Research article

Effects of mobile augmented reality apps on impulse buying behavior: An investigation in the tourism field

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ABSTRACT

Many of today's online services are designed specifically to encourage impulse buying. Moreover, many studies have shown that with the assistance of Mobile Augmented Reality, retailers have the potential to significantly improve their sales. However, the effects of Mobile AR on consumer impulse buying behavior have yet to be examined, particularly in the tourism field. Consequently, the present study integrates the Technology Acceptance Model (TAM), Stimulus-Organism-Response (SOR) framework, and flow theory to examine the effects of Mobile AR apps on tourist impulse buyingbehavior. The research model is implemented using an online questionnaire, with the results analyzed by Partial-Least-Squares Structural Equation Modeling (PLS-SEM) approach. The results obtained from 479 valid samples show that the characteristics of Mobile AR apps play an important role in governing tourist behavior in making unplanned purchases. In particular, as the utility, ease-of-use, and inter-activity of the apps increase, the perceived enjoyment and satisfaction of the user also increase and give rise to a stronger impulse buying behavior. The results also reveal a mediating effect of the flow experience on the relationship between the perceived ease of use of the Mobile AR app and the user satisfaction in using the app. Overall, the findings presented in this study provide a useful source of reference for Mobile AR app developers, retailers, and tourism marketers in better understanding users' preferences for Mobile AR apps and strengthening their impulse buying behavior in the tourism context as a result.

1. Introduction

Nowadays, consumers rely increasingly on information acquired from social websites to inform their purchase decisions. Typically, this information, which may include product reviews, celebrity endorsements, YouTube influencer recommendations, and so on, is acquired through a mobile platform (usually a smartphone). Notably, such human-computer interactions are not confined to the retail sector but are spreading increasingly to the tourism business. For example, tourists now often gather and access information to support their destination decision-making processes using simple-to-use but effective apps installed on their smartphones (Kramer et al., 2007). Furthermore, previous studies have shown that these days, smartphones and travel apps play a key role in enhancing tourists' travel experience (Dickinson et al., 2014). As a result, travel apps have undergone a massive increase in popularity and use by tourists in recent years, and are likely to continue to attract significant interest in the tourism business for years to come.

The proliferation of smartphone devices has led to the emergence of many new exciting technologies, including Mobile Augmented Reality (Mobile AR), in which real-world physical elements are combined with virtual three-dimensional (3D) digital graphics to provide a wide range of reality-based services and functions. With the development of Mobile AR technology, travelers now can access tourist resources pertinent to their travel choices directly from their smartphones (Chou and ChanLin, 2012; Linaza et al., 2012). For example, London Museum, the Powerhouse Museum in Sydney, and many other cultural and leisure-based venues around the world have developed their own Mobile AR apps to inform potential visitors of their exhibits, services, facilities, opening hours, and so on. It has been reported that the interpretative media and technologies provided by such apps enhance the tourist experience, and hence have significant potential for building the tourism industry and promoting tourism-related retail opportunities (Neuhofer et al., 2012).

For many tourists, one of the central activities in the travel experience is shopping (Fairhurst et al., 2007; Wilkins, 2011). Li et al. (2015) found that shopping accounts for as much as two-thirds of the total travel

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expenditure in some cases. Notably, travel is characterized as a procedure in which visitors leave their normal place of residence and travel to an unfamiliar or unknown place or region with recreational intentions in mind (Cohen, 1979). In this context, many of the purchases made by travelers at the airport, online, or the travel destination itself may be regarded as a form of impulse buying behavior (Rezaei et al., 2016). Many studies have been performed to investigate the psychological motivations underlying impulse buying (Amos et al., 2014; Xiao and Nicholson, 2013). However, these studies have generally focused on the effects of extrinsic external factors such as panel advertising, sales service staff, consumer behavior, or have focused on the specific context of online shopping. In other words, very few studies have actively set out to examine the role and effects of Mobile AR in determining impulse buying behavior, especially in the tourism field.

Augmented Reality Marketing is defined as a "strategic concept that integrates digital information or objects into the subject's perception of the physical world, often in combination with other media, to expose, articulate, or demonstrate consumer benefits to achieve organizational goals" (Rauschnabel et al., 2019, p. 44). It aims to exploit the full capabilities of modern mobile devices to perform enhanced marketing, e-commerce, and advertising tasks (Dwivedi et al., 2020; Rauschnabel et al., 2019). Augmented Reality Marketing also provides the ability to put the product into the hand of the users, thereby giving the consumer the chance to interact with the brand before purchase (Al-Modwahi et al., 2012), driving purchase intention through user experience, utilitarian benefits, and hedonic benefits (Rauschnabel, 2018). However, besides the benefits, it also poses some risks (e.g., privacy risks) (Rauschnabel et al., 2018). The complex combination of risks and benefits means that it is not yet known how consumers' interactions with AR may change over time when they become used to it (Hoffman and Novak, 2009). Furthermore, while Mobile AR apps have been confirmed to provide entertainment and experiential value (Maghnati and Ling, 2013), their effects on consumers' impulse buying are still unclear. Although impulse buying is one of the longest-lasting literature streams in the consumer research field, Tourist Impulse Buying has only recently gained traction among researchers (Sohn and Lee, 2017). Among those studies that have been performed in this field, most researchers have focused on its effects on the consumer feeling and experiences (Li et al., 2015; Sohn and Lee, 2017). However, as mentioned above, most of these studies investigated traditional ways of tourist impulse buying instead of new technologies like Mobile AR technologies.

Augmented reality has the potential to play a significant role in the tourism field (Loureiro et al., 2020; Tussyadiah and Wang, 2016). Various researchers have explored the role of Mobile AR in influencing tourist intention to visit a particular destination; be it in a mediating role (Wang et al., 2012), or a direct role (Chung et al., 2015; Haugstvedt and Krogstie, 2012; Jung et al., 2015). Linaza et al. (2012) evaluated several Mobile AR applications for tourism destinations with particular emphasis on the consumers' perceptions of their usefulness and potential opportunities for future improvements. Later, Han and Jung (2018) interviewed 49 tourists to determine their requirements for Mobile AR tourism applications in the field of urban heritage. More recently, Cranmer (2019) investigated the main value-adding features for Mobile AR tourism applications. However, as mentioned above, the literature still contains only scant information regarding the effects of Mobile AR on tourist impulse buying. And to the best of our knowledge, no research investigates the mechanism of these effects on TIB.

Most recent studies on impulse buying employ the Stimulus-Organism-Response (SOR) framework (Mehrabian and Russell, 1974) to explain the relationship between stimuli and impulse buying behavior. For MAR, interactivity is an important stimulus of AR systems because it could change the customer experiences of the AR systems (Pantano et al., 2017), which affect the impulse buying behavior. However, there is also no research that investigates the impact of Mobile AR interactivity on tourist impulse buying. By combining the SOR framework with the

Technology Acceptance Model (TAM), and flow theory, this study aims to investigate the role of Mobile AR apps on impulse buying behavior in the tourism field.

2. Literature review

2.1. Mobile Augmented Reality (MAR)

AR was originally developed as far back as the 1960s, but only entered the mainstream in the early 2000s (Billinghurst and Kato, 2002). The core idea of AR is to augment digital information onto the real world so that it is displayed right at the object or place it relates to (Azuma, 1997). With the facility it provides to composite computer-generated information with physical objects at the same time, AR has found many applications in fields as diverse as entertainment, education (Carlson and Gagnon, 2016; Kysela and Štorková, 2015), retail (Javornik, 2016), medicine (Botella et al., 2005; Li et al., 2020), traveling (Loureiro et al., 2020), military support (Livingston et al., 2011), and so on.

AR is regarded as a powerful tool for the online tourism industry in enhancing tourists' experience (Jung, 2016) due to its potential to change the users' perspective of their condition (Wang et al., 2013). Thus, various AR and Mobile AR apps have been developed for the tourism field, including Wikitude, Layar, and ETIPS. Besides, many studies have been performed, which demonstrate the potential of AR for enhancing the tourist experience in small cities (Han et al., 2013), Asian theme parks (Weng et al., 2011) and Disney World (Mine et al., 2012) UNESCO recognized museums in the UK (Cranmer, 2019) and urban heritage tourism sites (Boboc et al., 2019; Han and Jung, 2018). Several recent studies have also focused on the problem of identifying the particular application functions, which enhance tourist experience (Dangkham, 2018; Ocampo, 2019; Ramtohul and Khedo, 2019).

Mobile AR is one of the most rapidly developing research areas in AR. The interactions between the user and Mobile AR applications have thus attracted extensive attention in the literature (De Sá and Churchill, 2013; McLean and Wilson, 2019; Van Krevelen and Poelman, 2010). Mobile AR apps not only support the same interactive functions as traditional online websites but also offer additional features such as location-based services, feedback, and search for information. Smartphones and their apps facilitate easy access to information anywhere and anytime. As a result, they have immense potential to assist travelers in all manner of ways (Wang et al., 2012). According to Chung et al. (2015), AR plays a key role in determining the intention of tourists to visit a particular destination. In addition, AR apps help tourists acquire a profound comprehensive knowledge of the origins of geological heritage, gain valuable experience (Yovcheva et al., 2013) and localized knowledge without the need for a tour guide. Many Mobile AR apps have been introduced into the market in recent years to inform tourists' travel destination decisions and to provide them with a better understanding of the local environment and its attractions once they arrive there. By doing so, Mobile AR enhances the overall experience of travelers (Han et al., 2013; Yovcheva et al., 2014) and hence, greatly benefits the tourism industry in general.

2.2. Tourist impulse buying (TIB)

The phenomenon of tourist purchase behavior has long been of interest to the academic community (Gordon, 1986; Littrell et al., 1995). In the early days, researchers focused mainly on the choice of tourism souvenirs (Littrell et al., 1995). However, in recent years, attention has turned increasingly to tourist impulse buying since understanding tourists' impulse buying behavior can provide valuable information for the tourism industry in generating retail opportunities (Rezaei et al., 2016; Sohn and Lee, 2017). Similar to other impulse buying behavior, tourist impulse buying behavior is prompted by various factors, including easy access to products, easy purchasing, lack of social pressure, and absence of delivery effort (Jeffrey and Hodge, 2007).

2.3. Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) (Davis, 1989) is based on innovation diffusion theory and aspects of social psychology and provides a useful tool for exploring the communication and adoption of innovations and ideas (Rese et al., 2014). In exploring users' reasons for accepting (or rejecting) new technological innovations, TAM uses two measures, namely the Perceived Ease of Use and the Perceived Usefulness, to predict the users' final decision (Leue and Jung, 2014). The model has been widely used to examine the consumer response in many research areas, including information technologies related to tourism (Ayeh et al., 2013). However, the literature contains very few studies on the use of TAM to explore the acceptance of AR in the tourism industry (Haugstvedt and Krogstie, 2012). Accordingly, the present study integrates the TAM and SOR frameworks to develop a research model for predicting the effects of Mobile AR in inducing Tourist Impulse Buying.

2.4. Stimulus–Organism–Response (S-O-R) model

The Stimulus-Organism-Response (S-O-R) model has its roots in environmental psychology and has been used as the basis for many consumer behavior studies over the years (Russell and Pratt, 1980). The main concept of the S-O-R model is that a stimulus (S) affects people's internal affective evaluations (O) and leads to approach or avoidance responses (R) as a result. A stimulus is recognized as an object or phenomenon that is capable of waking up or promoting human actions. In the context of consumer decisions, a stimulus is defined as an external factor that pushes the shopper to make impulse buying decisions (Chan et al., 2017). Meanwhile, the term "organism" refers to the shoppers' emotional state and includes perceptual, physiological, feeling, and thinking processes (Sherman et al., 1997). Finally, "response" refers to the customers' behavioral activities that result from their mood and environment evaluation. Many studies have confirmed the role played by environmental cues in stimulating consumer impulse buying behavior (Chang et al., 2011; Floh and Madlberger, 2013).

3. Hypothesis development

3.1. The role of interactivity in mobile AR apps

Interactivity is defined as the ability of users to change the form and content of a mediated environment in real-time (Steuer, 1992). In previous studies of e-commerce, interactivity is widely examined under the perspective of the interaction between customer and product/services. For example, interactivity with products that enabled customers to change and customize the design elements, product features, and angle of view or distance of the product (Fiore et al., 2005). Beuckels and Hudders (2016) found that enhanced image interactivity positively impacts the luxury perception of a product. Moreover, interactivity also helps to enhance the customer experience by increasing the perceived ease of use of products/services. In the tourism field, perceived interactivity is one of the most important factors leading to the perceived ease of use of the online destination marketing and booking system (Herrero and San Martín, 2012; Park and Gretzel, 2007). When it comes to AR technology, the research of Pantano et al. (2017) showed that interactivity significantly facilitates the consumer's perceived ease of use of the AR try-on system for glasses. Accordingly, the present study proposes the following hypotheses:

H1. Perceived Interactivity has a positive impact on Perceived Ease of Use of Mobile AR.

3.2. Relationship between mobile AR apps experience and flow experience

Bhattacherjee (2001) argued that perceived usefulness is a valuable cognitive state in evaluating a user's performance perception following the information systems usage. However, both perceived usefulness and PEOU have been used as indicators of users' acceptance of new technologies in recent years. Hoffman and Novak (1996) discovered that when users' interactions with mobile devices proceed more smoothly, the user experiences a feeling of enjoyment that induces a flow state (i.e., a sense of being in the zone). In other words, the higher the degree of perceived ease of use or perceived usefulness of the user, the greater the enjoyment he or she will feel when browsing the platform content on a mobile device. Previous studies have shown that perceived interactivity (PI) of mobile platforms also has a concrete effect on consumer response; chiefly through the mediation of consumer experience-related concepts such as enjoyment (Hoffman and Novak, 2009). Ha and Stoel (2009) confirmed the significance of enjoyment for TAM factors of new technologies and concluded that enjoyment has a particularly strong effect on users' attitudes toward the use of AR applications. The TAM study of Haugstvedt and Krogstie (2012) in the cultural heritage field similarly showed that enjoyment is one of the most important factors in governing the acceptance (or otherwise) of AR apps. Based on a review of the literature above, the present study proposes the following three hypotheses:

H2a. Perceived Usefulness has a positive impact on Perceived Enjoyment of using Mobile AR.

H2b. Perceived Ease of Use has a positive impact on Perceived Enjoyment of using Mobile AR.

H2c. Perceived Interactivity has a positive impact on Perceived Enjoyment of using Mobile AR.

3.3. Relationship between mobile AR and satisfaction

Satisfaction is known to have a significant effect on consumers' purchase attitudes and repurchase intentions. Bressolles et al. (2007) argued that satisfaction is an export evaluation of consumers' experience with a service and is expressed as a positive, indifferent, or negative feeling. As with traditional online websites, Mobile AR apps provide many opportunities for man-machine interactions. However, in contrast to traditional websites, Mobile AR offers many additional interaction opportunities, such as location-based services and more customized and personalized functions. Zhao and Dholakia (2009) found that website interactivity is a major determinant of consumer satisfaction. Song and Zinkhan (2008) similarly reported that highly personalized messages raise stronger perceptions of interactivity, which further contributes to user satisfaction. Many studies have found a positive association between e-quality factors and satisfaction. However, relatively few studies have attempted to link TAM factors to satisfaction in the online shopping context. Lin and Sun (2009) examined the relationship between TAM factors and online consumer satisfaction. Meanwhile, Al-hawari and Mouakket (2010) investigated the effects of PEOU and PU on user satisfaction in the e-learning context. However, neither study considered the effects of the TAM factors on user satisfaction in the field of Mobile AR apps. Accordingly, the present study proposes the following hypotheses:

H3a. Perceived Usefulness has a positive impact on Satisfaction of using Mobile AR.

H3b. Perceived Ease of Use has a positive impact on Satisfaction of using Mobile AR.

H3c. Perceived Interactivity has a positive impact on Satisfaction of using Mobile AR.

3.4. Relationship between perceived enjoyment and satisfaction

One of the main factors influencing tourist impulse buying is perceived enjoyment. Intuitively, when tourists do not feel happy and content, they are less likely to participate in buying activities. In other

words, tourist satisfaction involves substantially more than just service quality, and hence the tourist industry should endeavor to create a positive flow state in everything it does (Mannell and Iso-Ahola, 1987). Skadberg and Kimmel (2004) suggested that the flow state can be defined as a state in which individuals lose their sense of time when occupied with activity due to the enjoyable experience it produces. Hence, while in a flow state, tourists are more likely to participate in all manner of different activities, including shopping. In the online context, Nusair and Kandampully (2008) used the perceived enjoyment (playfulness) of an online system as a determinant in evaluating the tendency of users to accept and adopt the system's recommendations for online purchasing. The present study argues that tourists who experience a greater perceived enjoyment when using a Mobile AR app are more likely to be satisfied by the app. In other words, the following hypothesis is proposed:

H4. Perceived Enjoyment has a positive impact on the Satisfaction of using MAR

3.5. Relationship between perceived enjoyment and impulse buying

Enjoyment is a feeling created by the interactions between an individual's experience and the surroundings. Furthermore, from flow theory, a higher desire to repeat activities occurs when the activity induces a greater enjoyment (Csikszentmihalyi, 1988). Similarly, in the online shopping context, the likelihood of the user making an impulse buying decision increases with an increasing sense of enjoyment when using the platform (Jeffrey and Hodge, 2007). Therefore, in designing platforms to support e-commerce, a tacit recognition of the factors affecting consumer enjoyment is essential in prompting impulse buying behavior. Sohn and Lee (2017) indicate that consumers' emotional experience has a strong and positive impact on consumers' impulse behavior. Thus, in the context of the present study, it can be inferred that tourists who experience a greater degree of enjoyment in using a Mobile AR app are more likely to exhibit tourism impulse buying behavior. In other words, the following hypothesis is proposed:

H5. Perceived Enjoyment of using Mobile AR has a positive impact on tourist impulse buying.

3.6. Relationship between satisfaction and impulse buying

Customer satisfaction has long been regarded as one of the most important and reliable predictors for a customer making impulse buys (Bressolles et al., 2007). However, the impact of customer satisfaction on impulse buying has yet to be fully clear. Nonetheless, it appears that satisfaction toward a retail setting promotes approach behaviors and,

more specifically, improves sales (Jones and Reynolds, 2006). Accordingly, the present study argues that satisfaction, as a positive affective state, promotes buying impulses by inducing positive evaluations after using a Mobile AR app. In other words, the following hypothesis is proposed:

H6. Satisfaction of using Mobile AR has a positive impact on Tourist Impulse Buying.

The research model of this research is showed in Figure 1.

4. Methodology

4.1. Sample and data collection procedure

The study aimed to examine the effects of Mobile AR on the decision-making process of tourists in conducting tourist impulse buying. Thus, only respondents who have had experience in using Mobile AR apps related to the tourism field were selected. Because of the unpopularity of these kinds of apps, we deliberately targeted particular individuals in carefully-chosen online communities, which have discussed Mobile AR apps. Members of those communities are interested in new technology and have experienced in using Mobile AR apps. Most of these communities can be found through a search engine with keywords such as Augmented reality group, AR group, VR and new technology, and so on. After targeting the potential respondents, online surveys were used to collect the data directly from them. Although online surveys often suffer the limitation of random sampling since most sampling procedures are chosen simply with the convenience sampling method, this method has some advantages such as the ability to choose the right respondents regardless of geographical limit, facilitating a quicker response, and reducing the survey cost. The questionnaire was implemented in an online form and distributed to the members of these communities. They were asked to recall occasions in the past on which they used Mobile AR apps and accepted its suggestions for in-app purchases.

A total of 503 survey samples were collected. After a careful review, 24 of the samples were rejected, leaving a total of 479 valid samples. Table 1 summarizes the main characteristics of the 479 respondents in terms of their gender, marital status, age, and education level.

As shown in Table 1, more than 75% of the respondents were male, and most of them were single and less than 26 years old. In addition, more than half of the respondents held an undergraduate degree or higher. Notably, most of the users belonged to Generation Z and were thus judged to be suitable for the present research context of tourism and new technology.
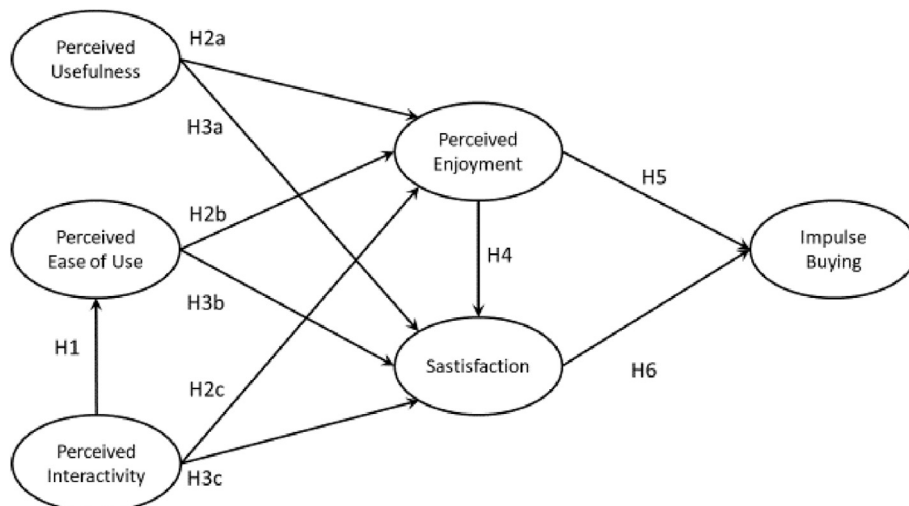

Figure 1. Research model.

Table 1. Characteristics of respondents (n = 479).

Characteristic		Frequency	Percent
Gender	Male	360	75.15
	Female	119	24.85
Age	<18	165	34.44
	19–25	261	54.48
	26–35	43	8.98
	36–45	9	1.89
	46–55	1	0.21
	>56	0	0
Marriage	Single	444	92.69
	Married	34	7.1
	Divorced	1	0.21
Education	Undergraduate	236	49.26
	Master	28	5.85
	Ph.D.	15	3.14
	Other	200	41.75
	Total	479	100

4.2. Construct measurements and data analysis methods

The model employed in the present study consisted of six constructs, namely the Perceived Usefulness (PU), the Perceived Ease of Use (PEOU), the Perceived Interactivity (PI), the Perceived Enjoyment (EN), the Satisfaction (SA) and Impulse Buying (IB) (See Table 2). The questionnaire items relating to the Perceived Usefulness and Perceived Ease of Use constructs were adapted from Koufaris (2002) and Davis and Venkatesh (1996), while those relating to Perceived Interactivity were adapted from Johnson et al. (2006) and (Lee, 2005). Similarly, the items relating to Perceived Enjoyment were adapted from Guo and Poole (2009), and Koufaris (2002), while those relating to SA were adapted from Fornell et al. (1996). Finally, the items relating to IB were adapted from Parboteeah et al. (2009), and Rook and Fisher (1995). All of the items were evaluated using seven-point Likert-scales ranging from 1 ("strongly disagree" or "very unlikely") to 7 ("strongly agree" or "very likely"). A group of 10 individuals, each with more than 3 years' experience of using AR apps, including at least one app in the tourism field (e.g., Wikitude, Layar, ETIPS), were formed and used to conduct a pilot study of the designed questionnaire. The outcomes of the pilot study were then used to construct a final version of the questionnaire for research purposes.

The research model was tested using Partial Least Squares (PLS) analysis with SmartPLS 3.0 (Ringle et al., 2015), a Structural Equation Modeling (SEM) technique that utilizes a nonparametric and component-based approach for estimation purposes. Notably, PLS enables latent factors to be demonstrated as formative constructs and places minimal demands on the sample size and residual distributions (Chin, 1998). In research related to AR technology, this method is more suitable

Table 2. Descriptive statistics and Factor Analysis results.

Factor	Items	Questions	Means	S.D.	Factor Loading	Cronbach's Alpha
Perceived Usefulness (PU)	PU1	Using Mobile AR apps while traveling enables me to find the travel product easily.	3.977	1.896	0.938	0.868
	PU2	Using Mobile AR apps while traveling enables me to access a lot of travel product information.	3.906	1.774	0.931	
	PU3	Product information on Mobile AR apps while traveling is clear and understandable.	4.109	1.842	0.927	
Perceived Ease of Use (PEOU)	PE1	Learning to use Mobile AR apps would be easy for me	4.397	2.066	0.919	0.853
	PE2	My interaction with Mobile AR apps while traveling is clear and understandable	4.443	1.813	0.934	
	PE3	It would be easy for me to become skillful at using Mobile AR apps	4.409	1.960	0.935	
	PE4	I find the Mobile AR apps easy to use.	4.418	1.897	0.907	
Perceived Interactivity (PI)	PI1	Learning to use Mobile AR apps would be easy for me	4.200	1.813	0.851	0.766
	PI2	I was in control over the content of Mobile AR apps that I wanted to see	4.301	1.800	0.870	
	PI3	Customers share experiences about the product or service with other customers of Apps.	4.338	1.808	0.891	
	PI4	Customers of Mobile AR apps benefit from the community using these Apps.	4.355	1.832	0.865	
	PI5	Customers share a common bond with other members of the customer community using these Apps.	4.322	1.839	0.887	
	PI6	The information shown when I interacted with the Mobile AR apps was relevant.	4.284	1.780	0.895	
	PI7	The information shown when I interacted with the Mobile AR apps was appropriate.	4.378	1.774	0.870	
	PI8	The information shown when I interacted with the Mobile AR apps met my expectations.	4.315	1.776	0.870	
	PI9	The information shown when I interacted with the Mobile AR apps was suitable.	4.309	1.790	0.865	
	PI10	The information shown when I interacted with the Mobile AR apps was useful.	4.386	1.792	0.887	
Perceived Enjoyment (EN)	EN1	Using Mobile AR apps is fun to me while traveling	4.484	2.006	0.933	0.872
	EN2	Using Mobile AR apps is one of my favorite activities when I travel	4.317	1.841	0.932	
	EN3	Using Mobile AR apps is enjoyable to me while traveling	4.482	1.935	0.938	
	EN4	Using Mobile AR apps would make me feel good mood while I'm traveling	4.413	1.894	0.934	
Satisfaction (SA)	SA1	I am satisfied with the use of Mobile AR apps during the trip	4.267	1.886	0.908	0.745
	SA2	Mobile AR apps are exactly what I need for the trip	4.117	1.780	0.924	
	SA3	This Mobile AR apps haven't worked out as well as I thought it would	3.925	1.719	0.746	
Impulse Buying (IB)	IB1	When using Mobile AR apps while traveling, I often buy things spontaneously.	3.814	1.746	0.798	0.653
	IB2	"Just do it" describes the way I buy things while using Mobile AR apps during traveling.	3.666	1.777	0.807	
	IB3	When using Mobile AR apps while traveling, I often buy things without thinking.	3.587	1.805	0.817	
	IB4	"I see it, I buy it" is the way I buy things while using Mobile AR apps during traveling.	3.664	1.778	0.816	
	IB5	When using Mobile AR apps while traveling, I often have the idea "buy now, think about it later".	3.754	1.749	0.839	
	IB6	When using Mobile AR apps while traveling, sometimes I feel like buying	3.992	1.807	0.836	
	IB7	When using Mobile AR apps while traveling, I often buy things according to how I feel at the moment	3.841	1.771	0.834	
	IB8	When I using Mobile AR apps while traveling, I carefully plan most of the products which I bought.	4.219	1.783	0.733	
	IB9	When using Mobile AR apps while traveling, sometimes I am a bit reckless about what I buy.	4.027	1.751	0.785	

Table 3. Correlations between research constructs.

	AVE	C.R.	PU	PEOU	PI	EN	SA	IB
PU	0.924	0.952	0.932					
PEOU	0.943	0.959	0.704	0.924				
PI	0.966	0.970	0.698	0.823	0.875			
EN	0.951	0.965	0.654	0.774	0.821	0.934		
SA	0.826	0.897	0.641	0.704	0.750	0.802	0.863	
IB	0.933	0.944	0.598	0.570	0.667	0.620	0.710	0.808

Diagonal elements are the square root of the average variance extracted.

when the primary research objective focuses on prediction rather than testing an established theory (Hinsch et al., 2020).

5. Results

The reliability of the research model was analyzed by means of factor loading and composite reliability (C.R.). Moreover, the internal consistency of the variables was also measured using the Cronbach alpha coefficient (Hair et al., 2010). The results show that all of the factor loadings are higher than 0.7, Cronbach's alpha and composite reliability (C.R.) of all constructs are also greater than 0.7. In other words, the reliability of the model is confirmed (Hair et al., 2010). For convergent validity, following the criterion suggested by Chin (1998), we found that all constructs have the average variance extracted (AVE) greater than 0.50 which indicates an adequate convergent validity. The corresponding results are shown in Table 2.

In the present study, Fornell-Larcker's criterion (Fornell and Larcker, 1981) was used to assess discriminant validity. Table 3 showed that all square root of AVE of each construct (diagonal elements) are bigger than other inter-construct correlations, which indicate the discriminant validity of the measurement model.

The SEM was analyzed using Smart PLS 3.0 software. The structural parameter significance was estimated via a bootstrapping procedure with 5,000 number of bootstrap samples. Figure 2 shows the main outcomes of the PLS test, including the path coefficients (β), path significance (p-value), and variance explained (R^2 values). (Note that a 5% level of significance (as obtained using two-tailed t-tests) was applied in all of the statistical tests).

As shown, the structural model provides good explanatory powers of 52.2% for tourist impulse buying, 70.8% for Perceived Enjoyment, 51.7% for Satisfaction, and 67.8% for Perceived Ease of Use. The results thus provide strong support for the research model. Table 3 summarizes the hypothesis testing results. Except for H3b, it is seen that the hypotheses which test the direct relationships from H1 to H6 are all strongly supported. Hence, the main assumption of the model that Mobile AR influences tourist unplanned purchase behavior is confirmed. The results additionally indicate that as user satisfaction with the Mobile AR increases, the likelihood of tourist impulse buyingalso increases. Table 4 presents the results of all hypotheses.

Observing the results presented in Table 3, the significance of H1 indicates that the Perceived Interactivity has a high impact on the Perceived Ease of Use, which means the higher perceived interactivity of AR systems will lead to the better perceived ease of use of the consumer. Indeed, when tourists are more likely to interact with the app, they will find it easy to navigate, search for the necessary tourism information and therefore their perceived ease of use will be higher. This finding also aligned with the result of the research of Pantano et al. (2017) in a different AR context.

For Hypotheses H2a and H2b, it is seen that the relationships among Perceived Usefulness, Perceived Ease of Use and Perceived Enjoyment are highly supported. In other words, the perceived usefulness and perceived ease of use of Mobile AR apps have a positive impact on the enjoyment of the user. That is, tourists experience a greater sense of enjoyment when the Mobile AR app provides more useful information regarding their trip and the apps are more easily used. The present findings are thus consistent with those of previous research in the domain of technology acceptance, which showed that PEOU perceived ease of use and perceived usefulness PU are both important factors in increasing user enjoyment and adoption of this new technology (Haugstvedt and Krogstie, 2012). The result presented for Hypothesis H2c shows a strong relationship between the perceived interactivity of the Mobile AR app and the user enjoyment. This result is also consistent with the study of Pantano et al. (2017) in virtual try-on AR app. The finding of a positive relationship between the perceived interactivity of the Mobile AR app
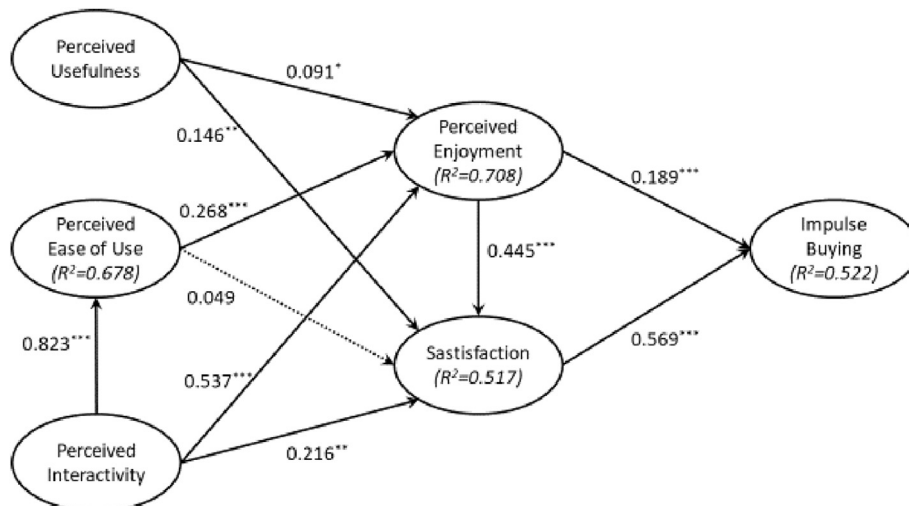

Figure 2. PLS analysis results for SEM.

Table 4. Hypothesis testing results.

Hypothesis	β	t	p	Results
H1: Perceived Interactivity–> Perceived Ease of Use	0.823	39.662	0.000	Supported
H2a: Perceived Usefulness–> Perceived Enjoyment	0.091	2.102	0.036	Supported
H2b: Perceived Ease of Use–> Perceived Enjoyment	0.268	4.276	0.000	Supported
H2c: Perceived Interactivity–> Perceived Enjoyment	0.537	8.484	0.000	Supported
H3a: Perceived Usefulness–> Satisfaction	0.146	2.763	0.006	Supported
H3b: Perceived Ease of Use–> Satisfaction	0.049	0.693	0.488	Not supported
H3c: Perceived Interactivity–> Satisfaction	0.216	2.814	0.005	Supported
H4: Enjoyment–> Satisfaction	0.445	6.671	0.000	Supported
H5: Enjoyment–> Impulse Buying	0.189	3.747	0.000	Supported
H6: Satisfaction–> Impulse Buying	0.569	11.483	0.000	Supported

and the user enjoyment is intuitive since apps that offer only low interaction opportunities (due to slow response time or insufficient meaningful information, for example) soon lead the user to switch to another app.

The results of H3a and H3b show that the degree of satisfaction of the user with the Mobile AR app increases with an increasing perceived usefulness and perceived interactivity. This result is consistent with the findings of Karahanna et al. (1999) that user satisfaction with new systems and technology products increases as the perceived usefulness and interactivity of a product or system increases. The unsupported H3c indicates that Perceived Ease of Use doesn't have a significant impact on Satisfaction. However, Liao et al. (2007) found that Perceived Ease of Use is a significant but weaker motivator of Satisfaction. This suggests the casual relationships between exogenous variables and endogenous variables can be examined by the inclusion of a third explanatory mediator variable (Hair et al., 2010) and in this case, it could be Perceived Enjoinment. We conducted a mediation analysis using SmartPLS 3.0 with the bootstrapping approach. The result showed that there is a significant indirect effect of Perceived Ease of Use on Satisfaction ($\beta = 0.505$, $p < 0.001$). Because the direct path of Perceived Ease of Use to SA is non-significant, the perceived Enjoyment was inferred to fully mediate the effect between Perceived Ease of Use and Satisfaction (Hair et al., 2010). In other words, the relationship between the perceived ease of use of the Mobile AR app and the resulting user satisfaction is fully mediated by the enjoyment factor. This finding is reasonable since satisfaction is an experience–specific effect in the context of Mobile AR app use (Oliver, 2014). Moreover, the present results also confirm that the users' perceived enjoyment when using a Mobile AR app is an important factor in determining their level of satisfaction with the app (the significant H4).

The significant results of H5 and H6 show that user enjoyment and user satisfaction when using Mobile AR apps are both critical drivers of tourist impulse buying. These findings are consistent with those of Bressolles et al. (2007) and (Verhagen and van Dolen, 2011), who found that the probability of impulse purchases increases as the customer satisfaction rate with the e-platform increases.

We also conducted robustness tests to assess the stability of the results. Following Sarstedt et al. (2019), we assessed the nonlinear effects of the SEM model. We used Ramsey (1969) regression equation specification error test (RESET) with SPSS. The results showed that no nonlinear relationship exists between research constructs which indicates the robustness of the conclusions.

6. Conclusion and implication

Although the literature contains many studies on the subject of online and offline impulse buying, very few of these studies consider the issue of tourist impulse buying (Sohn and Lee, 2017). Moreover, previous research on tourist impulse buying hasn't explored the application of Mobile AR in the tourism field. Therefore, this study has constructed an integrated model for predicting and interpreting TIB in the context of Mobile AR apps. The model integrates TAM, SOR, and flow theory and thus covers both the technical and the psychological aspects of tourist behavior when using Mobile AR apps. Empirical data were collected from a survey to examine the impact of Mobile AR apps characteristics on impulse buying.

This study contributes to the literature in several ways. Firstly, it offers an important theoretical underpinning of the role of Mobile AR apps in stimulating online and offline impulse buying behavior in the retail industry, in general, and the tourism industry in particular. Secondly, this research provides a response to the need to integrate technology and psychology models in the tourism field. On one hand, it enriches the literature of the SOR framework when it becomes one of the earliest studies employing this framework to explain the phenomenon of impulse buying in the tourism field. On the other hand, it also enriches the literature of TAM by adding the supplement aspect, such as interactivity into the acceptance of tourists in adopting this new technology. The integration of the two models provides important insights into tourist purchasing behavior. It not only captures the overall experience of tourists in using Mobile AR apps but also empirically demonstrates the relevance and significance of such apps in stimulating impulse buying behavior.

Besides the theoretical implication, several practical implications can also be drawn from this study. First, the results of this study showed that the interactivity of Mobile AR apps has a positive impact on perceived ease of use, enjoyment, and satisfaction of its user. Although interactivity is not a unique attribute that only Mobile AR apps have, it is the most important attribute, which helps users navigate the apps and enrich the user experiences when using the apps. In particular, the results show that a tourist impulse buying behavior can be induced by designing the Mobile AR app in such a way that a high level of interactivity is provided and the ease-of-use and usefulness of the app are easily perceived by its users. These results suggest that app developers should pay more attention to app design so that the app's interactivity is improved, helping to enhance the user experience. Second, the significance of H5 and H6 suggests that consumers are more likely to follow the purchase suggestion of Mobile AR apps if they feel a sense of enjoyment and satisfaction when using the app. Given the growth of mobile devices and apps in recent years, it is likely that Mobile AR apps will dominate in the future, particularly in the tourism industry. The present results are, therefore, useful not only in providing a conceptual understanding of tourist impulse buying but also in clarifying the particular characteristics of Mobile AR apps required to stimulate tourist impulse buying behavior. Third, the results presented in this study provide useful guidelines to tourism marketers in understanding the factors which govern the impulse buying behavior of tourists. Tourism marketers must seek to better understand tourists and respond quickly and strategically to their needs, preferences, and habits through the introduction and support of appropriate technology. The present study supports this need by extending the traditional TAM model to include a Perceived Interactivity construct, which is particularly relevant in today's rapidly-advancing IT environment.

Declarations

Author contribution statement

HN. Do: Conceived and designed the experiments; Performed the experiments; Contributed reagents, materials, analysis tools or data; Wrote the paper.

W. Shih: Conceived and designed the experiments; Contributed reagents, materials, analysis tools or data; Wrote the paper.

QA. Ha: Analyzed and interpreted the data; Wrote the paper.

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