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Assessing the impact of full-fledged location-based augmented reality games on tourism destination visits

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Location-based augmented reality (AR) games have the potential to transform tourism marketing, yet their proliferation in the tourism sector is limited. On the other hand full-fledged location-based AR games appeal to users, who readily adopt and use them. Although they are not developed to enhance tourist experience, these games facilitate the acquisition of knowledge related to points of interest in urban areas, and their use may entice visitors. This study empirically assesses the impact of full-fledged location-based AR games use on intentions to visit tourism destination, the role of knowledge acquired during the gameplay and factors driving these games adoption. The results of Structural Equation Model (SEM), based on a sample of 461 AR game users, confirm that game usage positively affects visit intentions. Our study reveals that knowledge acquired during gameplay has a statistically significant impact on intentions to visit. Intrinsic and extrinsic motivations have positive effects on knowledge acquisition, but only hedonic motivation affects users' intentions to use AR games.

Keywords: Smart tourism, Augmented reality; Games; Technology adoption; Visit intentions

Introduction

Although the application of information and communication technologies (ICT) in tourism is not new (e.g. the Internet, mobile technologies etc.) (Guttentag, 2010; Jung & tom Dieck, 2017), the development of augmented reality (AR) is recognised as a technology with the potential to transform the tourism sector (Chung, Lee, Kim & Koo, 2017). This is because AR enables users to see virtual objects, including information, specially superimposed over the real environment (Milgram & Colquhoun, 1999; Chung, Han & Joun, 2015). This contextually relevant information has a potential to increase tourists' cognitive capabilities to appreciate heritage sites and destinations, and helps them to gain knowledge and a better understanding of their heritage and cultural value (Jung, Chung & Leue, 2015; Chung *et al.,* 2015; Chung et al, 2017).

Destination marketing organisations (DMOs), recognising the benefits of AR, and thus they develop it. However, the introduction of AR does not guarantee users' adoption (Jung *et al.,* 2015). In fact, research suggests that although AR-enabled technologies can be found in the tourism sector, their actual use is limited (Chung *et al.,* 2015). A handful of studies examine the impact of AR on tourism experience, satisfaction, or loyalty (e.g. Jung *et al.,* 2015; Chung *et al.,* 2017). Research exploring the user adoption of AR, or the effect of its use on tourism, is in its infancy. Thus further research shedding light on the motives driving the use of AR-enabled technologies, and its impact on the tourist sector, is needed (Guttentag, 2010; Jung *et al.,* 2015; Chung *et al.,* 2015).

In addition to AR, games are prevailing trends in tourism (Xu, Buharis & Weber, 2017). Games- a type of persuasive technologies (Earp, Ott, Popescu, Romero & Usart, 2014), similar to AR, are found to 'feed tourism information to potential

tourists' (Xu *et al.,* 2017, p. 251), which enhances satisfaction, and increases brand awareness and loyalty to destinations. Unlike AR, tourism related games are limited, which is due to limited understanding of the motives driving the use those games (Xu *et al.,* 2015). Outside of the tourism sector, however new games emerge every day, reportedly attractive to a broader group of users who readily adopt them (Gentes, Guyot-Mbodji & Demeure*,* 2010; Li, Liu, Heikkila & van der Jeijden, 2015). Location-based AR games are particularly popular nowadays, and their application in tourism sector has been acknowledged (Tabacchi, Caci, Carbaci & Perticone*,* 2017). In this emerging research stream, Aluri (2017) revealed that nearly 80% of game users would use it as a travel guide since they enable location of points of interests (PoIs) in area-based GPS locations. PoIs include physical structures, historic and cultural objects, landmarks etc., and are also referred to as destinations (Tussyadiah, Jung & tom Dieck*,* 2017), thus in this research we use both terms interchangeably. Furthermore, since those AR-enabled games facilitate access to contextually-relevant information about PoI cultural and heritage value, they assist users with cognitive experiences with the destinations, which may attract game users (i.e. potential tourists) to take action and visit those destinations (Xu *et al.,* 2017). This impact, however, is yet to be empirically examined.

To address this void in the literature, the purpose of this research is threefold: (1) to examine the impact of full-fledged location-based AR games' use on intentions to visit tourism destinations, (2) to assess the role of knowledge about PoIs acquired during the gameplay, and (3) to identify factors driving the use of AR-enabled games.

Literature review

Augmented reality in tourism

AR has been recognised as cutting-edge technology in the tourism sector (Jung *et al.,* 2015; Chung *et al.,* 2017), as it enables users to see virtual objects, including information, as part of real environment (Chung *et al.,* 2015). AR's increased popularity is related to enhanced mobile and smartphone capabilities such as GPS, internet connections, and cameras (Jung *et al*., 2015). The advent of mobile devices paired with the emergence of AR resulted in a change to the way tourists interact with the environment, and paved the way for location-based AR which provides new forms of travel and tourism experiences (Jung *et al.,* 2015; Chung *et al.,* 2017).

The above applications of location-based AR in the tourism sector are based on the assumption that AR is actively utilised. Contrary to expectations, Chung *et al.* (2015) report that it is not readily adopted. So far, few attempts have been made to address this issue, and assess AR use (Chung *et al.*, 2015; Chung *et al.,* 2017; Jung, Lee, Chung, & tom Dieck 2018). In the light of this limited empirical research, further studies exploring factors driving adoption and use of AR-enabled technologies are needed. Specifically, due to its interactive nature, Jung *et al.* (2015) call for research exploring marker-less AR use, which detects specific features (e.g. PoIs) from area-based GPS locations (Jung *et al.,* 2015).

A specific case of marker-less AR refers to a hybrid mixed reality in which physical space is augmented with the story space. Location-based AR games are the examples of marker-less AR in the gameplay of physical space (tom Dieck, Jung, & tom Dieck*,* 2016), and their potential to tourism sector has been recognised as significant (Xu *et al.,* 2017).

Games in tourism

Games, a type of persuasive technology, have been a focus of attention in a number of sectors, including education, finance and tourism (Earp *et al.,* 2014; Xu *et al.,* 2017). This is because location-based games use mobile technologies as interfaces, and the physical space as a 'game board', while AR-enabled games provide great potential for interaction when incorporated into the gameplay information (Roussou, Oliver & Slater*,* 2006). Although the main aim of games is to provide the user with a fun and entertaining experience (Hamari & Kovisto, 2015), the use of persuasive games can trigger behavioural change, and result in some desirable outcomes (Earp *et al.,* 2014; Robson*,* Plangger, Kietzmann, McCarthy & Pitt, 2015). For example, in the tourism sector Xu *et al.* (2017) note that the use of games can result in increased brand awareness and loyalty to the destination. Moreover, location-based AR games also enable immersion into a simulated travel world (Sigala, 2015). They create a deeper level of engagement with the destination (Weber, 2014), and thus they make the tourism experience richer and more participatory (Xu *et al.,* 2017).

Despite the benefits of games to tourism, currently tourism related games are limited, and only a few examples of games exist in the tourism sector (see Xu *et al.,* 2015). This is because game development is resource intensive; it requires careful design tailored to the destination and effective incorporation of tourism information into the gameplay (Weber, 2014; Xu *et al.,* 2017). This, coupled with poor user adoption caused by limited understanding of factors driving location-based games' use, prevent the rise of location-based AR games in tourism (Xu *et al.,* 2015).

Outside of the tourism sector, however, games are attractive to a broader group of users, who readily adopt them (Gentes *et al.,* 2010; Li *et al.,* 2015). Full-fledged location-based games are characterised by a strong connection to the destinations, while AR-enabled games also create true mixed reality experiences, which makes them of

interest for the tourist sector (Xu *et al.,* 2015). This is because full-fledged location-based AR games, similar to AR used in tourism, allow the detection of PoIs in area-based GPS locations. Furthermore, while building on AR technology, those games use visualisation techniques which allow for superimposition of information about the heritage and cultural value of PoIs in the real environment. Thus, similar to games used in tourism, full-fledged location-based AR games enhance users' cognitive experiences with the destination (Xu *et al.,* 2015) and their use may allure visit intentions (Xu *et al.,* 2017).

Full-fledged location-based AR games address the above-mentioned limitation of games in tourism; they effectively incorporate PoI information into the gameplay (Jung *et al.,* 2015; Chung *et al.,* 2015) and mediate users' learning experience about tourist destinations' cultural or heritage value (Leue, Han & Jung*.,* 2014; Jung and tom Dieck, 2017), which stimulate visit intentions (Xu *et al.*,2017). However, the impact of full-fledged location-based AR games' use on tourism destination visits, and the role of information supplied by their means, are yet to be empirically examined. To address this void in the literature, and fulfil the objectives of this research, we developed the research model and hypotheses as discussed below.

Research model and hypotheses development

A variance theory is commonly used to explain 'the variation in a dependent variable as a result of the variation in an independent variable' (Chiles, 2003; p. 288). In this approach, the phenomenon under investigation is examined based on the set of previously developed variables embedded in a nomological net. The roots of the nomological net used in our study date back to 1975 and the development of Theory of Reasoned Action (TRA), which initiated a series of intention-based models. Fishbein

& Ajzen (1975) demonstrate through TRA that individuals' behaviour can be predicted by intentions, and intentions are determined by attitudes towards the behaviour in question. Extensive research has confirmed this relationship (Liu & Li, 2011; Hamari & Koivisto, 2015; 2017). The relationship between attitudes and intentions has also been verified in tourism and hospitality studies (Kim *et al*., 2008; Ayeh, Au & Law, 2013, Wang, Fung & Sparks, 2016). Most recently, Chung *et al*. (2015) and Chung *et al*. (2017) successfully employ intention-based models in the context of AR-enabled technologies' adoption in the tourism sector where, in addition to AR use, destination visit intentions are studied. Furthermore, since Guttentag (2010) states that the adoption of virtual reality (VR), and by extension AR, is determined by attitudes towards it, and Chung *et al.* (2015) confirm that attitudes drive both intentions to use AR-enabled technologies and intentions to visit tourist destinations, we select the attitudes-intentions paradigm to form a skeleton for our research model (see Figure 1).

< Insert Figure 1.>

Behavioural intentions are the dependent variables of our model, and are defined as the degree to which an individual has formulated conscious plans to perform or not perform the behaviour (Venkatesh & Davis, 2000). Research indicates that user actions in the game reflect behaviour in the real world, while persuasive games use can also generate intentions to display new behaviours (Robson *et al.,* 2015). Xu *et al.,* (2017) add that in the tourism sector 'the widely used technology in gaming, such as virtual or augmented reality, (…) generate visiting interests' (p. 248). Outside of the tourism sector it has also been noted that, since AR-enabled games are characterised by a strong connection to the destination, they may entice users to visit those destinations,

and Colley *et al.* (2017) indicate that use of those games causes people to visit new locations at a remarkable scale. This is because AR-enabled technologies, developed in or beyond the tourism sector, provide users with enhanced experiences at the destinations, based on which users form attitudes towards the destination and subsequently develop visit intentions (Jung *et al.,* 2015; Chung *et al*., 2015; Chung *et al.*, 2017).

Empirical research confirms that technology can motivate users' travel intentions (Kaplanidou & Vogt, 2006; Guttenberg, 2010). However, research has not yet sufficiently examined AR use and its effect on tourist destination visits (Chung *et al*. (2015), while Xu *et al*. (2017) call for research examining the role of games in tourism. Furthermore, although Mikalef, Giannakos, Chorianopoulos & Jaccheri (2012) verify the relationship between games use and museum visits, they indicate that further research should examine augmented-reality games and visit intentions. To address this call for research, we aim to empirically examine the relationship between location-based AR game use (IUSE) and intention to visit tourist (IVISIT) destinations, and thus we propose the following hypothesis:

H1. Intentions to use AR games (IUSE) have a positive impact on intentions to visit (IVISIT)

Learning, defined as an activity or process of gaining knowledge, is the essence of travelling (Falk, Ballantyne, Packer & Benckendorff, 2012; Weber, 2014). It takes place during information acquisition, which in the tourism sector can be enhanced by ICT (Kaplanidou & Vogt, 2006; Guttentag, 2010; Choi, Hickerson & Kerstetter, 2017). Specifically, Huang, Backman Backman & Chang, 2015) state that the role of ICT in

tourism is to provide information, which coaxes potential tourists to take action and visit destinations. Guttenberg (2010) notes that AR capability to superimpose information about PoIs over the real environment boosts cognitive processes, and aids in decision making (Jung *et al,* 2015; Jung & tom Dieck, 2017; Chung *et al,* 2017), including decision to visit (Refsland, Ojika, Addison, & Stone, 2000). Furthermore, Roussou *et al.* (2006) postulate that AR incorporated in games provides a great potential for interaction with context-specific information. Notwithstanding, DMOs find it difficult to incorporate PoI information into the game design (Xu *et al.,* 2015). Full-fledged AR games address this limitation. Those games, while superimposing the user with contextually relevant information, are found to provide ample opportunities to embed learning experiences with the destinations (Earp *et al.,* 2014; Hamari and Kovisto, 2015; Xu *et al.,* 2015). Unlike AR games used in tourism which aim mainly to provide information to potential tourism, fully-fledged AR games facilitate knowledge acquisition which can occur in either a focused or incidental manner (Hopp & Baker, 2016). The latter may take place when there is a clear goal of information attainment (i.e. the AR game user may engage in the gameplay and consciously access tourism information to obtain knowledge). Alternatively, the game user may unlock information parenthetically while playing the game, and thus gain knowledge in the incidental manner. Knowledge acquired either in the focused and incidental fashion may, in turn, trigger visit intentions (Huang *et al.,* 2015; Xu *et al.,* 2017).

Research recognises the importance of games in facilitating knowledge acquisition (Xu *et al.,* 2015), and acknowledges their impact on intentions to visit (Huang *et al.,* 2015). Specifically, location-based AR games have been found to enhance users' cognitive capability to appreciate tourist destinations and heritage sites, which may generate intent to visit (Xu *et al.,* 2017). While distinguishing between

focused knowledge-gain (FKG) and incidental knowledge-gain (IKG), we aim to examine this assertion empirically and thus we state the following hypotheses:

H2. Focused knowledge-gain (FKG) has a positive impact on intentions to visit (IVISIT)

H3. Incidental knowledge-gain (IKG) has a positive impact on intentions to visit (IVISIT)

Tourist information incorporated into the game design not only stimulates visit intentions, but has also been found to be an important driver for those games use (Xu *et al.,* 2015). This is confirmed by previous research where cognitive motivations, referring to information and knowledge acquisition, have been shown to be a significant motive for technology usage, including use of AR (Leue *et al.,* 2014). Most recently, Muller-Stewens, Schlanger, Haubl & Herrmann(2017) confirm the positive impact of information incorporated into the game design on the adoption of games, stating that gamified information promotes innovation adoption. Building on previous research, we therefore hypothesise that focused knowledge-gain (FKG) and incidental knowledge-gain (IKG) have a positive impact on intentions to games use (IUSE).

H4. Focused knowledge-gain (FKG) has a positive impact on intentions to use AR games (IUSE)

H5. Incidental knowledge-gain (IKG) has a positive impact on intentions to use AR games (ISUE)

In addition to knowledge-gain, research recognises a number of motives stimulating technology use (see Venkatesh *et al.,* 2003, for an overview). Those include, but are not limited to, intrinsic and extrinsic reinforcements (Ayeh *et al.,* 2013; Robson *et al.,* 2015; Hamari & Kovisto, 2015), both of which are key to creating meaningful gaming experiences (Weber, 2014; Liu, 2016).

Intrinsic motivations refer to the degree to which performing an activity is perceived as providing pleasure and joy in its own right, aside from performance consequences (Venkatesh, Morris, David & Davis2003; Ayeh *et al.,* 2013). It refers to hedonic reinforcement and fun, entertainment, enjoyment, and pleasure, deriving from technology use (Venkatesh & Brown, 2001; van der Heijden, 2004). The importance of intrinsic motivations are confirmed in reference to various technologies' adoption (Venkatesh *et al.,*, 2003; van der Heijden, 2004; Ayeh *et al.,* 2013) including research examining games use (e.g. Hsu & Lu, 2007; Li *et al.,* 2015; Hamari, 2017). Xu *et al*. (2017) further confirm this taxonomy of games, recognising the hedonic value of the games in tourism. In this research stream, Wu & Liu (2007) recognise enjoyment as a consistently strong predictor of behavioural intentions to use the game, and Liu & Li (2011) and Liu (2016) stress that intrinsic motivation is crucial in games adoption. The positive impact of intrinsic motivation has also been acknowledged in the use of games in tourism (Xu *et al.,* 2015). Accordingly, the effect of intrinsic motivation (IM) on AR games use (IUSE) is expected to be positive and significant,, the following hypothesis is therefore stated:

H6. Intrinsic motivation (IM) has a positive impact on intentions to use AR games (ISUE)

The hedonic value of games not only impacts on intentions to use those games, but it also stimulates the learning process (Braghirolli, Ribeiro, Weise & Pizzolato 2017). Thus, aside from the primary aim of games use – to provide the user with a fun and entertaining experience – intrinsic motives deriving from persuasive games use enhance knowledge-gain (Earp *et al.,* 2014; Xu *et al.,* 2015). This is because playful interactions with persuasive games have been found to promote creative and exploratory behaviour (Hamari & Kovisto, 2015). For that reason, games have been implemented in education where their impact on learning performance has been evident in several areas, including cultural heritage education (Earp *et al*., 2014). Furthermore, Mikalef *et al.* (2012) confirm that the use of games enhances the learning performance of art gallery visitors, and Weber (2014) also claims that, through fun use of location-based AR games, users are educated about destinations. Following previous research findings, we thus hypothesise the positive effect of intrinsic motivation (IM) on knowledge gains.

H7. Intrinsic motivation (IM) has a positive impact on focused knowledge-gain (FKG)

H8. Intrinsic motivation (IM) has a positive impact on incidental knowledge-gain (IKG)

Although some research perceives games as solely hedonic systems, others strongly advocate that, alongside intrinsic motivation, utilitarian drivers have to be studied while examining games adoption (Liu, 2016; Hamari & Keronen, 2017; Braghirolli *et al.,* 2017). The evaluation of extrinsic reinforcements is particularly important while examining persuasive games use, including AR games use, the purpose

of which is more than mere entertainment (Earp *et al.,* 2014; Xu *et al.,* 2015). The aim of those games use is to pursue instrumental outcomes and to sustain learning (Earp *et al.,* 2014; Hamari & Keronen, 2017). This is confirmed by Xu *et al.* (2015), who claim that the role of games in tourism is to facilitate cultural heritage knowledge-gain. Following this line of thought, in addition to intrinsic motivation, we aim to study the role of extrinsic drivers operationalised as a perception of technology usefulness (Hamari, 2017; Hamari & Kovisto, 2015).

Perceived usefulness refers to the extent a user believes that a technology enhances the performance of a task (e.g. game progression or completion). Previous research has shown extensive evidence that behavioural intentions to use technology are determined by users' perception of its usefulness (Venkatesh & Davis, 2000; Venkatesh & Brown, 2001). The relationship between technology usefulness and its use has been verified in the tourism context (e.g. Kaplanidou & Vogt, 2006; Ayeh *et al.,* 2013), and researchers Chung *et al.* (2015) and Kim *et al*. (2016) reveal that perceived usefulness of AR applications determines their adoption by tourists. Furthermore, Hamari & Kovisto (2015) and Li *et al.* (2015) show that perceived usefulness has a positive impact on the intention to use games. Earlier research, however, failed to identify any significant relationship between extrinsic motivation and usage intentions of gamified systems (Hsu & Lu, 2004; Hamari, 2017). To validate the role of utilitarian drivers and their impact on intentions to use AR games, we aim to examine the impact of extrinsic motivation (EM) on location-based AR games use (IUSE). Thus, we postulate the following:

H9. Extrinsic motivation (EM) has a positive impact on intentions to use AR games (IUSE)

Extrinsic motivations drive user intentions to use technology in the pursuit of instrumental outcome (Venkatesh & Davis, 2000; Hamari & Keronen, 2017). The literature strongly postulates that the outcome of persuasive games use refers not only to game completion, but also knowledge-gain (Braghirolli *et al.,* 2017). Games are thus frequently used for the purpose of learning, training or instruction, as they were found to provide enhanced learning opportunities (Earp *et al.,* 2014). Most recently Xu *et al.* (2017) and others (tom Dieck *et al.,* 2016; Xu *et al.,* 2017) recognise the utilitarian value of games in the tourism context, which they state is the acquisition of tourism information incorporated into the game design. Furthermore, since Chung *et al.* (2017) state that the purpose of AR is to enhance users cognitive capabilities, it can be assumed that due to its strong connection to the environment, the outcome of location-based AR games use is learning and knowledge acquisition.

Previous research shows that individuals will use the technology if they find it useful for achieving specific tasks (Ayeh *et al.,* 2013). Braghirolli *et al.* (2017) find that perception of game usefulness has a positive effect on learning performance, showing that persuasive games use results in learning. However, the impact of the extrinsic motivation deriving from AR games use on knowledge acquisition has not been empirically assessed thus far. In order to address this gap, we aim to evaluate the impact of extrinsic motivations on knowledge acquisition. Specifically, we postulate that extrinsic motivation (EM) drives focused knowledge-gain (FKG) and incidental knowledge-gain (IKG). We state the following hypotheses:

H10. Extrinsic motivation (EM) has a positive impact on focused knowledge-gain (FKG)

H11. Extrinsic motivation (EM) has a positive impact on incidental knowledge-gain (IKG)

Research methodology

Our approach for research instrument development and data collation is similar to that employed in previous research studying behavioural intentions (e.g.; Ayeh *et al.,* 2013). To test the research model, our questionnaire was developed based on the established scales adopted from previous studies (see Table 1). The scales were modified to suit the nature of the research, and measured on a 7-point Likert-scale. Finally, a set of questions aimed at developing a demographic profile of respondents was included in the final section of the questionnaire.

To test the research hypotheses, data was collected online from active users of full-fledged location-based AR games (i.e. individuals who during the time the data was collected were using one or more full-fledged location-based AR games). Participants were asked to confirm that they are active players of full-fledged location-based AR games, which was a screening question. Data collection resulted in 461 usable responses. All of the respondents confirmed that they had previous experience in games use, and that at the time the data was collected they used one (35.8%) or more games.

< Insert Table 1. >

Data analysis and research findings

In the final sample, there was a near-equal distribution of male (47.5%) and female (49.7%) respondents. The majority of respondents fell into the 16-25 (43.8%) and 26-35 (37.3%) age categories. 64 (13.8%) respondents were between 36-45 years old, and 23 (5%) were 46 and older. 70 (15.2%) respondents had a high school education, and 150 (32.5%) a college education. 216 respondents held a university degree, including undergraduate (145 respondents), postgraduate (59 respondents), and doctorate degrees (12 respondents).. Detailed demographic characteristics of respondents are presented in Table 2.

< Insert Table 2.>

To assess the internal consistency reliability of the measured items, Cronbach's Alpha was computed (see Table 3). The results confirm that all variables of the model exceed the recommended minimum value of .70. We verified constructs validity using Corporate Reliability (CR) and Average Variance Extracted (AVE), expecting it to exceed the recommended minimum CR level (>.70) and AVE level (>.50) (Chung *et al.,* 2015). As presented in Table 3, CR for each construct ranged from .861 to 936, and AVE for each construct ranged from .675 to .829. Thus both CR and AVE exceed the minimum recommended values, confirming the high validity of measured items. We further verified construct validity examining factor loadings of measured items (see Table 1). Items validity is considered acceptable if factor loadings exceed .60 level, and ideally .70 (Bagozzi & Yi. 1988). As demonstrated in Table 2, factor loadings of all measured items exceed recommended .70 level, which verifies constructs validity.

< Insert Table 3.>

In order to test the research model, we employed a Structural Equation Model (SEM). SEM technique is commonly used in research examining intentions to visit and intentions to use technology, for example Chung *et al.* (2015) employ it to assess AR use and visit intentions. The SEM model was characterised by overall goodness of fit, as all fit indices exceed the recommended minimum values (see Table 4).

< Insert Table 4.>

Based on the results of the SEM presented in Table 5 and Figure 2., intentions to use full-fledged location-based AR games has a statistically positive effect on intentions to make a tourist destination visit; the relationship between IUSE and IVISIT is statistically significant at $p < .001$, which supports H1. Furthermore, from the results of the SEM, it is evident that the knowledge gained during gameplay positively affects intentions to visit tourist destinations. The research findings show that both focused (FKG) and incidental knowledge-gain (IKG) have a positive and statistically significant impact on intentions to visit at $p < .001$, which supports H2 and H3, respectively. The relationships between FKG and IKG and intentions to use AR games are not statistically significant, hence H4 and H5 are rejected. Finally, the results of the SEM suggest that intrinsic motivation has a positive effect not only on intentions to use AR games, but also on knowledge-acquisition. Thus, there is a positive and statistically significant relationship between IM and IUSE at $p < .001$, IM and FKG at $p < .001$, and IM and IKG at < .001. Consequently, H6, H7 and H8 are supported. The hypothesised

relationship between extrinsic motivation and intentions to use location-based AR games is not found to be statistically significant, thus H9 is rejected. However, a relationship between EM and knowledge-acquisition is evident, thereby supporting H10 and H11. The effect of EM on FKG is significant at $p < .01$, while the effect on EM on IKG is significant at $p < .05$.

< Insert Table 5.>

Discussion and Conclusion

AR is considered to be new technology in the tourism sector. Despite its novelty, its potential benefits to tourism are increasingly recognised as vast and significant (Guttentag, 2010). Those benefits, however, are hindered by poor user adoption (Chung *et al.,* 2015; Xu *et al.,* 2017). Thus, further studies exploring adoption and AR impact on the tourism sector are needed (Chung *et al.,* 2017). Jung *et al.* (2015) explicitly call for research exploring marker-less AR use. Location-based AR games are examples of marker-less AR, and although their potential value to the tourism industry is unprecedented tourists, are not receptive towards games (Xu *et al.,* 2017). Outside of the tourism domain, however, location-based AR games are readily adopted by a broader group of users, who while acquiring knowledge about PoIs during the gameplay and may develop visit intentions (Gentes *et al.,* 2010). This research empirically examines impact of these games' use on intentions to visit tourism destinations.

Our findings reveal that, similar to other ICT developed outside of the tourism sector (Guttenberg, 2010), full-fledged location-based AR games have a direct positive impact on tourism. Our research shows that the intentions to use those games generate

intentions to visit tourism destinations. These findings confirm previous research assertions that AR games allure visit intentions (Xu *et al.,* 2017; Colley *et al.,* 2017).

Furthermore, the results of our study confirm that AR games enhance cognitive experiences with the destination (Jung *et al.,* 2015; Chung *et al.,* 2015). Our research shows that AR games support both focused and incidental knowledge-gain about heritage sites and destinations, which subsequently triggers visit intentions. This is also in line with Refsland *et al.* (2010), who indicate that knowledge acquired by the means of virtual technologies can encourage tourists to visit destination. This is also further confirmed by numerous research studies which acknowledge that, while gratifying user information needs, AR supports knowledge gain of PoI cultural or heritage value (Jung *et al*., 2015; Kim *et al*., 2016; tom Dieck *et al*., 2016). This in turn leads to visit intentions (Huang *et al.,* 2015). Although we identified a positive impact of knowledge acquisition on intentions to visit, we were unable to verify if knowledge acquired during the gameplay affects AR games use. Thus, contrary to Leue *et al.* (2014) and Muller-Stewens *et al.* (2017) we were not able to identify any significant role of knowledge gained on intentions to use persuasive games.

Finally, our study reveals that the use of full-fledged games is subject to intrinsic reinforcement, rather than extrinsic drivers. Similar to the findings by Hsu & Lu (2004), we are unable to identify any significant relationship between gamified system usefulness, and intentions to use. We echo previous research, which stresses the value of intrinsic drivers on persuasive games use (Hamari & Keronen, 2017). Although our research shows that only hedonic motivations drive AR games adoption, we found that knowledge acquisition is equally driven by intrinsic and extrinsic factors. Through the course of our research, we found that hedonic and utilitarian reinforcements affect focus and incidental knowledge gain, which is in line with game-based learning literature.

Theoretical and practical contributions

First, we address the recent call for research on the impact of AR-enabled technologies use on tourist destination visits (Chung *et al.,* 2015; Jung *et al.,* 2015) as well as the call to examine the role of full-fledged games on tourism (Xu *et al.,* 2017). We thus contribute to the emerging body of research on AR games and their impact on the tourism sector. The present research complements Mikalef *et al.* (2012), and assesses the effect of AR games on intentions to visit.

Second, our study findings address tom Dieck *et al.'s* (2016) call for new studies to examine AR-enabled technology learning experiences, and its impact on the tourism sector. We extend tom Dieck *et al.'s* (2016) contributions showing that AR can be used not only to enhance knowledge in the art gallery or museum setting, but that AR-enabled technologies, and particularly location-based AR games, can be effectively used to provide information about heritage sites and destinations. Our research shows that AR games facilitate both focused and incidental knowledge gain, which triggers tourist destination visit intentions.

Finally, our study also contributes to the research on AR and games adoption, and thus we address Chung *et al.,* (2015) and Hamari's (2017) concern that there is a relative dearth of a coherent body of empirical evidence confirming AR and game use motives. Our study shows that the adoption of location-based AR games is driven by hedonic factors. Although hedonic motives drive AR game use, we found that knowledge acquisition is driven by both hedonic and utilitarian drivers.

In addition to theoretical contributions, our study has direct practical implications. Our study shows that the use of full-fledged AR games generates users' intentions to visit tourist destinations, and that game use facilitates information

acquisition about PoIs, which subsequently leads to visits. DMOs, thus, should follow the example set by businesses, which already invest in sponsored locations within location-based AR games. By following this direction, DMOs will be able to harness the popularity of location-based AR games for the benefit of the tourism sector. Furthermore, as the number of these games continues to increase, there will be more opportunities for in-game promotion and advertising.

Alternatively, DMOs are encouraged to invest in AR games development. Focus should be placed on hedonic game attributes, which has been shown to encourage game use. AR games should therefore be designed to provide users with playful, enjoyable experiences. However, in other to gratify user information needs about PoIs, utilitarian game attributes should be incorporated as secondary to hedonic drivers. Combining intrinsic and extrinsic reinforcements, AR games should provide users with ample opportunities to access information and learn about PoI heritage and cultural value, and thus enhance game user's experiences with the destinations.

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Table 1. Questionnaire scales and factor loadings

Constructs	**Measured item**	**References**	**Factor loadings**
IVISIT	I intend to visit tourist destinations in the next 12 months after playing AR game	Tian-Cole *et. al.,* (2002); Lam and Hsu (2006); Zabkar *et. al.,* (2010); Chung *et. al.,* (2017)	.802
	I plan to visit tourist destinations in the next 12 months after playing AR game		.776
	I want to visit tourist destinations after playing AR game		.806
	I will recommend tourist destinations to my family and friends after playing AR game		.859
	I will say positive things about tourist destinations playing AR game		.881
	I will recommend tourist destinations to others after playing AR game		.800

IUSE	I intend to play AR game in the next 12 months	Venkatesh *et. al.,* (2003); Chung *et. al.,* (2015)	.962
	I predict I would play AR game in the next 12 months		.870
	I plan to play AR game in the next 12 months		.897
FKG	I often learn something I need to know about tourist destinations when playing AR game	Hopp and Barker (2016)	.721
	AR game effectively communicates what I need to know about tourist destinations		.862
	AR game helps me learn what I need to know about tourist destinations		.873
IKG	I enjoy learning new things about tourist destinations by accident when playing AR game	Hopp ans Barker (2016)	.764
	I often learn interesting things about tourist destinations that I was not looking for when playing AR game		.890
	Sometimes I learn something new about tourist destinations that was not intended when playing AR game		.873
EM	Playing AR game enables me to accomplish the game-related task more quickly	Hsu and Lu (2004)	.858
	Playing AR game enables me to fulfill the game-related task effectively		.910
	Playing AR game enables me to satisfy the game-related task easier		.919
IM	I find playing AR game to be enjoyable	Venkatesh *et. al.,* (2003); Davis *et. al.,* (1992); Ayeh *et. al.,* 2013)	.853
	The actual process of playing AR game is pleasant		.821
	I have fun playing AR game		.809

Table 2. Demographic characteristics of respondents (N461)

Characteristics		**Frequencies**	**Percentage**
Gender	Male	219	47.5
	Female	229	49.7
	Prefer not to say	12	2.6
	Other	1	.2
Age	16-25	202	43.8
	26-35	172	37.3
	36-45	64	13.8
	46 or older	23	5.1
Education	High School	70	15.2
	College	150	32.5
	Undergraduate Degree	145	31.5
	Postgraduate Degree	59	12.8
	Doctorate Degree	12	2.6

	Other	25	5.4
Games experience	6 months or less	60	13.0
	7-12 months	16	3.5
	1-2 years	38	8.2
	2-3 years	60	13.0
	3-4 years	49	10.6
	More than 4 years	238	51.6
No. of games played simultaneously	1	165	35.8
	2	151	32.8
	3	78	16.8
	4	24	5.2
	More than 5	43	9.3

Table 3. Cronbach's α, CR, AVE

	Cronbach's α	**CR**	**AVE**
IVISIT	.929	.926	.675
IUSE	.952	.936	.829
FKG	.852	.861	.675
IKG	.879	.881	.713
IM	.861	.867	.685
EM	.924	.924	.803

Table 4. Model fitness

	Desired values	
Chi-Squared (p>0.50)	*p*>.50	99.328
Degrees of freedom (>0)	>0	170
Chi-Squared/degrees of freedom (<3.0)	<3.0	2.937
GFI	>.90	.908
AGFI	>.09	.875
REMSEA	<.80	.065
CFI	>.90	.959
TLI	>.90	.950
PNFI	>.50	.761
PGFI	>.50	.668

Table 5. SEM (*** p<.001, ** p<.01, * p<.05)

H1	IUSE→IVISIT	.246***	Supported
H2	FKG→IVISIT	.284***	Supported
H3	IKG→IVISIT	.351***	Supported
H4	FKG→IUSE	-.110	Rejected
H5	IKG→IUSE	.024	Rejected
H6	IM→IUSE	.727***	Supported
H7	IM→FKG	.222***	Supported
H8	IM→IKG	.377***	Supported
H9	EM→IUSE	-.067	Rejected
H10	EM→FKG	.178**	Supported
H11	EM→IKG	.150*	Supported