

THE EFFECTS OF AVATAR'S REALITY LEVEL ON METAVERSE APPLICATION COMPATIBILITY AND USE INTENTION

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ABSTRACT

Objective: The aim of this study is to analyze metaverse application compatibility and application use intention depending on reality level of avatars and examine moderating effects of avatar-self-image identification and body ratio.

Theoretical framework: The Proteus effect is the tendency for people to be affected by their digital representations, such as avatars. The Uncanny Valley effect is a hypothesized relation between an object's degree of resemblance to a human being and the emotional response to the object.

Methodology: To test hypotheses, this study conducted an online and offline mixed survey to 219 respondents. To test validity and reliability of measurement tools, this study did factor analysis and reliability analysis. Hypotheses were tested with t-test and ANOVA analysis. To test mediating effects, it did mediating regression analysis.

Results: The findings of data analysis were as follows. First, the lower the reality level of avatars is, the higher the higher metaverse application compatibility gets. Second, the moderating effect of avatar-self image identification was not statistically significant. Third, the moderating effect of avatar body ratio was confirmed. Forth, metaverse application compatibility was found to have positive effect on application use intention. Fifth, the mediating effect of application compatibility on the effect of reality level of avatars on application use intention was confirmed.

Research, Practical & Social implications: The findings of this study will be good reference data for production of metaverse platforms using avatars, and scholastic and practical use of avatars.

Originality/value: This study is an empirical analysis of outside characteristics of avatars based on Proteus effect and uncanny valley effect.

Keywords: avatar, metaverse, reality level, identification, body ratio, application compatibility, use intention.

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OS EFEITOS DO NÍVEL DE REALIDADE DO AVATAR NA COMPATIBILIDADE DO APLICATIVO METAVERSO E NA INTENÇÃO DE USO

RESUMO

Objetivo: O objetivo deste estudo é analisar a compatibilidade do aplicativo metaverso e a intenção de uso do aplicativo, dependendo do nível de realidade dos avatares, e examinar os efeitos moderadores da identificação da autoimagem do avatar e da proporção corporal.

Referencial teórico: O efeito Proteus é a tendência das pessoas serem afetadas por suas representações digitais, como avatares. O efeito Uncanny Valley é uma relação hipotética entre o grau de semelhança de um objeto com um ser humano e a resposta emocional ao objeto.

Metodologia: Para testar hipóteses, este estudo realizou uma pesquisa mista online e offline para 219 entrevistados. Para testar a validade e confiabilidade das ferramentas de medição, este estudo fez análise fatorial e análise de confiabilidade. As hipóteses foram testadas com teste t e análise ANOVA. Para testar os efeitos mediadores, ele fez uma análise de regressão mediadora.

Resultados: Os resultados da análise de dados foram os seguintes. Primeiro, quanto menor for o nível de realidade dos avatares, maior será a compatibilidade do aplicativo metaverso. Em segundo lugar, o efeito moderador da identificação da autoimagem do avatar não foi estatisticamente significativo. Em terceiro lugar, o efeito moderador da proporção do corpo do avatar foi confirmado. Em quarto lugar, verificou-se que a compatibilidade do aplicativo metaverso tem um efeito positivo na intenção de uso do aplicativo. Em quinto lugar, foi confirmado o efeito mediador da compatibilidade do aplicativo no efeito do nível de realidade dos avatares na intenção de uso do aplicativo.

Pesquisa, implicações práticas e sociais: Os resultados deste estudo serão bons dados de referência para a produção de plataformas metaversas usando avatares e uso escolar e prático de avatares.

Originalidade/valor: Este estudo é uma análise empírica das características externas dos avatares com base no efeito Proteus e no efeito do vale misterioso.

Palavras-chave: avatar, metaverso, nível de realidade, identificação, proporção corporal, compatibilidade de aplicativos, intenção de uso.

1 INTRODUCTION

Recently, metaverse service spread widely not only in the IT industry, but in daily life. Metaverse is a compound word of 'meta' meaning virtual reality or transcendency and 'verse' meaning universe, and it means 3-dimensional virtual world. The term metaverse appeared for the first time in Snow Crash, science fiction of Neal Stephenson, published in 1992. The term 'avatar' appeared for the first time in the book as well. Currently, as well-known avatars, there are 'Zepeto', an augmented reality service run by NaverZ, and 'Minecraft', 'Roblox', and 'Fortnite', etc. In addition, Instagram, Facebook, Tiktok, Kakao Talk, and Telegram, etc. can also be considered as metaverses where



people record real lives in digital spaces. And, in the 20th presidential election held in March 2022, in Korea, SK Telecom broadcast presidential election vote counting in the metaverse space called 'E-Friend' with terrestrial broadcasts and cable channels like KBS, MBC, JTBC, and TV Joseon, etc. for the first time in the world. As such, metaverse service is expanding in our daily lives.

Three core components of metaverse are avatar, virtual world, and activities. Among these, avatar is online character representing a person, and is now being called 'Digital Me'. In the virtual reality called metaverse, users express themselves through their avatars, and meet with other avatars representing other people, playing, consuming, and communicating.

This study was performed to empirically analyze the effect of reality level (high vs. low) of avatars on application compatibility and application use intention. In addition, this study wanted to analyze moderating effects of avatar-self image identification (high vs. low) and body ratio of avatars (realistic vs. unrealistic) on the effect of reality level of avatars on metaverse application compatibility, and the mediating effect of metaverse application compatibility on the effect of reality levels of avatars on intention to use application.

2 THEORETICAL FRAMEWORK

2.1 METAVERSE AND AVATAR

Metaverse is a compound of 'meta' and 'universe', indicating 3-D virtual world. It appeared for the first time in Snow Crash, a novel of Neal Stephenson. The term avatar also appeared in the book for the first time (Kim, 2021). Avatar originates from Sanskrit 'avatara', physical appearance of deity in Hinduism. In 1986, avatar was first used in the video game called 'Habitat' to indicate characters of users. But, the momentum the term began to be used in full scale in cyber space from Snow Crash (Lim, 2021). Avatar exists as an object expressing another self of the user as 'cyber animation character containing consciousness of the user' and 'virtual body expressed as visual image' (Lee & Jo, 2010). Another way of defining metaverse is 'The 3D-based virtual world where, through the avatar representing me, I lead daily life and economic life.' So, avatar can be called an essential element which is inevitable in the metaverse platform (Ko, Chung, Kim & Shin, 2021). In addition, metaverses and avatars are actively used in SNS, and companies are



using Snapchat, Instagram, Facebook, and Twitter to provide instant response and assistance to customers(Moathen & Almaktoom, 2023).

Recently, with the increasing demand for non face-to-face service due to the COVID-19 pandemic, metaverse provides a platform where people can gather together, act, and consume online. The popularity of 'additional character', or 'buke' in Korean pronunciation, has contributed to the popularity of metaverse. Buke is another character of a person, and the person projects oneself to the buke(Kim, 2021). Avatar, one of the essential elements of metaverse service, is the same concept with buke existing in virtual reality. Users create their own avatars, provide them with IDs, design them with what they want them to be, and communicate with other users in the metaverse world(Kim, 2021). In addition, avatar is a major income source to the company providing metaverse service. Avatar-related items, and advertisement are major business model of metaverse service.

2.2 REALITY LEVEL OF AVATAR AND PROTEUS EFFECT

Avatar is increasingly important as the medium which interacts with other people on behalf of the user, and its role is expanding in the sense that it goes beyond the role of delivering information or working as the means of representing the user, and plays the role of escaping from the real world, and immersing itself to virtual world and other roles(Kim & Na, 2018). In the real world, visual interactions between people are mainly made through facial expressions and body movements. In the dialogues between avatars, in the virtual world, facial expressions and body movements can be important means for mutual communication.

One of the reasons why avatar gets spotlight is emergence of 5G communication service where applications linking the real world and the virtual world allow users to go across the borders between the two worlds smoothly. For example, at the CES held in Las Vegas in 2021, Hans Vestberg, CEO of Verizon predicted that quick speed and large-volume data transfer capacity of 5G will change many things, and trigger the appearance of new consumer applications(Park, 2021). In the K-POP music area, Aespa, the four-person female idol group belonging to the SM Entertainment which debuted in 2020 became sensational when it was found that the group is composed not only of 4 real singers, but of 4 avatars acting in the virtual world. Besides, other major K-POP artists like BlackPink, Twice, Sunmi have made avatars and actively are communicating with



their pans in the metaverse platform. The outside appearances or reality levels of those avatars are close to cartoon characters rather than real persons.

Meanwhile, it is known that the behaviors of users can be affected by the characteristics of given avatars. It is called Proteus effect. Yee & Bailenson[9] offered the concept of Proteus effect for the first time by experimentally showing that the appearance of one's online avatar affects one's offline behavior. According to Proteus effect, when one enters into virtual reality, one changes one's behavior depending on the characteristics of one's own avatar. For example, the avatar which has attractive appearance shares more information about itself, and is more confident in relations with others than less attractive avatars are(Yee & Bailenson, 2007).

This study divided avatars into two groups: those which are similar in appearance to humans (high reality level) and those similar to cartoon characters (low reality level), and examined whether reality level affects metaverse application compatibility. According to Proteus effect, one changes one's real behavior in virtual reality depending on the characteristics of one's avatar. Therefore, we can assume that, in the metaverse platform, one will prefer the avatar which is similar to cartoon character (with low reality level), and its face and body form can be easily changed by the users than the avatar similar to humans (with high reality level). Accordingly, assuming that the lower reality level of avatar is, the higher metaverse application compatibility gets, this study set hypothesis 1, based on Proteus effect and previous researches.

H1. Depending on reality level (high vs. low), metaverse application compatibility will vary.

H1-1. The higher reality level is, the lower metaverse application compatibility gets.

H1-2. The lower reality level is, the higher metaverse application compatibility gets.

2.3 MODERATING EFFECT OF AVATAR-SELF IMAGE IDENTIFICATION

Identification is linkage or emotional attachment consumer feels toward a specific object(Ahn, Yoo & Kim, 2004). The avatar reflecting a unique personality of the user strongly reveals his or her identity. The appearance of personalized avatar is different from avatars of other users, and from other virtual objects, and is perceived as an existence which can communicate(Benford, Bowers, Fahlen, Mariani & Rodden, 1994). Therefore,



we can assume that the higher avatar-self image identification is, the more the user desires to reveal himself or herself through the avatar. So, we can assume that, to express their characters well, users will prefer avatars similar to cartoon characters (with low realistic level). On the contrary, we can also assume that the user whose avatar-self image identification is low will have little difference in application compatibility depending on avatar reality level. Based on the above discussion and previous researches. this study set hypothesis 2.

H2. The effect of avatar reality level on metaverse application compatibility will be moderated by avatar-self image identification.

H2-1. The higher avatar-self image identification is, the higher metaverse application compatibility will be.

H2-2. The lower avatar-self image identification is, there will be no difference in metaverse application compatibility.

2.4 VIRTUAL HUMAN AND UNCANNY VALLEY

Virtual human in online platform like metaverse application is also called 'virtual influencer'. Virtual human is virtual existence embodied in 3-D graphic based on AI. Virtual human can be made into various images, and can be changed into various forms, depending on the intentions of manufacturers. Thus, virtuous human is suitable for customized advertisement.

In 2021 in Korea, virtual human model 'Rozy' which appeared in ShinhanLife advertisement has caused good responses from the advertisement business and consumers. Other virtual influencers — 'Keem Reah' of LG Electronics, 'Rui' of DOB Studio, 'Han Yua' of Smile Gate, and 'Lucy' of Lotte Home Shopping - are also active as models. 'Lil Miquela', one of the most famous virtual influencers, was generated by the U.S. startup Brud in 2016. There are other well-known virtual influencers like 'Noonoouri' in France, 'Imma', advertisement model of Japan's Ikea, and 'Shudu', digital supermodel in the United Kingdom(Lee, Hong & Park, 2021). Virtual humans which have appeared up to now are mainly young ladies in their 20s. Those models have merits like they do not get old; they are free from limits of time and space. In addition, they are cheaper than famous real human entertainers or advertisement models, and they do not make any scandal in their private lives. Therefore, we can expect that activities of such virtual humans in advertisement and other online areas will be accelerated.



Uncanny valley theory assumes that, when humans look at a humanoid object, they favor it more and more as it resembles humans more closely. But, the resemblance reaches a certain point, humans feel repulsive toward it on the contrary (Mori, MacDorman & Kageki, 2012). Beyond that point, if they resemble humans so much that it is difficult to distinguish them from each other, the favorability will rise again. It is called the Uncanny valley theory because it has a deep valley shape when graphing the favorability section where it plunged and then rose sharply. Virtual humans which are currently active like Rosy, Kim Re-a, Lui, and Lucy are finely and elaborately manufactured as much as we have difficulty distinguishing them from actual human beings. Accordingly, following the uncanny valley theory, we can assume that avatars resembling humans with higher reality level will be favored than those which do not resemble humans much (to stimulate repulsive feeling).

2.5 MODERATING EFFECT OF BODY RATIO OF AVATAR

When we talk about appearance characteristics of avatars, we mainly deal with facial form, expression, height, clothes, and hair style, etc. But, body part ratio is one of the important elements of appearance of avatar. About the method of designing avatars, Kim & Na[7] suggested the followings: First, we should embody design and animation reflecting face-to-face interaction; second, we should apply interaction functions using various channels; third, we should reflect interaction between avatar and environment. In metaverse platform, avatars are usually manufactured to express facial expressions well. Accordingly, we can assume that, unlike virtual humans whose body part ratios are similar to actual humans, avatars tend to have improper fraction with head and face being larger than actual ratio of them.

In their research on body part ratio of digital characters, Seol & Han(2004) found out that the larger the ratio of face among all parts of body of digital characters is, the more users favor, want to purchase, and get access to the site again. That is, it was found that the digital characters with bigger ratio of face are more favored by users, because effective representation of facial expression needs faces bigger in ratio than actual sizes of humans. Facial expression is the strongest emotional expression consciously and unconsciously made by humans, and it plays an important role in human relations (Kim & Na, 2018). Therefore, we can presume that, in the metaverse platform, users favor



avatars which have well-shaped faces. Based on the above discussion and previous researches, this study set hypothesis 3.

H3. The effect of reality level of avatar on metaverse application compatibility will be moderated by body part ratio of avatar.

H3-1. If the body part ratio of avatar is realistic, avatar whose reality level is high will be high in its application compatibility.

H3-2. If the body part ratio of avatar is unrealistic, avatar whose reality level is low will be high in its application compatibility.

2.6 METAVERSE APPLICATION COMPATIBILITY AND USE INTENTION

Rogers(2003) defined compatibility as "the degree to which the innovation is perceived as being consistent with existing values, past experiences, and needs of potential adopters." This study used application compatibility because most of metaverse platforms are occupied by smartphone applications. And, application use intention is defined as intention to use application(Kwon & Yun, 2010), and continuous use of applications can be seen as the activities to use applications in their works(Kim, 2007). To generate consumer purchase intention, astute marketing skills are needed by marketing personnel in introducing a product (Popp & Woratschek, 2017; Tilaar, Mulyana, Komaladewi & Saefullah, 2023). In the IT field, Bhattacharjee(2001) viewed continuous use intention as an important concept along with adoption of information system. Previous researches on compatibility and use intention found that compatibility had positive effect on relative advantages of innovation objects and use intention(Park, 2011), and perceived compatibility works negatively to resistance to innovation, while it works positively to perception of relative advantages and use intention(Chang & Park, 2010). And social media users' attitudes toward eWOM content can have a positive impact on customers' perceptions of a product or service and their likelihood to purchase(Madhumithaa, Mishra, Sruthi, Sivaperumal & Adhav, 2023; Tan, Quang & Duc Thanh Dat, 2023). Based on such researches, this study set hypothesis 4 and hypothesis 5.

H4. Metaverse application compatibility of avatar will have positive (+) effect on application use intention.

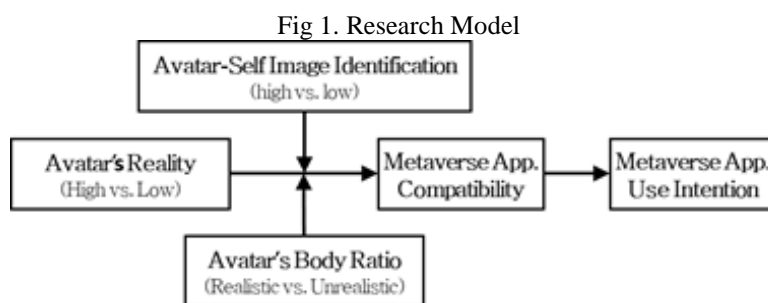
H5. The effect of reality level of avatar on application use intention will be mediated by metaverse application compatibility.



3 METHODOLOGY

3.1 RESEARCH MODEL

The aim of this study is to examine whether metaverse application compatibility can vary depending on reality level (high vs. low) of avatar, and whether it can be regulated by avatar-self image identification (high vs. low) and avatar body ratio (realistic vs. unrealistic). Thus, this study developed two stimulants depending on reality levels of avatars, and classified avatars depending on body ratios of them with two stimulants, and measured metaverse application compatibility of them. By integrating the above discussions, this study developed the research model shown in Figure 1 [2(reality level: high vs. low) × 2(avatar-self image identification: high vs. low)].



Source: Prepared by authors (2023).

3.2 DEVELOPMENT OF STIMULANTS AND EXPERIMENTAL PROCEDURE

As stimulants, this study manufactured four avatars in total depending on reality levels and body ratios of them. First, to express an avatar which is high in reality level like virtual human, this study manufactured an Asian female model (reality level: high). Then, to express an avatar which is low in reality level like cartoon character, this study manufactured an avatar using a Zepeto application, and decorating the model with hair style and clothes similar to the first model (reality level: low). Then, this study made two different avatars depending on body ratios of them. One has the body ratio which is similar to real human (body ratio: realistic), and the other has the unrealistic body ratio (the ratio of face and other parts of the body is almost 1:1) (body ratio: unrealistic). To control the effects of external variables which can occur when clothes, hair styles, and body poses of avatars are different, the four avatars wore similar clothes without clothes brand, and had the same hair style and body pose. Depending on the reality level (high vs. low), and body ratio (realistic vs. unrealistic), this study manufactured four kinds of avatars. To let experimental participants simultaneously compare four stimulants, this



study exposed those four stimulants simultaneously on the questionnaire. The four stimuli are shown in Figure 2 below.

Fig 2. Stimuli



Source: Prepared by authors(2023).

To create the data, this study conducted a survey from March 7 to April 2, 2022 to 219 common people and undergraduate and graduate students in total living in Korea. Considering the COVID-19 pandemic, this study conducted the survey by mixing face-to-face/non-face-to-face (offline/online) methods. Among the 219 copies of the questionnaire, this study used 215 copies in final analysis, excluding 4 which contained many missing values and abnormal ones. To induce them to respond actively and sincerely, this study provided a gift to each respondent.

3.3 MANIPULATION CHECK OF STIMULANTS

The stimulants used in the questionnaire were 2 avatars depending on the reality level. One is an Asian female model whose reality level is as high as virtual human. The other is cartoon character whose reality level is low. It was manufactured to make it look like the first model using a Zepeto application.

Before conducting the survey, to control the effects of external variables, this study did manipulation checks of the two stimulants, using 30 graduate school students and master's and doctor's degree owners from Kumoh National Institute of Technology located in Gumi city. There should be no difference in familiarity to two kinds of avatars (reality level: high vs. low) to respondents. Following Kent & Allen(1994) and Park(2019), this study asked respondents to choose from the 7-point Likert scale (from 'not at all' = 1 to 'definitely yes' = 7) to the statement (have seen it, know it well, familiar with it).



The manipulation checks showed that there was no difference in familiarity between the avatar whose reality level is high and the other avatar whose reality level is low. The results are shown in Table 1 ($M_{High} = 2.556$, $M_{Low} = 2.978$, $t = -.970$, $p = .336$).

Table 1. Familiarity to stimulants

	Reality	N	Mean	S.D.	t	p
Familiarity	High	30	2.556	1.5545	-.970	.336
	Low	30	2.978	1.8087		

Source: Prepared by authors (2023).

3.4 MEASUREMENT OF VARIABLES

In this study, the number of the avatar types used for independent variables and moderating variables were four: two depending on the reality level (high vs. low) and two depending on the body ratio (realistic vs. unrealistic). They were offered as nominal variables. Avatar-self image identification offered as another moderating variable was measured with five items ('My avatar and I are the same being', 'Praise on my avatar is praise on me', 'Blame of my avatar is blame of me', 'I am concerned of how my avatar is evaluated', 'My avatar is my alter ego') referring to Ahn, Yoo & Kim(2004). Respondents were asked to choose from the same 7-point Likert scale. Respondents were classified into three groups, based on mean value of avatar-self image identification scores: those who had higher values (1/3 of respondents, $n = 70$), those with middle values (1/3 of respondents, $n = 74$), and those with lower values (1/3 of respondents, $n = 71$). Those with middle values were excluded in the analysis.

Metaverse application compatibility used as a dependent variable and the mediating variable was measured with five items ('My avatar is harmonious with the metaverse application', 'My avatar is suitable to the management of the metaverse application', 'My avatar can be used in other application', 'My avatar raises efficiency of life'), referring to Lee & Na(2012). Respondents were asked to choose from the same 7-point Likert scale. (Metaverse application compatibility: Cronbach’s $\alpha = .958$). Respondents were divided into three groups: those with high scores in avatar-self image identification (high 1/3, $n = 17$), those with middle scores in avatar-self image identification (middle 1/3, $n = 74$), and those with low scores in avatar-self image identification (low 1/3 $n = 71$). In the moderating effect analysis, those with middle scores were excluded. Metaverse application use intention used as a dependent variable was measured with four items ('I intend to use the application', 'I want to use the new function



of the application', 'The application has positive effect on my life', 'I want to recommend the application to others') referring to Zhong & Park(2019). Respondents were asked to choose from the same 7-point Likert scale (Metaverse application use intention: Cronbach's alpha = .959).

4 RESULTS AND DISCUSSION

4.1 THE CHARACTERISTICS OF THE SAMPLE

To create the data for analysis, this study conducted a survey to common people and undergraduate and graduate school students living in Gyeongbuk and Daegu. The survey was performed for about 4 weeks from March 7, 2022. Before doing the main survey, this study did the preliminary survey two times to those who were graduate school students and who had got master's and doctoral degrees from Kumoh National Institute of Technology located in Gumi city, Gyeongbuk province. With the findings of this preliminary survey and Focus Group Interview (FGI), this study examined the relations among variables. Considering the COVID-19 pandemic, the main survey was performed in the mixed format of online and offline method. To induce sincere answers to the questions from respondents, this study provided them with small gifts. Among 219 copies of the questionnaire collected, 126 were done online and 93 were done offline. Excluding 4 copies which were judged to have been filled out not sincerely or had many missing values, 215 copies were used in final analysis. The demographic characteristics of respondents are shown in Table 2.

Table 2. Demographic characteristics of respondents

		Frequency	Percent
Gender	Male	136	63.3%
	Female	79	36.7%
	Total	215	100.0%
Age	10s	1	0.5%
	20s	56	26.0%
	30s	23	10.7%
	40s	78	36.3%
	50s~	57	26.5%
	Total	215	100.0%

Source: Prepared by authors (2023).



4.2 FACTOR ANALYSIS AND RELIABILITY ANALYSIS

Before doing statistical analysis on the relationship among variables, this study did factor analysis on independent variables, and reliability analysis to check internal consistency. The findings of the analysis are shown in Table 3.

Table 3. Factor Analysis

	Component			Cronbach- α
	1	2	3	
Identification1	.093	.876	.183	.943
Identification2	.148	.906	.138	
Identification3	.169	.898	.095	
Identification4	.154	.833	.238	
Identification5	.115	.853	.265	
Compatibility1	.906	.128	.244	.958
Compatibility2	.908	.171	.262	
Compatibility3	.843	.138	.314	
Compatibility4	.853	.144	.342	
Compatibility5	.751	.174	.454	
Use Intention1	.428	.243	.792	.959
Use Intention2	.400	.229	.819	
Use Intention3	.333	.263	.845	
Use Intention4	.378	.249	.842	

Source: Prepared by authors (2023).

The factor analysis of three major variables of this study (avatar-self image identification, metaverse application compatibility, and metaverse application use intention) showed that they were separate factors. Cronbach- α value for reliability analysis was over 0.9, proving internal consistency.

4.3 HYPOTHESIS TEST

4.3.1 Test of hypothesis 1

Hypothesis 1 is to examine whether metaverse application compatibility varies depending on reality level of avatar. This study did t-test using reality level of avatar (high vs. low) as independent variable and metaverse application compatibility as dependent variable. As Table 4 shows below, the lower reality level of avatar was, the higher metaverse application compatibility was ($M_{High} = 3.894$, $M_{Low} = 4.918$, $t = -4.795$, $p = .000$). Thus, hypothesis 1 assuming that metaverse application compatibility will vary depending on reality level of avatar was supported at significance level .05.



Table 4. The relationship between avatar reality and app compatibility

Reality	N	Mean	S.D.	t	p
High	115	3.894	1.7414	-4.795	.000
Low	110	4.918	1.3871		

Source: Prepared by authors (2023).

4.3.2 Test of hypothesis 2

Hypothesis 2 is to examine whether the effect of reality level of avatar on metaverse application compatibility is moderated by avatar-self image identification (high vs. low). That is, the higher avatar-self image identification is, the higher metaverse application compatibility with low reality level of avatar is (H2-1), and the lower avatar-self image identification is, there will be no difference in metaverse application compatibility (H2-2). To test such hypotheses, this study divided 215 copies of the questionnaire into three groups: those with high scores in avatar-self image identification (high 1/3, n = 17), those with middle scores in avatar-self image identification (middle 1/3, n = 74), and those with low scores in avatar-self image identification (low 1/3 n = 71). In the moderating effect analysis, those with middle scores were excluded. Test results of the moderating effect through two-way ANOVA analysis are shown in Table 5.

Table 5. Moderating Effect of Identification

Dependent Variable: Compatibility

Source	Type III Sum of Squares	df	Mean Square	F	p
Corrected Model	209.856a	40	5.246	2.527	.000
Intercept	1554.633	1	1554.633	748.853	.000
Reality(A)	30.764	1	30.764	14.819	.000
Identification(B)	128.012	22	5.819	2.803	.000
A*B	38.360	17	2.256	1.087	.377
Error	207.602	100	2.076		
Total	3098.160	141			
Corrected Total	417.458	140			

a. R Squared = .503 (Adjusted 1R Squared = .304)

Source: Prepared by authors (2023).

The interaction effect between reality level of avatar and avatar-self image identification was found to be not significant ($F = 1.087$, $p = .377$ ($p > .05$)). Therefore, metaverse application compatibility depending on reality level of avatar does not vary depending on avatar-self image identification.

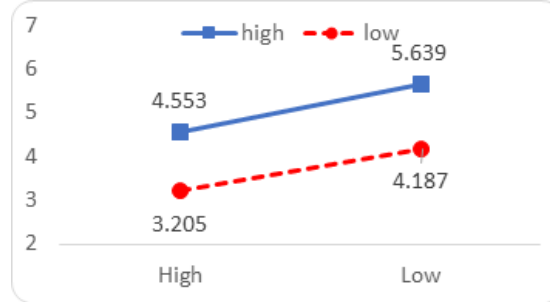


Table 6. Compatibility dependent on Identification (1)

Reality	Identification	N	Mean	S.D.	t	p
High	high	34	4.553	1.7882	3.535	.001
	low	41	3.205	1.5149		
Low	high	36	5.639	1.0721	4.468	.000
	low	30	4.187	1.4874		

Source: Prepared by authors(2023).

Fig 3. Compatibility dependent on Identification (2)



Source: Prepared by authors(2023).

As Table 6 and Figure 3 show, avatar application compatibility to avatar with high reality level was higher among those with high avatar-self image identification than among those with low avatar-self image identification ($M_{\text{high}} = 4.553$, $M_{\text{low}} = 3.205$, $t = 3.535$, $p = .001$), and it was statistically significant ($p < .05$). And, metaverse application compatibility to avatar with low reality level was high among the users high in avatar-self image identification than among those low in avatar-self image identification ($M_{\text{high}} = 5.639$, $M_{\text{low}} = 4.187$, $t = 4.468$, $p = .000$), and it was statistically significant ($p < .05$).

4.3.3 Test of hypothesis 3

Hypothesis 3 examines whether the effect of reality level of avatar on metaverse application compatibility is moderated by avatar body ratio (realistic vs. unrealistic). That is, it assumes that, if the body ratio of avatar is realistic, the metaverse application compatibility of avatar with high reality level will be high (H3-1), but, if the body ratio of avatar is unrealistic, the metaverse application compatibility of avatar with low reality level will be high(H3-2). The results of the test of moderating effect through two-way ANOVA analysis are shown in Table 7.



Table 7. Moderating Effect of Body Ratio

Dependent Variable: Compatibility

Source	Type III Sum of Squares	df	Mean Square	F	p
Corrected Model	87.193a	3	29.064	12.141	.000
Intercept	4097.407	1	4097.407	1711.659	.000
Reality(A)	60.082	1	60.082	25.099	.000
Body Ratio(B)	10.704	1	10.704	4.471	.036
A*B	18.359	1	18.359	7.669	.006
Error	505.096	211	2.394		
Total	4698.560	215			
Corrected Total	592.289	214			

a. R Squared = .147 (Adjusted R Squared = .135)

Source: Prepared by authors (2023).

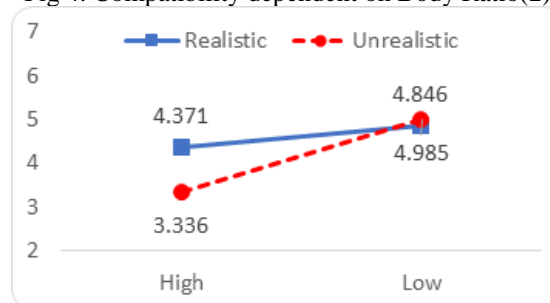
Interaction effect of reality level of avatar and body ratio of avatar was significant ($F = 7.669$, $p = .006$ ($p < .05$)). Therefore, application compatibility of avatars depending on reality level of avatars varies depending on body ratio of avatars.

Table 8. Compatibility dependent on Body Ratio(1)

Reality	Body Ratio	N	Mean	S.D.	t	p
High	Realistic	62	4.371	1.6974	3.314	.001
	Unrealistic	53	3.336	1.6370		
Low	Realistic	48	4.846	1.3229	-.498	.620
	Unrealistic	52	4.985	1.4535		

Source: Prepared by authors (2023).

Fig 4. Compatibility dependent on Body Ratio(2)



Source: Prepared by authors(2023).

As Table 8 and Figure 4 show, metaverse application compatibility to avatars high in reality level was higher among those with avatars with realistic body ratio than among those with avatars with unrealistic body ratio ($M_{\text{Realistic}} = 4.371$, $M_{\text{Unrealistic}} = 3.336$, $t = 3.314$, $p = .001$), and it was statistically significant ($p > .05$). Metaverse application



compatibility to avatars low in reality level was lower among those with avatars with realistic body ratio than among those with avatars with unrealistic body ratio ($M_{\text{Realistic}} = 4.486$, $M_{\text{Unrealistic}} = 4.985$, $t = -.489$, $p = .620$). But, it was not statistically significant ($p > .05$).

4.3.4 Test of hypothesis 4

Hypothesis 4 examines whether metaverse application compatibility has positive (+) effect on application use intention. Therefore, this study did regression analysis using metaverse application compatibility as independent variable and application use intention as dependent variable. The results are shown in Table 9.

Table 9. The effect of Compatibility on Use Intention

Model	Unstandardized Coefficient		Standardized Coefficient	t	Sig.	2	F	
	B	.E.	B					
(Constant)	1.136	.215		6.128	.000		230.628	.000
Compatibility	.698	.046	.721	15.186	.000	.518		

a. Dependent Variable: Use Intention

Source: Prepared by authors (2023).

Table 9 shows that $R^2 = .518$, which means that independent variable (metaverse application compatibility) explains 51.8% of dependent variable (application use intention). Thus, metaverse application compatibility was found to have positive (+) effect on application use intention. So, hypothesis 4 which assumes that metaverse application compatibility will have positive (+) effect on application use intention was supported at significance level .05.

4.3.5 Test of hypothesis 5

Hypothesis 5 examines whether the effect of reality level of avatars on metaverse application use intention is mediated by metaverse application compatibility. To test the hypothesis, this study did mediation regression analysis using reality level of avatars as independent variable, and metaverse application compatibility as mediating variable, and metaverse application use intention as dependent variable, and the results of the analysis are shown in Table 10 and Table 11.



Table 10. Mediating Effect of Compatibility(Step 1.)

			Compatibility			
			Unstandardized		Standardized	Sig.
			B	SE	B	p
S T E P 1	(Constant)		2.870	.336		
	Independent Variable	Reality	1.024	.217	.308	.000
	Mediating Variable	Compatibility				
	R ²		.090			
	F-value		22.284			
	p		.000			

***p<0.001, **p<0.01, *p<0.05

Source: Prepared by authors (2023).

Table 11. Mediating Effect of Compatibility(Step 2-3)

			Use Intention			
			Unstandardized		Standardized	Sig.
			B	SE	B	p
S T E P 2	(Constant)		3.489	.336		
	Independent Variable	Reality	.598	.217	.186	.006
	Mediating Variable	Compatibility				
	R ²		.030			
	F-value		7.610			
	p		.006			
S T E P 3	(Constant)		1.453	.274		
	Independent Variable	Reality	-.129	.161	-.040	.425
	Mediating Variable	Compatibility	.710	.048	.733	.000
	R ²		.517			
	F-value		115.439			
	p		.000			

***p<0.001, **p<0.01, *p<0.05

Source: Prepared by authors (2023).

Table 10 shows the followings. As the first stage of mediation regression analysis, it was found that reality level of avatars as independent variable has positive and significant effect on metaverse application compatibility as mediating variable (B = .308, p < .05). Table 11 shows that, as the second stage of mediation regression analysis, reality level of avatars as independent variable has positive and significant and positive effect on application use intention as dependent variable (B = .186, p < .05).

As the third stage of mediation regression analysis, this study entered both reality level of avatars and metaverse application compatibility as independent variables to see the effect of them on application use intention, and found that application compatibility



has positive and significant effect on application use intention ($B = .733, p < .05$), while reality level of avatars does not have significant effect on application use intention ($B = -.040, p > .05$). Therefore, it was identified that reality level of avatars completely mediates metaverse application compatibility, and affects application use intention.

5 CONCLUSION

With the rapid expansion of metaverse-related platforms and services in recent days, this study empirically analyzed the effect of reality level (high vs. low) of avatars, the core element of metaverse service, on metaverse application compatibility and metaverse application use intention. In addition, this study tested moderating effects of avatar-self image identification (high vs. low) and avatar body ratio (realistic vs. unrealistic).

Research findings can be summarized as follows. First, respondents were found to favor metaverse application compatibility when reality level of avatars was low more than when it was high. Second, the moderating effect of avatar-self image identification was not significant. Third, the moderating effect of body ratio of avatars was confirmed. That is, when the body ration was realistic, respondents favored avatars with low reality level to those with high reality level. And, even when the body ration was unrealistic, respondents favored avatars with low reality level to those with high reality level. Forth, metaverse application compatibility was found to have positive effect on application use intention. Fifth, the mediating effect of metaverse application compatibility on the effect of reality level of avatars on application use intention was confired.

The findings of this study suggest the following theoretical and practical hints. First, this study is probably the first research which analyzed external characteristics of avatars based on Proteus effect and uncanny valley effect. According to Proteus effect, users in virtual reality tend to change their behaviors depending on the characteristics of outside characteristics of their avatars, and it was confirmed that users prefer avatars of cartoon characters which they can easily transform into avatars as they want. Uncanny valley effect explains that humans get increasingly favorable to humanoid objects as they resemble humans more and more, but that, as resemblance of those objects reaches a certain level, humans feel repulsive toward them. It was found that, in the case of avatars high in reality level, that is, those of the level of virtual humans, application compatibility of unrealistic body ratio was low. Second, it is expected that, by empirically analyzing



external characteristics of avatars such as reality level and body ratio, the findings of this study will serve as reference data on production of avatar-using metaverse platforms and scholastic and practical uses of them.

Despite the possibility of this study giving some hints in the related field, it has the following limits. First, avatars in the metaverse platforms have recently been developed from 2-D forms into 3-D forms. But, this study offered 2-D forms as stimulants to respondents. Thus, in the future researches, stimulants should be more sophisticated and ramified. Second, the virtual human (with high reality level) avatar is the photo of real Asian female model who is little known to Koreans. So, it is difficult to generalize it as virtual human avatar. Considering that recently various forms of virtual human models have emerged in the advertisement field, it is necessary to do researches on various types and male and female avatars in the future.

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