

Study on the Influence Mechanism of Metaverse Virtual Live Broadcasting Based on SOR Model on Consumers' Participation Intention

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Abstract: The “14th Five-Year Plan for Digital Economy Development” proposes the advancement of humanoid intelligence, natural interaction, virtual reality, and other technologies. With the progress of digital technology, the metaverse offers consumers new purchasing avenues, enabling them to enter a three-dimensional immersive experience space and enhancing their engagement. This paper, based on the Stimulus-Organism-Response (SOR) model, explores the mechanisms of how the characteristics of virtual anchors and virtual scene marketing in the metaverse virtual live broadcasting environment affect consumers' participation intention. It proposes hypotheses on the impacts of characteristics of virtual anchor, virtual scene marketing, and flow experience on consumers' participation intention. SPSS and AMOS were used to analyze 533 consumers in Guangdong province. The results show that: (1) The characteristics of virtual anchor and virtual scene marketing have significant positive effects on flow experience. (2) The characteristics of virtual anchor, virtual scene marketing and flow experience have significant positive effects on consumers' participation intention. (3) Flow experience plays a mediating role between the characteristics of virtual anchor and consumers' participation intention. (4) Flow experience plays an intermediary role between virtual scene marketing and consumers' participation intention.

Keywords: Metaverse, Virtual Anchor, Virtual Scene Marketing, Consumers' Participation Intention, Flow experience

1. Introduction

The “14th Five-Year Plan for Digital Economy Development” emphasizes the need to enhance the research and development of technologies such as humanoid intelligence, natural interaction, virtual reality, micro-photonics, and optoelectronics. With the rapid development of digital technology, the metaverse possesses core characteristics such as “digital identity, social attributes, and immersion,” enabling consumers to access new purchasing channels and immerse themselves in three-dimensional virtual experiences. This addresses issues such as limited interaction between buyers and sellers and insufficient consumer understanding and experience of products. Through vivid, diverse, and integrated virtual scenes, guided by virtual hosts, the metaverse fully engages the body's sensory and motor systems with the environment, enhancing consumer participation and experience. According to a report by iMedia Consulting, 62.4% of internet users explicitly express their willingness to participate in metaverse social interactions. It is evident that conducting marketing activities in high-quality, real-time interactive virtual scenes based on virtual beings holds limitless prospects for accumulating brand value and uncovering consumer value.

Consumer engagement is pivotal in purchase decisions. Despite academic and industry attention, research on virtual beings and live streaming is limited, offering room for exploration. Grounded in the Stimulus-Organism-Response (SOR) model, this study explores how virtual anchors and scenes affect consumer engagement in the metaverse. Through empirical research, it aims to deepen understanding of consumer engagement mechanisms, enrich theoretical research, and provide theoretical guidance for businesses in understanding consumer psychology and formulating marketing strategies in metaverse virtual live streaming, facilitating China's cultivation of new consumption patterns.

2. Literature Review

2.1. Definition and Application of the Metaverse

The meta universe is based on the 1992 science fiction novel *Snow Crash* by American author Neal Stephenson. Stephenson first proposed that “the meta-universe refers to a virtual world that is born out of the real world, parallel to the real world, interacts with the real world, and is always online.”

The year 2021 is known as the first year of the meta-universe, which has also attracted the attention of scholars at home and abroad. At present, the academic community generally believes that the meta-universe is a parallel and interactive virtual world with the real world. It is a new social form formed by relying on digital technology to transcend the real world and enhance the interactive space of reality. It has the characteristics of comprehensive integration, immersion freedom, virtual-real interaction and so on.^[1] With the gradual maturity of various information technologies, the Yuan era has quietly arrived, and has been applied to education, games, tourism, e-commerce and other scenes.

2.2. Influencing Factors of Consumers' Purchase Intention

Purchase intention refers to the possibility that a consumer's psychological state changes when receiving external information or stimulation, leading to consumption and purchase.^[2] At present, scholars based on different research perspectives have put forward different opinions on the influencing factors of consumers' online purchase intention. Relevant research at home and abroad has found: Consumer characteristics (such as age, gender, education, work nature, income, lifestyle and life concept, etc.), product characteristics (such as function, quality, price and after-sales service, etc.), consumer psychology (such as opinion leaders, shopping atmosphere, perceived value, service attitude, flow experience, etc.) Scene (such as sense of presence, network characteristics, etc.) is the main factor affecting the purchase intention. After combing the relevant literature, please see the following Table 1 for details.

Table 1: Literature review on consumers' purchase intention.

Dimensionality	Subdivision	Source
Product characteristics	the impact of pricing, promotion, brand, goodwill and other factors on online purchase intention	Iwaarden et al. (2004) Chu et al. (2005)
	Price or type	Chiang (2001) Song Zhijie et al. (2019)
	The content or form of online product information presentation	Yu Xin (2017)
Consumer psychology	Website quality, website atmosphere, trust, shopping behavior	Corritore et al. (2003)
	Trust, opinion leader, anchor characteristics, network celebrity characteristics	Ni Yigang (2008), Mengfei (2012), Meng Lu et al. (2020), Miao et al. (2021) Song Chenting et al. (2021) Lin Ling et al. (2022), Yin Yuan et al. (2022)
	Perceives payment risk and personal privacy risk	Wood and Scheer (1996) Chen Fuji et al. (2013) Kovacich (1998)
	Perceived value, perceived benefit and perceived risk	Liao and Cheung (2001), Wang Chong (2007), Yang Minru (2015), Xu Manman et al. (2021), Liu Yu (2022) Zhang Zheqiong et al. (2022)
	Brand awareness, social comparison, fashion innovation	Zhang et al. (2013)
	Brand attitude	Chen Jie et al. (2014)
	Brand interaction, consumer interaction	Xu Xinliang et al. (2017) Liu Rong (2017) Yang Jing (2017)
	Flow experience	Koufaris (2002) Korzaan & Boswell (2008) Chen Jie et al. (2009) Yang Liu (2017)
Scene and environment	Spatial presence or social presence	Xu Manman et al. (2021) Zheng Ranran et al. (2022) Yin Yuan et al. (2022)
	Network characteristics	Hausman & Siekpe (2009)
	Online shop appeal	Chen Jiayin et al. (2020)

At present, the literature on consumers' online purchase intention is based on real live broadcasting situations, while there is no research on the influencing factors of consumers' purchase intention under the meta-universe virtual live broadcasting. Based on this, this paper introduces the core variable of consumers' participation intention, that is, consumers' willingness to use digital substitutes to participate in interaction, online purchase, offline experience and recommendation when watching virtual live broadcasting in the meta-universe through virtual anchors.

2.2.1. Characteristics of virtual anchor

Anchors play a key role in live shopping, influencing consumers' purchase intention through product introduction, interaction and scene marketing.^[3] Anchors should have credibility, professionalism and attractiveness, which can influence users' purchasing decisions by influencing their psychological state. For example, Han Xiaoyi et al. (2020) divided anchors' attributes into four categories: charm, recommendation, display and interaction through qualitative analysis.^[4] Zhou Fei et al. (2018) proposed that virtual spokespersons should enhance consumers' perceived authenticity and integrate marketing to enhance emotional experience. Yin Yuan et al. (2022) found that personal characteristics of anchors, such as professionalism, can reduce users' doubts, while attractiveness can improve shopping experience and increase user stickiness. The theoretical model constructed by Fang Lin and Wang Yanjie (2022) shows that opinion leaders affect consumers' evaluation perception through charm and interactive attributes, and improve consumers' trust perception through recommendation and marketing information, thus affecting their purchase intention.

Compared with human anchors, virtual anchors have the following advantages: they can fill the gap between live broadcasts continuously and attract consumers who enter at different times; Its unique avatars add interest and thus attract the attention of the audience^[5].

2.2.2. Virtual scene marketing

Scene marketing helps consumers complete desired activities to achieve sales through enterprise intervention or construction of consumer activity scenes.^[6] It takes consumers as the center, establishes the connection between enterprises and consumers, and makes products meet the needs of consumers in specific scenarios. The multi-agent scene is more popular with consumers, because its social satisfaction and close connection between consumers can enhance adhesion and improve marketing success rate.

Metaverse technology creates new scenarios for consumers in the mobile Internet environment, breaks the realistic restrictions, promotes consumer interaction and product understanding, and enhances the purchase tendency^[7]. Xu Manman et al. (2021) confirmed that scene marketing positively affects purchase intention. Xu Shishu (2018) found that the accuracy and interactivity of scene characteristics improved the purchasing tendency. In the era of mobile Internet, social interaction speeds up the dissemination of information, improves the marketing effect, and shortens the distance between enterprises and consumers. Xu Yanqin (2016) believes that the interaction and entertainment of scene marketing can stimulate the demand. This study believes that the accurate matching, entertainment and social interaction of scene marketing can stimulate the purchase desire.

2.2.3. Flow experience

"flow" is a concept proposed by Csikszentmihalyi in 1975, which describes the state of an individual's high concentration during an activity due to internal pleasure, including two dimensions of concentration and pleasure. Flow experiences allow individuals to focus and enjoy the process, are not goal-oriented, and were originally observed through activities such as rock climbing and dancing.^[8]

At the end of the 20th century, flow theory was applied to the study of online consumer behavior. Studies have shown that flow experiences are drivers of sustained behavior (Csikszentmihalyi, 1990; Wang Qiong, 2017; Trevino, 1992). In recent years, researchers have begun to pay attention to the flow phenomenon in online activities such as online shopping, games, and education. Flow experiences affect individual attitudes, intentions, and behaviors, such as increasing satisfaction, loyalty, purchase intentions, service use intentions, and promoting consumption and information use.^[9] The influence of flow experience on consumers can be analyzed from the personal characteristics of consumers and the characteristic attributes of websites. Individuals focus on live viewing, interact in real time, and have confidence in shopping.^[10] The design of live streaming platform and small task links have an important impact on flow experience. Flow experience is highly correlated with purchase intention.^[11]

2.2.4. SOR Model

SOR (Stimulus-Organism Response) model, or stimulus-organism response theory, is mainly used to explain the influence of environmental stimuli on human behavior. Among them, “S” refers to the independent variable, which is generally the external environmental stimulus; “O” is the intermediary variable, which refers to the psychological changes of the individual after the external stimulus; “R” is the result variable, that is, the psychological changes are ultimately reflected in the individual behavior. The process from receiving information to the final decision is not direct. The stimulation of the external environment will lead to changes in psychological perception, and the accumulation of such perceptual changes will eventually be reflected in certain behavioral tendencies.

Eroglu et al. (2001) for the first time applied SOR model to online purchasing situations and concluded that consumers would have different inner psychological feelings when they are in a specific online shopping environment, leading to the occurrence of purchasing behaviors. In the virtual live broadcast environment, consumers can feel more external stimuli, which may include the characteristics of virtual anchors and the influence of virtual scenes. Therefore, this study believes that SOR model can be used to study the impact of consumer participation intention in virtual live broadcasting environment.

3. Research Design

3.1. Research Hypothesis

Combined with relevant literature study at home and abroad and based on SOR theory, this study takes the characteristics of virtual anchors and virtual marketing scenes as stimulus variables, flow experience as the body variable, and consumers’ participation intention as the response variable, to explore the effective empirical techniques and methods of the mechanism of the influence of Metaverse virtual live broadcasting on consumers’ participation intention. Figure 1 illustrates the hypothetical model of the study. The assumptions for this project are summarized as follows:

H1 The characteristics of virtual anchors have a significant positive impact on flow experience

H2 Virtual scene marketing has a significant positive impact on flow experience

H3 The characteristics of virtual anchors have a significant positive effect on consumers’ participation intention.

H4 Virtual scene marketing has a significant positive effect on consumers’ participation intention.

H5 Flow experience has a significant positive effect on consumers’ participation intention.

H6 Flow experience plays a mediating role between the characteristics of virtual anchors and consumers’ participation intention.

H7 Flow experience mediates between virtual scene marketing and consumers’ participation intention.

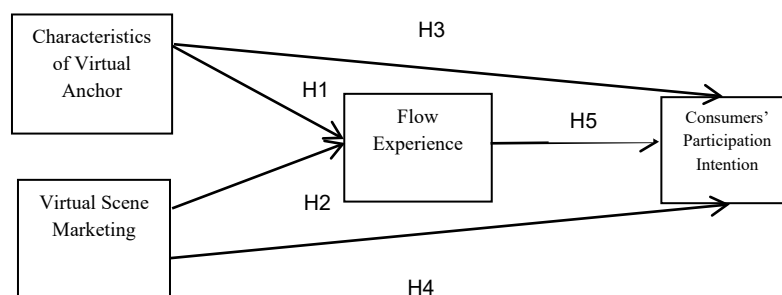


Figure 1: hypothetical model

3.2. Research Object

The reliability and validity of the scale were tested by pre-test for students, and the scale was optimized and perfected. In Guangdong Province, we adopted a combination of online questionnaire and written questionnaire survey to carry out research on people who had participated in the

meta-universe virtual live broadcast. A total of 700 questionnaires were issued in this survey, and 533 valid questionnaires were recovered, including 252 for men and 281 for women.

3.3. Scale Description

Based on domestic and foreign literature review and maturity scale, combined with the characteristics of meta-universe virtual broadcast, this paper uses 5-level Likert scale to measure major variables, which is divided into five parts:

Based on the Ohanian (1991) and Liu Fengjun (2020) scales, the characteristics of virtual anchors are measured from three dimensions: professionalism, attractiveness and interactivity.

Virtual scene marketing measurement, including accurate matching, entertainment, social interaction three characteristics. For the accurate matching scale, refer to Gao Lihua and Lu Qingyuan (2016), for the entertainment scale, refer to Arnett (2000), and for the social interaction scale, refer to Barker (2009).

The flow experience measurement, referred to Koufaris (2002), was carried out with a total of 5 questions on two dimensions of concentration and pleasure.

Based on Taylor (1995), the measurement of consumers' participation intention is carried out in five questions from four dimensions: interaction intention, online purchase intention, offline experience intention and recommendation intention.

Demographic variables, including age, gender, education, income, and occupation.

3.4. Research Methods and Tools

In this study, reliability and validity tests were carried out at first. Then, Amos25.0 was used to conduct structural equation model analysis on characteristics of virtual anchor, virtual scene marketing, flow experience and consumers' participation intention. Finally, Bootstrap was used to test the mediating effect.

4. Results

4.1. Reliability and Validity Test

Table 2: Reliability and convergent validity

Variable	Item	Cronbach's α	KMO	CR	AVE	Factor Loading
Characteristics of Virtual Anchor	CVA1	0.874	0.715	0.880	0.710	0.859
	CVA2					0.895
	CVA3					0.769
Virtual Scene Marketing	VSM1	0.904	0.753	0.905	0.760	0.845
	VSM2					0.862
	VSM3					0.907
Flow Experience	FE1	0.936	0.885	0.937	0.749	0.848
	FE2					0.868
	FE3					0.844
	FE4					0.879
	FE5					0.886
Consumers' Participation Intention	CPI1	0.920	0.847	0.939	0.793	0.836
	CPI2					0.897
	CPI3					0.908
	CPI4					0.918

The reliability test includes internal consistency reliability and combination reliability. As shown in Table 2, Cronbach's α value of all constructs was above 0.800, higher than the recommended value of 0.700, indicating high internal consistency of each construct. In addition, the combined reliability (CR) of all constructs ranged from 0.880 to 0.939, which was higher than the recommended value of 0.700, indicating that the combined reliability of all constructs was high. The validity test includes convergence validity and discriminant validity. Confirmatory factor analysis is used to test convergence validity. It can be seen from Table 2 that the factor load of each measurement item is greater than 0.500,

indicating that these measurement items are more suitable for measuring the corresponding constructs. In addition, the test results of discriminant validity are given in Table 2. The discriminant validity was tested by mean variance extraction value (AVE). As shown in Table 2, AVE values of all constructs were above 0.500. In addition, the AVE arithmetic square root (diagonal data in Table 3) is higher than the correlation coefficient between the factors (triangle data in Table 3), indicating that the constructs have good discriminant validity. In summary, the data in this study have good reliability and validity, which is suitable for further testing and analysis.

4.2. Discriminant Validity

Table 3: Discriminant validity

	1	2	3	4	5
CVA	0.843				
VSM	0.623**	0.872			
FE	0.746**	0.738**	0.866		
CPI	0.591**	0.724**	0.820**	0.891	

4.3. Structural Equation Model Analysis

Amos25.0 software was used to analyze the structural model of variable data, and the fit indexes of absolute fit and value-added fit were tested. The absolute fit index: Chi-square degree of freedom ratio (χ^2/df) was 2.989, lower than 3. The mean square and square root of progressive residuals (RMSEA) is 0.016, lower than the standard 0.08. The benign fit index (GFI) was 0.945, and the adjusted benign fit index (AGFI) was 0.918, both greater than 0.90. Value-added fit index: The standard fit index value NFI is 0.969, the value-added fit index value IFI is 0.979, and the comparative fit index value CFI is 0.979, all of which meet the standard greater than 0.90. In summary, a good degree of fit is shown between the hypothetical model and the data in this study.

The path coefficients of the model and the validation of research hypotheses are shown in Table 4. The results show that the characteristics of virtual anchors have a significant positive effect on flow experience ($\beta=0.519$, $P < 0.001$), and H1 passes the test. Virtual scene marketing had a significant positive effect on flow experience ($\beta=0.437$, $P < 0.001$), H2 passed the test; The characteristics of virtual anchors positively affected purchase intention ($\beta=0.379$, $P < 0.001$), and H3 passed the test; Virtual scene marketing positively affected purchase intention ($\beta=0.344$, $P < 0.001$), and H4 passed the test; Flow experience positively affected purchase intention ($\beta=0.858$, $P < 0.001$), and H5 passed the test.

Table 4: Structural equation modeling test

Hypothesis	Path	Normalized Path Coefficient	Standard Error	T Value	P Value	Conclusion
H1	CVA→FE	0.519	0.042	11.498	***	support
H2	VSM→FE	0.437	0.044	9.935	***	support
H3	CVA→CPI	0.379	0.057	6.450	***	support
H4	VSM→CPI	0.344	0.054	6.570	***	support
H5	FE→CPI	0.858	0.074	12.041	***	support

In this study, the mediation effect test program proposed by Zhao et al. (2010) was adopted and the Bootstrap method of SPSS25.0 software was used to test the mediation effect. The intermediary effect is significant according to whether the indirect effect contains 0 in the 95% confidence interval. The data analysis results (Table 5) show that the characteristics of virtual anchors influence purchase intention through the mediating effect of flow experience. The β value is 95% confidence interval (0.7047, 0.9169), and H6 is valid. Virtual scene marketing influences purchase intention through flow experience, with a β value of 95% confidence interval (0.4941, 0.7317), and H7 is also supported.

Table 5: Bootstrap analysis of the mediation effect test

Hypothesis	Mediation Effect	Effect	Standard Error	95% Confidence Interval		Conclusion
				Lower Limi	Upper Limit	
H6	CVA→FE→CPI	0.808	0.054	0.7047	0.9169	support
H7	VSM→FE→CPI	0.6103	0.060	0.4941	0.7317	support

5. Conclusions

Based on SOR model, this study explores the influence mechanism of virtual anchor characteristics, virtual scene marketing and flow experience on consumers' participation intention in meta-universe virtual live broadcasting. The study found that the characteristics of virtual anchors (such as interactivity, attractiveness and trustworthiness) and the marketing strategies of virtual scenes (such as environmental immersion and scene relevance) can significantly and positively affect consumers' flow experience. In addition, flow experience not only directly enhances consumers' willingness to participate, but also plays an important intermediary role between the characteristics of virtual anchors and consumers' willingness to participate, and between virtual scene marketing and consumers' willingness to participate. Specific marketing strategies are as follows:

5.1. Enhance the Interactive and Personalized Characteristics of Virtual Anchors

Enterprises should attach importance to the design and training of virtual anchors, and improve the flow experience of consumers by enhancing their interaction, attractiveness and credibility. For example, by using advanced AI technology to simulate more natural verbal communication and facial reactions, virtual anchors are able to personalize interactions based on feedback from different users. In addition, the appearance and sound of virtual anchors should also be optimized according to the preferences of target audience groups to enhance their appeal and credibility.

5.2. Create Immersive Virtual Scenes

Strengthening the sense of reality of virtual environment is the key to improve user immersion. Businesses can create high-quality visual and sound effects by collaborating with professional visual artists and sound designers. At the same time, the scene design should be closely related to the live content, such as creating a virtual concert hall during a live concert, or designing a futuristic runway during a fashion show. Such scene design not only enhances the audience's sense of immersion, but also enhances the overall viewing experience.

5.3. Use Flow to Enhance User Engagement

Given the critical role of flow experiences in increasing consumer engagement, companies should develop strategies to facilitate the generation of such experiences. First, ensure that the technical performance of the livestream platform is high enough to reduce delays and load times, so as not to interrupt the flow experience of users. Secondly, adding interactive elements, such as real-time voting, gamification elements and audience participation, can keep users highly engaged during the viewing process. In addition, providing users with personalized Settings that can be adjusted, such as selecting different camera angles or adjusting audio and video Settings, can also increase their sense of control over live content, further enhancing the flow experience.

5.4. Establish a Long-Term User Engagement Mechanism

In addition to enhancing the flow experience, companies should also establish mechanisms to continuously attract and maintain user engagement. For example, set up reward mechanisms and loyalty programs, provide regular content updates and interactive activities to motivate users to return repeatedly and participate in virtual live streaming.

6. Discussion

At present, 533 questionnaire data have been collected in this study, and future studies may consider expanding the sample size or conducting in-depth studies for specific populations. Since cultural background may affect consumers' behaviors and preferences, future studies can explore whether consumers' responses to virtual live broadcasting differ in different cultural backgrounds, and how to adapt the elements of virtual live broadcasting to different cultural needs.

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