoretical contributions to the literature on AR tourism and holds significant practical significance for promoting the sustainable development of tourism in Dunhuang and the inheritance of world cultural heritage. It provides a comprehensive and practical framework for enhancing the tourist experience at the

Mogao Caves through AR tourism and deeply analyzes the key factors influencing AR tourist experiences and behavioral intentions.

From the content perspective, the Mogao Caves represent rich cultural heritage in art, religion, and history. When designing and developing AR tourism products, it is essential to delve into the historical, cultural, and artistic significance of the Mogao Caves to increase cultural value and allow tourists to truly experience its profound cultural connotations.

From the system perspective, the quality of AR tourism systems is one of the key factors influencing tourist experiences. Tourism enterprises and scenic area planners should attach great importance to the construction of AR tourism system quality, continuously optimize system functionality and experience, improve tourist satisfaction and loyalty, thereby promoting the sustainable development of the tourism industry.

From the interactive perspective, interactive quality serves as the bridge between AR tourism and destination scenic spots. Introducing more advanced sensors and interactive devices into AR tourism, in addition to traditional cultural introductions and historical narrations, can also add more interactive elements and personalized experiences. This provides adventurers with virtual reality journeys, allowing them to immerse themselves in the world of historical culture and participate in the inheritance of cultural heritage.

5.5.2 Recommendations for Further Research

Recommendations for further studies are presented as follows:

Enhancing Cultural Depth and Innovating Cultural Value. The Mogao Caves cultural heritage encompasses art, religion, and history. AR displays should delve into its artistic significance, religious connotations, and historical value. Encouraging collaborative value creation fosters cultural innovation. Providing more interactive experiences through role-playing, gamification, or emotional storytelling encourages collaborative value creation with visitors, promoting cultural innovation.

Enriching and enhancing the cognitive experience of AR tourism. Collaborate with local communities and Destination Marketing Organizations (DMOs) to

provide richer, more locally distinctive content for AR tourism. Work with cultural historians and archaeologists to ensure the accuracy and authenticity of AR content presentation. Enhance the narrative and educational value of AR experiences.

Meet the individual needs of tourists. Emphasize digital inclusivity to cater to the preferences and needs of diverse tourist groups. Design user-friendly interfaces, multilingual content, audio descriptions, tactile elements, and other features for people with disabilities, elderly individuals, and non-English speakers. Provide low-cost or free access options for economically disadvantaged tourists to ensure accessibility to AR experiences for all.

Develop sustainable development strategies. Provide training programs on the use and maintenance of AR technology for employees and the local community to ensure sustainable and effective enhancement of the tourist experience through AR. Establish continuous assessment and feedback mechanisms to evaluate the effectiveness of AR experiences. Recommend tourism enterprises and planners to develop long-term visions and strategies to ensure that AR applications can continuously meet tourist demands and provide high-quality experiences.

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APPENDIX

APPENDIXE A

Index of Item Objective Congruence: IOC

(Summary)

Research Topic

An Analysis of Tourist Experience and Behavioral Intention of the Augmented Reality Tourism of Mogao Caves in China

Evaluation Experts

Professor CK, Professor Jammy, Professor ButuKingKanok, Replace E1, E2, and E3 in the table respectively.

Index of Item Objective Congruence (IOC) Score

Part 1: General Information Questionnaire for Tourists							
NO.	E1	E2	E3	Total	Average	Result	Comments
QI	1	1	1	3	1	Agree	E1: Add gender options.
Q2	1	1	1	3	1	Agree	E3: Add Older than 55 years old.
Q3	1	1	1	3	1	Agree	
Q4	0	0	1	1	0.33	Neutral	E1: Please separate these choices: teachers and other technical personnel. There are different occupations. E2: What is the meaning of Private business principal military and Teachers and other technical personnel?
Q5	1	1	1	3	1	Agree	
Part 2: Questionnaire on Content Quality, System Quality, and Interactive Quality of AR Tourism at Mogao Caves							
1. Content Quality							
NO.	E1	E2	E3	Total	Average	Result	Comments
Q1.1	0	1	1	2	0.67	Agree	E1: Please separate the question about accuracy and richness from the question about visual appeal because there are differences. E2: Are you satisfied with the accuracy, depth, and visual appeal of the content delivered by the Mogao Caves AR system?

Index of Item Objective Congruence (IOC) Score (Continue)

Q1.2	1	1	1	3	1	Agree	E2: Were the specific features or information in the AR content intriguing or engaging for you?
Q1.3	1	1	1	3	1	Agree	E2: Did the AR content enhance your understanding of the artistic and historical culture associated with the Mogao Caves?
2. System Quality							
NO.	E1	E2	E3	Total	Average	Result	Comments
Q2.1	1	1	1	3	1	Agree	
Q2.2	1	1	1	3	1	Agree	
Q2.3	1	1	1	3	1	Agree	
3. Interactive Quality							
Q3.1	1	0	1	2	0.67	Agree	
Q3.2	1	1	1	3	1	Agree	
Q3.3	1	1	1	3	1	Agree	
Part 3: Questionnaire on Tourism Experience							
1.Emotional Experience							
NO.	E1	E2	E3	Total	Average	Result	Comments
Q1.1	1	1	1	3	1	Agree	
Q1.2	0	1	0	1	0.33	Neutral	E3: I am quite not understanding this Question.
Q1.3	1	0	1	2	0.67	Agree	
2. Leisure Experience							
NO.	E1	E2	E3	Total	Average	Result	Comments
Q2.1	1	1	1	3	1	Agree	
Q2.2	1	1	1	3	1	Agree	
Q2.3	1	1	1	3	1	Agree	
3. Cultural Experience							
NO.	E1	E2	E3	Total	Average	Result	Comments
Q3.1	1	1	1	3	1	Agree	
Q3.2	1	1	1	3	1	Agree	
Q3.3	1	1	1	3	1	Agree	

Index of Item Objective Congruence (IOC) Score (Continue)

Part 4: Tourist Behavior Intention Questionnaire							
1. Stay Intention							
NO.	E1	E2	E3	Total	Average	Result	Comments
Q1.1	1	1	1	3	1	Agree	
2. Revisit Intention							
Q2.1	1	1	1	3	1	Agree	E2: Would you contemplate returning to the Mogao Caves in the future based on your current experience?
3. Recommendation Intention							
Q3.1	1	1	1	3	1	Agree	E2: Would you recommend the Mogao Caves AR tourism to others?
4. Premium Payment Intention							
Q4.1	1	1	1	3	1	Agree	E2: Are you willing to pay extra for an enhanced or extended AR experience for the Mogao Caves?
Part 5: Tourist Satisfaction Survey							
Q1	1	1	1	3	1	Agree	E2: Were you satisfied with the overall user experience of the AR tourism or online exhibition for the Mogao Caves?

APPENDIXE B

Augmented Reality Tourism Survey Questionnaire (Revised)

Dear Sir/Madam

Hello!

As a graduate student specializing in tourism management, I am conducting a survey to explore tourists' inclination towards utilizing augmented reality tourism offerings associated with the Mogao Caves. These may include online platforms like "Cloud Tour Dunhuang" and "Digital Dunhuang Immersive Exhibition". Rest assured, this survey is anonymous and does not request any personal information. Your participation would be immensely valuable. Thank you sincerely for your cooperation.

Warm regards, Lijinjuan.

1. Basic information of tourists (based on your actual situation "✓" Check)

(1) What is your gender?

1.1 Male ☐

1.2 Female ☐

(2) Which age group are you in?

2.1 18-25 years old ☐

2.2 26-35 years old ☐

2.3 36-45 years old ☐

2.4 46-55 years old ☐

(3) What is your highest education level?

3.1 Junior high school and below ☐

3.2 High school ☐

3.3 Junior College ☐

3.4 College/bachelor's degree ☐

3.5 Master's degree and above ☐

(4) What is your occupation?

4.1 Government officer ☐

4.2 Private Company employee ☐

4.3State enterprise employee ☐

4.4 Teachers and other technical personnel ☐

4.5 Students ☐

4.6 Others (Please specify.....) ☐

(5) Where are you come from?

5.1 South China ☐

5.11 Guangdong ☐

5.12 Guangxi ☐

5.13 Hainan ☐

5.14 Hong Kong ☐

5.15 Macao ☐

5.2 East China ☐

5.21 Taiwan ☐

5.22 Fujian ☐

5.23 Jiangxi ☐

5.24 Zhejiang ☐

5.25 Anhui ☐

5.26 Shanghai ☐

5.3 Central China ☐

5.31 Hunan ☐

5.32 Hubei ☐

5.33 Henan ☐

5.4 Southwest China ☐

5.41 Yunnan ☐

5.42 Guizhou ☐

5.43 Chongqing ☐

5.44 Sichuan ☐

5.45 Tibet ☐

5.5 Northwest China ☐

5.51 Shanxi ☐

5.52 Ningxia ☐

5.53 Gansu ☐

5.54 Qinghai ☐

5.55 Inner Mongolia ☐

5.56 Xinjiang ☐

5.6 North China ☐

5.61 Shanxi ☐

5.62 Hebei ☐

5.63 Beijing ☐

5.64 Tianjin ☐

5.7 Northeast China ☐

5.71 Heilongjiang ☐

5.72 Jilin ☐

5.73iaoning ☐

2. Augmented reality tourism of Mogao Caves (from 1 to 5 depending on your level of agreement "✓" Check)

	Agree → Disagree				
S-O-R Theory	5	4	3	2	1
Stimulus Factor					
1. Content Quality					
1.1 Are you satisfied with the accuracy, depth, and visual appeal of the content delivered by the Mogao Caves AR system?					
1.2 Were the specific features or information in the AR content intriguing or engaging for you?					

(Continue)

1.3 Did the AR content enhance your understanding of the artistic and historical culture associated with the Mogao Caves?
2. System Quality
2.1 How would you rate the overall performance and responsiveness of the AR system during your virtual tour of the Mogao Caves?
2.2 Is the operation of the AR system smooth for you, without any interruptions or technical problems?
2.3 How satisfied are you with the ease of navigation within the AR system during your virtual tour?
3. Interactive Quality
3.1 How would you rate the responsiveness of the AR system to your interactions and commands?
3.2 Assess the level of interactivity provided by the AR system during your virtual tour. Did it meet your expectations?
3.3 Were you able to control and manipulate the AR features effectively during your visit to Mogao Caves?
Tourist Experience
1. Emotional Experience
1.1 Did the AR technology contribute to an emotionally enriching experience at Mogao Caves?
1.2 Did you feel a sense of wonderment while exploring Mogao Caves through AR?
1.3 Did the AR experience evoke any feelings of nostalgia for the cultural heritage of Mogao Caves?
2. Leisure Experience

(Continue)

2.1 How much did the AR tour of the Mogao Caves contribute to your sense of relaxation? (e.g., Very relaxing, somewhat relaxing, Neutral, somewhat engaging, Very engaging)
2.2 Did the use of AR technology add a fun element to your visit to the Mogao Caves?
2.3 Did the AR features provide opportunities for engaging in leisure activities during your visit to Mogao Caves?
3. Cultural Experience
3.1 Did the AR experience enhance your appreciation for the cultural diversity showcased at Mogao Caves?
3.2 How much did the AR experience at Mogao Caves improve your understanding of the cultural significance of the site?
3.3 Did you learn new information about the cultural significance of Mogao Caves through the AR features?
Behavioral Intentions
1.Stay Intention
1.1 How likely are you to extend your stay in the Mogao Caves after experiencing augmented reality tourism?
2.Revisit Intention
2.1 Would you contemplate returning to the Mogao Caves in the future based on your current experience?
3.Recommendation Intention
3.1 Would you recommend the Mogao Caves AR tourism to others?

(Continue)

4.Premium Payment Intention
4.1 Are you willing to pay extra for an enhanced or extended AR experience for the Mogao Caves?

3. Were you satisfied with the overall user experience of the AR tourism or online exhibition for the Mogao Caves?

☐ Most satisfied

☐ Satisfied

☐ Neutral

☐ Dissatisfied

☐ Most dissatisfied

Thank You

APPENDIXE C

Pictures of Augmented Reality Tourism in Mogao Caves

Tourists wearing AR glasses feel as if they have traveled through time and space, with the millennia-old murals and legends of the Mogao Caves vividly coming to life before their eyes.

AR technology allows students to virtually explore the Mogao Caves in the classroom, as if they are touching the pulse of history and deeply experiencing the richness of culture firsthand.

When tourists stand at designated spots and scan the cave murals with AR technology, it recreates the original appearance of the murals on the tourists' screens. It can even animate the characters in the paintings to tell their stories, vividly unfolding ancient legends and history before the tourists' eyes, enhancing their understanding and interest in the culture.

Users can easily experience the Mogao Caves AR tour through mobile devices, offline interactive devices, or web platforms, immersing themselves in the charm of millennia-old culture.

“The Dunhuang AR Smart Guide” is the first AR glasses guiding solution in China’s cultural tourism industry based on monocular vision SLAM. With AR glasses, visitors can join virtual guide “Dun Dun” to explore the Mogao Caves and learn about its past and present.

Tourists can experience the combined virtual and real-world Mogao Caves in Dunhuang simply by using a Huawei P40 series smartphone, where they can interact closely with the Nine-Colored Deer and Flying Apsaras.

VITA