Article

Technological Use from the Perspective of Cultural Heritage Environment: Augmented Reality Technology and Formation Mechanism of Heritage-Responsibility Behaviors of Tourists

Songhong Chen [ID], Yuanshu Tian *[ID] and Siyun Pei

Faculty of Hospitality and Tourism Management, Macau University of Science and Technology,
Taipa, Macau, China; shchen@must.edu.mo (S.C.); peisiyun1998@163.com (S.P.)
* Correspondence: childersmagic888@outlook.com

Abstract: This paper explores the integration of augmented reality (AR) technology within the realm of cultural heritage tourism, particularly its influence on the development of tourists' heritage-responsibility behaviors. Addressing the recovery and development of Chinese domestic tourism in the post-pandemic period, smart tourism technology innovations have been explored. The research demonstrates that AR, by surpassing physical and temporal constraints, fosters a deeper synthesis of traditional and contemporary cultures, thereby enriching the comprehension of national history and cultural heritage. Employing the stimulus–organism–response (SOR) theory, a theoretical framework is established to elucidate the causal links from AR attributes to perceived usefulness, enjoyment, and behavioral intentions. The analysis reveals that the interactivity, vividness, and novelty of AR significantly augment perceived usefulness and enjoyment, although augmentation quality does not notably impact enjoyment. Both perceived usefulness and enjoyment significantly drive the intention to recommend. This study offers valuable theoretical insights and practical recommendations for the strategic deployment of AR in the sustainable development of cultural heritage tourism.

Keywords: augmented reality (AR); cultural heritage sustainability; tourist behavior; stimulus–organism–response (SOR) theory; heritage responsibility

1. Introduction

In the advancement of the post-pandemic period, the significant downturn in domestic tourism has catalyzed an increased focus on sustainable development within the cultural and tourism sectors. There is a concerted effort to harness digital technology to bolster the environmental, social, and economic sustainability of the tourism industry. The survey conducted by the Ministry of Culture and Tourism in 2022 showed that China's domestic attractions saw 2.53 billion visits in 2022, a decrease of 716 million from the previous year, and down 22.1% year on year. The number of domestic tourists in 2022 was lower than that in 2020 [1]. For this reason, local culture and tourism departments worked hard to seek a "breakthrough" in online tours. With technological advancement, cultural heritage can be disseminated to various parts of the world through digital technology. Museums using digital information go beyond the physical space and time limitations to provide a high-quality experience for tourists, allow more tourists to visit museums, and promote the better use of the value and assets of museums in a wider range of fields [2–4]. Information technology has brought positive and real experiences in the field of cultural tourism, with the potential to create new forms of cultural experiences for users [5]. Through digital technology, museums enhance the integration of traditional and modern culture, lift them to a higher level, and greatly promote understanding of national history and culture.

Museums around the world, such as the British Museum and the Louvre Museum, have successively adopted AR applications on handheld devices. This also includes some museums in China [6,7]. AR is a technology that enriches the physical environment by

superimposing digital, computer-generated elements onto the real world, thereby creating an enhanced interactive experience [8]. AR does not require the substitution of the physical environment. Instead, it enhances the user's real-world experience by integrating virtual elements [9]. Azuma describes AR as a technology that merges aspects of both the real and virtual worlds, operating interactively in real time. To ensure the effectiveness of AR, precise registration within a three-dimensional space is essential, allowing the technology to be utilized on various devices beyond just head-mounted displays [9]. A handheld AR device, jointly developed by the National Cultural Heritage Administration (NCHA) and China Mobile, called the "AR Exploration Mirror", was used in Anhui Museum in early 2020 and then used in other museums, including Xi'an Museum and Henan Museum. It manifests as a mirror-like interactive device, integrating AR technology, predominantly employed to enhance the experiential journey of museum visitors. This apparatus captures real-world imagery through a camera, upon which it superimposes virtual information, such as text, images, animations, or 3D models. The "AR Exploration Mirror" at the Anhui Museum showcases a diverse array of historical artifacts, including heritage from the Neolithic Age in China, ancient Chinese bronze ware, pottery, ceramics, and jade from the different feudal dynasties in China [10]. The launch of such a digital exhibition not only enhances the visitor experience during museum tours but also subtly facilitates a more intuitive understanding of cultural heritage. Additionally, it encourages public engagement in the preservation and promotion of cultural heritage [10]. Visitors can observe the live image of the exhibit via the mirror's surface, while simultaneously, the mirror displays an array of supplemental content related to the exhibit, encompassing historical context, detailed explanations, relevant narratives, or interactive games. In the context of the post-pandemic period, the AR application showed its potential in museums and was used by more people [11]. To ensure the health of visitors and staff, museums choose to establish new connections with visitors through handheld AR applications, which meet the needs of visitors for indirect interpersonal self-service [12]. In accordance with the authoritative statistical data provided by the Anhui Museum, the rental frequency of the AR explanatory devices reached a cumulative total of 3030 instances throughout the year 2023 [10].

Jin et al. [13] explored the relationship between the local people's attitude toward the ecological environment of the Lijiang River, their perceived value, and their environmental responsibility behavior. The results of their study showed that the perceived value of Guilin residents produced a significant direct impact on environmental responsibility behavior and attitude. The research results of Zhang et al. [14] on tourists in ancient villages indicated that nostalgia felt by tourists produced a significant positive impact on leisure involvement, local attachment, and environmentally responsible behavior. Jiang et al. [15] conducted a study on the historical and cultural streets of the Liwan District, Guangzhou, with discussions on the formation mechanism of environmental responsibility behaviors among tourists in historical and cultural tourist destinations, as well as suggestions for improving the hygiene environment of historical and cultural streets. There are studies on other behavioral impacts that may arise after virtual reality (VR) adoption, such as loyalty to the application and willingness to continue using it [16,17]. In research on museums, cultural heritage is an important factor for tourist destinations [18]. Additionally, related academic researchers point out that the demand of tourists for destination cultural tourism shifted from traditional quantitative changes to qualitative changes, and tourists had a strong demand for cultural experiences [19,20]. As the handheld AR application is used more frequently in museums, more and more experts pay attention to the experiences of visitors using it in cultural heritage sites and museums [21–23]. These applications, whose properties serve as a prerequisite for users to have a good experience [24], produce a positive impact on the behavior or willingness of visitors [25,26].

Therefore, in summary, the study of the experience of AR technology has important practical and academic significance for promoting the responsible behavior of tourists towards cultural heritage. The aim of this study is to build a theoretical model based on SOR theory, which comprises the elements of stimulus, organism, and response. These

elements play a pivotal role in determining the behavioral outcomes of various events [27]. The interplay between stimulus and response is characterized as an integral aspect of both behavior and the surrounding environment. Environmental changes, particularly abrupt ones, can significantly disrupt an individual's psychological and emotional equilibrium, thereby precipitating behavioral shifts. A stimulus is conceptualized as an external factor that exerts influence on the individual, directly impacting their mental state [28]. This study also connects a series of pathways from AR attributes (i.e., the unique attributes of AR such as interactivity, vividness, novelty, and augmentation quality) to perceived usefulness, perceived enjoyment, and behavioral intention and response, exploring how external environmental stimulation affects the organism (i.e., users' perceived usefulness and perceived enjoyment of AR applications), as well as the response process (i.e., heritage-responsibility behavior towards the application). This study proposes the following research questions:

1. Which AR attributes affect perceived usefulness and perceived enjoyment?
2. What is the relationship between perceived usefulness, perceived enjoyment, and heritage-responsibility behaviors?
3. Do perceived usefulness and perceived enjoyment play a mediating role between AR and heritage-responsibility behaviors?

2. Literature Review

2.1. Stimulus–Organism–Response Framework

The stimulus–organism–response (S-O-R) model, initially proposed by Russell and Mehrabian in 1974 [29], suggests that environmental stimuli (S)—encompassing both physical and social elements—significantly influence individuals' internal states (O), which subsequently lead to varied behavioral responses (R) [30,31]. This theoretical framework indicates that external stimuli can evoke emotional and cognitive reactions, driving either positive or negative behaviors toward the environment [32]. The internal processes within the organism encompass a range of psychological experiences, including cognitive evaluations and emotional states [33], which guide their behavioral outcomes. For example, approach behaviors may manifest as proactive engagements, such as exploration, while avoidance behaviors could appear as passive responses to stimuli [29].

In recent years, researchers in the tourism field have effectively applied the S-O-R model to explore the impact of technological stimuli—notably AR applications—on users' internal states and subsequent behaviors. This model serves as a valuable analytical tool for examining the interactions between AR attributes, perceived usefulness, and enjoyment, particularly in enhancing heritage-protection intentions within museum settings [34,35]. Moreover, in tourism experiences related to AR, stimuli (S) are primarily reflected in the quality and interactivity of AR content, which effectively captures tourists' attention. Research indicates that vivid AR presentations, such as high-quality visual effects and interactive features, can significantly enhance tourists' immersion [36]. These stimuli influence the organism (O), encompassing aspects such as emotional states and cognitive responses, which, in turn, affect their behavioral responses (R), such as revisit intention or word-of-mouth communication [37]. However, as Eroglu et al. [31] point out, consumer behavior is inherently complex and shaped by various factors, including social, cultural, and psychological variables. The simplification inherent in the S-O-R framework may lead to an incomplete understanding of consumer responses in intricate environments. Additionally, with the rise of digital contexts, the applicability of the S-O-R framework has been questioned. Huang [38] argues that the framework, originally designed for physical settings, may not fully capture the unique characteristics of digital interactions, such as interactivity, virtual presence, and user-generated content. These elements call for a more flexible model that can accommodate the distinct nature of digital stimuli and responses.

Digital Narrative as Stimulus (S)

The "AR Exploration Mirror" employed in this study conveys artifact information to visitors through a digital narrative. Digital narratives, defined as stories expressed through

multimedia formats, including text, images, audio, and video, engage audiences interactively, fostering deeper emotional connections. As Murray [39] emphasizes, the essence of digital narrative lies in its interactivity and immersive qualities, which provide distinct advantages within museum contexts. Falk et al. [40] note that the incorporation of digital narratives enables visitors to engage more deeply with exhibition content, enhancing their learning outcomes and overall satisfaction. Moreover, Basaraba et al. [41] highlight that mobile applications delivering digital narratives can significantly boost visitor interaction and social engagement, enriching the overall museum experience.

Within the museum environment, digital narratives utilize various media formats, such as AR, VR, and interactive exhibits, to inform visitors, serving as the primary entry point for engagement with exhibitions. For instance, Trichopoulos et al. [42] found that exhibits featuring interactive digital narratives can capture visitors' attention and encourage deeper exploration of content. Additionally, compelling storytelling can elevate visitors' interest and emotional investment [43]. Upon encountering digital narratives, visitors' internal states, including emotional and cognitive responses, are influenced. Research demonstrates that a digital narrative can significantly enhance emotional resonance and immersive experiences. For instance, Munns [44] found that visitors showed marked improvements in understanding and retention of exhibition content, alongside increased emotional satisfaction after engaging with digital narratives. This process is shaped by visitors' personal experiences, background knowledge, and emotional states, ultimately affecting their comprehension and attitudes toward the exhibition.

Ultimately, visitors' responses manifest in their overall satisfaction with the museum, their willingness to revisit, and their propensity to share information about the exhibition. For example, Meng et al. [45] demonstrated that museums employing a digital narrative significantly enhance visitors' overall experiences and satisfaction, thus increasing the likelihood of recommendations to others. Positive visitor reactions may also facilitate word-of-mouth promotion for the museum, attracting more potential visitors.

Despite concerns regarding the applicability of the S-O-R framework in digital environments, by employing the S-O-R framework, researchers can gain a deeper understanding of how digital means not only convey information but also shape visitors' experiential perceptions and subsequent behaviors. This approach underscores the role of digital means as catalysts for enhanced visitor engagement, providing insights into how museums can leverage technology to create memorable and impactful experiences that resonate with their audiences [24,46–48].

2.2. Environmental Stimulation: Interactivity in Immersive Environments

Interactivity is the extent to which users can participate in real time in the modification of the form and content of the media environment [49]. From a technical perspective, the perceived interactivity is related to technical components, including speed of operation, accuracy of drawing, and the possible range of changed contents [49]. Users' perceptions of interactivity involve individual participation motivation [50]. In this study, the concept constructed by McLean and Wilson [51] and based on the complementary viewpoint of Yim et al. [52] defines interactivity in AR as the ability to control the interaction between the augmented sensory content seen by users and their physical environment. The interactivity of AR is considered a favorable factor in driving consumer reactions, as it enables consumers to obtain relevant information about virtual products and encourages them to actively participate in product information processing, thereby promoting a positive shopping experience and purchasing decisions [52]. In the context of museum-related research [53], scholars have demonstrated through empirical evidence that digital museums, underpinned by AR and blockchain technology, significantly surpass traditional museums in terms of interactivity. Viewed from the perspective of younger individuals, the average interactivity scores for traditional and digital museums were, respectively, quantified at 47.20% and 78.20%. Conversely, from the standpoint of older adults, these scores were recorded as 59.04% and 70.36%. AR technology, through the provision of

superior content and system experiences, markedly elevates the level of interactivity and immersion for visitors within museum environments [54]. In addition, in the research on the Egyptian museum [55], scholars have underscored the role of AR technology in enhancing museum interactivity. The interactive capabilities of AR technology not only elevate the visitor experience but may also amplify the economic benefits and cultural value within the domains of museums and cultural heritage. This study, building upon the scholarly research conducted previously, delves deeply into the impact of museum AR technology's interactivity on visitors' heritage-responsibility behaviors.

2.3. Environmental Stimulation: Vividness in Immersive Environments

Vividness is defined as "the ability of technology to create sensory rich media environments" [49]. Vividness may be exchanged with the term quality of the imagery or richness [56]. In the media environment of technology, a higher extent of vividness depends on the depth and breadth of the media, which specifically refers to the quality of information perceived by users and the number of sensory dimensions [51,57]. Vivid information includes images, audio, video, color, and so forth in the media environment that can stimulate users' cognitive processing of information and trigger related behaviors [58]. Media environments of information can be different forms of virtual environments, for example, traditional or mobile media environments and so on, generated by computers and immersive technology [59]. In AR technology, this study, with reference to the study by McLean and Wilson [51], describes vividness as the clear and detailed presentation of 3D-image information in a media environment that combines the real and virtual worlds. In the discourse pertaining to museum studies, Paliokas et al. [60] have deliberated upon the vivacity engendered by AR devices within the museum setting, elucidating how such vividness augments interactivity and proffers a more enriched visual experience, thereby elevating the overall visitor engagement. Moreover, scholars have expounded upon vividness as an integral attribute of AR technology [61], delineating its implementation through the superimposition of synthetic imagery onto real-world visuals. As an interactive medium, AR glasses furnish a virtual interface between the user and the physical milieu, thereby enhancing the user's auditory and visual faculties, as well as their cognitive processes. Nonetheless, despite the academic discourse on the influence of AR's technological characteristics on user satisfaction and behavioral intentions, the extant research has not substantiated a significant impact of interactivity, vividness, and these outcomes [61]. This study endeavors to delve deeper into the ramifications of AR vividness on visitors' heritage-responsibility behaviors.

2.4. Environmental Stimulation: Novelty in Immersive Environments

Novelty is defined as the combination of new and unusual stimulation [62]. Novelty is often used to explain people's psychological responses to the stimulation from new things and is a subjective perceptual structure [62]. In the technological media environment, novelty is the core characteristic of innovative products [63], which represents the extent to which each reaction is "rated as new, unique, and different" [64]. When users are stimulated by new technologies, strong emotional responses may appear [52]. But, the responses are affected by the user's familiarity with the stimulation. As familiarity increases, the responses gradually weaken [65]. In AR technology, the new stimulation experienced by users comes from different ranges when the real world and virtual world are combined each time they operate [51]. That is, the new, unique, personalized, and novel content that users see through AR displays [66]. This study refers to the concept of novelty in AR technology from McLean and Wilson [51]. Namely, when users use AR each time, they combine the real world and virtual world to gain unique sensory information, which includes text, images, video, other virtual objects, etc. [67].

2.5. Environmental Stimulation: Augmentation Quality in Immersive Environments

The concept of augmentation quality was initially proposed by Henderson [68] and is a unique attribute of AR technology [67]. In previous studies, experts generally made the concept of augmentation operationalized from the perspective of user perception and technical features [38]. In terms of technical features, Lee, Xu, and Porterfield [69] explained augmentation as the ability of technology to augment or add virtual features in real-time interaction or static views of the physical environment. In terms of user perception, Javornik [67] believed that the augmented perception of users comes from visual and perceptual illusions, which is perceptual consistency between virtual and physical worlds. Hilken et al. [70] pointed out that the augmented perception is related to spatial presence, which allows users to focus on the augmented experience itself rather than the underlying technology. Rauschnabel et al. [71] conceptualized environmental embedding and simulated physical control based on constructing spatial presence to describe the augmented quality as the extent to which users perceive the augmented content (i.e., seamless integration of physical and virtual worlds) as a real situational experience. Due to the museum's commitment to presenting users with realistic and accurate 3D models of cultural relics or exhibits through handheld AR applications and providing an immersive experience [72], this study, with reference to Rauschnabel et al. [71], defines the augmented quality as the extent to which users perceive the augmented content as real.

2.6. Perceived Usefulness

Perceived usefulness and perceived enjoyment are considered to represent the cognitive and emotional states of users, respectively, as triggered by technological stimuli within the SOR theoretical framework. Specifically, the usefulness of handheld perception in museums was initially developed in the context of workplace systems [73]. As one of the basic concepts involved in the technology acceptance model (TAM), it refers to the extent to which a person believes that using a specific technology will improve their work performance [74]. Perceived usefulness reflects the user's belief and subjective cognition of a specific technology [75]. Perceived usefulness arises when a specific technology may contribute to achieving specific results [76]. When predicting the extent of acceptance, perceived usefulness focuses on the total value perceived by users after actively using a new technology product or application. When predicting behavioral intention after acceptance, perceived usefulness focuses on the subjective evaluation of the perceived performance by users after using the information system [77]. In terms of museum mobile navigation, the evaluation of perceived usefulness mainly involves the effectiveness of relevant information and services [78]. That is, whether relevant information and services can achieve the expected performance level and meet the needs of tourists [79]. Therefore, based on the study by Davis [74], this paper defines the perceived effectiveness of museum handheld AR applications as the extent to which tourists believe that museum handheld AR applications will improve their efficiency in visiting museums and understanding cultural relics or exhibits.

2.7. Perceived Enjoyment

The concept of perceived enjoyment, which initially originated from the motivation theory and later became one of the concepts in technology acceptance models, is used to predict user behavioral intentions [74]. It is defined as "the extent to which the activities of using computers are considered enjoyable in addition to the potential performance consequences" [74]. In motivation theory, perceived enjoyment is seen as an intrinsic motivation that can drive users with enjoyment purposes to obtain more emotional experiences when pursuing pleasure, enjoyment, and sensory stimulation [80,81]. On the other hand, perceived enjoyment, as an indicator of evaluation, can be used to measure the happiness and well-being perceived by users in virtual or online environments [82]. For museum mobile navigation, the evaluation of perceived enjoyment involves the extent to which visitors enjoy the multimedia interaction and entertainment activities provided by the naviga-

tion [83]. Therefore, this study interprets the perceived enjoyment of museum handheld AR applications [74] as the extent to which activities using museum handheld AR applications are considered enjoyable, in addition to the potential performance consequences.

2.8. Heritage-Responsibility Behaviors

Individual behavior and its influencing factors from a cultural perspective have always attracted the attention of many experts and industry practitioners. With the proposal of sustainable development goals, the sustainable development of the cultural heritage industry and the construction of its dynamic inheritance mechanism path have become a key issue. However, in previous studies, researchers were focused on the mechanism of individual consumption and promotion behavior from a micro-perspective, so they ignored the spatial representation of heritage value by consumers or residents in a broad sense, as well as the construction of the cognitive system on the economic and moral levels involved in the process. As a result, the formation mechanism of the heritage-responsibility behaviors of visitors in museums is a key issue that urgently needs to be addressed in the field of cultural heritage inheritance. The concept of heritage responsibility [84] originated from the concept of social responsibility in the tourism-related industry, which refers to the legal and economic responsibility undertaken by participants in the process of spatial representation of heritage value. Heritage responsibility is also defined by researchers as the obligation to protect cultural heritage in a narrow sense, covering the moral and economic responsibility in the protection of cultural heritage and natural heritage [85]. In addition, experts such as Ju Yingying [86] think that social embedding exists in heritage-responsibility behaviors. That is, it exists in the cultural ecosystem formed by tourists, residents, and cultural heritage. Hence, Li et al. [87] proposed a definition and framework of heritage-responsibility behavior based on the perspectives of residents and tourists and analyzed the similarities and differences between the two. Aiming to explore the formation mechanism of heritage behaviors of tourists based on the perceived attributes generated by AR technology, this paper defines heritage responsibility as the heritage-responsibility protection value and the responsibility view generated by tourists based on their perception of AR devices.

2.9. Hypotheses and Models

2.9.1. Relationship between Interactivity, Perceived Usefulness, and Enjoyment

Interactivity refers to the extent to which users can participate in real time in the modification of the form and content of the media environment [88]. As a stimulus-driven variable, interactivity means gaining the ability of digital media to modify and adapt to virtual user environments in real time [89]. Some studies on electronic services have confirmed that the interactivity of AR technology increases the perceived practicality of consumer experience [90,91] and the perceived usefulness [51]. Tourism-related research has shown that the interaction between tourism applications and online tourism map services is positively correlated with perceived usefulness [17,92]. When users interact with AR systems in museums, manipulating and controlling 3D virtual objects increases the extent of interactivity and narrows the distance between users and exhibition content. Accordingly, visitors believe that AR systems are a useful media tool in informal learning environments [93]. Kowalczuk et al. [94] found that interactivity in mobile-shopping AR applications can produce a positive impact on consumers' perceived enjoyment.

Therefore, the following hypotheses are proposed:

H1. *The interactivity of handheld AR applications in museums has a positive impact on perceived usefulness for visitors;*

H2. *The interactivity of handheld AR applications in museums produces a positive impact on the perceived enjoyment of visitors.*

2.9.2. Relationship between Vividness, Perceived Usefulness, and Enjoyment

Vividness is defined as "the ability of technology to create sensory rich media environments" [95]. The high-resolution images and clear multi-dimensional images presented by AR technology and these kinds of vivid information are conducive to increasing the perceived practicality of consumers [96,97]. In the tourism environment, vividness is an important element of the technology-related tourism experience [17]. Fang et al. [98] pointed out that the vividness of information in online tourism communities can drive users' perceived usefulness. In addition, in their study, Khan et al. [99] found that the high-quality multimedia sensory information presented by the handheld AR application in museums meets the needs of visitors for relevant knowledge and detailed content on the exhibits and enables them to think about and understand the meaning and purpose of the exhibits. Jiang et al. [15] pointed out that, in the design of a handheld AR application for cultural tourism, the vivid experience provided by multiple senses can enhance tourists' positive emotions, thereby forming deeper and more meaningful memories.

Therefore, the following hypotheses are proposed:

H3. *The vividness of handheld AR applications in museums produces a positive impact on their perceived usefulness by visitors;*

H4. *The vividness of handheld AR applications in museums produces a positive impact on the perceived enjoyment of visitors.*

2.9.3. Relationship between Novelty, Perceived Usefulness, and Enjoyment

In the technological media environment, novelty represents the extent to which each response "is rated as new, unique, and distinct" [64]. The novelty of the content presented by AR meets the needs of consumers to obtain personalized and diverse information that fits the context and improves their personal shopping performance [51]. Experts found that the novelty of AR created a positive impact on perceived usefulness in their investigation of user engagement in mobile AR shopping applications [51]. In the field of tourism, when exploring the acceptance theory model of handheld AR applications for urban heritage tourism, the researchers pointed out that the novelty provided by tourism handheld AR applications can attract tourists' attention and create unique visiting experiences. The research also confirmed that creativeness has a positive impact on perceived usefulness [100]. Tom Dieck et al. [100] presented the creative content by AR that satisfies the user's curiosity for novelty and triggers a state of preoccupation, thereby increasing pleasure and perceived enjoyment [52,71]. Tom Dieck et al. [101] investigated the views of stakeholders on the use of AR technology in museums and found that visitors believe that AR technology, as a novel navigation device in museums, can create a pleasant visiting experience.

Therefore, the following hypotheses are proposed:

H5. *The novelty of handheld AR applications in museums produces a positive impact on their perceived usefulness for visitors;*

H6. *The novelty of handheld AR applications in museums produces a positive impact on the perceived enjoyment of visitors.*

2.9.4. The Relationship between Augmented Quality, Perceived Usefulness, and Enjoyment

Augmented quality refers to the extent to which users perceive the augmented content to be real [71]. The augmented quality can affect user response to stimuli, and high-level augmented quality allows users to experience seamless integration of virtual and real worlds [70]. In the electronic retail environment, previous studies demonstrated that the perceived reality of products to try-in provided by three-dimensional augmentation allows customers to verify the attributes and quality of the products before purchase [102], achieving smoother information processing and decision-making processes [103]. When

exploring the influencing factors of satisfaction with mobile AR shopping applications, the researchers confirmed the positive impact of perceived augmentation on perceived usefulness [3]. In the context of tourism, Triantafillidou and Lappas [104] found that, in the case of destination AR applications presenting high-quality and augmented monuments and buildings to them, tourists will have a real experience related to past historical periods and events and increase their understanding of the destination.

Therefore, the following hypotheses are proposed:

H7. *The augmentation quality of handheld AR applications in museums produces a positive impact on visitors' perceived usefulness;*

H8. *The augmentation quality of handheld AR applications in museums produces a positive impact on the perceived enjoyment of visitors.*

2.9.5. The Relationship between Perceived Usefulness, Perceived Enjoyment, and Heritage-Responsible Behavior

Perceived usefulness refers to the extent to which an individual believes that utilizing a specific technology will enhance their work performance [74]. Research related to technological experiences has demonstrated that perceived usefulness directly influences a user's intention to recommend technology [105–107]. For instance, studies investigating the motivations behind domestic users recommending bicycle-sharing applications have confirmed that practicality plays a pivotal role in shaping user recommendations [108,109]. Mensah's [107] findings indicate that perceived usefulness serves as a significant predictor for the intention to recommend e-government services within the context of digital governance.

In the context of tourism, however, the influence of perceived usefulness and perceived enjoyment on heritage-responsible behavior remains an underexplored area. Inan et al. [110] found that intelligent travelers' intentions to recommend mobile tourism recommendation systems are positively influenced by perceived usefulness, highlighting that interaction with recommendation systems enhances cognitive knowledge about the recommended destination. This suggests that, when visitors perceive AR applications in museums as useful, they are more likely to recommend them to others, thereby promoting responsible behaviors, such as heritage conservation and increased visitor engagement.

Furthermore, Davis' study [74] acknowledged perceived usefulness as a core cognitive component toward emerging technologies, reinforcing the idea that users are more likely to engage in responsible behavior when they believe the technology that they are using is beneficial. Thogersen [95] further asserted that cognitive information significantly influences consumers' responsible behavior, indicating that the more useful visitors perceive AR applications to be, the more likely they are to engage in behaviors that support heritage conservation.

Beyond cognitive factors, emotions also play a crucial role in influencing behavior. Zhao et al. [111] confirmed that consumers' anticipated emotions are significant antecedents of responsible behavior in the context of heritage tourism. This aligns with the notion that emotional engagement can mediate the relationship between perceived enjoyment and behavior. Research by Huang et al. [112] found that perceived enjoyment in using mobile applications significantly enhances the users' intention to engage in sustainable practices, suggesting a similar effect in the heritage-tourism context. When visitors find enjoyment in using AR applications, it heightens their emotional connection to the museum experience, which can further encourage heritage-responsible behaviors.

Thus, the following hypotheses are proposed:

H9. *The perceived usefulness of handheld AR applications in museums produces a positive impact on visitors' heritage-responsible behavior;*

H10. *The perceived enjoyment of handheld AR applications in museums produces a positive impact on visitors' heritage-responsible behavior.*

In summation, as depicted in Figure 1, the research model for this study has been constructed.
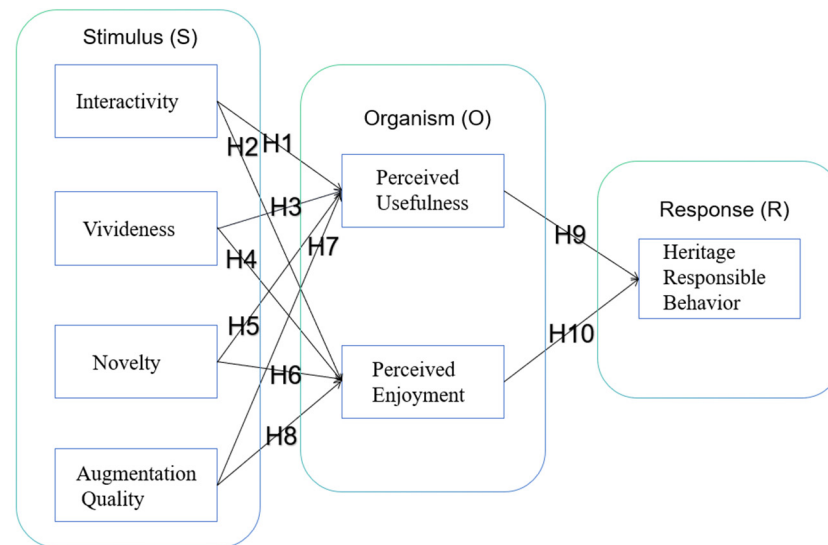

Figure 1. Research model.

3. Material and Method

3.1. Pilot Study

Following the preliminary questionnaire design based on established scales, it was imperative to conduct a pilot study to further ascertain the questionnaire's quality. This investigation was carried out through the Questionnaire Star platform from 15 January to 30 January 2022, yielding 175 responses. After discarding the responses that failed reverse-question screening, 137 questionnaires were deemed valid, bringing the recovery efficiency to 78.2%. Subsequently, this research employed SPSS v22 to calculate Cronbach's alpha coefficient as a measure of reliability for each latent variable. The reliability analysis of the pilot test revealed that the Cronbach's alpha coefficients for all latent variables met the minimum standard recommended by Taber [113], being above 0.7, indicating satisfactory internal consistency of the scale.

3.2. Formal Survey

This paper selects the handheld AR device in Anhui Museum, namely the "AR Exploration Mirror", as a case study to explore whether the above hypotheses and models are valid. This paper uses convenient sampling and online questionnaires as data-collection tools to collect the data required (See Appendix A). This study primarily employed an online survey methodology for data collection. By utilizing a purposive sampling technique, invitations were extended to tourists who had utilized the Anhui Museum's handheld AR guide application within the last year (specifically from April 2021 to March 2022). These invitations were disseminated through social media platforms, such as Weibo, WeChat, and Douban, from 1 April 2022 to 15 June 2022. As an incentive for completing the questionnaire, participants were offered monetary rewards in the form of digital red envelopes. To ensure the validity of the data collected, the questionnaire commenced with a screening question designed to verify whether the respondents had indeed used the "AR Exploration Mirror" within the stipulated time frame.

The questionnaire mainly involves two parts of content. The first part consists of seven subscales related to measurement variables, namely interactivity (primarily draws upon the research conducted by Komarac and Ozretić Došen [114], encompassing a total of three questions); vividness (principally incorporates insights from the studies by Nikhashemi et al. [91] and Yim et al. [52], addressing a total of six questions); novelty (primarily integrates findings from the research by McLean and Wilson [51], encompassing a total of

four questions); augmented quality (principally draws upon the research conducted by Rauschnabel et al. [71], addressing a total of three questions); perceived usefulness (primarily relies on the research by Chung et al. [115], encompassing a total of four questions); perceived enjoyment (principally utilizes the research by Jung et al. [116], addressing a total of four questions); and intention to recommend (primarily draws upon the research by Jung et al. [117], encompassing a total of three questions), for a total of 27 questions. The 5-point Likert scale is used, where 1—strongly disagree, 2—disagree, 3—neutral, 4—agree, and 5—strongly agree. The second part includes the user's basic information, for example, gender, age, education level, income level, and number of visits to the museum, with a total of 5 questions.

In the formal data-collection phase, a total of 336 questionnaires were gathered. Following the application of filters for the screening questions, reverse-coded items, and excessively brief responses, the effective response rate was established at 82.1%.

4. Data Analysis

4.1. Demographic Analysis

As shown in Table 1, males account for 32.6% of the total population and females 67.4%. The ages of the respondents are mainly concentrated in the 18–25- and 26–35-year-old groups, accounting for 69.6% and 27.2% of the total number of respondents, respectively. This indicates that the users of the handheld AR application in museums are mainly young people, which is consistent with the result of a previous study that shows that middle-aged and younger visitors are more interested in emerging technologies and willing to experience new technologies [116]. In addition, this age group is also the main active user group of current social media, who are willing to share their experiences on the use of social media and are interested in participating in surveys and discussions [118].

Table 1. Demographic profile of respondents.

Index	Option	Sample Size	Percentage
Gender	Male	90	32.60%
	Female	186	67.40%
Age	18–25	192	69.60%
	26–35	75	27.20%
	36–45	8	2.90%
	46–55	1	0.40%
	Above 55	0	0%
Educational Background	Middle school and lower	2	0.70%
	High School	7	2.50%
	Junior college and undergraduate	212	76.80%
	Postgraduate and higher	55	19.90%
Number of museum visits in the past year	1	88	31.90%
	2	84	30.40%
	3 to 4	72	26.10%
	Above 5	32	11.60%

More than half of respondents have a college degree or above, accounting for 76.8% of the total number of respondents. This indicates that the group with a higher education level is the main user group of the AR application in the museums that prefers to learn more about the historical background and knowledge related to cultural relics through various visiting tools [116].

4.2. Overview of Reliability and Validity (Cronbach's Alpha and KMO)

Employing Smart PLS with a maximum iteration count of 300 and a convergence criterion of seven, the analysis yielded Cronbach's alpha coefficients and composite reliability scores. The Cronbach's alpha values for each variable within the scale ranged from 0.713 to 0.832, while the composite reliability indices all surpassed 0.8, indicating a satisfactory level of reliability [119,120]. These findings substantiate the trustworthiness of the data collected in the current study and underscore the internal consistency of the scale, thereby validating its progression to subsequent validity assessments [121]. The overall KMO value for the questionnaire was 0.941, exceeding the threshold of 0.8 [122], and Bartlett's test of sphericity demonstrated a suitable p-value of less than 0.001 [123], affirming the robust validity of the scale as a whole. Consequently, a foundation has been established for subsequent factor analysis.

During the confirmatory factor analysis (CFA) process, this study incorporates the use of the standardized root-mean-square residual (SRMR) and the normed fit index (NFI) as proximal indices for estimating model approximation [124]. The findings reveal an SRMR value of 0.072, satisfying the criterion of being less than 0.08 [125], and an NFI of 0.741. Although slightly below the recommended 0.9 [126], it comfortably meets the minimum threshold of 0.7 [127], positioning the model's fit within acceptable bounds.

4.3. Model Validity Test

Prior to conducting a formal assessment of the structural model, it is imperative to ascertain the absence of multicollinearity among constructs by examining the variance inflation factors (VIFs) of latent variables (see Table 2). This precaution is crucial to mitigate the risk of compromised reliability in parameter estimation due to multicollinearity [128]. Multicollinearity refers to the presence of linear relationships between two or more variables within a regression model [129]. As depicted in Table 2, the VIF values for each measurement item range from 1.383 to 2.213, all of which are below the threshold of 3.3 [130,131]. This finding substantiates the non-existence of potential common method bias among the constructs.

Table 2. Factor loadings, AVE, and VIF for each variable.

Variable	Items	Factor Loading	AVE	VIF
Interactivity	IN1	0.833	0.676	1.599
	IN2	0.782		1.438
	IN3	0.850		1.781
Vividness	VID1	0.783	0.544	2.026
	VID2	0.698		1.459
	VID3	0.807		2.213
	VID4	0.712		1.505
	VID5	0.672		1.477
	VID6	0.747		1.552
Novelty	NOV1	0.737	0.537	1.480
	NOV2	0.718		1.288
	NOV3	0.732		1.474
	NOV4	0.744		1.346
Augmentation Quality	ARQ1	0.814	0.642	1.383
	ARQ2	0.755		1.384
	ARQ3	0.833		1.544
Perceived Usefulness	PU1	0.721	0.577	1.683
	PU2	0.744		1.846
	PU3	0.796		1.655
	PU4	0.776		1.713

Table 2. *Cont.*

Variable	Items	Factor Loading	AVE	VIF
Perceived Enjoyment	PE1	0.732		1.585
	PE2	0.754	0.559	1.666
	PE3	0.721		1.490
	PE4	0.774		1.544
Heritage-Responsible Behavior	HRB1	0.862		1.897
	HRB2	0.847	0.708	1.808
	HRB3	0.888		2.179
	HRB4	0.764		1.758

Using a two-step measurement, this study first examined the convergence validity and discriminant validity of the model. As shown in Table 3, the factor loading exceeded 0.7, and the average variance extracted from all constructs was higher than 0.5. So, the convergence validity was demonstrated. Regarding the discriminant validity, this study used the HTMT ratio as the evaluation criterion [121]. Generally speaking, when the HTMT value is below 0.85, this indicates the existence of discriminant validity [132]. But if there are conceptually similar constructs, a threshold below 0.9 is considered acceptable [132,133]. Therefore, as shown in Table 3, the discriminant validity of the model is demonstrated.

Table 3. HTMT discriminant validity analysis.

	IN	VID	NOV	ARQ	PU	PE	HRB
Interactivity							
Vividness	0.783						
Novelty	0.821	0.785					
Augmentation Quality	0.838	0.849	0.835				
Perceived Usefulness	0.817	0.867	0.810	0.867			
Perceived Enjoyment	0.760	0.751	0.838	0.728	0.893		
Heritage-Responsible Behavior	0.691	0.701	0.774	0.634	0.770	0.853	

4.4. Model Hypothesis Test

After completing the model fit test, this study set the subsample size to 5000 using the Bootstrapping algorithm in SEM-PLS to validate the path coefficients and examine the significance of pointers [121,134]. The two-tailed *t*-test was used [135]. When the t-value was greater than 1.96, it could reach a significance level of 0.05 ($p < 0.05$). When the t-value was greater than 2.63, it could reach a significance level of 0.01 ($p < 0.01$). When the t-value was greater than 3.4, it could reach a significance level of 0.001 ($p < 0.001$).

As shown in Table 4, in terms of AR attributes with handheld AR applications in museums, interactivity had a positive impact on perceived usefulness ($\beta = 0.191$, $p < 0.01$) and perceived enjoyment ($\beta = 0.196$, $p < 0.01$). Vividness had a positive impact on perceived usefulness ($\beta = 0.368$, $p < 0.001$) and perceived enjoyment ($\beta = 0.250$, $p < 0.001$). Novelty had a positive impact on perceived usefulness ($\beta = 0.157$, $p < 0.05$) and perceived enjoyment ($\beta = 0.306$, $p < 0.001$). Augmented quality had a positive impact on perceived usefulness ($\beta = 0.210$, $p < 0.01$), but its impact on perceived enjoyment was not significant ($\beta = 0.081$, $p > 0.1$). That is to say, except for hypothesis H8, all other hypotheses, H1–H7, were supported. These AR environmental stimuli explained 62.9% of the perceived usefulness ($R^2 = 0.629$) and 50.6% of the perceived enjoyment ($R^2 = 0.506$). In terms of the responses from visitors, perceived usefulness ($\beta = 0.292$, $p < 0.001$) and perceived enjoyment ($\beta = 0.481$, $p < 0.001$) had a significant positive impact on the intention to recommend, provided that both H9 and H10 were supported. Overall, the multivariate mediation model used in this study can explain 51.8% of the variance in the intention to recommend ($R^2 = 0.518$).

Table 4. Path coefficients and significance results.

Path Coefficients and Significance Results				
Hypothesis and Path	Path Coefficient	T Value	*p* Value	Result
H1→IN→PU	0.191	3.145	0.002 **	HOLD
H2→IN→PE	0.196	2.915	0.004 **	HOLD
H3→VID→PU	0.368	5.041	0.000 ***	HOLD
H4→VID→PEc	0.250	3.492	0.000 ***	HOLD
H5→NOV→PU	0.157	2.427	0.015 *	HOLD
H6→NOV→PE	0.306	3.769	0.000 ***	HOLD
H7→ARQ→PU	0.210	2.952	0.003 **	HOLD
H8→ARQ→PE	0.081	0.897	0.370	NOT HOLD
H9→PU→HRB	0.292	4.412	0.000 ***	HOLD
H10→PE→HRB	0.481	7.406	0.000 ***	HOLD

*, ** and *** indicate significance at the 0.05, 0.01 and 0.001 levels, respectively.

5. Discussion and Conclusions

5.1. Discussion

Heritage responsibilities include the moral and economic responsibilities involved in the protection of cultural and natural heritage [136,137]. Previous research has focused on the transmission, protection, and inheritance of cultural heritage by tourists and residents, as well as the formation mechanisms of heritage-responsibility behavior [138–140]. This paper is the first to explore the internal formation mechanism of heritage-responsibility behavior from the perspective of tourists based on the experiential elements of tourists during travel. This is the heritage knowledge system brought by AR technology and the enjoyment of experiences different from those in traditional cultural tourism. This article is also the first attempt to reveal the internal mechanism of the formation of the heritage-responsibility behavior of tourists assisted by new types of information technologies. The study results reported in this paper show that the perceived usefulness and perceived enjoyment generated by AR technology are important influencing factors on the user's heritage-responsibility behavior. This conclusion reveals the promoting effect of current technological device experience on cultural heritage behaviors from the perspective of cognition and relationship embedding. Also, this conclusion confirms the inherent connection between heritage-responsibility behaviors and external environmental factors, introducing technological elements into the traditional cultural ecosystem framework, and paving the way for subsequent research work on heritage-responsibility behaviors from the perspective of tourists.

In this study, the interactivity, vividness, and novelty of AR are positively correlated with perceived usefulness and perceived enjoyment. This is consistent with previous studies [51,91,114] that confirm that the interactivity, vividness, and novelty of AR in retail environments have a positive impact on perceived usefulness and perceived enjoyment, and emphasized their importance in AR applications [51,66]. The results of this study indicate that, in the case of handheld AR applications that provide visitors with highly manipulable interactive abilities, clear and sensory-rich multimedia information, and unique and personalized content, users are more likely to enjoy the use process and affirm its positive impact on museum visits.

Regarding the impact of augmented reality, it is found in this study that augmented reality is positively correlated with perceived usefulness and is the second most important attribute that affects perceived usefulness. This indicates that the realistic virtual content presented by the museum's handheld AR application is also important and meaningful for users. The research by other experts demonstrated the positive impact of augmented quality of tourism AR applications on perceived usefulness in tourism contexts [141]. However,

no significant positive impact is found from augmented quality on perceived enjoyment in this study (Hypothesis H8), which is inconsistent with the previous study [91]. One possible explanation is that the augmented quality provided by handheld AR applications in museums is not sufficient. Barteit et al. [142] pointed out that, when compared to head-mounted AR devices, handheld AR devices have a narrower visual range, which limits their perceived usefulness by the user and, to some extent, suppresses the user's related emotional perception and participation. Another explanation for the lack of significant impact on the hypothesis is that it may be related to the sample characteristics of this study, which mainly consisted of young women. When compared to men, women's active cognitive participation in three-dimensional digital environments is usually relatively lower, which may reduce their perception and experience of remote presentation and entertainment in digital environments [143].

5.2. Theoretical Implications

The article delineates a causal chain from the attributes of AR technology to tourists' perceived usefulness and enjoyment and, ultimately, to cultural heritage-responsibility behaviors, through the theoretical framework of SOR, providing a lucid theoretical pathway for understanding how technology influences tourist heritage-responsible behavior. Moreover, the study elucidates how the inherent characteristics of AR technology, such as interactivity, vividness, and novelty, significantly amplify the perceived utility and enjoyment of tourists, offering a novel perspective on comprehending the impact of technological attributes on user perceptions.

This study innovatively explores the intrinsic mechanisms of cultural heritage-responsibility behavior from the perspective of tourists, emphasizing the potential role of AR technology in enhancing tourists' cognition and actions towards cultural heritage preservation. The findings indicate that the perceived usefulness and enjoyment derived from the AR experience are significant factors influencing tourists' intention to recommend, offering new theoretical support for understanding the relationship between technology experiences and users' behavioral intentions. Moreover, through empirical research, this study clarifies the educational and communicative functions of AR technology in cultural heritage tourism, providing a theoretical foundation for the application of AR technology in cultural heritage transmission. Additionally, this research supplements the existing literature on cultural heritage tourism and the application of AR technology, while also challenging some traditional views, such as the insignificant impact of enhanced quality on perceived enjoyment, potentially guiding future research to reassess existing theories. By integrating theories and methods from environmental psychology, information technology, and tourism studies, this research paves new paths for interdisciplinary studies. Not only does this study contribute theoretically, it also provides practical guidance for the sustainable development of cultural heritage tourism, strategic deployment of AR technology, and enhancement of the tourist experience.

5.3. Managerial Implications

This study, through an analysis of the application of AR technology within the realm of cultural heritage tourism, has furnished a novel perspective and methodology for the digital display and dissemination of cultural heritage, fostering innovation and transformation in the cultural heritage-tourism industry. Additionally, the research delves into how AR technology can transcend physical and temporal constraints to deepen visitors' immersive experiences with the fusion of traditional and contemporary cultures, thereby enriching the understanding of national history and cultural heritage and offering practical guidance to enhance the visitor experience.

Employing the SOR theoretical framework, a causal chain was established linking AR attributes to perceived usefulness, enjoyment, and behavioral intention, laying a theoretical foundation to predict and guide tourists' recommendation intentions and responsible behavior towards cultural heritage. The outcomes of this study provide valuable recom-

mendations for the strategic deployment of AR technology in the field of cultural heritage tourism, especially regarding how to utilize AR to increase visitor engagement and satisfaction. In that it explores the formation mechanism of visitors' responsible behavior towards cultural heritage from their perspective, this research also contributes new pathways for thinking and practical strategies for the preservation and transmission of cultural heritage. Furthermore, by analyzing the impact of the interactivity, vividness, and novelty of AR technology on visitors' perceptions, the study furnishes pragmatic strategies to enhance technology acceptance and user satisfaction.

On the whole, this study is not only instructive for the field of cultural heritage tourism but also offers an empirical research foundation and lessons for the application of AR technology in other domains. In light of the impacts of the post-pandemic period on the tourism industry, the research showcases the potential of AR technology to sustain the vibrancy of cultural heritage tourism amidst the pandemic, presenting strategies for the tourism sector to navigate challenges and seize developmental opportunities in the post-pandemic period. Moreover, researchers have provided data-based tourist-behavior analysis and forecasting models through quantitative research methods, offering scientific decision-making support and sustainability planning for cultural heritage-tourism management departments and related enterprises.

5.4. Limitations and Further Research

The study presents certain limitations. It is advisable that future research integrates the SOR framework with other sociological or psychological theories and concepts to better elucidate the complex and multifaceted phenomena involved [144,145], thereby reducing potential argumentative biases that may arise from exclusive reliance on the SOR framework.

Additionally, the sample distribution in this study is skewed in terms of age, with an insufficient representation of the elderly population, who are also significant museum visitors [11]. Future research should aim to expand the sample size, particularly by including more elderly participants, to better understand their behavioral intentions and experiences with emerging technologies. Moreover, this study does not adequately account for the diverse perceptions and experiences of different user groups regarding AR, particularly those who are less technologically proficient or have lower levels of technology acceptance [146], which may limit the inclusivity of AR applications.

It is also crucial to acknowledge that AR devices may impact the authenticity of cultural heritage experiences [147]. While AR can enhance engagement, there is a risk of obscuring or distorting true cultural narratives and artifacts. Over-reliance on digital overlays might lead to a superficial understanding of cultural heritage, shifting the focus from the tangible site to the technological experience. Future research should prioritize this issue and explore its implications in greater depth.

Finally, the study may insufficiently address the potential negative impacts of AR. Specifically, if the technology is improperly implemented, overly complex, or acts as a distraction rather than an enhancement, it could negatively affect user enjoyment. Future research should further investigate how varying user preferences, particularly among those who favor traditional, non-digital experiences, contribute to differences in perceived enjoyment. Furthermore, ethical considerations related to AR [148], such as the potential risks of cultural appropriation, the commercialization of heritage, and privacy concerns arising from data collection and tracking, are critical issues that have often been overlooked in previous research.

Author Contributions: S.C. made significant contributions to this study, including the development of the research framework, conceptualization, methodology design, variable selection, data analysis, manuscript drafting, formal analytical procedures, content refinement, editorial supervision, critical review, and overall guidance. Y.T. played a crucial role in manuscript drafting, data collection, result interpretation, participation in the literature review, and the editorial and revision processes. Additionally, he served as the corresponding author for this study. S.P. was responsible for conducting

the fieldwork, effectively communicating the questionnaire content to respondents, and clarifying any potential ambiguities. Moreover, she contributed to the drafting of the research framework. In sum, all three authors made substantial contributions to this study. All authors have read and agreed to the published version of the manuscript.

Appendix A

Table A1. Research scale and items.

Variable	Items	Source
Interactivity	The application of AR-guided tours within the museum context has facilitated an interactive engagement for the user.	Komarac and Ozretić Došen [114] Pallud [149] McLean and Wilson [51]
	I perceive that I possess the agency to modulate my interaction with the museum's AR guided tour.	
	The museum AR guide responds to my actions.	
Vividness	I consider the images provided by the museum AR guide to be of high clarity.	Nikhashemi et al. [91] Yim et al. [52] Wei et al. [150]
	I consider the images delivered by the museum AR guide to be detailed in nature.	
	I perceive the images furnished by the museum AR guide to exhibit a degree of blurriness.	
	I consider the images provided by the museum AR guide to be characterized by their vividness.	
	I consider the images rendered by the museum AR guide to be distinguished by their sharpness.	
	I consider the images supplied by the museum AR guide to be notable for their well-defined contours.	
Novelty	For me, utilizing the museum AR guide consistently yields novel insights with each use.	McLean and Wilson (2019) [51]; Yim et al. [52]; Li et al. [151]
	For me, the utilization of the museum AR guide affords unique informational insights.	
	For me, engaging with the museum AR Guide consistently presents distinct content with each interaction.	
	For me, the application of the museum AR guide offers distinctive content.	
Augmentation Quality	Through the utilization of the museum AR guide, I perceive artifacts as genuinely existing within the real-world context.	Rauschnabel et al. [71]; Hilken et al. [70] Javornik [67]; Vorderer et al. [152]
	The museum AR guide facilitates a perceptual shift wherein artifacts appear to transition from the display screen into the tangible realm of the real world.	
	The museum AR guide engenders a sense of verisimilitude, such that all that is beheld on the display screen appears to possess a genuine reality.	

Table A1. *Cont.*

Variable	Items	Source
Perceived Usefulness	For me, the utilization of the museum AR guide proves to be efficacious in the context of museum visitation.	Chung et al. [115] Jung et al. [116] Wu et al. [153]; Zhuang [154]
	For me, the museum AR guide constitutes an effective modality for engaging with museum exhibits.	
	For me, the application of the museum AR guide facilitates enhanced access to information pertaining to cultural artifacts.	
	In summation, I perceive the utilization of the museum AR guide to be highly advantageous.	
Perceived Enjoyment	For me, the interaction with the museum AR guide to acquire information is an engaging endeavor.	Chung et al. [115]; Jung et al. [116]; Lee et al. [155]
	I consider that the utilization of the museum AR guide has imparted a significant degree of amusement to me.	
	I derive enjoyment from the application of the museum AR guide.	
	The utilization of the museum AR guide has not engendered a sense of tedium for me.	
Heritage-Responsible Behavior	I will stop somebody from destroying the heritage site that I have viewed from the museum AR guide.	Gursoy et al. [85]
	I will try to convince partners to protect the heritage site.	
	I am willing to take part in the protection activities.	
	I am willing to organize everyone to protect the heritage site.	

References

1. Ministry of Culture and Tourism of the People's Republic of China. 2022 Annual Domestic Tourism Data Overview. Available online: https://zwgk.mct.gov.cn/zfxxgkml/tjxx/202301/t20230118_938716.html (accessed on 18 January 2023).
2. Mason, M.C.; Riviezzo, A.; Zamparo, G.; Napolitano, M.R. It is worth a visit! Website quality and visitors' intentions in the context of corporate museums: A multimethod approach. *Curr. Issues Tour.* **2022**, *25*, 3027–3041. [CrossRef]
3. Choi, B.; Kim, J. Changes and challenges in museum management after the COVID-19 pandemic. *J. Open Innov. Technol. Mark. Complex.* **2021**, *7*, 148. [CrossRef]
4. De Bernardi, P.; Bertello, A.; Shams, S.M.R. Logics Hindering Digital Transformation in Cultural Heritage strategic Management: An Exploratory Case Study. *Tour. Anal.* **2019**, *24*, 315–327. [CrossRef]
5. Ammirato, S.; Felicetti, A.M.; Linzalone, R.; Carlucci, D. Digital business models in cultural tourism. *Int. J. Entrep. Behav. Res.* **2022**, *28*, 1940–1961. [CrossRef]
6. Do, H.-N.; Shih, W.; Ha, Q.-A. Effects of mobile augmented reality apps on impulse buying behavior: An investigation in the tourism field. *Heliyon* **2020**, *6*, e04667. [CrossRef]
7. Tan, G.-S.; Ab Aziz, K.; Ahmad, Z. Ensuring resilience using augmented reality: How museums can respond during and post COVID-19? In *Augmented Reality in Tourism, Museums and Heritage: A New Technology to Inform and Entertain*; Geroimenko, V., Ed.; Springer: Cham, Switzerland, 2021; pp. 195–210. [CrossRef]
8. Hantono, B.S.; Nugroho, L.E.; Santosa, P.I. Meta-Review of Augmented Reality in Education. In Proceedings of the 2018 10th International Conference on Information Technology and Electrical Engineering (ICITEE), Kuta, Indonesia, 24–26 July 2018.
9. Azuma, R.T. A Survey of Augmented Reality. In *Presence: Teleoperators and Virtual Environments*; MIT Press: Cambridge, MA, USA, 1997; Volume 6, pp. 355–385.
10. Anhui Museum. 2023. Available online: https://www.ahm.cn/News/ListT/ndbg (accessed on 24 March 2023).
11. Falomo, B.L.; Bernardi, E.M.; Ferrari, A.; Garbarino, M.C.; Vai, A. Augmented Reality Application for Handheld Devices: How to Make It hAPPen at the Pavia University History Museum. *Sci. Educ.* **2021**, *30*, 755–773. [CrossRef] [PubMed]
12. Potts, T. The J. Paul Getty Museum during the coronavirus crisis. *Mus. Manag. Curatorship* **2020**, *35*, 217–220. [CrossRef]
13. Jin, M.; Juan, Y.; Choi, Y.; Lee, C.K. Estimating the preservation value of world heritage site using contingent valuation method: The case of the Li River, China. *Sustainability* **2019**, *11*, 1100. [CrossRef]
14. Zhang, C.; Chen, P.; Wang, X. Conceptualizing heritage responsibility in world heritage sites: Insights from Levinas' ethics of responsibility. *Asian J. Tour. Res.* **2017**, *2*, 80–101. [CrossRef]
15. Jiang, S.; Moyle, B.; Yung, R.; Tao, L.; Scott, N. Augmented reality and the enhancement of memorable tourism experiences at heritage sites. *Curr. Issues Tour.* **2023**, *26*, 242–257. [CrossRef]

16. Du, W.B.; Liang, R.Y.; Liu, D.H. Factors Influencing School Teachers' Continuous Usage Intention of Using VR Technology for Classroom Teaching. *Sage Open* **2022**, *12*, 16. [CrossRef]

17. Wu, X.; Lai, I.K.W. Identifying the response factors in the formation of a sense of presence and a destination image from a 360-degree virtual tour. *J. Destin. Mark. Manag.* **2021**, *21*, 100640. [CrossRef]

18. Khakzad, S. Promoting coastal communities through cultural tourism: The case of fishing communities in Brunswick County, North Carolina. *J. Herit. Tour.* **2018**, *13*, 455–471. [CrossRef]

19. Chen, H.; Rahman, I. Cultural tourism: An analysis of engagement, cultural contact, memorable tourism experience and destination loyalty. *Tour. Manag. Perspect.* **2018**, *26*, 153–163. [CrossRef]

20. Chen, H.; Wang, Y.C.; Li, N. Research on the Relationship of Consumption Emotion, Experiential Marketing, and Revisit Intention in Cultural Tourism Cities: A Case Study. *Front. Psychol.* **2022**, *13*, 894376. [CrossRef]

21. Jingen, L.L.; Elliot, S. A systematic review of augmented reality tourism research: What is now and what is next? *Tour. Hosp. Res.* **2021**, *21*, 15–30. [CrossRef]

22. Loureiro, S.M.C.; Guerreiro, J.; Ali, F. 20 years of research on virtual reality and augmented reality in tourism context: A text mining approach. *Tour. Manag.* **2020**, *77*, 104028. [CrossRef]

23. Wei, W. Research progress on virtual reality (VR) and augmented reality (AR) in tourism and hospitality: A critical review of publications from 2000 to 2018. *J. Hosp. Tour. Technol.* **2019**, *10*, 539–570. [CrossRef]

24. Li, M.L.; Sun, X.Y.; Zhu, Y.; Qiu, H.L. Real in virtual: The influence mechanism of virtual reality on tourists' perceptions of presence and authenticity in museum tourism. *Int. J. Contemp. Hosp. Manag.* **2024**, 23. [CrossRef]

25. Chung, N.; Lee, H.; Kim, J.Y.; Koo, C. The role of augmented reality for experience-influenced environments: The case of cultural heritage tourism in Korea. *J. Travel Res.* **2018**, *57*, 627–643. [CrossRef]

26. Fenu, C.; Pittarello, F. Svevo tour: The design and the experimentation of an augmented reality application for engaging visitors of a literary museum. *Int. J. Hum. Comput. Stud.* **2018**, *114*, 20–35. [CrossRef]

27. Zhang, G.; Yue, X.; Ye, Y.; Peng, M.Y.-P. Understanding the Impact of the Psychological Cognitive Process on Student Learning Satisfaction: Combination of the Social Cognitive Career Theory and SOR Model. *Front. Psychol.* **2021**, *12*, 712323. [CrossRef] [PubMed]

28. Fu, S.; Chen, X.; Zheng, H. Exploring an adverse impact of smartphone overuse on academic performance via health issues: A stimulus-organism-response perspective. *Behav. Inf. Technol.* **2021**, *40*, 663–675. [CrossRef]

29. Russell, J.A.; Mehrabian, A. Distinguishing anger and anxiety in terms of emotional response factors. *J. Consult. Clin. Psychol.* **1974**, *42*, 79–83. [CrossRef] [PubMed]

30. Donovan, R.J.; Rossiter, J.R. Store Atmosphere—An Environmental Psychology Approach. *J. Retail.* **1982**, *58*, 34–57.

31. Eroglu, S.A.; Machleit, K.A.; Davis, L.M. Atmospheric qualities of online retailing: A conceptual model and implications. *J. Bus. Res.* **2001**, *54*, 177–184. [CrossRef]

32. Han, H. Consumer behavior and environmental sustainability in tourism and hospitality: A review of theories, concepts, and latest research. *J. Sustain. Tour.* **2021**, *29*, 1021–1042. [CrossRef]

33. Sugiarto, A.; Lee, C.W.; Huruta, A.D.; Dewi, C.; Chen, A.P.S. Predictors of Pro-Environmental Intention and Behavior: A Perspective of Stimulus-Organism-Response Theory. *Sustainability* **2022**, *14*, 16047. [CrossRef]

34. Kourouthanassis, P.; Boletsis, C.; Bardaki, C.; Chasanidou, D. Tourists responses to mobile augmented reality travel guides: The role of emotions on adoption behavior. *Pervasive Mob. Comput.* **2015**, *18*, 71–87. [CrossRef]

35. Lee, S.; Lee, N.; Lee, T.J.; Hyun, S.S. The influence of social support from intermediary organizations on innovativeness and subjective happiness in community-based tourism. *J. Sustain. Tour.* **2023**, *34*, 795–817. [CrossRef]

36. Wu, C.H.; Lin, Y.F.; Peng, K.L.; Liu, C.H. Augmented reality marketing to enhance museum visit intentions. *J. Hosp. Tour. Technol.* **2023**, *14*, 658–674. [CrossRef]

37. Bachiller, C.; Monzo, J.M.; Rey, B. Augmented and Virtual Reality to Enhance the Didactical Experience of Technological Heritage Museums. *Appl. Sci.* **2023**, *13*, 3539. [CrossRef]

38. Huang, M.-H. Designing website attributes to induce experiential encounters. *Comput. Hum. Behav.* **2003**, *19*, 425–442. [CrossRef]

39. Murray, J.H. *Hamlet on the Holodeck: The Future of Narrative in Cyberspace*; MIT Press: Cambridge, MA, USA, 1997.

40. Falk, J.H.; Dierking, L.D.; Adams, M. Living in a learning society: Museums as informal learning envi-ronments. In *The Handbook of Museum Studies*; Wiley-Blackwell: Hoboken, NJ, USA, 2008; pp. 185–202.

41. Basaraba, N.; Conlan, O.; Edmond, J.; Arnds, P. Digital narrative conventions in heritage trail mobile apps. *New Rev. Hypermedia Multimed.* **2019**, *25*, 1–30. [CrossRef]

42. Trichopoulos, G.; Aliprantis, J.; Konstantakis, M.; Michalakis, K.; Caridakis, G. Tangible and Personalized DS Application Approach in Cultural Heritage: The CHATS Project. *Computers* **2022**, *11*, 19. [CrossRef]

43. Li, N.; Li, L.Y.; Chen, X.M.; Wong, I.A. Digital destination storytelling: Narrative persuasion effects induced by story satisfaction in a VR context. *J. Hosp. Tour. Manag.* **2024**, *58*, 184–196. [CrossRef]

44. Munns, D. Discovering History in a Digital World: The Texas Story Project. *J. Mus. Educ.* **2016**, *41*, 192–201. [CrossRef]

45. Meng, L.; Liu, Y.; Li, K.W.; Lyu, R.M. Research on a User-Centered Evaluation Model for Audience Experience and Display Narrative of Digital Museums. *Electronics* **2022**, *11*, 1445. [CrossRef]

46. Capuano, N.; Gaeta, A.; Guarino, G.; Miranda, S.; Tomasiello, S. Enhancing augmented reality with cognitive and knowledge perspectives: A case study in museum exhibitions. *Behav. Inf. Technol.* **2016**, *35*, 968–979. [CrossRef]

47. Leow, F.T.; Ch'ng, E. Analysing narrative engagement with immersive environments: Designing audience-centric experiences for cultural heritage learning. *Mus. Manag. Curatorship* **2021**, *36*, 342–361. [CrossRef]

48. Guo, K.X.; Fan, A.L.; Lehto, X.; Day, J. Immersive Digital Tourism: The Role of Multisensory Cues in Digital Museum Experiences. *J. Hosp. Tour. Res.* **2023**, *47*, 1017–1039. [CrossRef]

49. Steuer, J.; Biocca, F.; Levy, M.R. Defining virtual reality: Dimensions determining telepresence. *Commun. Age Virtual Real.* **1995**, *33*, 37–39. [CrossRef]

50. Downes, E.; McMillan, S. Defining Interactivity: A Qualitative Identification of Key Dimensions. *New Media Soc.* **2000**, *2*, 157–179. [CrossRef]

51. McLean, G.; Wilson, A. Shopping in the digital world: Examining customer engagement through augmented reality mobile applications. *Comput. Hum. Behav.* **2019**, *101*, 210–224. [CrossRef]

52. Yim, M.Y.-C.; Chu, S.-C.; Sauer, P.L. Is Augmented Reality Technology an Effective Tool for E-commerce? An Interactivity and Vividness Perspective. *J. Interact. Mark.* **2017**, *39*, 89–103. [CrossRef]

53. Hu, W.M.; Han, H.; Wang, G.L.; Peng, T.; Yang, Z.Q. Interactive Design and Implementation of a Digital Museum under the Background of AR and Blockchain Technology. *Appl. Sci.* **2023**, *13*, 4714. [CrossRef]

54. Cheng, A.P.; Ma, D.M.; Pan, Y.H.; Qian, H. Enhancing Museum Visiting Experience: Investigating the Relationships Between Augmented Reality Quality, Immersion, and TAM Using PLS-SEM. *Int. J. Hum. Comput. Interact.* **2023**, *12*, 4521–4532. [CrossRef]

55. Hammady, R.; Ma, M.H.; Al-Kalha, Z.; Strathearn, C. A framework for constructing and evaluating the role of MR as a holographic virtual guide in museums. *Virtual Real.* **2021**, *25*, 895–918. [CrossRef]

56. Babin, L.A.; Burns, A.C. A modified scale for the measurement of communication-evoked mental imagery. *Psychol. Mark.* **1998**, *15*, 261–278. [CrossRef]

57. Keller, P.A.; Block, L.G. Vividness effects: A resource—Matching perspective. *J. Consum. Res.* **1997**, *24*, 295–304. [CrossRef]

58. Flavián, C.; Gurrea, R.; Orús, C. The influence of online product presentation videos on persuasion and purchase channel preference: The role of imagery fluency and need for touch. *Telemat. Inform.* **2017**, *34*, 1544–1556. [CrossRef]

59. Coyle, J.R.; Thorson, E. The Effects of Progressive Levels of Interactivity and Vividness in Web Marketing Sites. *J. Advert.* **2001**, *30*, 65–77. [CrossRef]

60. Paliokas, I.; Patenidis, A.T.; Mitsopoulou, E.E.; Tsita, C.; Pehlivanides, G.; Karyati, E.; Tsafaras, S.; Stathopoulos, E.A.; Kokkalas, A.; Diplaris, S.; et al. A Gamified Augmented Reality Application for Digital Heritage and Tourism. *Appl. Sci.* **2020**, *10*, 7868. [CrossRef]

61. Chen, Y.G.; Wang, X.N.; Le, B.; Wang, L. Why people use augmented reality in heritage museums: A socio-technical perspective. *Herit. Sci.* **2024**, *12*, 19. [CrossRef]

62. Berlyne, D.E.; Craw, M.A.; Salapatek, P.H.; Lewis, J.L. Novelty, complexity, incongruity, extrinsic motivation, and the GSR. *J. Exp. Psychol.* **1963**, *66*, 560–567. [CrossRef] [PubMed]

63. Pratama, A.B. The landscape of public service innovation in Indonesia: A comprehensive analysis of its characteristic and trend. *Innov. Manag. Rev.* **2020**, *17*, 25–40. [CrossRef]

64. Massetti, B.; Zmud, R.W. Measuring the Extent of EDI Usage in Complex Organizations: Strategies and Illustrative Examples. *MIS Q.* **1996**, *20*, 331–345. [CrossRef]

65. Tellis, G.J. Effective frequency: One exposure or three factors? *J. Advert. Res.* **1997**, *37*, 75.

66. Brannon Barhorst, J.; McLean, G.; Shah, E.; Mack, R. Blending the real world and the virtual world: Exploring the role of flow in augmented reality experiences. *J. Bus. Res.* **2021**, *122*, 423–436. [CrossRef]

67. Javornik, A. Augmented reality: Research agenda for studying the impact of its media characteristics on consumer behaviour. *J. Retail. Consum. Serv.* **2016**, *30*, 252–261. [CrossRef]

68. Henderson, A. Interaction design: Beyond human-computer interaction. *Ubiquity* **2002**, *2002*, 6. [CrossRef]

69. Lee, H.; Xu, Y.; Porterfield, A. Consumers' adoption of AR-based virtual fitting rooms: From the perspective of theory of interactive media effects. *J. Fash. Mark. Manag.* **2021**, *25*, 45–62. [CrossRef]

70. Hilken, T.; de Ruyter, K.; Chylinski, M.; Mahr, D.; Keeling, D.I. Augmenting the eye of the beholder: Exploring the strategic potential of augmented reality to enhance online service experiences. *J. Acad. Mark. Sci.* **2017**, *45*, 884–905. [CrossRef]

71. Rauschnabel, P.A.; Felix, R.; Hinsch, C. Augmented reality marketing: How mobile AR-apps can improve brands through inspiration. *J. Retail. Consum. Serv.* **2019**, *49*, 43–53. [CrossRef]

72. Alakhtar, R.A. Using Augmented Reality to Explore Museum Artifacts. In Proceedings of the 2020 IEEE International Symposium on Mixed and Augmented Reality Adjunct (ISMAR-Adjunct), Recife, Brazil, 9–13 November 2020; IEEE: Piscataway, NJ, USA, 2020; pp. 295–299. [CrossRef]

73. Pai, C.K.; Chen, H.; Lee, T.J.; Hyun, S.S.; Liu, Y.; Zheng, Y. The impacts of under-tourism and place attachment on residents' life satisfaction. *J. Vacat. Mark.* **2023**. [CrossRef]

74. Davis, F.D. Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *Mis Q.* **1989**, *13*, 319–340. [CrossRef]

75. Liu, C.; Shyu, C.-S.; Chou, T.-Y.; Chen, C.-C.; Wu, C.-H. What Is the Current Development Status of Wearable Device in Industrial 4.0? Using Technology Acceptance Model to Explore the Willingness and Pattern of Usage of the Consumers. *Math. Probl. Eng.* **2020**, *1*, 9762015. [CrossRef]

76. Tan, G.W.-H.; Lee, V.H.; Lin, B.; Ooi, K.-B. Mobile applications in tourism: The future of the tourism industry? *Ind. Manag. Data Syst.* **2017**, *117*, 560–581. [CrossRef]

77. Bhattacherjee, A. Understanding information systems continuance: An expectation-confirmation model. *Mis Q.* **2001**, *25*, 351–370. [CrossRef]

78. Liu, Z.; Park, S. What makes a useful online review? Implication for travel product websites. *Tour. Manag.* **2015**, *47*, 140–151. [CrossRef]

79. Zhang, Y.; Wang, L. Influence of sustainable development by tourists' place emotion: Analysis of the multiply mediating effect of attitude. *Sustainability* **2019**, *11*, 1384. [CrossRef]

80. Chun, H.; Lee, H.; Kim, D. The Integrated Model of Smartphone Adoption: Hedonic and Utilitarian Value Perceptions of Smartphones Among Korean College Students. *Cyberpsychol. Behav. Soc. Netw.* **2012**, *15*, 473–479. [CrossRef] [PubMed]

81. Roca, J.C.; Gagné, M. Understanding e-learning continuance intention in the workplace: A self-determination theory perspective. *Comput. Hum. Behav.* **2008**, *24*, 1585–1604. [CrossRef]

82. Kim, J.; Ahn, K.; Chung, N. Examining the factors affecting perceived enjoyment and usage intention of ubiquitous tour information services: A service quality perspective. *Asia Pac. J. Tour. Res.* **2013**, *18*, 598–617. [CrossRef]

83. Kang, J.H.; Jang, J.C.; Jeong, C. Understanding museum visitor satisfaction and revisit intentions through mobile guide system: Moderating role of age in museum mobile guide adoption. *Asia Pac. J. Tour. Res.* **2018**, *23*, 95–108. [CrossRef]

84. Chaozhi, Z. Heritage responsibility: Conception, characteristics and research issues. *Tour. Trib./Lvyou Xuekan* **2014**, *29*, 45.

85. Gursoy, D.; Zhang, C.Z.; Chi, O.H. Determinants of locals' heritage resource protection and conservation responsibility behaviors. *Int. J. Contemp. Hosp. Manag.* **2019**, *31*, 2339–2357. [CrossRef]

86. Ju, Y.-y.; Cheng, L. Formation mechanism of heritage responsibility behavior of residents in the tourism community of cultural heritage sites:Based on the fuzzy-set qualitative comparative analysis. *J. Nat. Resour.* **2023**, *38*, 1135. [CrossRef]

87. Li, Y.; Wang, X.; Chen, P. Development and testing of heritage responsibility scale: Based on perspectives of tourists and residents. *Tour. Trib.* **2019**, *34*, 60–75.

88. Steuer, J. Defining Virtual Reality—Dimensions Determining Telepresence. *J. Commun.* **1992**, *42*, 73–93. [CrossRef]

89. Spielmann, N.; Mantonakis, A. In virtuo: How user-driven interactivity in virtual tours leads to attitude change. *J. Bus. Res.* **2018**, *88*, 255–264. [CrossRef]

90. Hsu, H.-L.; Chen, H.H.-J.; Todd, A.G. Investigating the impact of the Amazon Alexa on the development of L2 listening and speaking skills. *Interact. Learn. Environ.* **2021**, *31*, 5732–5745. [CrossRef]

91. Nikhashemi, S.R.; Knight, H.H.; Nusair, K.; Liat, C.B. Augmented reality in smart retailing: A (n) (A) Symmetric Approach to continuous intention to use retail brands' mobile AR apps. *J. Retail. Consum. Serv.* **2021**, *60*, 102464. [CrossRef]

92. Marzuki, M.; Rosly, A.; Roslan, N.; Abdullah, D.; Kamal, S.; Azmi, A. The Role of Perceived Interactivity, Perceived Ease of Use, Perceived Usefulness, and Perceived Enjoyment toward Intention to Use Online Mapping Service Applications. *Int. Acad. Res. J. Bus. Technol.* **2016**, *2*, 135–139.

93. Hsiao, H.-S.; Chang, C.-S.; Lin, C.-Y.; Wang, Y.-Z. Weather observers: A manipulative augmented reality system for weather simulations at home, in the classroom, and at a museum. *Interact. Learn. Environ.* **2016**, *24*, 205–223. [CrossRef]

94. Kowalczuk, P.; Siepmann, C.; Adler, J. Cognitive, affective, and behavioral consumer responses to augmented reality in e-commerce: A comparative study. *J. Bus. Res.* **2021**, *124*, 357–373. [CrossRef]

95. Thogersen, J. A cognitive dissonance interpretation of consistencies and inconsistencies in environmentally responsible behavior. *J. Environ. Psychol.* **2004**, *24*, 93–103. [CrossRef]

96. Kim, K.; Hwang, J.; Zo, H.; Lee, H. Understanding users' continuance intention toward smartphone augmented reality applications. *Inf. Dev.* **2016**, *32*, 161–174. [CrossRef]

97. Zeng, J.Y.; Xing, Y.; Jin, C.H. The Impact of VR/AR-Based Consumers' Brand Experience on Consumer–Brand Relationships. *Sustainability* **2023**, *15*, 7278. [CrossRef]

98. Fang, J.; Li, J.; Prybutok, V.R. Posting-related attributes driving differential engagement behaviors in online travel communities. *Telemat. Inform.* **2018**, *35*, 1263–1276. [CrossRef]

99. Khan, M.A.; Israr, S.; Almogren, A.; Din, I.U.; Almogren, A.; Rodrigues, J.J.P.C. Using augmented reality and deep learning to enhance Taxila Museum experience. *J. Real-Time Image Process.* **2021**, *18*, 321–332. [CrossRef]

100. tom Dieck, M.C.; Jung, T.H. A theoretical model of mobile augmented reality acceptance in urban heritage tourism. *Curr. Issues Tour.* **2018**, *21*, 154–174. [CrossRef]

101. tom Dieck, M.C.; Jung, T.H. Value of augmented reality at cultural heritage sites: A stakeholder approach. *J. Destin. Mark. Manag.* **2017**, *6*, 110–117. [CrossRef]

102. Kim, J.; Forsythe, S. Adoption of Virtual Try-on technology for online apparel shopping. *J. Interact. Mark.* **2008**, *22*, 45–59. [CrossRef]

103. Huang, T.-L.; Liao, S. A model of acceptance of augmented-reality interactive technology: The moderating role of cognitive innovativeness. *Electron. Commer. Res.* **2015**, *15*, 269–295. [CrossRef]

104. Triantafillidou, A.; Lappas, G. Virtual and Augmented Reality in Serious Tourism Games: Opportunities, Tourist Motives, and Challenges. *SHS Web Conf.* **2022**, *139*, 3021. [CrossRef]

105. Aguiar-Castillo, L.; Clavijo-Rodriguez, A.; De Saa-Perez, P.; Perez-Jimenez, R. Gamification as An Approach to Promote Tourist Recycling Behavior. *Sustainability* **2019**, *11*, 2201. [CrossRef]

106. Kaur, P.; Dhir, A.; Singh, N.; Sahu, G.; Almotairi, M. An innovation resistance theory perspective on mobile payment solutions. *J. Retail. Consum. Serv.* **2020**, *55*, 102059. [CrossRef]

107. Mensah, I.K.; Adams, S.; Adjei, J.K.; Mwakapesa, D.S. Drivers of egovernment adoption amidst COVID-19 pandemic: The Information Adoption Model (IAM) approach. *Inf. Dev.* **2022**, *38*, 494–509. [CrossRef]

108. Kim, H.L.; Hyun, S.S. Paradoxical effects of tourism ethnocentrism on domestic tourism: The moderating effect of pandemic anxiety travel. *Int. J. Tour. Res.* **2024**, *26*, e2628. [CrossRef]

109. Ma, L.; Zhang, X.; Wang, G.S. Identifying the Reasons why Users in China Recommend Bike Apps. *Int. J. Mark. Res.* **2017**, *59*, 767–786. [CrossRef]

110. Inan, D.I.; Abidin, Z.; Hidayanto, A.N.; Rianto, M.E.; Zakiri, F.; Praharsa, M.D.; Phusavat, K. Factors Influencing Mobile Tourism Recommender Systems Adoption by Smart Travellers: Perceived Value and Parasocial Interaction Perspectives. In *Design, Operation and Evaluation of Mobile Communications, Proceedings of the First International Conference, MOBILE 2020, Held as Part of the 22nd HCI International Conference, HCII 2020, Copenhagen, Denmark, 19–24 July 2020*; Springer International Publishing: Berlin/Heidelberg, Germany, 2020; pp. 52–62.

111. Zhao, X.; Wang, X.; Ji, L. Evaluating the effect of anticipated emotion on forming environmentally responsible behavior in heritage tourism: Developing an extended model of norm activation theory. *Asia Pac. J. Tour. Res.* **2020**, *25*, 1185–1198. [CrossRef]

112. Huang, M.; Saleh, M.S.; Zolkepli, I.A. The Moderating Effect of Green Advertising on the Relationship between Gamification and Sustainable Consumption Behavior: A Case Study of the Ant Forest Social Media App. *Sustainability* **2023**, *15*, 2883. [CrossRef]

113. Taber, K.S. The Use of Cronbach's Alpha When Developing and Reporting Research Instruments in Science Education. *Res. Sci. Educ.* **2018**, *48*, 1273–1296. [CrossRef]

114. Komarac, T.; Ozretić, D.Đ. Discovering the determinants of museum visitors' immersion into experience: The impact of interactivity, expectations, and skepticism. *Curr. Issues Tour.* **2022**, *25*, 3675–3693. [CrossRef]

115. Chung, N.; Han, H.; Joun, Y. Tourists' intention to visit a destination: The role of augmented reality (AR) application for a heritage site. *Comput. Hum. Behav.* **2015**, *50*, 588–599. [CrossRef]

116. Jung, T.H.; Lee, H.; Chung, N.; tom Dieck, M.C. Cross-cultural differences in adopting mobile augmented reality at cultural heritage tourism sites. *Int. J. Contemp. Hosp. Manag.* **2018**, *30*, 1621–1645. [CrossRef]

117. Jung, T.; Chung, N.; Leue, M.C. The determinants of recommendations to use augmented reality technologies: The case of a Korean theme park. *Tour. Manag.* **2015**, *49*, 75–86. [CrossRef]

118. Villaespesa, E.; Wowkowych, S. Ephemeral Storytelling with Social Media: Snapchat and Instagram Stories at the Brooklyn Museum. *Soc. Media Soc.* **2020**, *6*, 205630511989877. [CrossRef]

119. Carlson, K.D.; Herdman, A.O. Understanding the Impact of Convergent Validity on Research Results. *Organ. Res. Methods* **2012**, *15*, 17–32. [CrossRef]

120. Lance, C.E.; Butts, M.M.; Michels, L.C. The Sources of Four Commonly Reported Cutoff Criteria: What Did They Really Say? *Organ. Res. Methods* **2006**, *9*, 202–220. [CrossRef]

121. Hair, J.F.; Sarstedt, M.; Ringle, C.M. Rethinking some of the rethinking of partial least squares. *Eur. J. Mark.* **2019**, *53*, 566–584. [CrossRef]

122. Selickaitė, D.; Hutzler, Y.; Pukėnas, K.; Block, M.E.; Rėklaitienė, D. The Analysis of the Structure, Validity, and Reliability of an Inclusive Physical Education Self-Efficacy Instrument for Lithuanian Physical Education Teachers. *SAGE Open* **2019**, *9*, 1–17. [CrossRef]

123. Li, X.; Pu, R.; Liao, H. The impacts of innovation capability and social adaptability on undergraduates' employability: The role of self-efficacy. *Front. Psychol.* **2022**, *13*, 954828. [CrossRef]

124. Schuberth, F.; Rademaker, M.E.; Henseler, J. Assessing the overall fit of composite models estimated by partial least squares path modeling. *Eur. J. Mark.* **2023**, *57*, 1678–1702. [CrossRef]

125. Natarajan, T.; Raghavan, D.R.V. Does service journey quality explain omnichannel shoppers' online engagement behaviors? The role of customer-store identification and gratitude toward the store. *TQM J.* **2023**. [CrossRef]

126. Deng, J.; Hao, W.; Zhang, W.; Han, X.; Li, K.; Feng, Y.; Yang, G. Exploring Farmers' Pro-Ecological Intentions after Ecological Rehabilitation in a Fragile Environment Area: A Structural Equation Modeling Approach. *Sustainability* **2018**, *10*, 29. [CrossRef]

127. Kim, H.; Ku, B.; Kim, J.Y.; Park, Y.-J.; Park, Y.-B. Confirmatory and Exploratory Factor Analysis for Validating the Phlegm Pattern Questionnaire for Healthy Subjects. *Evid.-Based Complement. Altern. Med.* **2016**, *1*, 2696018–2696019. [CrossRef]

128. Jou, Y.-J.; Huang, C.-C.L.; Cho, H.-J. A VIF-based optimization model to alleviate collinearity problems in multiple linear regression. *Comput. Stat.* **2014**, *29*, 1515–1541. [CrossRef]

129. García, C.B.; García, J.; Martin, M.M.L.; Salmerón, R. Collinearity: Revisiting the variance inflation factor in ridge regression. *J. Appl. Stat.* **2015**, *42*, 648–661. [CrossRef]

130. Abbasi, A.Z.; Nisar, S.; Rehman, U.; Ting, D.H. Impact of HEXACO Personality Factors on Consumer Video Game Engagement: A Study on eSports. *Front. Psychol.* **2020**, *11*, 1831. [CrossRef] [PubMed]

131. Hair, J.F.; Ringle, C.M.; Sarstedt, M. PLS-SEM: Indeed a silver bullet. *J. Mark. Theory Pract.* **2011**, *19*, 139–152. [CrossRef]

132. Henseler, J.; Ringle, C.M.; Sarstedt, M. A new criterion for assessing discriminant validity in variance-based structural equation modeling. *J. Acad. Mark. Sci.* **2015**, *43*, 115–135. [CrossRef]

133. Franke, G.; Sarstedt, M. Heuristics versus statistics in discriminant validity testing: A comparison of four procedures. *Internet Res.* **2019**, *29*, 430–447. [CrossRef]

134. Kukah, A.S.K.; Owusu-Manu, D.G.; Badu, E.; Asamoah, E. Structural equation model (SEM) for evaluating interrelationships among risks inherent in Ghanaian public–private partnership (PPP) power projects. *Eng. Constr. Archit. Manag.* **2022**, *31*, 2327–2352. [CrossRef]

135. Helm, S.T.; Andersson, F.O. Beyond taxonomy: An empirical validation of social entrepreneurship in the nonprofit sector. *Nonprofit Manag. Leadersh.* **2010**, *20*, 259–276. [CrossRef]

136. Fennell, D.A. *Ecotourism: An Introduction*, 2nd ed.; Routledge: London, UK, 2004. [CrossRef]

137. Smint, V.L. *Hosts and Guests: The Anthropology of Tourism*, 2nd ed.; University of Pennsylvania Press, Inc.: Philadelphia, PA, USA, 1989. [CrossRef]

138. Gao, J.; Lin, H.X.; Zhang, C.Z. Locally situated rights and the 'doing' of responsibility for heritage conservation and tourism development at the cultural landscape of Honghe Hani Rice Terraces, China. *J. Sustain. Tour.* **2021**, *29*, 193–213. [CrossRef]

139. Liang, B.Y.; Zhang, Z.S.; Zhang, N.J.; Feng, Q.H. Heterogeneity of residents' heritage responsibilities in the process of cultural communication: The case of the Genglubu heritage site in Tanmen, China. *Int. J. Herit. Stud.* **2023**, *29*, 881–907. [CrossRef]

140. Yi, X.L.; Fu, X.X.; Lin, B.N.; Sun, J.X. Authenticity, identity, self-improvement, and responsibility at heritage sites: The local residents' perspective. *Tour. Manag.* **2024**, *102*, 15. [CrossRef]

141. Ahmad, H.; Butt, A.; Muzaffar, A. Travel before you actually travel with augmented reality—Role of augmented reality in future destination. *Curr. Issues Tour.* **2023**, *26*, 2845–2862. [CrossRef]

142. Barteit, S.; Lanfermann, L.; Bärnighausen, T.; Neuhann, F.; Beiersmann, C. Augmented, mixed, and virtual reality-based head-mounted devices for medical education: Systematic review. *JMIR Serious Games* **2021**, *9*, e29080. [CrossRef] [PubMed]

143. Stavropoulos, V.; Alexandraki, K.; Motti-Stefanidi, F. Flow and Telepresence contributing to Internet Abuse: Differences according to Gender and Age. *Comput. Hum. Behav.* **2013**, *29*, 1941–1948. [CrossRef]

144. Atsiz, O.; Çokal, Z.; Yildirim, I.; Cankül, I. Understanding travelers' masstige consumption values: An application of masstige theory and S-O-R model paradigm. *Asia Pac. J. Tour. Res.* **2024**, *29*, 1170–1184. [CrossRef]

145. Nian, S.F.; Li, D.H.; Zhang, J.; Lu, S.; Zhang, X.W. Stimulus-Organism-Response Framework: Is the Perceived Outstanding Universal Value Attractiveness of Tourists Beneficial to World Heritage Site Conservation? *Int. J. Environ. Res. Public Health* **2023**, *20*, 1189. [CrossRef] [PubMed]

146. Zheng, D.N.; Liu, S.S.; Lu, W. Do You Trust Digital Health Pass? Understanding Tourists' Responses toward Using Health QR Codes in Pandemic Travel. *J. China Tour. Res.* **2023**, *19*, 31–49. [CrossRef]

147. Zhu, C.; Io, M.U.; Ngan, H.F.B.; Peralta, R.L. Interpreting the impact of augmented reality on heritage tourism: Two empirical studies from World Heritage sites. *Curr. Issues Tour.* **2024**, 1–15. [CrossRef]

148. Ursin, F.; Timmermann, C.; Benzinger, L.; Salloch, S.; Tietze, F.A. Intraoperative application of mixed and augmented reality for digital surgery: A systematic review of ethical issues. *Front. Surg.* **2024**, *11*, 1287218. [CrossRef]

149. Pallud, J. Impact of interactive technologies on stimulating learning experiences in a museum. *Inf. Manag.* **2017**, *54*, 465–478. [CrossRef]

150. Wei, W.; Qi, R.; Zhang, L. Effects of virtual reality on theme park visitors' experience and behaviors: A presence perspective. *Tour. Manag.* **2019**, *71*, 282–293. [CrossRef]

151. Li, C.-Y.; Fang, Y.-H.; Sukoco, B.M. Value proposition as a catalyst for innovative service experience: The case of smart-tourism destinations. *Serv. Bus.* **2021**, *15*, 281–308. [CrossRef]

152. Vorderer, P.; Klimmt, C.; Ritterfeld, U. Enjoyment: At the Heart of Media Entertainment. *Commun. Theory* **2004**, *14*, 388–408. [CrossRef]

153. Wu, S.-T.; Chiu, C.-H.; Chen, Y.-S. The influences of innovative technological introduction on interpretive experiences of exhibition: A discussion on the intention to use augmented reality. *Asia Pac. J. Tour. Res.* **2020**, *25*, 662–677. [CrossRef]

154. Zhuang, X.; Hou, X.; Feng, Z.; Lin, Z.; Li, J. Subjective norms, attitudes, and intentions of AR technology use in tourism experience: The moderating effect of millennials. *Leis. Stud.* **2021**, *40*, 392–406. [CrossRef]

155. Lee, H.; Chung, N.; Jung, T. Examining the cultural differences in acceptance of mobile augmented reality: Comparison of South Korea and Ireland. In *Information and Communication Technologies in Tourism, Proceedings of the International Conference, Lugano, Switzerland, 3–6 February 2015*; Springer International Publishing: Berlin/Heidelberg, Germany, 2015; pp. 477–491.