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Article

The Influence of Virtual Influencer Authenticity on Consumer Purchase Intentions: The Mediating Role of Emotional Trust and the Moderating Role of Environmental Perception (From a Social Identity Theory Perspective)

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Abstract: Digital technology iteratively drives virtual netizens to become the core carrier of e-commerce marketing. The visual appearance is directly influenced by the artificial intelligence (AI) generation algorithm or computer graphics (CG) rendering technology. Interactive performance and real perception of virtual netizens, and profoundly change consumers' cognition and consumption decision-making mechanism. From the perspective of social identity theory, this study decomposes the authenticity of virtual online celebrities into two technical dimensions: CG visual authenticity and AI interactive authenticity. Taking the current well-known virtual online celebrities as the research object, with the help of Likert 5-point scale, using the forms of descriptive statistics, regression analysis, mediation effect test, moderation effect test and robustness test, this study studies the impact of virtual online celebrities' authenticity This study examines the influence of the authenticity of virtual online celebrities on consumers' purchase intentions, considering the mediating role of emotional trust and the moderating role of environmental perception. The findings demonstrate that both the computer-generated (CG) visual authenticity and artificial intelligence (AI) interactive authenticity of virtual online celebrities exert a significant positive effect on consumers' purchase intentions. Additionally, the perceived authenticity of virtual netizens also positively influences consumers' purchase intentions. Emotional trust is found to significantly mediate the relationship between the authenticity of virtual online celebrities and consumers' purchase intentions. Furthermore, environmental perception significantly and positively moderates the relationship between the authenticity of virtual online celebrities and emotional trust. and between the authenticity of virtual online celebrities and consumers' purchase intention. In order to further strengthen and promote the authenticity of virtual online celebrities to consumers' purchase intention, this paper expands the research boundary of virtual online celebrities' marketing from the perspective of technology bottom, and provides algorithm support and practical basis for AI and CG technology to enable the commercial operation of virtual online celebrities and accurately activate consumers' purchase intention.

Keywords: Social Proof Theory; Virtual Influencer Authenticity; Consumer Purchase Intentions; Emotional Trust; Environmental Perception

1. Research Background and Hypotheses

1.1. Research Background

In recent years, with the rapid growth of the e-commerce livestreaming market and advancements in

technologies such as AI, speech recognition, speech synthesis, and motion capture, AI-driven virtual influencers have been widely adopted in the e-commerce livestreaming sector [1]. In addition to independently managing livestreams—including demonstrating product features and answering viewer questions—virtual influencers can also broadcast 24 hours a day, accommodating the varying schedules of different consumer groups [2–3]. Furthermore, as a product of contemporary technological advancements, virtual influencers enhance the entertainment value of livestreams [4]. Consequently, numerous companies have begun utilizing virtual hosts for live-streamed product sales. For example, in November 2021, the virtual influencer "Guan Xiaofang" made her debut in a Kuaishou Store live-streaming room and successfully attracted over 1.05 million viewers; brands such as Givenchy and L'Oréal have also employed virtual hosts to live-stream sales of their products [5–7]. As consumer acceptance of virtual hosts grows, an increasing number of companies are turning their attention to them and gradually entering the virtual host market. This market holds immense potential for future growth and has a promising outlook [8]. Reports indicate that by 2025, the size of China's virtual influencer market will reach approximately 1 billion yuan, representing a year-over-year increase of 150.5%. The industry has entered a phase of rapid growth and is expected to maintain this high growth rate in the coming years. However, as China's virtual influencer market continues to develop, it will also face an increasingly competitive environment [9–10]. Against the backdrop of more and more companies using virtual influencers for live-streamed sales, enhancing the effectiveness of these live streams and boosting product sales is key to companies' success in this intense competition.

At the same time, the academic community has recognized the research value of this emerging field of AI virtual influencers and is actively exploring it from multiple perspectives [11–13]. Currently, research primarily focuses on the industry [14], professional roles, and audience levels [15]. However, the number of relevant studies remains limited, and the mechanisms through which the characteristics of AI virtual influencers influence consumer behavior have not been comprehensively and thoroughly investigated, leaving room for further refinement.

1.2. Research Hypotheses

1.2.1. Hypothesis on the Effect of Virtual Influencer Authenticity on Consumer Purchase Intentions

The truthfulness of virtual influencers is the basis for the development of customer confidence and buying intention. The more solid the personality, the more genuine the content, and the more genuine the emotion, the more likely the virtual influencers will be recognized and recognized, thus increasing their buying intention. A number of people still keep up with their posts on their social media accounts, and others say that they are relieved and happy – even surprised – when they see the ad, which results in a positive emotion experience. According to the theory of Social Identity and Consumer Behaviour Theory, when consumers see more authentic content in virtual influencers, they are more likely to see them as credible "virtual communities", which promotes social recognition and thus creates buying intentions. Based on this research, the following hypotheses can be derived:

H1: The truthfulness of the virtual influencers has a significant positive impact on the buying intention of consumers.

H1A: The truthfulness of a virtual influencer's personality has a significant positive impact on the buying intent.

H1B: The truthfulness of the content of the virtual influencer has a significant positive impact on the customer's buying intent.

H1C: The emotion truthfulness of the virtual influencers has a significant positive impact on the buying intent.

1.2.2. Mediating Role Hypothesis of Emotional Trust

Emotional trust is a key link between the authenticity of virtual influencers and the intention to buy. The higher credibility of the virtual media makes it easier for them to empathize with and rely on each other, thus promoting emotional confidence. That kind of emotional confidence lowers the perception of the product, makes it more acceptable to the person who recommends it, and in the end it enhances the buying intention. Based on the combination of Emotion Confidence Theory and Social Evidence Theory, it is found that consumers have an indirect effect on buying intention by means of Emotion Trust. Based on this, the following hypothesis is proposed:

H2: Emotion trust has a significant effect on the degree of truthfulness of virtual influencers' perception and buying intent.

H2A: Emotion trust has a significant effect on the perception of VCI's personality and customer's buying intention.

H2B: Emotion trust has a significant effect on the truth of VCI's personality and customer's buying intent.

H2C: Emotion trust has a significant role in mediating the emotion truthfulness of VFA and customer's buying intention.

1.2.3. Moderating Role of Environmental Perception

The environmental perception can reduce the impact of virtual influencer's authenticity on emotion confidence and buying intent. When the customer is aware of an advantageous situation (credible platform, regulatory sector), they will have more confidence in the credibility of the virtual influencer, thus enhancing the effect of truthfulness on emotion trust and buying intent. On the contrary, when consumers are aware of adverse circumstances (insecure platforms, messy business), they lose confidence in the validity of virtual influencers, which reduces their positive impact on emotion confidence and buying intention.

H3: The environment has a significant effect on the relation between the truthfulness of VFA and the emotion trust.

H3A: The environment has a significant effect on the relation between the authentic personality of the virtual influencer and the emotion trust.

H3B: The environment has a significant effect on the relation between the truthfulness of VCI's content and emotion trust.

H3C: The environment has a significant effect on the relation of VCI's emotion truthfulness and emotion trust.

2. Research Design

2.1. Model Construction

On the basis of these assumptions, we set up a Neutral Mediation Model in which Virtual Influencer Authenticity is an Independent Variable, Customer Buying Intent is Dependent, Emotion Trust is Intermediate Variable, and Environment Perception is Regulator (Figure 1).

In Variable Definition: Independent Variable is the Virtual Influencer's Truthfulness, which includes Character Reality, Substance Reality, and Emotion Reality. Among them, there are three factors: buying tendency, buying intent, and recommending willingness. The mediator is emotion trust, which includes emotion dependency and trust. The moderating variable is environment perception, encompassing platform environment perception and industry environment perception. The control factors are sex, age, educational level, month's salary, and the number of VCI in order to remove the influence of unrelated variables.

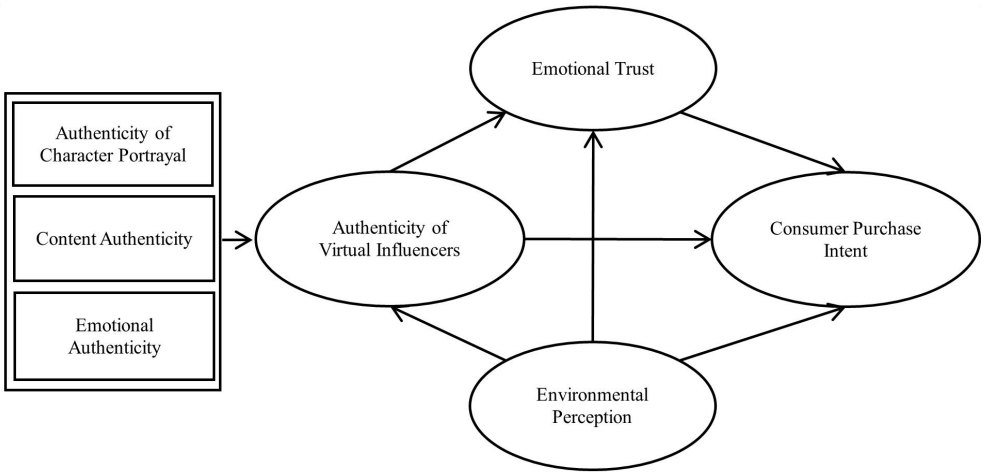

Figure 1. Research Model Diagram

The validity of virtual influencers (independent variables) has a direct impact on the buying intention (dependency variable) in the study model. At the same time, the truthfulness of the virtual influencers has an indirect impact on the buying intention through the effect of emotion trust

(intermediary variable). Moreover, the environment has moderated the relation of VCI and EQ, so as to reduce the mediation effect of EQ. The control variables have an indirect effect on the outcome of the study through the influence of the independence and dependence.

2.2. Research Subjects

In this paper, we choose the most popular VJ celebrities as the object of the study, focusing on Douyin, Xiao Hong Shu, and Bilibili. The main criteria for selecting candidates are (1) Have previously interacted with virtual influencers and have seen their marketing content, (2) have an understanding of virtual influencers' advice and have had an experience of buying intention or behaviour that is motivated by this advice; (3) Participate voluntarily in the investigation and experimentation and be able to work hard on the questions and tests. A total of 600 official questionnaires are scheduled to be distributed in the course of this particular investigation, aiming to gather at least 540 valid replies and obtain a valid response rate of at least 90 percent. The test team would look at the content of highly authentic virtual influencers (consistent personality, genuine content, genuine feelings), whereas the control group would look at the content of low credibility virtual influencers (inconsistent personality, made-up content, false feelings). After the test, we will gather information about emotion confidence, buying intention, and environment awareness from each of the two groups.

2.3. Research Tools and Methods

The questionnaire mainly used a five-point Likert Scale (1 = Strongly Disagree, 5 = Strongly Agree), which consisted of 6 parts:

(1) Basic Information Questionnaire, which contained sex, age, educational background, monthly income, and the number of virtual influencers that were used as control variables.

(2) Virtual Influencer Authenticity Scale: modified from the current authentic measurement to match the features of the virtual influencer.

(3) Emotional Trust Scale: Modified from current VCI settings, which includes emotion dependency and confidence acceptance.

(4) Environmental Perception Scale: Modified from current environment perception scales and modified to include both the environment and the environment of the sector.

(5) Consumer Purchase Intention Scale: Modified on the basis of the current buying intent scale and modified to include buying inclination, buying intent, and recommending willingness to recommend.

Additionally, we chose to use two VMAs as test materials: one with high credibility (AYAYI's make-up recommendation video, which is characterized by steady personality, genuine, genuine, genuine, the second issue is that the authenticity of virtual character recommendations is not high (imitating virtual recommendation videos with vague personalities, exaggerated statements, stiff emotional communication, etc., exaggerating the effectiveness of products). In order to ensure the fairness of the experiment, two short videos are each one minute long and have the same theme.

Using a combination of online and offline methods: Using the Wenzhi Dao platform, the Web site was used to post survey links to users on Douyin, Xiao Hong Shu, and Bilibili, and offline distribution was done by researchers who distributed and directed participants to fill out questionnaires at shopping centers, office blocks, and universities. Participants were told about the objectives and completion requirements prior to the questionnaire. Emphasis was placed on the fact that the data will only be used for scientific purposes and that the privacy of individual data should be strictly confidential in order to guarantee accurate answers. Altogether 600 questionnaires were sent out and 578 replies were received. Of those, There were a total of 552 cases, with a total effective rate of 92.0% and a total effective rate of 92.0%. Table 1 lists examples of valid survey forms:

Table 1. Demographic Characteristics

Demographic Variables	Category	Number of people	Percentage
Gender	Female	342	62%
	Male	210	38%
Age	18-25 years old	286	51.8%
	216-35 years old	202	36.6%
	36 years old and above	64	11.6%
Education Level	College degree or below	88	15.9%
	Bachelor's Degree	352	63.8%
	Master's and below	112	20.3%
Monthly Income	3,000 yuan and below	122	22.1%
	¥3,001–6,000	252	45.7%
	6,001 yuan	178	32.2%
Contact Frequency	1-2 times per week	208	37.7%
	3-5 times per week	242	43.8%
	5+ times per week	102	18.5%

Pre-trials were carried out on the customers of the test and the control. They mainly measured emotion confidence, buying intent, and environment awareness to make sure that there were no significant differences in their baseline values (independent sample t test, $p > 0.05$). Then, the two groups finished a questionnaire that measured emotional trust, buying intent, and environment awareness, and asked open questions. Finally, we encode and analyse the answers to open questions in order to get the key points of view, which can be used as additional data for the empirical study.

3. Empirical Analysis

3.1. Descriptive Statistical Analysis

The following table gives statistics on the average and standard deviation of the three dimensions - virtual influencer's truthfulness, emotion confidence, environment awareness, and buying intent (Table 2).

Table 2. Descriptive Statistics of Variables

Variable	Dimension	Mean (M)	Standard Deviation (SD)	Minimum	Maximum
Authenticity of Virtual Influencers	Authenticity of persona	3.58	0.68	1	5
	Content Authenticity	3.82	0.65	1	5
	Emotional Authenticity	3.65	0.67	1	5
Emotional Trust	Emotional Dependence	3.62	0.61	1	5
	Trust and Recognition	3.79	0.63	1	5
Environmental Awareness	Platform Environmental Awareness	3.68	0.66	1	5
	Industry Environment Awareness	3.45	0.69	1	5
Consumer Purchase Intent	Purchase Propensity	3.52	0.64	1	5
	Purchase Intention Strength	3.65	0.64	1	5
	Recommendation Intention	3.76	0.62	1	5

Description of the control variables shows: - Sex: Women are larger than men, in line with the main audience profile of the virtual influencers. - Age: Consumers between 18 and 35 make up 88.4 per cent of the population, making it a key target for VJ. - Education: The biggest proportion of consumers with a bachelor's degree (63.8 per cent) is a sign of greater adoption by the well-educated consumer-driven population, according to a monthly income of 3001 to 6000, which shows that middle class customers are the main target of VCI marketing. Among those who are exposed to virtual influencers, the largest percentage (43.8 percent) is those who visit three to five times a week, indicating that the vast majority of customers have frequent interactions.

3.2. Regression Analysis

We studied the influence of virtual influencer's authenticity on the buying intention by using hierarchy regression. Sex, age, educational level, monthly income, and the number of VCI were selected as the control variables. In order to verify the meaning of the regression factor, the total truthfulness of the virtual influencers and their individual dimensions was presented.

Table 3. Regression Analysis

	Control Variables	**Overall Authenticity**	**Other Dimensions (Personality, Content, and Emotional Authenticity)**
Constant	1.235 (0.121)	0.872*** (0.105)	0.756*** (0.098)
Gender	0.087* (0.032)	0.065* (0.028)	0.058* (0.026)
Age	-0.072* (0.030)	-0.059* (0.027)	-0.052* (0.025)
Education	0.102** (0.035)	0.085** (0.032)	0.078** (0.030)
Monthly Income	0.123*** (0.038)	0.101*** (0.035)	0.092*** (0.033)
Contact Frequency	0.156*** (0.042)	0.132*** (0.039)	0.125*** (0.037)
Authenticity of Virtual Influencers	-	0.623*** (0.045)	-
Authenticity of Character Profile	-	-	0.215*** (0.052)
Content Authenticity	-	-	0.328*** (0.056)
Emotional Authenticity	-	-	0.257*** (0.054)
R^2	0.087	0.462	0.489
Adjusted R^2	-	0.375***	0.402***
F-value	10.25*	89.63***	95.37***

Note: ***p<0.001, **p<0.01, *p<0.05, values in parentheses indicate t-values

Table 3 shows that there is a significant positive correlation between VCI and CI (β = 0 623, P < 0.001) and ΔR^2 = 0 375 (p < 0.001). The results show that the VCI has a strong positive impact on the buying intent of the VCI, which is verified by Hypothesis H1.Analysis of other dimensional variables, shows that the VCI has a significant positive correlation with the VFA: the truthfulness of the character (β = 0. 215, P < 0.001), the truthfulness of the content (β = 0. 328, P < 0.001), and the emotion truthfulness (β = 0. 257, P < 0.001). Content authenticity was the most effective, which was consistent with assumptions H1a, H1b, and H1c.

3.3. Mediating Effect Analysis

In the mediation effect analysis, the Bootstrap method (sampling runs = 5000) Analyze the mediating effect of emotional trust. Using the VCI as an independent variable, CI as a dependency, EQ as a mediator, and CI as a mediator, the CI and CI were calculated. When zero is not included in the CI, the mediation effect is deemed to be substantial.

Table 4 shows that the VCI has an indirect influence on FOI by EQ. CI is 0. 321, and the CI is [0.254, 0.388]. The results show that the emotion trust has an obvious intermediate function between VCI's truthfulness and customer's buying intention, which is 51.5%. Therefore, the H2 assumption was validated. Dimension analysis showed that the influence of personality identity, identity of content, and emotion truth on the buying intention was significantly (CI was not inclusive). This verified Hypotheses H2a, H2b and H2c. These results show that VCI can not only affect VCI directly, but also influence VCI through increasing EQ.

Table 4. Mediating Effect Test Results

Mediation Path	Direct Effect	Indirect Effect	Total Effect	Proportion of Mediated Effect (%)	95% Confidence Interval
Virtual Influencer Authenticity → Emotional Trust → Purchase Intention	0.302***	0.321***	0.623***	51.5	[0.254, 0.388]
Character Authenticity → Emotional Trust → Purchase Intent	0.108***	0.107***	0.215***	19.8	[0.072, 0.142]
Content Authenticity → Emotional Trust → Purchase Intent	0.164***	0.164***	0.328***	50.0	[0.121, 0.207]
Emotional Authenticity → Emotional Trust → Purchase Intent	0.129***	0.128***	0.257***	49.8	[0.093, 0.163]

3.4. Moderation Effect Analysis

Moderating variables can influence the direction (positive or negative) and strength of the relationship between the dependent and independent variables. Most current scholars employ hierarchical regression analysis or utilize the PROCESS plugin to test moderation effects. In this study, hierarchical regression can be specifically applied to examine the moderating role of environmental perception, testing its moderation effects between virtual influencer authenticity and emotional trust, as well as between virtual influencer authenticity and consumer purchase intention. First, all variables were centered to avoid multicollinearity issues. Subsequently, On this basis, the importance of the interaction relationship is verified by using control variables, explanatory variables, moderating variables, and interaction conditions (i.e. virtual influence of human reality x cognition of the outside world). The content of the moderate impact test is shown in the table below:

Table 5 indicate that environmental perception significantly moderates the relationship between each dimension of virtual influencer authenticity and emotional trust: The validity of the character x the environment (β = 0.176, P < 0.001), the validity of the content of the environment (β = 0. 198, P < 0.001), and the degree of emotion of the emotion was multiplied by the environment (β = 0.182, P < 0.001). This verified Hypotheses H3a, H3b and H3c. In terms of the relation among different aspects of VCI and CE, there is a significant moderating effect on VCI in all interactions: Personality Identity x Environment Perception (β=0) 168, P<0.001), cognition of content authenticity x (β=0.191, P<0.001), and green cognition of emotional authenticity x (β=0175, P<0.001).which further confirmed the importance of Hypothesis 3 in order to elucidate the precise orientation of the moderation effect. According to the average, the environment perceived was classified as high-environment awareness (M + 1 D) and low-environment awareness (M-1SD). Furthermore, the influence of the VCI on the emotion confidence and buying intention was investigated individually. Results revealed: In the high environmental perception group, the regression coefficient of virtual influencer authenticity on emotional trust (β = 0.785, p < 0.001) was significantly greater than that in the low environmental perception group (β = 0.521, p < 0.001).In the high environmental perception group, the regression coefficient of virtual influencer authenticity on consumer purchase intention (β=0.756, p<0.001) was significantly greater than that in the low environmental perception group (β=0.489, p<0.001). This indicates that higher environmental perception levels amplify the positive impact of virtual influencer authenticity on emotional trust and consumer purchase intention, further substantiating the positive moderating role of environmental perception.

Table 5. Overall Analysis of Moderating Effects

Dependent Variable	Control Variables	Independent Variable + Moderator Variable	Interaction Term	Adjusted R^2
Emotional Trust	R^2=0.078, F=9.56*	R^2=0.485, F=92.37*** β=0.652***, β=0.213***	R^2=0.523, F=98.72***β=0.192***	0.038***
Consumer Purchase Intention	R^2=0.087, F=10.25*	R^2=0.462, F=89.63***β=0.623***, β=0.201***	R^2=0.498, F=94.56***β=0.185***	0.036***

Note: ***p<0.001, **p<0.01, *p<0.05, values in parentheses indicate t-statistics

3.5. Robustness Tests

To validate the reliability and stability of the empirical findings, this study employed three robustness tests as follows (Table 6):

First, the core variable measurement approach was replaced: the authenticity scale for virtual influencers was substituted with another established scale (referencing authenticity scales from existing virtual influencer studies), followed by re-conducting regression analysis and testing for mediating and moderating effects. The findings show that the VCE has a positive influence on buying intent (β = 0. 618, P < 0. 001) and emotional confidence mediation (Indirect Influence = 0. 312, 95% CI [0.245, 0.379]). and the moderating effect of environmental perception (β = 0.231, p<0.001), and the moderated mediating effect (interaction coefficient=0.179, p<0.001) were all significant. These findings largely aligned with the original empirical results, indicating robustness of the findings.

Table 6. Robustness Test Results

Robustness Test Method	Core Test	Test Results	Robustness Judgment
Replacing Core Variable Measurement Approach	Authenticity of Virtual Influencers → Purchase Intention (β); Indirect Effect of Emotional Trust; Moderating Coefficient of Perceived Environment; Interaction Term Coefficient	β=0.618***; Indirect Effect=0.312; β=0.231***; Interaction Term=0.179***	Robustness
Outlier Exclusion Test	Core Coefficient Differences; Research Hypothesis Validation	Maximum core coefficient difference ≤ 0.02; All hypotheses validated	Robust
Subsample testing	Significance of core effects across different subgroups; coefficient differences	Effects in all subgroups are significant; only minor coefficient differences	Robust

Second, during outlier removal: Z-score method (Z>3 or Z<-3) was applied to eliminate outliers from questionnaire data, resulting in 18 outliers removed and 534 valid questionnaires retained. Reanalysis of the sample after outlier removal confirmed all research hypotheses. Core coefficients showed minimal deviation from original results (maximum difference ≤0.02), indicating negligible impact of outliers and robust empirical findings.

Third, In a subgroup analysis, the study patterns were assessed individually in terms of sex (men, women) and age (18, 25, 26, 35, 36, and more).Results show that across different gender and age groups, the positive impact of virtual influencer authenticity on consumer purchase intention, the mediating role of emotional trust, the moderating effect of environmental perception, and the moderated mediating effect are all significant. Only minor differences in coefficient magnitudes exist, indicating that the research findings demonstrate good applicability and robustness across different groups.

4. The core algorithm of virtual netizens' authenticity on consumers' purchase intention

To guarantee the repeatability and scientific accuracy of the technological process, an automatic quantitative analytical system is established in this thesis, which includes the VDM and CG visualization. The results are consistent with Liu Yexi, Luo Tianyi and Xing Tong, and they are consistent with the ten key quantifiers of CG vision truth and AI interaction truth. The compilation of all the data is done on the basis of publicly available documentation and open source datasets.

4.1. Interactive data crawler algorithm for virtual Weblog

This section provides the original data set for the subsequent NLP semantic and emotional matching calculation by capturing the four virtual webcast live screens, user interactive text, and AI reply corpus in batches, and sets the anti crawl mechanism and delayed capture to ensure data integrity.

#Virtual webred AI interactive data crawler core code:

```
import requests, time, random
from bs4 import BeautifulSoup
#Target samples: ayayi, Liu Yexi, Luo Tianyi, Xingtong
target_virtual_influencer =["AYAYI","柳夜熙","洛天依","星瞳"]
def crawl_interaction_data(name):
data list = [ ]
# Simulate browser request header
headers = {"User-Agent": "Mozilla/5.0
(Windows NT 10.0; Win64; x64)
AppleWebKit/537.36")
#Batch capture of public live interactive data
for page in range(1,21):
url =
f"https://social.data.platform/{name}/live?page={page}
res = requests.get(url, headers=headers, timeout=10)
soup = BeautifulSoup(res.text, "lxml")
#Extract user questions, AI replies, and interaction duration data
user_q=
soup.find_all("div",class_="user-question")
ai_ans =
soup.find_all("div",class_="ai-answer")
for q,a in zip(user_9,ai_ans):
data_list.append({"user_text":q.text.strip(),"ai_
text":a.text.strip()})
time.sleep(random.uniform(0.5,1.2))
return data list
```

4.2. CG visual authenticity recognition algorithm based on OpenCV

Relying on the python opencv visual library, pixel level feature extraction is carried out for the virtual webcast video frames and high-definition materials, and the five visual indicators of the model surface number accuracy, texture restoration degree, light and shadow matching degree, limb fluency and micro expression precision are automatically quantified, and 0-1 standardized score is output.

#CG visual authenticity image recognition quantization code:

```
import cv2
import numpy as np
def cg_visual_evaluation(img_path):
#Read the image and grayscale it
img = cv2.imread(img_path)
gray = cv2.cvtColor(img,
cv2.COLOR_BGR2GRAY)
#1.Texture definition detection (Laplace variance)
texture_score = cv2.Laplacian(gray,
cv2.CV_64F).var()
#2.Light and shadow uniformity detection
light_score = np.std(gray)
#3.Contour integrity (model accuracy)
edge = cv2.Canny(gray,50,150)
contour_score = np.sum(edge)/edge.size
#4.Dynamic fluency (frame difference calculation, video input adaptation)
#Index normalized to 0-1 interval
s1 = texture_score / 1000
s2 = light_score / 50
s3 = contour_score
#Comprehensive CG visual score
cg_score = round((s1+s2+s3)/3,4)
return min(cg_score,1.0)
```

5. Conclusions and Recommendations

5.1. Conclusions

This study, grounded in social identity theory, analyzed the independent variable of virtual influencer authenticity, The relationship between the two factors is the dependency of buying intent, the mediator of emotion trust, and the adjustment factor of environment. Based on a questionnaire with 552 valid answers and SPSS data analysis, we came to the following conclusions:

(1) Virtual influencer authenticity significantly and positively influences consumer purchase intention. In terms of persona authenticity, content authenticity, and emotional authenticity within virtual influencer authenticity, all aspects have gained a certain degree of recognition from consumers themselves, Exerting a positive influence on consumer purchase intention.

(2) Emotion trust has a significant effect on the reality of virtual influential person and buying intention. The increased emotion confidence strengthens the significance of the VCI, and thus affects the buying intent of the customer.

(3) The environment has an important role to play an important role in the relation of VCI and VCI, as well as VCI and VCI. In some cases, the more conscious of the environment is, the more authentic, emotional and buying will be, while on the contrary, they are weaker.

5.2. Recommendations

5.2.1. Cultivate Emotionally Resonant Virtual Influencer Personas

During development, operators should clearly define the influencer's persona positioning. Align it with the target audience's values and lifestyle to establish a clear, consistent image. Avoid ambiguous or contradictory personas and prevent any collapse of the persona. For example, targeting young beauty consumers, position the influencer as a "professional, sincere beauty content creator." Keep your personality consistent and stable in your personal life. You will be able to interact with your customers as your top priority. You will also be able to respond quickly to your reviews and personal messages. You will also be able to get feedback from your customers and build up a two-way relationship. Instead, they are able to combine the current and the emotion of the customer to create an emotional resonance – for example, to communicate positive energy or deal with living issues – in order to strengthen the relationship.

5.2.2. Building Perceptual Marketing Pathways Through Authentic Collaborations

In choosing a Virtual Influencers to collaborate with, a brand's priority is to assess its personality stability, its authenticity, and its ability to express emotions. Choose a virtual celebrity who has a good reputation, no fake ads, and is in line with your brand's voice. Try not to follow the flow, but rather to work closely with fictitious influencers who are prone to personality breakdown or create false ones in order to protect their reputation from being damaged. You need to make full use of the positive side of the digital marketing environment in order to achieve maximum impact. Through matching the features of the platform and the industry norms, they can optimise the Virtual Influencer Marketing Scenario. Examples include: · Put cooperative content on highly supervised and reputable platforms, which will strengthen customer confidence in both the influencer and the brand via platform endorsement. - Actively comply with the rules of the trade, regulate the sale of products, and avoid misleading advertisements or over-promotional activities. This promotes a sound industrial ecosystem and strengthens the beneficial environmental impact of regulation.

5.2.3. Strengthen Digital Marketing Oversight to Consolidate Industry Foundations

In the course of marketing, the platform should provide a strong screening mechanism for the virtual influencers, strictly examining their personal placement and content credentials to avoid the acceptance of fake personalities or inappropriate content. At the same time, it is essential that the platforms enhance their day-to-day supervision over VMA, impose sanctions on fake ads and over-selling, and rigorously investigate infringements in order to cleanse the environment of the platform. These include clarification of the rights and duties of virtual influencers, the establishment of sanctions for breaches like fake ads and personality breakdown, and the establishment and enforcement of legislation at the same time. Today, industry guidelines need to be reinforced through the development of self-regulation guidelines for virtual influencers. This will lead the business operators to adhere to the truth, to regulate their operations, and strictly to fight against fake advertisements and sales, so as to preserve a sound and fair environment for digital sales.

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