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Impact Factors Analysis on AR Shopping Service's Immersion

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Abstract

Purpose – It is very important to examine customer's behavior about AR shopping either practically or academically. Thus, it will be worthwhile to discuss more in details about AR utility which is even in early stage of distribution industry now. **Research design, data, and methodology** - This study has designed in consideration of control effects of perceived complexity based on customer's flow as dependent variable, and on AR characteristics and technology readiness as independent variables. Study data has been collected from questionnaires after using AR shopping service directly by those who are 20-30 years old of male and female respondents, which has been analyzed with 167 questionnaires. Hypothesis is verified using by hierarchical regression analysis. **Results** - After results of hypothesis verified, positive influence has been shown in terms of sensory immersion, manipulation, and optimism, however, it is rejected in relation to navigation and innovativeness. Control effect of perceived complexity has not been appeared. **Conclusions** - Implications of this study are as follows. First, AR shopping service has to provide an informational value. Second, by providing AR service to customer group, marketing activities will be in effects. Third, recognized complexity is not connected with significant control effect in terms of customer's devotion of service

Keywords: Augmented Reality, AR's Characteristics, Shopping Service, Technology Readiness, Perceived Complexity.

JEL Classification Code: M0, M1, M3, O3, Z0

1. Introduction

The modern society is facing a great change that has not existed as the digital environment is universalized by the development and spread of high technology. Such changes are taking place in the distribution industry, and companies are making great efforts to respond to the rapidly changing distribution environment. Among them, Augmented Reality (AR) technology, which implements objects based on real reality, provides new experiences to people by maximizing the value of 'experience'

(Brown & Cairns, 2004). Thus, the navigation of services, purchases, and post-purchase evaluations can have an impact on experience throughout the consumption process

(Hairong, Terry, & Frank, 2001). As such, augmented reality is being used to pioneer new areas of 'experience distribution' to increase consumer satisfaction and provide differentiated competitiveness for companies (Chris,

Anna, & Efraxia, 2012). Despite the importance of these technologies, however, when comparing virtual reality and augmented reality technologies, augmented reality tended to receive less attention than virtual reality, and the studies on consumer perception of augmented reality-based shopping services are difficult to find.

Meanwhile, global companies tend to pay more attention to augmented reality technology than virtual reality technology. Iceland's game developer, CCP Games, has shut down its virtual reality service, and Google rarely mentions it after closing in March 2018 its virtual reality content studio 'Spotlight Stories' On the other hand, global distribution service companies such as e-Bay and Amazon are responding to the changing shopping environment by launching VR-based shopping services. Considering that there is a difference in the degree of interest in the use of technology between academic and industrial field, it is considered that looking at the consumer perception of augmented reality at the present time will be a great help

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not only for academic contribution but also practical use. Therefore, this study is to analyze how augmented reality-based shopping service affects consumers.

2. Theoretical Background

2.1 Augmented Reality Shopping Service

Augmented Reality (AR) is a technology that embodies our real world with computers and allows us to access more diverse information than virtual reality through a virtual environment. Virtual Reality (VR) differs from AR in that it implements three-dimensional reality using digital technology in an environment that is blocked from reality (Azuma, 1997; Gervautz & Dieter, 2012). However, these technologies are common in that they can be implemented in smartphones and provide various contents and experiences to users due to the development of the Internet and mobile technologies. In particular, the use of augmented reality technology in the distribution industry is powerful enough to change the paradigm of distribution. Companies recognize that augmented reality will be useful in the future and will play a positive role (Hairong, Terry, & Frank, 2001).

E-Bay, one of the world's largest e-commerce companies, uses augmented reality technology to provide a magic mirror system that allows customers to wear virtually clothing or accessories. Consumers can match products or obtain information related to products by looking at the mirror with a touch screen function in an offline store. And IKEA, a Swedish furniture company, has released the IKEA Place App, a mobile implementation of augmented reality technology, to help consumers change the interior by placing virtual furniture in a virtual home (Mihai & Simona, 2018).

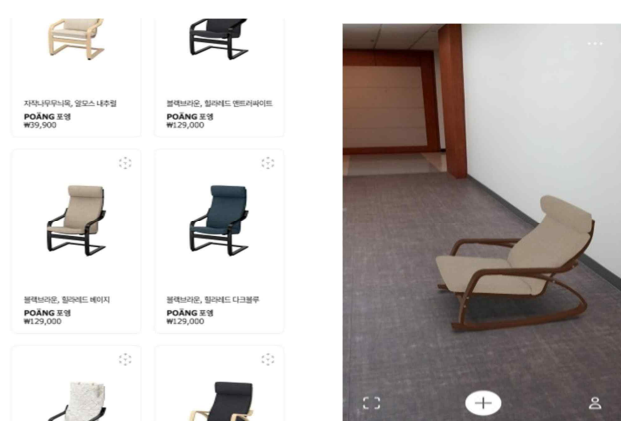


Figure 1: IKEA Place AR App.

Therefore, it is very important to analyze the consumer's perception of a shopping service based on augmented reality if companies in the retail industry reflect the augmented reality technology and the social acceptance of it continues as IT technology develops. In particular, unlike advertising, which focuses on message delivery, augmented reality shopping services will enable consumers to effectively flow themselves in the service and evaluate it while realizing the product directly in accordance with their needs (Hairong, Terry, & Frank, 2001).

2.2. AR Shopping Service Characteristics and Consumers Immersion

The biggest feature of the virtual or augmented reality service is the flow of users to the service and content. Therefore, the media characteristics of augmented reality and virtual reality related to user's flow have similarities. (Brown & Cairns, 2004; Kim & Sun, 2011). The flow of users through virtual or augmented reality means that users perceive the interaction between themselves and the service as fun and navigable activity. In other words, users do not think about any activities that they are not relevant when they are focusing on the service (Csikszentmihalyi, 1975; Trevino & Webster, 1992). The reason why the user's flow to VR or AR services is important in the retail industry is that consumers gain value for the product or brand not only through the consumption of the product but also through the experience of the product purchasing process (Vijayasathay & Jones, 2000). Thus, companies need to increase the value of the consumer's experience in order to differentiate themselves from the competition companies (Pine & Gilmore, 1998). Consumers experiencing products through augmented reality get different values for the product or brand (Hairong, Terry, & Frank, 2001; Susan, Neil, & Moira, 2011). It is therefore important for companies to look at consumer responses to augmented reality shopping services (Heo & Chung, 2011).

According to Lavroff's (1994) study of virtual reality, the media characteristics that cause user's immersion are classified into three dimensions: sensory immersion, navigation, and manipulation. First, immersion in media is about recognizing that a user is experiencing a virtual world rather than viewing the content on the screen. That is, the user is immersed in sensory immersion while receiving visual and auditory stimuli from the screen. Second, navigation is the recognition that the user can explore and interact with the virtual reality as the user want to. This is what makes virtual reality feel like it is. Thirdly, the manipulation is the user's will to perform specific actions such as grabbing, pushing, or bringing contents in the media. These characteristics of virtual reality not only provide users with a new experience, but also lead them to

immersion while attracting fun and interest. These immersion effects are similar regardless of age (Lee, Cha, & Kwon, 2016). However, compared with the recent phenomenon of using computer and smart devices with the development of IT technology, Lavroff used the head mounted display (HMD) to study the characteristics of virtual reality, so the result may be different.

Subsequent studies reflecting computer and mobile media have been conducted, but the results are inconsistent. An empirical study by Kye and Kim (2008) argued that presence is a strong influence on immersion and analyzes the effect of navigation on presence and immersion, but the research result shows that navigation has a meaningless effect on presence and commitment. However, according to Chun and Park (2015), their study examining the impact of smartphone augmented reality empirically verifies that navigation affects presence and leads to immersion. The study also suggests that the user's sensory experience with augmented reality may also vary with the level of sensory stimulation. Augmented reality is a technology that combines virtual and visual information based on reality (Javornik, 2016). Therefore, media that provide relative screen sizes and sounds, such as HMD, computers, and smart devices, can be immersed depending on their characteristics. In particular, portable mobile devices that are most likely to be exposed to noise stimuli may be more immersed depending on the usage environment (Kim & Sung, 2011).

Analyzing these discussions, it is expected that identifying how augmented reality shopping services affect consumer engagement can help predict consumer behavior. Therefore, this study established the following research hypothesis.

H 1: The characteristics of augmented reality shopping service will have a positive (+) effect on users' service immersion.

H 1-1: Users' sensory immersion characteristics in augmented reality shopping service will have a positive effect on service commitment.

H 1-2 : The exploratory characteristic of augmented reality shopping services will have a positive effect on service immersion.

H 1-3: The operational characteristics of the augmented reality shopping service will have a positive effect on service immersion.

2.3. Consumer Technology Readiness and Immersion

With the rapid development of information and communication technology, companies apply new technology in various management fields, and consumers

also use the new technology for their own various consumption activities. In recent years, however, advanced technologies have developed very rapidly, which has resulted in an increasing number of consumers who are unable to keep up with the pace of technology development or feel tired (Garcia & Calantone, 2002). In relation to this phenomenon, various studies on the new technologies acceptance by consumers have been conducted. Parasuraman (2000) proposes "Technology Readiness" as the rationale for the existence of positive or negative perceptions for new technologies among people. Technology readiness means four concepts: Optimism, Innovativeness, Discomfort, and Insecurity. Optimism and innovativeness were considered positive factors, and discomfort and anxiety were considered negative factors. 36 items were developed to measure these factors. This study considered optimism and innovativeness as positive factors in order to analyze the effects on augmented reality shopping service commitment. Negative factors in technology readiness are the tendency to avoid complexity while pursuing the basic function of technology (Meuter, Bitner, Ostrom, & Brown, 2005).

Optimism means a positive attitude that new technologies can give them the flexibility, efficiency, and convenience of life in their daily lives. Optimistic consumers are less likely to reject new technology when they accept it, and through technology they can have efficient work performance and positive psychological stimuli. (Parasuraman, 2000). This optimism allows consumers to compare products or explore choices on their own based on reality. In this sense, consumers are immersed in services and are the biggest factor for them to gain the utility of technology.

Innovativeness tends to be perceived by consumers as being able to embrace new technologies themselves. (Parasuraman, 2000). They tend to be curious and willing to try even if they have no experience with technology or services yet. Innovative consumers of technology enjoy their access to technology use or even help others. Therefore, consumers who encounter augmented reality shopping services will be able to immerse themselves in the service more actively because they want to satisfy their own needs through various attempts. Therefore, this study established the following research hypothesis.

H 2: Consumer technology readiness will have a positive impact on augmented reality shopping service commitment.

H 2-1: Consumer optimism will have a positive impact on augmented reality shopping service commitment.

H 2-2: Consumer innovativeness will have a positive impact on augmented reality shopping service commitment.

2.4. Moderating Effect in Perceived Complexity

Perceived Complexity is one of the variables that can explain the concentration and preference of the object, which consumers perceive as difficult to understand the technology or the object (Bressler & Bodzin, 2013). In other words, Perceived Complexity means the skills, procedures, and visual complexity required by consumers when using augmented reality shopping services.

Perceived Complexity related to user immersion has been analyzed in various ways. According to Lowe and Alpert (2015), users experiencing high levels of complexity feel that they are not comfortable with the use of the technology. Therefore, it was analyzed that Perceived Complexity could act as a resistance to consumers in accepting, using and immersing the technology and contents. Berlyne's (1970) study, however, argues that moderate levels of complexity can provide users with the value of "enjoyment." In other words, if the level of complexity is too low, the user does not pay attention to or concentrates on the object, and if the level of complexity is too high, interest in the object falls due to the user's perception limit. The complexity of users' immersion can vary depending on what they are facing. For example, if the content itself is the user's goal, such as games and simulations, they will need to actively engage in cognitive efforts to gain higher pleasure. Cognitive stimuli can thus regulate the level of interest of users (Bressler & Bodzin, 2013).

Although various previous studies have discussed the moderating role of Perceived Complexity, there are limitations in interpreting the effects of perceived complexity of consumers in augmented reality shopping services in the same context as the above mentioned studies. Unlike the above-mentioned users' purpose of using games or simulation contents, the augmented reality shopping service is intended to allow consumers to decide on the purchase of a product after obtaining information about the product while using the content (Kyung, 2019). Therefore, it is necessary to analyze whether the complexity of augmented reality shopping service actually has a significant effect on consumer immersion and what role the influence plays. However, it is difficult to find a study on this part. Therefore, this study established the following research questions.

R 1: Does the impact of augmented reality features and technical readiness on augmented reality shopping service immersion depend on the perceived complexity of the user?

3. Methodology

3.1. Research Model

In accordance with the above-mentioned discussion, this study anticipated that the characteristics of augmented reality technology would affect consumer commitment (H1). Therefore, the hypothesis of this study was established that higher levels of sensory commitment (H1-1), navigation (H1-2), and manipulation (H1-3), which are sub-dimensions of augmented reality technology, increased consumer involvement. This study hypothesized that the higher the level of technology preparation by consumers, the more likely they will actively accept or use technology (H2), while the higher the level of optimism and innovativeness, the higher the level of consumer commitment (H2-1, H2-2). Lastly, this study presented research question (R1) and designed a research model such as <Figure 2> to confirm whether perceived complexity of consumers plays a moderating role in consumer immersion.

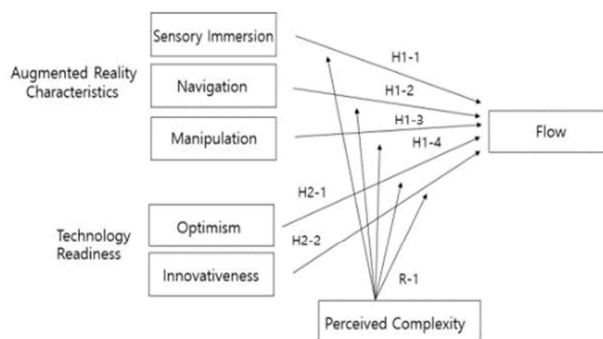


Figure 2: Research Model

3.2. Sample Design and Analysis Method

The study was conducted for two months from October 2019 to November 2019. Respondents selected for the survey were aimed at males and females in their 20s and 30s who felt less rejection when using smartphones and were able to install and handle augmented reality shopping services. Respondents used the IKEA PLACE app from IKEA, a furniture brand that is well known in Korea for augmented reality shopping service.

This study showed how to use the app after showing respondents an example video of the virtual reality shopping service. Each respondent installed the IKEA Place app directly on their smartphone and was asked to answer the questionnaire to be used for this study after allowing them to use as much as they wanted.

3.3. Measurement of Variables

This study measured three variables that are the characteristics of augmented reality service: sensory immersion, navigation, and manipulation. This study also measured optimism and navigation as a positive influence on technology readiness, complexity as a regulatory variable, and service immersion as a dependent variable. Sensory immersion, navigation, and manipulation were measured using nine items that were partially modified by the analysis scale in Lavroff (1994) and Kye and Kim (2008). Optimism and innovativeness were measured in six categories by partially modifying the research analysis scales of Lin and Hsieh (2007) and Chung, Lee, and Koo (2014). The perceived complexity was measured with four

items by some modifications to Kim and Jeon's (2018) scale. Service immersion was measured using three items with some modifications to the research analysis scales of Han (2017) and Hoffman and Novak (1997).

The measurements were made using three items, some of which were modified from the study analysis scales of Han (2017) and Hoffman and Novak (1997).

Each variable was measured using Cronbach's alpha confidence coefficient. As a result of confirming the reliability, each variable showed more than .07. Therefore, this study was judged well enough to proceed. Each measurement item and reliability can be found in <Table1> below.

Table 1: Measurement Items and Reliability Test Results

Variable	Measurement Item	Cronbach's alpha
Sensory Immersion	The products in the shopping service seemed to make no difference compared to the actual products.	.770
	The products in the shopping service seemed to the real ones.	
	The products in the shopping service seemed to actually exist.	
Navigation	It was possible to explore the shopping service freely.	.862
	It was possible to explore the shopping service at my will.	
	It was possible to explore the shopping service as much as I wanted.	
Manipulation	I would be free to explore the products of the shopping service.	.831
	I think I can look at the products of the shopping service appropriately for my situation.	
	I think I can look at the products of the shopping service according to my situation.	
Optimism	Technology enables people to manage their daily routines efficiently.	.712
	Products and services combined with technology make it easy to use.	
	It is good to use the most advanced technology.	
Innovativeness	Technology gives me more freedom and mobility.	.798
	I tend to use new products faster than others.	
	I want to use it as soon as new technology comes up.	
Perceived Complexity	I think it will take a lot of effort to use the shopping service.	.903
	I think it will take a long time to fully understand and use the shopping service.	
	Using the shopping service is complicated and doesn't seem useful to me.	
	I am uncomfortable with the difficulty of using the shopping service.	
Flow	While I was using augmented reality shopping services, I was completely immersed in them.	.727
	I used augmented reality shopping services longer than I expected.	
	While I was using augmented reality shopping services, I became insensitive about what was happening around me.	

4. Research Results

4.1. Sample Characteristics

A total of 172 respondents participated in this study.

After excluding five questionnaires of unsatisfied respondents, 167 were used for the analysis.

Respondents consisted of 91 males (54.5%) and 76 females (45.5%), with a higher proportion of male respondents. The average age of the respondents was 23.8 years. Their education was 125 in college, 27 in college, 12

in graduate school, and 3 from graduate school.

4.2. Research Model Verification Result

The hypotheses and research questions presented in this study were verified using hierarchical regression analysis. A summary of the results is shown in Table 2 below. As a result of the hypothesis test, the sensory immersion ($t = 2.526$, $p < .05$) and operation characteristics ($t = 4.539$, $p < .001$) among the characteristics of augmented reality had a

significant effect on the user's service immersion. Optimism ($t = 3.748$, $p < .001$), one of the positive factors in consumer technology readiness, has a significant effect on user's service immersion. Meanwhile, the navigation characteristics of augmented reality and the innovativeness of consumer technology preparation were rejected. The hypothesis of this study predicted that perceived complexity would play a moderating role, but the effect was not statistically significant.

Table 2: Hierarchical Regression Analysis Results

Independent Variable	Model 1			Model 2			Model 3			
	SE	β	t(p)	SE	β	t(p)	SE	β	t(p)	VIF
(a Constant)	.277	2.690	9.694***	.473	-.143	-.303	.470	-.241	-.513	
Sex	.097	.235	2.418*	.086	.332	3.860***	.087	.278	3.182	1.272
Age	.011	.035	3.234**	.009	.032	3.442**	.009	.029	3.150	1.193
Sensory Immersion				.066	.165	2.526*	.071	.240	3.373	1.465
Navigation				.068	-.001	-.021	.074	.005	.062	1.518
Manipulation				.069	.315	4.539***	.069	.307	4.462	1.209
Optimism				.080	.300	3.748***	.082	.249	3.040	1.206
Innovativeness				.044	-.045	-1.026	.047	-.003	-.053	1.225
Perceived Complexity							.049	-.029	-.593	1.426
Sen $\times$ Com							.086	.041	.483	2.356
Navi $\times$ Com							.089	-.174	-1.947	2.391
Mani $\times$ Com							.080	.017	.215	1.394
Opt $\times$ Com							.095	-.065	-.686	1.142
Inn $\times$ Com							.039	-.074	-1.892	1.282
F, R ² , ΔR^2	R ² =.070, ΔR^2 =.059, F=6.219, $p < .01$			R ² =.333, ΔR^2 =.304, F=12.508, $p < .001$			R ² =.379, ΔR^2 =.326, F=1.902, p =.084, Dubin-Watson=1.812			

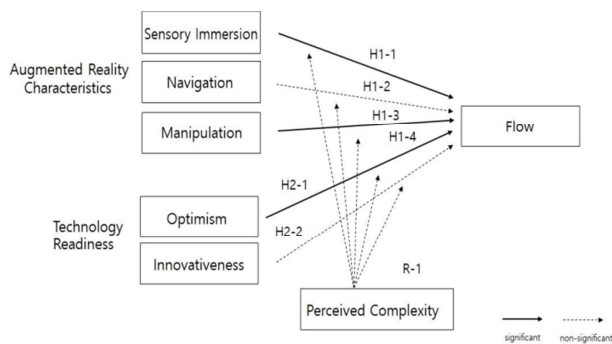


Figure 3: Hypothesis Testing Results

5. Research Results and Implications

This study examined the characteristics of shopping service using augmented reality technology and the effect of consumer's technical readiness on service immersion. The discussion and implications of this study are as follows.

First, among the three characteristics of augmented reality, sensory immersion, navigation, and manipulation, sensory immersion and manipulation showed a significant effect on service immersion. The results showed

empirically that the search characteristics were not statistically significant. These results are similar with the results to previous studies in that the consumer's sensory experience can be maximized and consumers can shop according to their own situations (Kye & Kim, 2008; Chun & Park, 2015). Meanwhile, the navigation characteristic was rejected. This supports the findings of previous studies like Kye and Kim's (2008), and as mentioned above, sensory involvement and operational characteristics had an effect on consumer's service immersion, and navigation characteristics did not show any significant effect. Contrary to the point that the portability of mobile devices will significantly influence the navigation effect (Kim & Sung, 2011), this study rejected the navigation effect. It is expected that narrow mobile screens resulted in insignificant results on consumers' navigation. In addition, the current level of augmented reality shopping service quality is not as high as consumer expectations, and it may be the reason for the results of the navigation factor analysis. In consideration of the currently launched services, this study utilized one of the most active augmented reality shopping services. However, when respondents demonstrated augmented reality shopping service, there were some problems such as error or bug in product implementation. These problems would have a direct impact on navigation characteristic when consumers use and manipulate augmented reality shopping services. Therefore, considering the above research results, it is important for companies to implement augmented reality shopping service to visualize the reality in the mobile screen sufficiently to reflect the reality rather than to highlight the products or show the advantages. The purpose of the shopping service is to help consumers identify the advantages and disadvantages of products they want to buy and make reasonable choices (Kyung, 2019). Therefore, augmented reality shopping service can reflect the reality and maximize the information of the product while consumers experience the service.

Second, the results of this study showed that optimism, a positive aspect of consumer technology readiness, had a significant effect on the consumers' service immersion. Optimism is a kind of consumers' expectation for new technology. In other words, the degree of service immersion depends on how well the technology satisfies the consumer's expectation. The development of full-scale augmented reality shopping service is only recently made. The service offers consumers a distinction from the traditional on-line shopping service that mainly provided

information by text or image. Therefore, if augmented reality shopping service is actively provided to consumers who are expected to be highly optimistic through analysis of consumer purchasing patterns and service usage behavior, consumers will be deeply immersed in the service.

Third, perceived complexity did not show a moderating effect on consumer's service immersion. This finding will help to change consumers' perception that augmented reality shopping service is a new technology and should maximize service convenience. However, it should be taken into account that respondents are in their early 20s and 30s who are accustomed to dealing with digital devices, and that they are not reflecting various functions since augmented reality service implementation is still in its infancy. Indeed, Amazon, the world's largest retailer in the industry, has begun AR View, an augmented reality distribution service, but the service has not been running smoothly. It9, an augmented reality shopping service launched by e-Bay in Korea, has not been well underway. Thus, a further analysis for the degree of complexity that affects consumers in the future will lead to more insightful results.

6. Limitations and Future Research

This study has the following limitations. First, the participants of this study were university students and graduate students. Because they are accustomed to using smartphones, thus, they are likely already using AR applications. These conditions may have influenced the research analysis of factors based on technical experience. In addition, certain objects, such as students, are collected for convenience, which can be difficult to apply and generalize to all consumers. Therefore, it is necessary to classify and analyze the consumer group in consideration of the consumer's technical experience and age group.

Second, the place where demonstrating augmented reality shopping service to respondents was an arbitrary space like a lecture room. This means that consumers are different from the situation of using augmented reality shopping services in their private space.

Third, when respondents use augmented reality shopping services, the environment that demonstrates augmented reality technology and its demonstrations was not completely controlled. Therefore, it needs to control variables such as errors and bugs of the service itself, creating an environment suitable for the consumers' situation, and preconceived their opinions of a specific brand.

Fourth, this study considered consumer's immersion as a dependent variable with one dimension and conducted a questionnaire. However, immersion involves various

dimensions, such as empirical, behavioral, and emotional immersion (Csikszentmihalyi, 1975). If these various dimensions of immersion are taken into account, more in-depth discussions will be possible.

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