GOOGLE MAPS AUGMENTED REALITY AND SMART TOURISM IN EUROPE: AN EXTENDED TECHNOLOGY ACCEPTANCE MODEL

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Abstract. *This study will ascertain which elements influence tourists' intention to use augmented reality (AR) applications during their trips. An online questionnaire collected data from 318 European tourists and their perceptions of Google Maps AR. Data were analyzed using partial least squares structural equation modeling. Findings show that an authentic experience and perceived enjoyment influence the intention to use AR apps and that personal innovativeness positively moderated these two significant relationships. The two factors from the Technology Acceptance model significantly affected the outcome of behavioral intention to use. Oppositely, interactivity did not impact the intention to use in the proposed model. Results from the multi-group analysis indicated higher importance of an authentic experience for males and higher importance of the perceived enjoyment for females. Personal innovativeness was found to enhance three relationships on behavioral intention to use: authentic experience, perceived enjoyment, and perceived interactivity. Instead, the analysis showed that the two moderation hypotheses on the Technology Acceptance Model constructs were not supported, demonstrating that for innovative individuals it is less vital that the new technology is simple and useful. Rather, the AR app must be unique, engaging, and enjoyable. We contribute to the current literature on AR usage and the Technology Acceptance Model in the tourism sector, offering implications for businesses and practitioners. This study's findings may benefit tourism professionals and developers of AR applications. Developing an authentic experience is still costly but worth the effort as one of the breakthroughs of this research. The importance of experience authenticity is higher for males and this should be considered especially for AR apps aimed at male consumers as a target. Enjoyment showed to be relevant for intention to use and stronger for females. With the increasing use of new techniques, more interactive apps could be developed and this factor, despite not being significant here, might influence future inquiries.*

Keywords: *Augmented reality; smart tourism, technology acceptance, authentic experience, enjoyment, interactivity, personal innovativeness.*

Introduction

Individuals' interactions with their physical and virtual environments have shifted dramatically because of recent technological breakthroughs. Augmented reality (AR) has received significant attention from industry and academia over the last five years as one of the most innovative technologies impacting human behavior (He *et al.,* 2018). One explanation for this surge in popularity is that more people are becoming aware of AR's ability to produce a filtered impression of the real world by seamlessly combining it with computer-generated material (Han *et al*., 2016). Worldwide spending on AR is estimated to rise from over US$12.0 billion in 2020 to US$ 72.8 billion in 2024 (Statista, 2022).

The tourism sector can benefit greatly from AR because it promises to provide more interactive and authentic tourist experiences (Loureiro *et al*., 2020; Tussyadiah & Wang, 2016). Mobile tourism apps enable users to get information about a destination while traveling through it (Kenteris *et al*., 2011). Location-based applications (Noguera *et al*., 2012), social networking sites such as mobile guides (Viana *et al.,* 2011), and navigation maps such as Google Maps all offer data that enables users to utilize while traveling. This data is merged to create digital maps that are realistic representations of the actual world, making them ideal for on-the-go tourists. Studies have been conducted demonstrating the potential of AR to improve the tourism experience in small towns, amusement parks, heritage sites, art galleries, and historic urban tourist industry sites (Boboc *et al*., 2019; Cranmer, 2019; Han et al., 2016; Mine *et al*., 2012). Various recent researchers have examined the properties of apps that enhance the visitor experience (Ramtohul & Khedo, 2019; Ocampo, 2019).

This study investigates the factors influencing Google Maps AR's behavioral intention to use European tourists. We fill the gaps indicated by previous studies claiming tourist behaviors connected with smart tourism are mostly unknown (Hew *et al.,* 2017) and the understanding of how people interact with AR while traveling and/or afterward remains restricted (Kumar, 2021). This research contributes to the scholarly literature by extending the Technology Acceptance Model (TAM, Davis & Venkatesh, 1996), adding three important variables previously identified in the AR literature: authentic experience, perceived interactivity, and perceived enjoyment. TAM has grounded most of the research in the field (Cranmer *et al*., 2019; Han *et al*., 2016; Leue *et al*., 2014), but we go beyond previous studies by proposing a model that includes the analysis of the moderating role of personal innovativeness, contributing to research done in the field of this individual trait (Huang & Liao, 2015).

Theoretical framing and hypotheses

The TAM is based on innovation disclosure and social psychology thus a useful framework for examining the communication and acquisition of innovations and concepts (Davis & Venkatesh, 1996). TAM was selected by past research to develop a conceptual model to investigate users' adoption of AR in tourism (Leue *et al*., 2014), examine users' intentions to use AR apps Haugstvedt & Krogstie, 2014), and to investigate users' acceptability of AR smart glasses (Kalantari & Rauschnabel, 2018). TAM was recently broadened to include additional determinants of acceptability, such as subjective criteria, in various study contexts (McLean & Wilson, 2019).

Behavior intention consists of the degree to which a person has developed conscious plans to behave or not in a certain way in the future (Warshaw & Davis, 1985). In other words, usage intentions reflect an individual's degree of deliberate engagement in a specific activity. The greatest predictor of an individual's conduct is his or her desire to act (Ajzen & Fishbein, 1980). Prior research shows that intention is critical in determining actual behavior (Venkatesh & Davis, 2000). In tourism, "effective behavioral intention" refers to a desire to travel, plan to visit, or invest money and time in tourism products and services (Meng & Choi, 2016).

Authentic experience

Authenticity is a consumer sensibility centered on how the services of one experience as fresh, genuine, one-of-a-kind, and outstanding (Gilmore & Pine, 2007). Variables such as knowledge, external information seeking, and a sense of authenticity, have a strong influence on slow-trip customer behavior (Meng & Choi, 2016). Additionally, the similarity with a real experience gained through technology boosts the user's behavioral intention (Guttentag, 2010; Yung & Khoo-Lattimore, 2019). Specifically, the realistic experience of mobile computing technologies enhances travel consumers' inclination to reuse mobile technologies (Kim *et al.,* 2017). Therefore, the following hypothesis is formulated:

H1. Authentic experience has a positive impact on behavioral intention to use AR apps.

Perceived enjoyment

Enjoyment can be defined as the extent to which an individual considers an activity pleasurable by itself, regardless of the expected performance consequences (Zhang *et al.,* 2012). Moreover, consumers' emotional experiences substantially and positively impact their behavior (Sohn & Lee, 2017). Recently, the emphasis on pleasure as an external attribute has grown considerably (Lee *et al*., 2012). The role of fun in defining the adoption of new technology was found to be strong in consumers' perceptions of AR app usage (Ha & Stoel, 2009). Based on the previous literature examining the effect of perceived enjoyment (Leue *et al*., 2014; Wojciechowski & Cellary, 2013), we formulate the following:

H2. Perceived enjoyment has a positive effect on behavioral intention to use AR apps.

Perceived interactivity

Interactivity in AR apps improves the user experience, enhancing engagement by allowing users to modify the virtual world and its modules (Nikhashemi *et al.,* 2021). Some studies have argued that interactivity should be further explored as a unique attribute of AR apps for its implicit ability to drive attitudinal and behavioral outcomes (McLean & Wilson, 2019; Yim *et al.,* 2017). More recently, one study revealed that perceived interactivity within AR influences mental images that ultimately trigger positive consumer attitudes and behavioral intentions (Park & Yoo, 2020). Thus, the following hypothesis is proposed:

H3. Perceived interactivity has a positive impact on behavioral intention to use AR apps.

Perceived ease of use and perceived usefulness

TAM determined that perceived ease of use and perceived usefulness are the two primary elements influencing customers' attitudes and inclination to use new technology (Davis, 1989). Several studies have simplified the TAM by omitting attitude (Venkatesh & Davis, 2000). The attitude construct's mediation effect on behavioral intention was not substantial (Lee & Lehto, 2013). Additionally, Venkatesh and Davis (2000) claimed that the simplified TAM may be more effective at predicting consumer behavior than the original TAM.

The term perceived usefulness is the degree to which system users believe the technology will boost their productiveness when performing activities such as traveling (Rouibah & Abbas, 2006). The term "perceived ease of use" refers to the degree to which a user believes that utilizing a system is simple (Davis, 1989). Previous research has confirmed the significant role of these two constructs of the TAM (Haugstvedt & Krogstie, 2014; Kalantari & Rauschnabel, 2018; Leue *et al*., 2014), thus we hypothesize:

H4. Perceived usefulness has a positive impact on behavioral intention to use AR apps.

H5. Perceived ease of use positively impacts behavioral intention to use AR apps.

Personal innovativeness: moderation effect

Personal innovativeness refers to an individual's predisposition to be the first to accept unique ideas, concepts, or products, such as new technology (Lu *et al.,* 2013). Additionally, this individual ingenuity tremendously impacts consumers' willingness to embrace new technologies (Rogers, 1995). Individuals with a higher level of personal innovativeness will have a more favorable view of technological innovation and a desire to adopt it (Lu *et al.,* 2013). According to innovation diffusion theory, individuals with a high level of innovativeness are more likely to endorse new technology and services, have a greater ability for dealing with uncertainty, and tend to underestimate the impact of risks (Agag & El-Masry, 2016). In this study, personal innovativeness will be tested as a moderator in the proposed model, thus we hypothesize:

H6. Personal innovativeness strengthens the relationship between the authentic experience and behavioral intention to use.

H7. Personal innovativeness strengthens the relationship between perceived enjoyment and behavioral intention to use.

H8. Personal innovativeness strengthens the relationship between perceived interactivity and behavioral intention to use.

H9. Personal innovativeness strengthens the relationship between perceived usefulness and behavioral intention to use.

H10. Personal innovativeness strengthens the relationship between perceived ease of use and behavioral intention to use.

Methodology

The study's target audience comprises Europeans who travel at least once a year and have previously used Google Maps during their travels. Two screening questions were included at the survey's start to ensure that only respondents from the intended group could submit their responses. The current study uses a quantitative approach with an online questionnaire in two versions revised by native speakers (English and Italian). The survey was developed using Sphinx Declic software. The measures were taken and adapted (when necessary) from previous literature using a five-point agreement Likert scale. Personal innovativeness (PIN) was measured using 4 items (Agarwal & Prasad, 2021), authentic experience (AE) was measured using 4 items (Kim *et al.,* 2017), perceived enjoyment (PE) was measured using 6 items (Do *et al*., 2020), perceived interactivity (PI) was measured using 5 items (Do *et al*., 2020), perceived usefulness (PU) was measured using 4 items (Zhuang *et al.,* 2022), perceived ease of use (PEOU) was measured using 4 items (Zhuang *et al.,* 2022), and lastly, behavioral intention to use (BITU) was measured using 4 items (Hsu *et al*., 2021).

A pilot survey was conducted with 15 individuals to gather feedback about the clarity and understandability of the items. After the questionnaire was refined, it was circulated through social media networks. A snowball sampling strategy was also used, disseminating an online link that ensured people could directly access and disseminate the survey. Seven responses were eliminated from the total of 325 respondents participating in the survey, leaving us with 318 valid responses. Table 1 shows the sample characteristics.

Table 1. Demographic profile of respondents (Author's Own Source)

Characteristics	Number	%
Gender		
1. Female	161	50.6%
2. Male	155	48.7%
3. Rather not to say	2	0.6%
Age group		
1. Under 25 years	152	47.8%
2. 25 to 39 years	150	47.2%
3. Over 40	16	5.0%
Country		
1. Italy	162	50.9%
2. Germany	55	17.3%
3. Netherlands	30	9.4%
4. France	21	6.6%
5. Spain	15	4.7%

6. Other	35	11.1%
Reason		
1. Mobility	117	36.8%
2. Tourist attractions	76	23.9%
3. Food or drinks	65	20.4%
4. Accommodation	42	13.2%
5. Other	18	5.6%
Destination		
1. National	82	25.8%
2. International	236	74.2%
Frequency		
1. Once a year	126	39.6%
2. Once every 6 months	87	27.4%
3. Once every 3 months	72	22.6%
4. Once a month	33	10.4%
Total	318	100%

The proposed research model included reflective measures and tests for moderating relationships, so partial least squares (PLS) structural equation modeling with SmartPLS 3.0 was used to test the model (Hair *et al.,* 2011). The SmartPLS multi-group analysis (MGA) was used to determine whether there are substantial variations in parameter estimations between preset data groups (Hair *et al.,* 2016).

Results

Evaluation of the measurement model

Reflective assessment methods require the validity and reliability of the items and conceptions (Hair *et al.,* 2013). Items with a loading of 0.40 to 0.70 may be retained in the model if their omission impairs the model's overall content validity (Hair *et al.,* 2011), as indicated by Average Extracted Variance (AVE) and Composite Reliability (CR). According to the analysis, the factor loading of the PIN3 item was insufficient thus this item was removed from the model to improve internal consistency. Since the items used to define these constructs are unidimensional and the equally reliable measurements are interchangeable, they can be modified or removed without affecting the construct (Bollen & Lennox, 1991). To assess convergent validity, three indicators were used: individual factor loadings, Cronbach's alpha (α), composite, reliability (CR), and average variance extracted (AVE). Table 2 shows the results of the outer model reliability and convergent validity.

Table 2. Measurement model results

Construct	Items	Loadings	α	CR	AVE
PIN	PIN1	0.916	0.827	0.893	0.737
	PIN2	0.781			
	PIN4	0.873			
AE	AE1	0.874	0.918	0.942	0.802
	AE2	0.918			
	AE3	0.878			
	AE4	0.912			
PE	PE1	0.814	0.937	0.950	0.762
	PE2	0.877			
	PE3	0.910			
	PE4	0.893			
	PE5	0.840			
	PE6	0.899			
PI	PI1	0.808	0.905	0.930	0.726
	PI2	0.857			
	PI3	0.879			
	PI4	0.884			
	PI5	0.831			
PU	PU1	0.703	0.819	0.879	0.647
	PU2	0.837			
	PU3	0.867			
	PU4	0.801			
PEOU	PEOU1	0.812	0.881	0.917	0.734
	PEOU2	0.868			
	PEOU3	0.883			
	PEOU4	0.862			

BITU	BITU1	0.867	0.886	0.922	0.747
	BITU2	0.792			
	BITU3	0.908			
	BITU4	0.887			

Discriminant validity must be established to verify that constructs are unique or extremely like one another. The Fornell-Larcker statistic is a critical component of partial least squares research since it is used to determine the discriminant validity of a model (Hair *et al.,* 2016). Table 3 shows the discriminant validity results.

Table 3. Fornell-Larcker criterion (Author's Own Source)

Construct	1	2	3	4	5	6
1. AE	0,896					
2. BITU	0,687	0,865				
3. PE	0,779	0,761	0,873			
4. PEOU	0,424	0,572	0,537	0,857		
5. PI	0,560	0,648	0,661	0,658	0,852	
6. PU	0,619	0,757	0,699	0,616	0,750	0,804

Evaluation of the structural model

To determine the magnitude and significance of path relationships inside the research model, it is important to analyze the p-values and t-statistics produced from a bootstrap with a level of 1000 subsamples and a significance level of 5% as recommended in the literature (Henseler *et al*., 2009). The path coefficient values correspond to each hypothesized relationship between the latent variables (Hair *et al.,* 2016), indicating whether the formulated hypothesis is accepted or rejected. Personal innovativeness was tested as a moderator in the proposed model. Table 4 summarizes the hypotheses' acceptance results.

Table 4. Hypotheses acceptance results (Author's Own Source)

Hypotheses		β	t-value	p-value	Supp.
H1	AE → BITU	0,162	2,542	0,011	Yes

H2	PE → BITU	0,312	4,935	0,000	Yes
H3	PI → BITU	0,006	0,111	0,912	No
H4	PU → BITU	0,354	6,125	0,000	Yes
H5	PEOU → BITU	0,117	2,364	0,018	Yes
H6	MOD PIN H1	0,144	2,323	0,020	Yes
H7	MOD PIN H2	-0.204	3,339	0,001	Yes
H8	MOD PIN H3	0,146	2,162	0,031	Yes
H9	MOD PIN H4	0,006	0,101	0,919	No
H10	MOD PIN H5	-0,045	0,846	0,397	No

The coefficient of determination expresses the exogenous component's effect on the endogenous component quantitatively. In mathematical words, R2 is the proportion of variance in the independent construct explained by the dependent variable (Hair *et al.,* 2011). The coefficient of determination quantifies the model's predictive capability (Hair *et al.,* 2016). The R2 value of 0.695 indicates that the proposed model has a strong explanatory power of the dependent variable behavioral intention. Figure 1 illustrates the research model and the obtained structural model results.

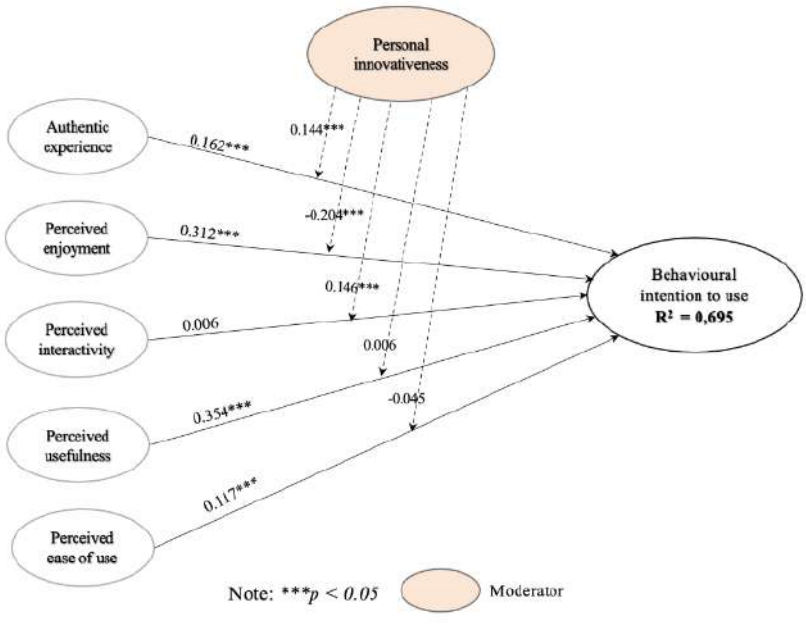

Figure 1. Structural model results

MGA was conducted to determine any discrepancies between subgroups in the sample. We tested for differences regarding age, gender, the reason to use Google Maps and frequency of travel. Only gender produced meaningful differences. The influence of authentic experience on behavioral intention to use AR apps is significantly different for males and females ($p = 0.002$) being stronger for males ($t = 4.613$) than for females ($t = 0.059$). Further, perceived enjoyment had a higher effect on behavioral intention to use for females ($t = 4.814$) than for males ($t = 1.936$), and this difference is statistically significant ($p = 0.008$).

Results and Discussions

This study aimed to determine how AR applications affect tourists' experiences by orienting them toward behavioral use intentions. To accomplish this, a research model extending TAM was devised, and Google Maps AR was chosen to be investigated.
This research contributes to the disciplines of AR in the tourism sector by expanding the classic TAM model, including the variables of perceived interactivity, enjoyment, and authentic experience (Yung & Khoo-Lattimore, 2019). The proposed research model had strong explanatory power and explored the moderating role of personal innovativeness (Lu *et al.,* 2005).

The findings indicate that authentic experience predicts purchase intention, which aligns with previous literature on AR (Kim *et al,* 2017; Yung & Khoo-Lattimore, 2019). An authentic experience is one of the premises of virtual reality and augmented reality (Riva *et al.,* 2016), but its implementation still faces technological limitations. The importance of a credible experience was stronger for men. AR apps with males as the audience should be aware of the importance of a convincing app that brings an immersive and authentic experience.

The second hypothesis showed to be significant since perceived enjoyment is an intrinsic payoff to the use of technology (Davis, 1989). Numerous experts have emphasized the importance of enjoyment and general physiological experiences in adopting augmented reality in the tourism business (Haugstvedt & Krogstie, 2014; Leue et al., 2014). This study confirms that visitors who experience greater enjoyment when interacting with a mobile AR application are more likely to continue to do so in the future. The finding from the MGA revealed that perceived enjoyment has a stronger effect on females' behavioral intentions than males. This finding contradicts previous studies and deserves further investigation (Khedhaouria & Beldi, 2014).

Perceived interactivity was shown to not impact purchase intention. This finding contradicts prior research in the field (Pantano *et al*., 2017). Recent research has proven the positive impact of interactivity on female consumers in South Korea (Park & Yoo, 2020). One of the reasons might be that Google Maps AR does not yet have many interactive AR features implemented, users did not recognize the importance of this factor for an experience worth repeating. The fourth and fifth relationships examined in this study belong to the TAM and the two relationships were found to be significant.

Finally, personal innovativeness was revealed to enhance three relationships on behavioral intention to use: authentic experience, perceived enjoyment, and perceived interactivity. These findings indicate that innovative individuals are quite willing to move to new technologies in exchange for the unique experience provided by AR apps.

Previous research (Lu *et al.,* 2013) established the critical role of personal innovativeness in explaining people's behavior in various IT environments. Typically, innovative individuals are the first to embrace new technologies. They are satisfied with the application of modern technologies to their objectives (Huang & Liao, 2015). Instead, the analysis showed that the two remaining hypotheses were not supported. This demonstrates that for innovative individuals, it is less vital that new technology is simple and useful. Rather, the AR application must be unique, engaging, and enjoyable.

Limitations and future research

This study is not without limitations leading to future research possibilities. Our sample is restricted to the European continent; thus, it is recommended that future researchers consider other continents and countries, running cross-cultural comparisons. China is a rapidly developing destination with high investments in AR apps and could be the focus of further inquiry. Our main limitation resides in Google Maps AR selection. This tool brings only a few functionalities and its use is not yet popular among travelers. Our sample was not fully familiar with the application. The three variables added to the TAM model highly depend on how advanced the functionalities of the AR application are. Future studies should select AR apps promoting a realistic, fun, and interactive experience to test the motives behind tourists' intention to keep using those applications.

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Appendix

Measurement items

Constructs	Items	Source
Personal Innovativeness (PIN)	If I heard about a new technology, I would look for ways to experiment with it. Among my peers, I am usually the first one to try out new information technologies. In general, I am hesitant to try out new information technologies. I like to experiment with new information technologies.	(Agarwal & Prasad, 2021)
Authentic Experience (AE)	Using Google maps AR app would provide (provides) me authentic experience while travelling. Using Google map AR app would provide (provides) me genuine experience while travelling. Using Google maps AR app would provide (provides) me unique experience while travelling. Using Google maps AR app would provide (provides) me exceptional experience while travelling.	(Kim et al., 2020)

Perceived Enjoyment (PE)	Using Google maps AR app would be (is) one of my favorite activities when travelling. Using Google maps AR app would be (is) enjoyable for me while travelling. Using Google maps AR app would make (makes) me feel good while travelling. Using Google maps AR app would be (is) pleasurable for me while travelling. Using Google maps AR app would be (is) fun for me while travelling. Using Google maps AR app would keep (keeps) me happy while travelling.	(Hai et al., 2020)
Perceived Interactivity (PI)	The information shown when I interact with the Google maps AR app would be (is) relevant while travelling. The information shown when I interact with Google maps AR app would meet (meets) my expectations while travelling. The information displayed when I interact with Google maps AR app would be (is) appropriate while traveling. The information shown when I interact with Google maps AR app would be (is) suitable while travelling. The information displayed when I interact with Google maps AR app would be (is) useful while traveling.	(Hai et al., 2020)
Perceived Usefulness (PU)	Using Google maps while travelling would allow (allows) me to easily find my destination. Using Google maps AR app while travelling would enable (enables) me to access more information about the destination of my trip. Using Google map AR app would improve (improves) the quality of my travel. The indication on the Google maps AR app regarding the destination while travelling would be (is) clear and understandable.	(Zhuang et al., 2021)
Perceived Ease of Use (PEOU)	Learning how to use Google maps AR app while traveling would be (is) easy for me. My interaction with Google maps AR app while traveling would be (is) clear and understandable. It would be (is) easy for me to become comfortable using Google maps AR app while travelling. I find the Google maps AR app easy to use while travelling.	(Zhuang et al., 2021)

Behavioral Intention to Use (BITU)	I think I will use Google maps AR app or other AR apps in the future. I will always try to use Google maps AR app in daily life. I recommend to other to use Google maps AR app while travelling. I will tell other people positive things about the content of Google maps AR app.	(Hsu et al., 2021)