Social presence and experience economy: the effects of augmented and virtual reality in museums

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Abstract: The purpose of this study is to explore the effects of augmented reality (AR) and virtual reality (VR) on visitors' museum experience. To date, some studies have investigated the factors that enhance visitor experiences through AR and VR; however, research focusing on social presence and experience economy in mixed-reality environments, combining both VR and AR, is limited. Therefore, the aim of this study is to examine the effect of social presence in mixed environments on tourist experiences by applying social

presence and experience economy theories. Questionnaires were conducted with 163 museum visitors and found that social presence is a strong predictor of the four realms of the experience economy. In addition, three realms, except aesthetic experience, had an effect on the visitor experience, which consequently influenced tourists' intention to revisit the museum. Implications are drawn and presented for the adoption of AR and VR technologies in museums.

Keywords: virtual reality; augmented reality; visitor experience; experience economy; social presence.

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1   Introduction

Today's technologies, such as augmented reality (AR) and virtual reality (VR), play an important role in protecting cultural integrities of intangible cultural heritage by

digitalising them (Alt, 2021; Jing et al., 2021). Cultural tourism organisations around the world have started to use AR and VR as tools to enhance the visitor experience (Trunfio and Campana, 2019). Especially AR has increasingly been used as a way of providing enjoyable, immersive and educating tourism experiences. Example of such AR applications include Dublin AR (Han et al., 2013), AR at Deoksugung Palace (Lee et al., 2015b), and AR at the Manchester Art Gallery (Leue et al., 2015; Jung et al., 2020b). Although it has existed for a longer time, VR has fewer implementations within the tourism context (Tussyadiah et al., 2018). According to Guttentag (2010), some of these applications include training, education, marketing, entertainment, accessibility and tourism. Nevertheless, to the best of our knowledge, few attempts have been made to explore factors that enhance the visitor experience using a combination of both AR and VR technologies.

AR makes it possible to enhance users' immediate surroundings through the display of digital information in the real environment, and its opportunities have been widely discussed in various research contexts (Rauschnabel et al., 2019, 2022). From the tourism perspective, recent scholars have recognised the opportunities of AR for the enhancement of the tourism experience (Chung et al., 2015a). Using marker or location-based applications, users can obtain instant information on unknown surroundings (Rauschnabel et al., 2019). This makes AR particularly attractive for cultural heritage sites, as it allows tourists to receive digital signage and content without the need to compromise the original landscapes (Trunfio and Campana, 2019). In addition, Leue et al. (2015) found another benefit of AR within the cultural heritage context by confirming that interactive and engaging AR applications contribute to a positive and long-lasting learning experience.

In contrast, according to Guttentag (2010), VR is the immersion in a digital and artificially built environment. According to Guerra et al. (2015, p.50), "the difference between augmented reality and virtual reality is that the first digital information is added to images and real-life contexts, while the second offers the user a new world in which he is immersed allowing, for example, to fly over a city without taking his feet off the ground." Thanks to the development and widespread availability of highly powerful, low-cost and user-friendly VR devices such as Oculus Quest and Samsung Gear, use cases are becoming increasingly available in tourism (tom Dieck et al., 2018; Kim et al., 2020; Martínez-Molés et al., 2021). VR makes it possible to visit inaccessible sites that might be endangered, as shown by a study by tom Dieck et al. (2019), in the interest of sustaining endangered landscapes, heritage attractions and destinations for generations to come. AR and VR present new opportunities for the tourism industry by adding value to the visitor experience (Cranmer et al., 2020). However, research exploring both augmented and VR is limited (e.g., Trunfio et al., 2020). Therefore, further research is essential to fully understand the potential of the combined experience of AR and VR within the tourism and cultural heritage context.

Recently, a wide range of theoretical foundations of AR and VR studies have appeared within the tourism and cultural heritage context, including adoption (Jung et al., 2020a), brand loyalty (Bae et al., 2020), business model (Cranmer et al., 2021), value co-creation (Jung and tom Dieck, 2017), gamification (e.g., Paliokas et al., 2020), user experience (e.g., Han et al., 2018) and experience economy (Lee et al., 2020). In addition, new methodological approaches have been tested and proposed, such as EEG (e.g., Han et al., 2020). Loureiro et al. (2020, p.17) published a meta-analysis in *Tourism*

Management of the progress of AR and VR research within the tourism context. They concluded that "future studies need to be focusing on extending the adaptation of well-known models and frameworks […] develop a framework specific to VR and AR technology, which can be used to understand the tourists' behavior and their approach or avoidance of these experiences."

Especially, the experience economy has gained momentum as part of AR and VR tourism research in the past few years, with a number of studies focusing on its elements as part of the visitor experience (e.g., Lee et al., 2020; tom Dieck et al., 2018). One of the remaining questions has been "how to extend the four realms of experience economy to the virtual and augmented reality tourism destination", according to Loureiro et al. (2020, p.16). This was confirmed by tom Dieck et al. (2018), who suggested that the experience economy should not be explored in isolation but explained by AR and VR context-specific constructs in order to enhance the explanatory power. However, the analysis of Loureriro et al. (2020) revealed limited studies with a focus on social presence. Considering these gaps in the literature, we believe further work is needed exploring the influence of social presence as part of the experience economy.

Consequently, assuming the theoretical foundation of social presence, which refers to "the extent to which other beings (living or synthetic) also exist in the virtual environment" [Schuemie et al., (2001), p.184], this study aims to explore the use of AR and VR to enhance the visitor experience. Social presence is considered one of the key factors influencing experiences in the immersive tech environment (Daassi and Debbabi, 2021; tom Dieck and Han, 2021). Within the marketing research domain, social presence has been proposed to play an important role in the enhancement of immersive experiences. For instance, according to tom Dieck and Han (2021, p.4), the "concept of social presence makes immersive technologies such an effective tool for marketing- and business-related purposes." Previously, the role of social presence was explored with a focus on VR environments, as research found that the increased importance of AR and VR in tourism leads to increasingly immersive experiences as part of the tourist journey (Lee, 2002). Kang and Gretzel (2012) revealed that a strong sense of social presence occurs when tourists perceive experiences as genuine and non-mediated. Some research focused on the role of social presence within the VR tourism context (e.g., Tussyadiah et al., 2018); however, to the best of our knowledge, no previous study has focused on the effect of social presence in mixed (VR and AR) environments on visitor experiences. Therefore, this study aims to explore, with a focus on the experience economy, whether the visitor's overall experience can be enhanced by social presence in the augmented and VR context, further leading to revisit intentions toward visitor attractions and destinations. This gap in the literature and the resulting aim lead to two research questions:

RQ1   Is social presence a suitable theory to enhance the experience economy in the AR and VR museum context?

RQ2   How does the experience economy influence the overall museum tour experience?

2 Theoretical background and hypotheses development

2.1 Social presence theory

According to Steuer et al. (1995), presence is defined as 'the sense of being in an environment' and is considered an indispensable component for the improvement of media performance as it delivers a feeling of 'being there'. Presence can be classified into three types, according to Heeter (1992), including personal, social and environmental presence. Kang and Gretzel (2012) found that out of those three classifications, social presence is a crucial component of technology experiences.

Short et al. (1976) posited the social presence theory, which defines social presence as "the extent to which other beings (living or synthetic) also exist in the virtual environment" [Schuemie et al., (2001), p.184]. With the constant development of technology and its rapid advancements in use cases, a combination of multiple immersive technologies including VR and AR have increasingly been used in tourism. These technologies have in fact increasingly provided tourists with more real and immersive environments. According to Lee (2002), this conveys a strong social presence. Consequently, it is anticipated that the less users perceive technology to be artificial or mediated, the more social presence occurs as part of the tourism experience (Kang and Gretzel, 2012; Lee, 2002). Ultimately, this led to a large interest of social presence as part of virtual tourism environments (e.g., Schuemie et al., 2001; Tussyadiah et al., 2018). Kang and Gretzel (2012) explored the effect of social characteristics of podcasts on social presence and ultimately tourists' experience and found that social presence has a strong effect on tourists' experiences. In another study, Lee et al. (2013) looked at the impact of social presence on tourists' experience with smartphone applications and its effects on three experience economy dimensions. Recently, Tussyadiah et al. (2018) conducted a study on VR presence in the context. Their research found that a heightened feeling of being at a destination virtually results in stronger preferences in the destination. Nevertheless, little work has been done in the AR content in terms of the effects of social presence on tourists' behaviour.

AR is the digital overlay of information in users' direct environment; for this reason, social presence in the AR context is expected to be different from findings of previous VR studies, whereby environments are complete digitally recreated. Therefore, this study aims to extend the research area of social presence to the mixed reality environment by looking at both VR and AR technologies.

For the context of this study, social presence is defined as the sense of being immersed in an environment while still experiencing human elements and senses. The importance of social presence for the experience economy dimensions within the tourism context has been previously confirmed by Kang and Gretzel (2012). Consequently, integrating the AR and VR experience in all four experience economy dimensions, the following hypotheses are proposed:

H1   Social presence has a positive impact on AR and VR education experience.

H2   Social presence has a positive impact on AR and VR aesthetic experience.

H3   Social presence has a positive impact on AR and VR entertainment experience.

H4   Social presence has a positive impact on AR and VR escape experience.

2.2   Experience economy

The experience economy is a theory that has received increased attention over the past decade due to a general shift of from focusing on the product or services itself to enhancing tourists' experiences and making those experiences more memorable (tom Dieck et al., 2018). Developed by Pine and Gilmore (1998), the experience economy has been regarded as a predominant concept in the experience area. Pine and Gilmore (1998) focused their efforts on the importance of staging experiences, a core product of the tourism industry (Sternberg, 1997). The experience economy classifies these experiences into four realms on two spectrums of participation (passive and active) and connection (absorption and immersion):

1   entertainment

2   education

3   aesthetics

4   escapism (called the 4Es) (see Figure 1).

Figure 1   Four realms of experience economy
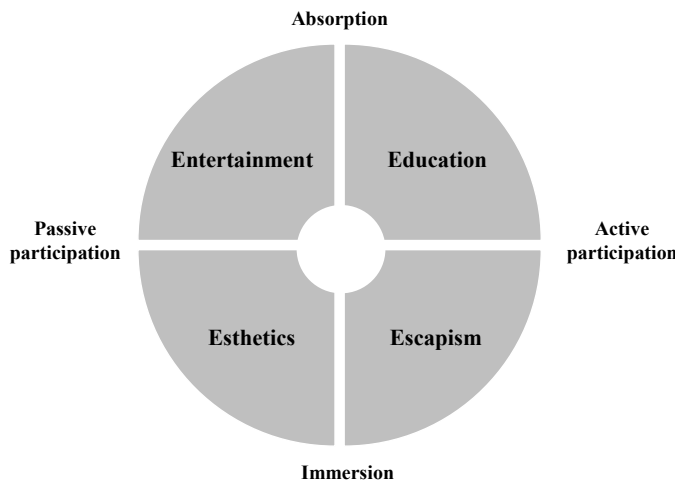
Source: Pine and Gilmore (1998)

These four experience economy constructs are defined as follows. Aesthetics refers to "the beauty that can be expressed though the elements such as color, photographs, font style, and layout" [Lee et al., (2015a), p.481]. Entertainment is "an activity that provides amusement and pleasure" [Benny, (2015), p.7]. Education refers to "the absorption of events unfolding before [a tourist] at a destination, while actively participating through interactive engagement of the mind" [Oh et al., (2007), p.121]. Finally, escapism is defined as the "escape of regular environments to suspend the power of norms and values that govern [individuals'] ordinary lives or to think about their lives and societies from a different perspective" [Oh et al., (2007), p.122].

   Education and entertainment are classified under absorption. According to Oh et al. (2007), in the case of educational experiences, tourists tend to participate in activities to

enhance their skills and knowledge. In the context of AR and VR, for example, tourists are able to acquire information and knowledge about destinations through the use of immersive technology. Therefore, it comes as no surprise that many studies have started to focus on the role of AR and VR from the education perspective (e.g., Mintz et al., 2001; Moorhouse et al., 2019). According to Pine and Gilmore (1999), the most prevalent concept of today's tourism environments is entertainment, as tourists often travel to enjoy activities at a destination for pleasure. Entertainment is therefore regarded as a crucial component of hedonic information system (IS) adoption (e.g., tom Dieck et al., 2017; Van der Heijden, 2004).

On the other hand, aesthetics and escapism are classified under immersion, which is defined as "becoming physically or virtually a part of the experience itself" [Pine and Gilmore, (1999), p.31]. In fact, aesthetics and escapism have been explored by a number of VR (e.g., Marković, 2010) and AR studies (e.g., Lee et al., 2015a, 2015b). In these experiences and examples, tourists are able to be immersed in VR's virtual world or AR's virtually enhanced world (Di Serio et al., 2013).

Table 1 presents an overview of previous experience economy studies within the context of AR/VR and tourism. Of note is the lack of VR studies utilising the experience economy as a theoretical foundation. In addition, no previous studies have incorporated social presence theory into their experience economy research.

Table 1 Previous experience economy AR and VR tourism studies

Reference	Context	Extended constructs
Olya et al. (2020), tom Dieck et al. (2018)	AR in cultural festivals	Satisfaction, memory, engagement
Jung et al. (2020)	AR in museums	Perceived value
Armingeon et al. (2019)	AR in tourism	Not extended
Neuburger and Egger (2018)	AR in museums	Engagement, knowledge, meaningful experiences, emotional connection
Our study	AR and VR in museums	Social presence, tour experience

2.2.1 Experience economy and visitor experience

Pine and Gilmore (1998) revealed that the four realms of experience are crucial components in the development of memorable experiences. VR and AR are immersive technologies that have been found to enhance learning and entertainment (Leue et al., 2015), offer aesthetic experiences (Lee et al., 2015a) and facilitate the escape from reality (Jung et al., 2015). In tourism, staging of entertaining, educational, aesthetic and escape experiences is considered important for creating satisfactory holidays (Morgan et al., 2009). The positive link from the experience economy constructs to visitor experiences has been confirmed in a number of studies (Oh et al., 2007; Song et al., 2015). Also, tom Dieck et al. (2018) found a positive link between experience economy and the behavioural intention to use AR applications. Consequently, the following hypotheses are proposed:

H_5 AR and VR education experience has a positive impact on visitor experience.

H_6 AR and VR aesthetic experience has a positive impact on visitor experience.

H$_7$ AR and VR entertainment experience has a positive impact on visitor experience.

H$_8$ AR and VR escape experience has a positive impact on visitor experience.

2.2.2 *Visitor experience and intention to revisit visitor attraction*

Contrary to a mandatory work setting, where it is vital to make employees use a company's ISs easily and effectively, the ultimate goal of developing and launching ISs is not only encouraging tourists to use them but also enhancing their experience and intention to revisit the destination (Chung, et al., 2015b; Chung et al., 2018; Pallud and Straub, 2014). Previous studies have found a strong contribution of positive experience to the use of ISs that stimulate people to visit real destinations. Chung et al. (2015a) found that individuals' positive experience of an official website of a Destination Marketing Organization (DMO) can foster their intention to visit a real destination. Chung et al. (2018) showed that visitors' attitude toward cultural heritage sites formed through AR satisfaction stimulate visitors' intention to revisit them.

Keng et al. (2007) previously supported a strong effect of experience on behavioural intentions within the retail context. More recently, Jung et al. (2021) supported the effect of user perception of AR on purchase intention. Nevertheless, also within the tourism context, Hosany and Witham (2010) found that well-staged experiences lead to satisfied tourists and intentions to re-visit. This seems to be especially important in the intangible tourism and hospitality industry; therefore, the following hypothesis is proposed:

H$_9$ Visitor experience has a positive impact on intention to revisit the visitor attraction.

Figure 2   Proposed research model
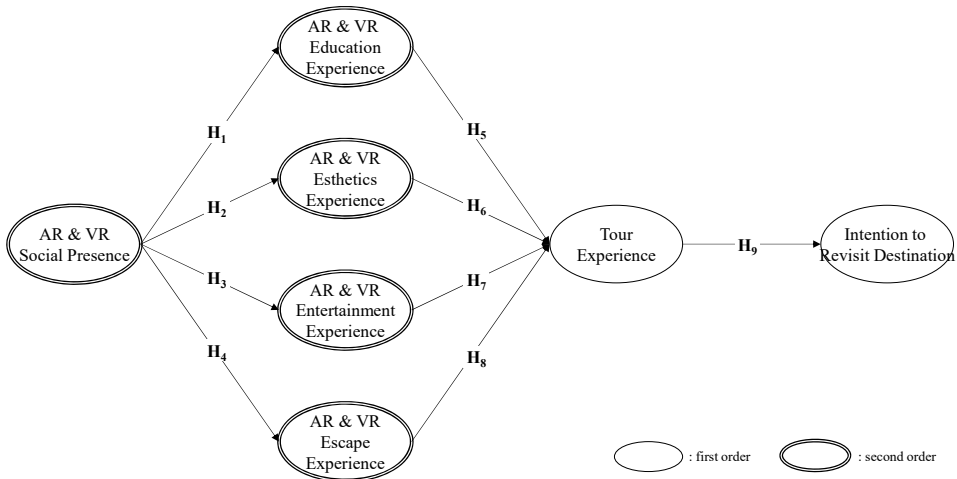
This study aims to investigate the relationship between social presence and the visitor experience through mixed reality experiences using both VR and AR in the cultural heritage tourism context. Taking into consideration previous literature, we propose the research model shown in Figure 2. Since VR and AR experiences are presumably similar, the social presence and four realms of the experience economy were measured as second-order constructs by two reflective constructs of VR and AR, respectively.

3 Methods

3.1 Operational definitions and measures

For our study, we define the variables based on previous studies (Oh et al., 2007; Pine and Gilmore, 1998; Um et al., 2006). Escapism is defined as a user's perception of entering a new reality for a short period of time. The 46 measurement items of this study were taken and adopted from previous studies [social presence (Gefen and Straub, 2003), education, aesthetic, entertainment and escape experiences (Oh et al., 2007), visitor experience (Kim and Tussyadiah, 2013) and intention to revisit (Chung et al., 2015a). The same items of social presence and the four realms of the experience economy were adopted for VR and AR experiences, respectively. Thus, the respondents were asked to answer the same questions on social presence and four realms of the experience economy in the context of VR and AR, respectively, resulting in 45 measurement items [summarised in Table 5: social presence (three items + three items), education experience (four items + four items), aesthetic experience (three items + three items), entertainment experience (five items + five items), escape experience (four items + four items), visitor experience (three items), and intention to revisit attraction (four items)]. All items were ranked on a seven-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree).

Table 2 Operational definitions of the variables

Variables	Operational definitions
AR and VR social presence	The extent to which a tourist feels the sense of being immersed inside the VR and AR environments while still experiencing human elements and senses.
AR and VR educational experience	The extent to which the VR and AR experiences are perceived as knowledgeable and well-informed.
AR and VR aesthetic experience	The extent to which VR and AR experiences enable a tourist to indulge in well-designed and attractive environments.
AR and VR entertainment experience	The extent to which VR and AR experiences allow a tourist to be entertained and generate positive feelings and emotions.
AR and VR escape experience	The extent to which VR and AR experiences allow a tourist to perceive that he or she enters a new reality for a short period of time.
Tour experience	The extent to which a tourist perceives that VR and AR experiences enriched his/her trip.
Intention to revisit destination	The extent to which a tourist intends to choose the same destination in the future after experiencing VR and AR.

3.2 Data collection

This study was conducted at Geevor Tin Mine Museum which is a recognised UNESCO World Heritage Site located in Cornwall, UK. This particular museum was chosen as it had started to engage in the latest immersive technologies in order to their visitors' experience, including the use of AR and VR. Not many cultural heritage organisations have developed both types of applications for their visitor experience, and therefore this museum was considered a suitable case study. The data collection approach was to ask

every visitor at the museum over two days to participate in the study. The stratified random sampling method was employed to ensure each age group is adequately represented within the whole population of museum visitors, and any visitors under 16 were excluded. Overall, the sample matches the demographic profile of visitors to Geevor Tin Mine Museum.

A total of 163 visitors agreed to participate and took part in the study. As part of the experiment, visitors tried both AR and VR applications. First, the Geevor AR application provided overlaid 3D animations in the form of a virtual tour guide, text, video and audio to guide them through the museum, its history and points of interest. In particular, machinery was brougbanimated to be brought back to life, and a number of plaques were explained. Second, participants tried a VR application (using Samsung Gear VR) that enabled them to experience a lift ride down the mine shaft, re-enacting how miners originally started their work shifts. Since the lift is currently not in operation and not accessible to visitors, this experience was only possible for those visitors using the VR application. At the end of the museum visit, during which visitors tried both the augmented and VR applications, the 163 participants were invited to complete a questionnaire based on their experience.

Figure 3   Snapshot of VR and AR experience at Geevor Tin Mine Museum (see online version for colours)

3.3   Demographics

According to Gefen et al. (2000), to use PLS, the minimum acceptable sample size is ten times the number of items in the most complex construct. In this study, the most complex construct (entertainment) has five items; thus, our sample size (163) is well above this minimum to draw reliable conclusions.

Table 3 shows demographic characteristics of the respondents. More than half of the respondents were male (94, 57.7%), and rest were female (69, 42.3%). Of the respondents, 49 (30.1%) were between 45 and 54 years of age, 39 (23.9%) were between 35 and 44, 26 (16.0%) were between 55 and 64. About half of respondents were full-time employees (77, 47.2%) and the UK tourists (92, 56.4%) accompanied by family and friends (105, 64.4%).

Table 3 Demographic characteristics of the respondents

Profile category	Frequency	Percentage
Gender		
Male	94	57.7
Female	69	42.3
Age		
Under 18	4	2.5
18–24	19	11.7
25–34	9	5.5
35–44	39	23.9
45–54	49	30.1
55–64	26	16.0
65+	17	10.4
Income		
Less than £13,000	18	11.0
£13,000–20000	15	9.2
£20,000–£26,000	7	4.3
£26,000–£32,000	11	6.7
£32,000–£39,000	14	8.6
£39,000–£45,000	20	12.3
£45,000–£52,000	10	6.1
£52,000–£58,000	8	4.9
£58,000–£64,000	16	9.8
£64,000–£70,500	6	3.7
£70,500–£77,000	8	4.9
£77,000–£83,000	2	1.2
£90,000–£96,000	5	3.1
£96,000+	18	11.0
No response	5	3.1
Occupation		
Full-time employed	77	47.2
Part-time employed	22	13.5
Self-employed	11	6.7
Housewife/husband	7	4.3
Retired	25	15.3
Student	21	12.9
Where		
Local resident	17	10.4
Cornwall resident	8	4.9
UK tourist	92	56.4
International tourist	46	28.2

Table 3   Demographic characteristics of the respondents (continued)

Profile category	Frequency	Percentage
Company		
Alone	11	6.7
With a partner	46	28.2
With family and friends	105	64.4
With a group	1	.6
Education		
No formal qualification	10	6.1
GCSE/O-level	28	17.2
A-level	28	17.2
Undergraduate degree	45	27.6
Postgraduate degree	37	22.7
Doctoral degree	2	1.2
Professional degree	13	8.0
Total	*163*	*100*

4   Analysis and results

4.1   Descriptive statistics

Before conducting any analysis, descriptive analysis of the variables should be conducted. In order to check the normality, we calculated the skewness and kurtosis values of the variables (Tabachnick and Fidell, 2007). Skewness should be less than an absolute value of 3, and kurtosis should be smaller than an absolute value of 8 (Kline, 1998). Table 4 presents descriptive statistics for the variables. Skewness values of the variables were found to range from –2.109 (ENT_VR) to 0.002 (ESC_AR) and the kurtosis values of the variables ranged from –0.625 (ESC_AR) to 7.670 (ENT_VR). Therefore, the items of this study can be said to be approximately normally distributed.

4.2   Common method bias test

To minimise the concern of common method bias, Harman's one-factor test was conducted (Podsakoff et al., 2003). If only one factor explains over 50% of the covariation, the risk of common method bias is regarded to exist. We put all 46 measurement items into an exploratory factor analysis and examined the unrotated factor solution. Eight dimensions with a default minimum eigenvalue of 1 were produced. Each dimension explains from 2.202% to 46.530% of the covariation; thus, none of the factors of this study explains more than 50% of covariation. Therefore, this study is free from the risk of common method bias.

Table 4   Descriptive statistics for the variables

	Mean	*SD*	*Skewness*	*Kurtosis*
SCP_VR	4.333	1.265	–0.182	–0.030
SCP_AR	4.732	1.462	–0.498	–0.181
EDU_VR	5.948	0.805	–1.447	4.228
EDU_AR	6.014	0.840	–1.907	7.530
EST_VR	5.791	0.855	–1.217	3.249
EST_AR	5.697	0.992	–1.480	3.673
ENT_VR	6.090	0.916	–2.109	7.670
ENT_AR	5.505	1.091	–1.084	2.015
ESC_VR	4.952	1.294	–0.513	–0.248
ESC_AR	3.839	1.458	0.002	–0.625
EXP	5.791	0.988	–1.359	3.633
RVISIT	4.551	1.182	–0.157	–0.181

4.3   Measurement model

A PLS regression analysis, using SmartPLS, was used to test the proposed research model (shown in Figure 2). According to Ahuja and Thatcher (2005), PLS regression analysis has several advantages, including a smaller required sample size compared to traditional structural equation modelling (SEM) techniques and a few assumptions about measurement scale and normal distribution.

Table 5   Measurement model

Constructs and measurement items			*Loadings*	*CR*[1]	*Alpha*[2]	*AVE*[3]
SCP	VR	There is a sense of human contact in VR	.916	0.946	0.914	0.853
		There is a sense of sociability in VR	.929			
		There is a sense of human warmth in VR	.926			
	AR	There is a sense of human contact in AR	.939	0.965	0.945	0.902
		There is a sense of sociability in AR	.964			
		There is a sense of human warmth in AR	.946			
EDU	VR	I learned something new during VR use	.765	0.883	0.823	0.655
		The experience made me more knowledgeable	.861			
		It stimulated my curiosity to learn new things	.771			
		VR provided a good experience for learning	.836			
	AR	I learned something new using AR	.847	0.930	0.899	0.769
		The experience has made me more knowledgeable	.924			
		It stimulated my curiosity to learn new things	.849			
		AR provided a good experience for learning	.885			

Notes: EDU = education experience, EST = aesthetics experience, ENT = entertainment
    experience, ESC = escape experience, SCP = social presence, EXP = visitor
    experience and VST = intention to revisit attraction.
    [1]Composite reliability, [2]Cronbach's alpha and [3]average variance extracted.

Table 5   Measurement model (continued)

Constructs and measurement items			Loadings	CR[1]	Alpha[2]	AVE[3]
EST	VR	Using VR was very attractive	.802	0.848	0.718	0.651
		VR demo payed close attention to detail	.737			
		Using VR was very pleasant	.875			
	AR	Using AR was very attractive	.885	0.923	0.874	0.800
		The setting of AR paid close attention to details	.867			
		Using AR was very pleasant	.930			
ENT	VR	Using VR was amusing	.802	0.936	0.903	0.786
		Using VR was captivating	.888			
		Using VR was entertaining	.928			
		Using VR was fun	.924			
	AR	Using AR was amusing	.869	0.942	0.916	0.802
		Using AR was captivating	.860			
		Using AR was entertaining	.933			
		Using AR was fun	.918			
ESC	VR	I felt I played a different character when using VR	.880	0.923	0.887	0.749
		I felt like I was living in a different time or place	.885			
		The VR experience let me imagine being someone else	.897			
		I completely escaped from reality	.797			
	AR	I felt I played a different character when using AR	.931	0.966	0.952	0.876
		I felt like I was living in a different time or place	.960			
		The AR experience let me imagine being someone else	.924			
		I completely escaped from reality	.930			
EXP		Using VR and AR contributed positively to my overall visitor experience	.952	0.959	0.935	0.886
		Using VR and AR helped me to enjoy my travel	.959			
		Using VR and AR assisted me in gaining a meaningful visitor experience	.912			
RVST		I will visit Geevor again after experiencing VR and AR	.923	0.917	0.881	0.731
		I intend to visit Geevor frequently after experiencing VR and AR	.801			
		I will continue to visit Geevor in the future after experiencing VR and AR	.888			
		I want to recommend Geevor to others after experiencing VR and AR	.802			

Notes: EDU = education experience, EST = aesthetics experience, ENT = entertainment
experience, ESC = escape experience, SCP = social presence, EXP = visitor
experience and VST = intention to revisit attraction.
[1]Composite reliability, [2]Cronbach's alpha and [3]average variance extracted.

Table 6   Correlation matrix (HTMT)

Construct		Correlations										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) SCP_VR	1											
(2) SCP_AR	0.554	1										
(3) EDU_VR	0.565	0.431	1									
(4) EDU_AR	0.468	0.512	0.804	1								
(5) EST_VR	0.633	0.478	0.629	0.552	1							
(6) EST_AR	0.679	0.525	0.451	0.386	0.654	1						
(7) ENT_VR	0.493	0.462	0.640	0.629	0.581	0.302	1					
(8) ENT_AR	0.500	0.581	0.657	0.745	0.473	0.546	0.660	1				
(9) ESC_VR	0.656	0.489	0.876	0.681	0.684	0.446	0.873	0.651	1			
(10) ESC_AR	0.533	0.571	0.717	0.835	0.550	0.469	0.627	0.870	0.730	1		
(11) EXP	0.581	0.505	0.763	0.763	0.579	0.489	0.790	0.744	0.817	0.727	1	
(12) RVISIT	0.570	0.443	0.620	0.556	0.545	0.522	0.589	0.658	0.600	0.610	0.629	1

We followed the approach suggested by Chin (1998) to validate reflective constructs through composite reliability (CR), Cronbach's alpha and average variance extracted (AVE) before conducting SEM. This is done in order to confirm and claim convergent and discriminant validity. First, convergent validity can be assessed by checking whether the values of CR, Cronbach's alpha and AVE are greater than the threshold values (Cronbach's alpha $\geq$ 0.7, CR $\geq$ 0.7 and AVE $\geq$ 0.5) (Fornell and Larcker, 1981). According to the estimates presented in Table 5, each of the reliability measures is greater than the associated threshold value.

4.4   Heterotrait-monotrait ratio

In order to claim discriminant validity, we used heterotrait-monotrait (HTMT) ratio proposed by Henseler et al. (2015). As shown in Table 6, all values of HTMT are below the threshold of 0.9, which confirms discriminant validity.

4.5   Structural model

4.5.1   Hierarchical component modelling

SEM is unavailable to report universal fit measures such as chi-square (Chin, 1998; Wetzels et al., 2009). In order to overcome this shortcoming of SEM and measure the second order constructs, we conducted hierarchical component modelling.

The five variables including social presence and 4Es were populated with six or eight observed indicators, respectively; these indicators were repeatedly used for first-order constructs (e.g., AR education experience and VR education experience). In SmartPLS, the first step is generating and saving the standardised latent scores of all constructs by conducting consistent bootstrapping. Then, the second step is using or replacing these scores as observed indicator values. After conducting these two steps, the structural model was tested.

4.5.2   Explanatory power and predictive relevance

The adjusted R-square values mean the explanatory power of predictors of onto the respective constructs. In the circles in Figure 2, the adjusted R-square values are reported. AR and VR social presence explains from 30.0% (AR and VR education experience) to 47.3% (AR and VR escape experience). The 4Es together explain 69.3% of the tour experience level. Finally, experience explains 35.0% of the intention to revisit.

Meanwhile, predictive relevance can be assessed by Stone-Geisser's Q^2 value (Stone, 1974). In SmartPLS, this value can be given by using a blindfolding procedure. This approach skips some indicator values and then predicts them by using the calculated parameter. The gap between skipped and predicted value is used as a basis for calculating the Q^2 value. Therefore, it refers to the degree to which the empirically collected data is well reconstructed using the model and PLS parameters generated from the initial analysis (Henseler et al., 2009). A Q^2 value below 0 is indicate a lack of predictive relevance, whereas a Q^2 value greater than 0 means that the model has predictive relevance (Henseler et al., 2009). All Q^2 values for the variables were found to be greater than 0, indicating satisfactory predictive relevance: 0.173 (education), 0.221

(entertainment), 0.210 (aesthetics), 0.305 (escapism), tour experience (0.610) and intention to revisit (0.236).

4.5.3 Structural model test

Since the reliability and convergent/discriminant validity of our measurement model were established, we conducted SEM to assess the hypothesised relationships. The size of bootstrapping was 5,000. The results are shown in Figure 4 and Table 7. First, Hypotheses 1 through 4 postulate a positive causal relationship between social presence and the 4Es. Supporting these hypotheses, social presence was found to have a strong influence on all of the 4Es: education ($\beta = 0.552$ t = 9.113, $p < 0.001$), aesthetic ($\beta = 0.626$, t = 11.981, $p < 0.001$), entertainment ($\beta = 0.604$, t = 10.835, $p < 0.001$) and escape experience ($\beta = 0.690$, t = 15.815, $p < 0.001$). Second, Hypotheses 5 through 8 postulate a positive causal relationship from the 4Es to visitor experience. Education ($\beta = 0.302$, t = 3.380, $p < 0.01$) and entertainment ($\beta = 0.452$, t = 4.901, $p < 0.001$) were found to have a positive impact on visitor experience, and escape experience ($\beta = 0.096$, t = 1.768, $p < 0.1$) was found to marginally increase visitor experience. Therefore, H_5, H_7 and H_8 were supported. However, aesthetic experience was not found to have a significant influence on visitor experience ($\beta = 0.085$, t = 0.916, n.s); thus, H_6 was not supported. As visitor experience was found to be a strong predictor of visitors' intention to revisit the destination ($\beta = 0.595$, t = 12.301, $p < 0.001$), H_9, postulating the impact of visitor experience on intention to revisit destination, was supported.

Figure 4   Path estimates by PLS analysis
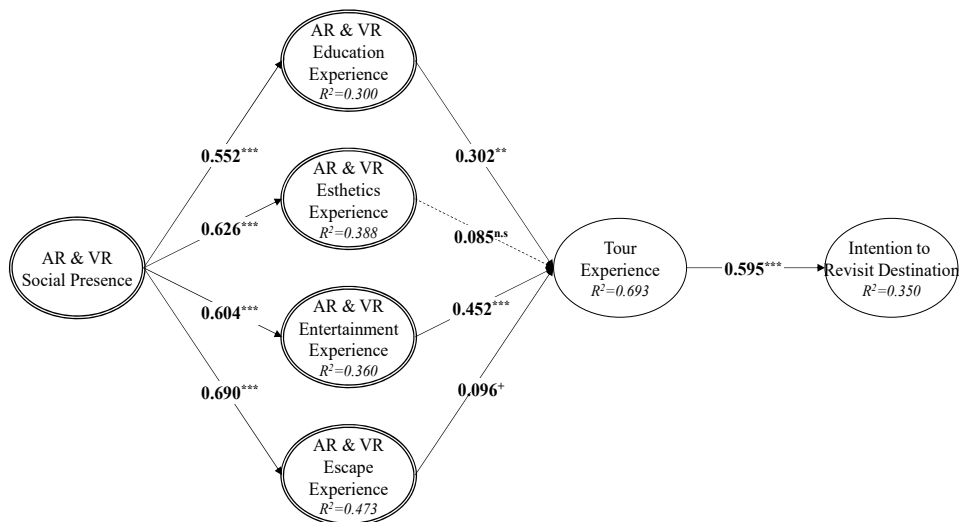
Note: $^+p < 0.1$, $^{**}p < 0.01$ and $^{***}p < 0.001$.

Table 7   Standardised structural estimates and tests of the hypotheses

Hypotheses			Estimates	t-value	Results
H₁	Social presence	→ Education experience	0.552	9.113	Supported
H₂	Social presence	→ Aesthetic experience	0.626	11.981	Supported
H₃	Social presence	→ Entertainment experience	0.604	10.835	Supported
H₄	Social presence	→ Escape experience	0.690	15.815	Supported
H₅	Education experience	→ Visitor experience	0.302	3.380	Supported
H₆	Aesthetic experience	→ Visitor experience	0.085	0.916	*Rejected*
H₇	Entertainment experience	→ Visitor experience	0.452	4.901	Supported
H₈	Escape experience	→ Visitor experience	0.096	1.768	Supported
H₉	Visitor experience	→ Intention to revisit destination	0.595	12.301	Supported
Adjusted R²					
Education experience			0.300 (30.0%)		
Aesthetic experience			0.388 (38.8%)		
Entertainment experience			0.360 (36.0%)		
Escape experience			0.473 (47.3%)		
Visitor experience			0.693 (69.3%)		
Intention to revisit destination			0.350 (35.0%)		

5   Discussion and conclusions

This study aimed to explore the influence of social presence and experience economy in a museum's mixed VR and AR environment on visitors' overall experience and intention to revisit. In particular, we set out to answer two research questions, and this discussion will be structured around them.

RQ1   Is social presence a suitable theory to enhance the experience economy in the AR and VR museum context?

Our findings show great support for the notion that social presence within augmented and VR environments is a strong predictor of the four concepts of the experience economy (education, aesthetics, entertainment and escapism). These findings support previous research by Kang and Gretzel (2012), who confirmed strong paths between social presence and experience. Considering the limited research on social presence and the experience economy, particularly within the VR context, this result is a strong implication of our study. Our results are especially meaningful for both academia and industry as we move into the era of the Metaverse, where visitors can have both physical and VR experiences in a wider context. The role of social presence in the context of museum experience in the Metaverse space will be much more important than before.

RQ2   How does the experience economy influence the overall museum tour experience?

Furthermore, except for the realm of aesthetic experiences, the remaining three constructs had a significant effect on the tourism experience, which in turn positively influences tourists' intention to revisit attractions. This finding is surprising, as a recent study by tom Dieck et al. (2018) claimed that aesthetics is the most important experience economy dimension as part of AR experiences, as it is linked to application design. It should be noted that visitors' AR and VR experience might have been affected by the type of content hey experienced. The context of this study was visitors' experience at a cultural heritage museum, and the findings show that education, entertainment and escape experiences had a positive influence on the museum visitors' overall experience. However, outcomes and AR and VR contents might be different in different contexts, such as art galleries, where aesthetic experience has been shown to have a positive influence on visitor experience (tom Dieck et al., 2018). This possibility should be considered in future investigations. Moreover, compared to AR, participants seemed to find the VR experience much less pleasant, attractive, and detailed within this study which may have resulted in the insignificant relationship with the visitor experience. This study used Samsung Gear VR as a headset, which is generally considered not to be as powerful a VR experience as can be offered by other types of headsets; thus, other headsets may result in more pleasant and powerful experiences. These findings lead to the clear implication that VR applications should be designed well and use a powerful headset in order to create impactful aesthetic experiences. In this study, entertainment experience was found to be the strongest predictor of tourist experiences in the AR and VR museum context. Menon and Kahn (2002) explain this phenomenon in terms of carry-over effects, meaning that pleasurable experiences are developed from an initial experience. Therefore, in our context, augmented and VR entertainment experiences are found to lead to enhanced overall tourist experiences.

5.1   *Theoretical contributions*

This study provides a number of theoretical contributions. First, we furthered the study of social presence within AR environments. Previously, a number of scholars focused on social presence in VR environments; however, to the best of our knowledge, no previous research has looked into mixed AR and VR and social presence and their effects on the visitor experience, which in turn leads to revisit intention. According to Jung et al. (2015), AR plays an important part in the enhancement of tourists' social awareness and experience; thus, it is considered very important to broaden the research on social presence to AR applications and contexts. Second, this study aimed to examined how tourists' experience, enhanced by immersive technologies (such as AR and VR) can contribute to improving overall tourist experience and enhancing revisit intention. Previously, only a few scholars (e.g., Kang and Gretzel, 2012; Pallud and Straub, 2014) have looked into the roles of tourism and technology experiences and the influence on revisit intention. Third, while VR has previously been considered a tool to gather information on tourism prior to the travel experience, this study supported the use of both AR and VR to enhance tourists' on-site experience while visiting destinations. This onsite experience using mixed reality can thus be considered another theoretical contribution by this study.

5.2   *Practical implications*

Practically, the findings of this study provide a number of implications for tourism businesses, app developers, and tourism destination management organisations. First, in order to create enriched experiences that lead tourists to revisit attractions and destinations, the focus on social presence and experience in VR and AR environments should be considered an essential element of the tourist experience. This can be achieved by offering high-quality applications and devices and by providing more authentic augmented and VR environments that allow tourists to be fully immersed. Second, organisations and developers should provide captivating content including 3D animations to bring the experience realistically to life. This, in turn, is expected to benefit users' entertainment experience, which this study found to be the most important factor of the overall experience and to have the greatest influence on revisit intention. After the COVID-19 pandemic, this approach will be even more important. Instead of focusing on an on-sided experience, there will be an increased need for digital content and for people to experience cultural heritage within their own surroundings. Blended approaches to the museum experience will therefore become more essential. Creating educational, entertaining and escapist content that can be consumed as part of the tour or in visitors' own surroundings will be key for revisits and possibly the intention to visit in person. The advancements in headsets and mobile capabilities will enable tourism practitioners to design and offer AR and VR experiences that allow visitors to enter a highly immersive and escapist experience, which will be critical for visitor satisfaction.

5.3   *Limitations and future research*

Despite the aforementioned strengths and contributions, this research has a number of limitations that provide avenues for future research. First, the experiments were conducted using both AR and VR applications. While this is a strength of this study, it is

possible that the differences between AR and VR in terms of design and functionality may have been overlooked. Therefore, it would be worthwhile to further explore tourists' social presence and experience in AR and VR environments separately. Second, although the experience economy concept by Pine and Gilmore (1998) is considered one of the most powerful theories with regard to tourist experiences, other factors not related to the experience economy have not been included in this study. Therefore, a mixed-methods approach exploring context-specific factors for AR and VR experiences could be used to identify and test AR and VR experience models. Recently, by embracing artificial intelligence (AI), big data, and internet of things (IoT) technologies, AR and VR have been expanded into extended reality (XR) technologies and the Metaverse, the extension of the universe of physical and VR. Due to this technological advancement, it is recommended that future research focus on the role of social presence in the visitor experience in the context of a Metaverse tourism environment. Further, technological manipulation in a controlled environment could be conducted in the future to better understand visitors' AR VR museum experience and behaviour.

Acknowledgements

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