Research on the Developmental Genealogy of Virtual Endorsers: A Media Evolution Perspective

Manqing Wang[1]

[1] *School of Economics and Management, Communication University of China, Beijing 100024, China*
[1]*Corresponding author. Email: wangmanqing@cuc.edu.cn*

ABSTRACT
The rapid advancement of digital technology is reshaping the logic of commercial communication. Based on Media Evolution Theory, this paper focuses on the evolution of virtual endorsers from tools of technological display to carriers of cultural meaning. By tracing their technological genealogy, this study establishes an analytical framework comprising "Technological Compensation – Application Practice – New Technological Trap." It deconstructs the evolutionary trajectory of virtual endorsers from "media toys" to "social mirrors." A review of the development history reveals that the evolution of virtual endorsers is a discontinuous, upward spiral: essentially, each technological breakthrough acts as media compensation for the "traps" of the previous generation. While overcoming existing limitations, this compensation inevitably generates new technological traps, driving the media to continuously evolve toward a "humanized interface." This paper reveals how technological artifacts transform from instrumental tools to cultural carriers through the co-shaping of commercial mechanisms and social cognition. Finally, it discusses new challenges, such as human-machine ethics, within the context of virtual-real symbiosis.

Keywords: *Virtual endorser, Media compensation, Technological genealogy, AIGC, Media Evolution Theory.*

1. INTRODUCTION

The rapid advancement of digital technology is reshaping the communication logic of the business world at an unprecedented pace. From Hatsune Miku pioneering subcultural consumption as a virtual diva, to hyper-realistic digital humans like Liu Yexi triggering phenomenal dissemination on short-video platforms, virtual digital humans have successfully transitioned from niche subcultures to the mass consumer market. This process not only illustrates the evolutionary path of technological innovation but also reveals the logic by which emerging media functionally substitute traditional media. The dynamic interplay of three forces—technological breakthroughs, capital drivers, and user demands—propels this evolution, collectively shaping the forms of endorsement media.

Paul Levinson's Media Evolution Theory offers a critical perspective for this exploration. He posits that the emergence of new media is essentially a "compensation" for the defects of older media. Its evolution follows the three-stage pattern of "Toy-Mirror-Art": initially pursued for novelty, becoming tools for practical needs upon maturity, and finally sublimating into carriers of creative expression. The diachronic evolutionary path of virtual endorsers validates the predictive framework of Media Evolution Theory. Human endorsers are constrained by moral hazards, cultural barriers, and physiological limitations. In contrast, virtual endorsers are reshaping the fundamental rules of brand communication through technological compensation characterized by controllability, malleability, and intelligence[1].

Virtual endorsers are reshaping the rule system of brand communication through three dimensions of technological compensation: digital controllability, cultural malleability, and intelligent interactivity. Amidst industry debates over whether "AIGC will replace humans," it is crucial to revisit the history of technology and examine how virtual endorsers have progressively broken through capability boundaries across generational

transitions. This inquiry concerns not only the integrity of academic theory but also holds practical significance for brands formulating technology adaptation strategies and for policymakers balancing innovation with regulation.

This paper aims to establish an analytical framework of "Technological Compensation – Application Practice – New Technological Trap." By tracing the technological genealogy of virtual endorsers, it deconstructs their evolutionary trajectory from "media toys" (technological spectacles) to "social mirrors" (cultural representations). Furthermore, it reveals how technological artifacts transform from instrumental tools to cultural carriers through the co-shaping of commercial mechanisms and social cognition.

The core research proposition focuses on the following question: How do virtual endorsers reconstruct the interaction mode between brands and consumers through continuous media compensation as they evolve from tools of technological display into carriers of cultural meaning?

2. THE PROTOTYPES OF 2D FIGURES UNDER MEDIA COMPENSATION (1980–2000)

2.1 Functional Expansion Driven by 2D Image Technology

In essence, the technological origins of the virtual endorser concept represent an early practical exploration of Media Compensation Theory within the field of commercial communication. In terms of technical implementation, 2D flat image technology constituted the primary means of compensation during this period. A landmark case is the 1982 Japanese anime Macross, which successfully created the virtual diva Lynn Minmay. Its production relied on labor-intensive hand-drawn cel animation. Although this technical path imposed a significant cost burden, it unexpectedly pioneered a groundbreaking commercial endorsement model. Additionally, the virtual host Max Headroom, launched by Britain's Channel 4 in 1985, exemplified early technical attempts at computer-generated imagery. The character was distinguished by a highly futuristic and recognizable digital appearance.

In terms of technical limitations, early advertising content produced using traditional hand-drawn animation technology incurred high production costs. However, this investment failed to effectively translate into commensurate communication impact and audience reach. A particularly pronounced limitation at the time was the inability of virtual endorsers to make timely, dynamic adjustments to their image, style, or communication strategy in response to market changes and consumer feedback. When consumers expected real-time interaction during specific marketing campaigns, system responses often suffered from significant latency due to the underdeveloped technology of the era. This "response gap" in the interaction process directly contradicted the fundamental requirement for feedback immediacy posited by modern marketing communication theory[2].

2.2 Commercialization Attempts Under the One-Way Communication Model

Against the backdrop of an era where advertising communication was dominated by one-way information output, brands began employing digital image carriers to mitigate the high costs and potential risks associated with human endorsement. This approach aligns closely with the core mechanism elucidated by the "Meaning Transfer Model" in celebrity endorsement theory. The practical commercial application of virtual endorsers was characterized chiefly by "mediated endorsement." Taking Lynn Minmay as an example, Sony Music officially appointed her as an endorser for record products. The single she endorsed, Do You Remember Love? (Ai Oboete Imasu ka), achieved a sales record of approximately 270,000 copies[3]. This success preliminarily validated the potential value of virtual images in product promotion and endorsement. The case clearly demonstrates how virtual characters can leverage the narrative power of anime storylines to construct a distinct persona. Ultimately, they effectively transfer the specific cultural symbols they carry onto the commercial products they endorse.

Another significant application case is Max Headroom, who was selected by the global beverage giant Coca-Cola as its brand endorser. He promoted the slogan "Coke is it!" in television commercials across multiple countries, including the United States and the United Kingdom[4]. During this developmental stage, the commercial value of virtual endorsers was realized primarily through indirect channels, such as the sale of derivative merchandise like posters and stickers. For instance, Lynn Minmay's charisma stemmed

from the "wartime idol" narrative context meticulously constructed within the anime's plot. This storytelling approach endowed her associated music albums with a narrative-driven "endorsement premium" that transcended the functional value of the products themselves. Consumer purchasing decisions were largely driven by identification with the symbolic meanings embodied by the character.

Overall, the influence of virtual endorsers primarily permeated within and remained confined to specific subcultural circles. For instance, Lynn Minmay's appeal was concentrated among Japanese anime enthusiasts; conversely, Max Headroom achieved relatively high recognition among young audiences in Europe and the United States. While this application model achieved success within a limited scope, its market application remained in a nascent stage. The scale was relatively small, far from forming a mature commercial ecosystem capable of economies of scale and sustainability.

2.3 Limitations in Expressiveness and Interactivity of 2D Technology

In the initial stage of development, virtual endorsement encountered multiple structural technological traps, which significantly constrained the full realization of endorsement functions. In terms of commercial application, the association between virtual endorsers and endorsed brands appeared relatively weak. Virtual characters failed to establish a deep, exclusive binding relationship with specific product categories or brands. Taking Lynn Minmay as an example, her commercial value as an endorser diminished concurrently with the waning popularity of the original anime. This phenomenon clearly illustrates the inherent defects of digital virtual endorsement compared to traditional human endorsement, particularly in terms of image adaptability and dynamic response capability.

When Max Headroom endorsed Coca-Cola, although marketing campaigns endeavored to portray him as a "computer-generated" image imbued with a futuristic technological aura[5], in reality, the so-called "interactive" experience with consumers was primarily underpinned by a set of fixed, pre-set Q&A scripts. Once users detected obvious repetitiveness or a mechanical nature in his responses during actual interactions, it rapidly triggered a crisis of public trust regarding the authenticity and reliability of his endorsement. This phenomenon strongly corroborates a core principle of advertising endorser theory: the authenticity of the endorser's image and the consistency of the communicated message are the fundamental cornerstones for establishing consumer trust in a brand[6].

Furthermore, the highly stratified distribution of audience groups directly resulted in a distinct "ceiling effect" on the commercial value realizable by the virtual endorsement model at that time. This limitation not only restricted the breadth of dissemination but also compromised the brand image: when consumers encountered response latency and a mechanical nature during interactions, it was prone to triggering skepticism regarding the authenticity and credibility of the brand's promotional content. On the whole, the scale of its market application remained in a very preliminary, nascent stage, with a relatively small volume, far from forming a mature commercial ecosystem capable of economies of scale and sustainability.

3. THE 3D REVOLUTION AND THE RISE OF PARTICIPATORY ENDORSEMENT (2001–2010)

3.1 Technological Compensation Driven by Interaction Empowerment and Communication Dimension Enhancement

The technological breakthroughs of this phase essentially served as targeted technical compensation for the limitations of one-way communication inherent in the nascent stage. Three-dimensional modeling technology, by optimizing polygon mesh topology, enabled virtual endorsers to achieve 360-degree visibility. This compensated for the deficiency in spatial expressiveness of 2D flat images. Yamaha's VOCALOID 2 speech synthesis engine, released in 2007, featured core functionality that allowed users to generate vocal performances by inputting lyrics and pitch parameters. This enabled virtual divas like Hatsune Miku to "sing" songs created by users, effectively compensating for the limitations of repetitive, pre-recorded voice content characteristic of the Max Headroom era. Simultaneously, motion capture technology was applied during this stage. For instance, systems like Vicon were used to translate the performances of human actors into digital motion data[7], injecting richer capabilities for dynamic emotional expression into virtual endorsers.

Together, these technologies formed a "Triple Compensation Upgrade":(1) Spatial dimension compensation broke the constraints of flat media; (2) Sound generation compensation realized the personalization of content output; (3) Motion data compensation endowed virtual images with more realistic body language.

The 3D technology revolution propelled virtual endorsers to evolve from mere "visual symbols" into media entities possessing interactive potential. The enhancement of their compensation efficacy is directly reflected at the level of user cognition. Multiple studies indicate that compared to 2D figures, 3D virtual endorsers can generate higher brand message recall.

3.2 Commercial Value Reconstruction Driven by User Participation

The application paradigm of virtual endorsers underwent a fundamental transformation during this period. The core breakthrough lay in the disruption of the traditional one-way endorsement model by the User-Generated Content (UGC) mechanism. Through the Piapro creation platform opened by Crypton Future Media, Hatsune Miku allowed users to customize songs and character images, thereby forming a new model of co-creation between the brand and users[8]. This participatory endorsement was validated in actual commercial cases. For instance, when Toyota utilized Hatsune Miku for promotion in 2009, the user-created commercial song Hatsune Miku no Gekisou generated a positive response among the young target demographic, driving sales growth for the relevant car models. The Chinese virtual singer Luo Tianyi also successfully applied the UGC concept to the local market. For example, the "Vitamin Water" brand she endorsed solicited advertisement scripts via the Bilibili platform. This campaign attracted a large volume of user submissions, and the relevant videos garnered substantial view counts[9].

Holographic concerts pioneered a new scenario for immersive endorsement. Hatsune Miku's "MIKUPA" concert, held in 2009, employed advanced holographic projection technology to project 3D figures performing endorsement tracks onto transparent media. This transformed mere brand exposure into a deeper experience of emotional connection. This new paradigm propelled a significant leap in the commercial value of virtual endorsement. The global market scale for virtual endorsement achieved substantial growth during this period, expanding from millions of dollars in 2001 to hundreds of millions by 2010. This growth momentum stemmed largely from marketing activities related to UGC. A key advantage lies in the co-construction mechanism of the endorser's persona. Through continuous secondary creation, users constantly enriched the character settings of virtual figures like Hatsune Miku, extending their lifecycle as endorsers far beyond the cycle limitations of traditional human stars.

3.3 New Technological Traps Constituted by Lack of Immersion and Data Silos

As technological compensation continued to deepen, the second generation of technological traps emerged during this phase, directly constraining the transformation process of virtual endorsers toward full-scenario penetration.

The primary issue was the distortion of emotional expression. Although motion capture technology could record body movements, the accurate transmission of facial micro-expressions still relied heavily on manual post-production adjustments. For instance, when early virtual endorsers attempted to visualize "product experiences" in advertisements, the refinement of their facial animation often required artists to perform frame-by-frame adjustments. This resulted in an emotional transmission efficiency far inferior to that of human endorsers[10].

Secondly, there was the issue of cross-platform data fragmentation. The image data of virtual endorsers across different application scenarios (such as concerts, games, and advertisements) were typically incompatible. For example, a virtual figure model designed for a specific advertising project might not be directly transferable to a gaming platform. This phenomenon of "data silos" forced brands to repeatedly invest modeling resources across different projects and platforms, causing significant resource wastage[11]

The most potentially detrimental issue was the deficiency of real-time interaction capabilities. When early virtual assistants performed endorsement consultation functions, although they could answer basic product queries, they exhibited high error rates when handling multi-turn complex dialogues[12]. This exposed the bottlenecks in Natural Language Understanding (NLU) technology.

These technological traps constituted the primary direction for the technological leapfrog

efforts of the next developmental stage. Only when affective computing engines broke through the bottlenecks of micro-expression generation, cross-platform digital asset exchange pipelines dismantled data barriers, and deep learning-driven dialogue systems were upgraded, could virtual endorsement truly advance toward a new stage of full-scenario intelligent penetration. As communication scholar Henry Jenkinsforesaw in his Participatory Culture theory: "The core evolutionary direction of technical compensation lies in dissolving the interaction gap between the virtual and the real."[13]

4. FULL-SCENARIO PENETRATION DRIVEN BY INTELLIGENCE (2011–2020)

4.1 Technological Compensation Embodied in Deepened Emotional Interaction and Scenario Breakthroughs

The technological evolution during this phase focused on resolving the legacy issues of distorted emotional expression and deficient real-time interaction from the exploratory period.

AI-driven compensation mechanisms achieved critical upgrades at the 3D level. Micro-expression generation technology, utilizing Convolutional Neural Networks (CNN) to parse massive amounts of Facial Action Coding System (FACS) data, controlled facial muscle movement errors within an extremely high precision range. This effectively superseded the inefficient manual calibration process. Breakthroughs in real-time rendering pipelines were exemplified by the in-depth application of ray tracing technology. This significantly reduced latency levels for high-resolution rendering, making virtual endorser livestream sales capable of supporting massive-scale concurrent users in a single session a reality. Of greatest compensatory value was the continuous evolution of intelligent dialogue systems. Taking a virtual endorser from a financial institution as an example, its integrated affective computing module could identify various complex emotional states in real time. It dynamically adjusted product recommendation strategies accordingly, ultimately achieving a significant increase in the conversion rate for wealth management consultations.

This series of technological leaps propelled virtual endorsers to complete a qualitative transformation from "visual symbols" to emotional interactive media. Empirical research data confirms that virtual endorsers possessing emotional feedback capabilities receive higher brand favorability scores than basic virtual figures[14]. This signifies that the technological compensation mechanism has preliminarily achieved the core demands of interpersonal communication, establishing an effective bond of emotional connection.

4.2 Construction and Operation of Cross-Scenario Commercial Ecosystems

Virtual endorsers achieved a paradigm leap from single-point exposure to full-chain marketing during this phase, with commercial applications covering multi-domain scenarios.

In the FMCG sector, PepsiCo employed the virtual idol Limu in 2018 to endorse its sugar-free series. Launching an "AI Mixologist" interactive campaign on Instagram, users could upload selfies to generate exclusive beverage visuals mixed by the virtual endorser. This campaign achieved a cumulative reach of over 100 million, validating the scalable commercial potential of the UGC interaction model.

In the beauty sector, the Chinese brand Florasis (Hua Xizi) launched its eponymous virtual endorser "Huaxizi" in 2020. Featuring a Dunhuang Apsaras design, the character utilized real-time motion capture technology during a Taobao livestream to demonstrate makeup techniques, achieving single-session sales in the range of tens of millions of RMB—setting an industry record for virtual endorsement sales.

The luxury goods industry pioneered a new mode of digital twin endorsement. Louis Vuitton collaborated deeply with the video game League of Legends in 2020, designing collaborative Prestige Skins for game characters. The physical versions of the collaborative apparel worn by the virtual figure were released synchronously and sold out rapidly, forming a closed loop of "virtual endorsement driving physical consumption."

Regarding localized innovation, when the Indian virtual influencer Kyra endorsed Amazon India, she supported interaction in multiple regional languages, including Hindi and Tamil. This significantly increased the purchase conversion rate among users in Tier-2 cities, underscoring the importance of adapting technological compensation to regional cultural contexts.

Driven by full-scenario penetration, the global market scale of virtual endorsement has achieved multifold growth over the past decade. The core growth momentum stems from the maturation of the technological compensation mechanism. Virtual endorsers now possess emotional bonding efficacy approaching that of human endorsers, along with extremely high scenario adaptability.

4.3 New Technological Traps Highlighted by Cognitive Fragmentation and Ownership Dilemmas

The third-generation structural contradictions engendered by deep technological compensation have become profound challenges hindering the integration of virtual endorsers with the metaverse ecosystem.

The primary issue manifests as cross-platform cognitive dissonance: the same virtual endorser often presents significant personality fragmentation between social media scenarios and customer service scenarios, leading to significant disparities in user satisfaction[15].

Secondly, the risk of the decision black box is prominent. In recommendation models built on deep learning, the prevalence of explainable algorithms remains relatively low[16]. When virtual endorsers provide erroneous advice to users based on opaque algorithms, brands face a surge in ethical complaints.

The most severe challenge stems from the digital asset ownership dilemma. A dispute over the legal validity of existing endorsement contracts for a well-known virtual idol, triggered by a corporate merger event[17, exposed the industry pain point regarding the absence of legal status for virtual subjects.

The path to resolving these traps relies on three innovations in technological compensation: integrating fragmented personality dimensions via cross-scenario identity containers; realizing the authentication of digital asset ownership and automated execution using blockchain smart contracts; and enhancing decision-making transparency through Explainable Artificial Intelligence (XAI) technology[18] This evolutionary direction corroborates the core argument of Manuel Castells[19]: "The construction of the value closed loop for virtual endorsement essentially lies in reconstructing the relational network among people, products, and scenarios through technological compensation."

5. VIRTUAL-REAL SYMBIOSIS IN THE METAVERSE ERA (2021–PRESENT)

5.1 Technological Compensation Constituted by Progress in Property Rights Confirmation and Deepened Scenario Integration

Metaverse technologies have achieved a multi-dimensional compensatory leap regarding the ownership dilemmas and scenario fragmentation issues inherited from the growth phase.

The blockchain confirmation mechanism provides locking capabilities for the commercial rights of virtual endorsers through NFT smart contracts. Taking Gucci's virtual avatar assets as an example, their ownership status is permanently recorded via blockchain protocols. Brand partners can automatically distribute endorsement revenue based on on-chain smart contracts, fundamentally dissolving the ownership disputes characteristic of earlier stages.

Cross-scenario identity container technology, relying on advanced digital human frameworks, enables virtual endorsers to maintain high consistency of personality and image across diverse scenarios—such as gaming, social media marketing, and offline AR fitting rooms. This has significantly enhanced the unity of user cognition.

The most transformative development is the democratization of creation facilitated by Artificial Intelligence Generated Content (AIGC). Typical cases demonstrate that brand open platforms allow users to input product features to generate customized virtual endorsers; based on generative AI models, the system can output diverse design schemes within an extremely short timeframe.

These forms of technological compensation collectively propel the strategic transformation of virtual endorsers from "brand assets" to media for user co-creation. Empirical research indicates that virtual endorsement projects integrating blockchain confirmation and AIGC creation demonstrate a significantly higher Return on Investment compared to traditional models. This signifies that property rights protection and scenario integration have constituted the core compensatory value of this stage[20].

5.2 Evolution of the Commercial Ecosystem under Virtual-Real Symbiosis

Virtual endorsers drive the formation of a Metaverse commercial paradigm that reconstructs "people, products, and scenarios." Its application presents three innovation paths. The luxury sector pioneered a "digital twin endorsement matrix." Prada synchronously employed physical endorsers and their virtual counterparts. During digital fashion shows held by the latter on Metaverse platforms, digital outfits acquired by the audience could be immediately redeemed for exclusive in-store discounts, driving a significant increase in online sales. The FMCG sector deepened the UGC endorsement ecosystem. Pepsi upgraded its virtual endorser Lil Miquela (referenced as Limu) to an "A.I. Curator"[21]. Fans designed virtual can packaging on a Metaverse platform; after voting, winning designs were mass-produced as physical limited editions. A single campaign generated a vast amount of user-original works.

Propelled by the virtual-real integration ecosystem, the global market scale of virtual endorsement has achieved exponential growth. The core source of this growth lies in the continuous deepening of technological compensation. Virtual endorsers have become the core touchpoints bridging physical consumption and digital experiences.

5.3 New Technological Traps Formed by Human-Machine Ethical Challenges and Cognitive Overload

Deep Metaverse integration has spawned the fourth generation of ethical traps, manifesting as three types of structural contradictions.

The risk of personality alienation is the primary concern. When an AIGC-generated virtual endorser posted "anti-consumerism" remarks on social media that contradicted the brand's tonality, the brand's emergency deletion of the content triggered a wave of user boycotts. This exposed the crisis of loss of control between AIGC and the brand entity.

Second, the cognitive overload effect is becoming increasingly prominent. In complex scenarios such as Metaverse showrooms, when virtual endorsers process multitasking—such as consultation, customization, and reservation—simultaneously, some users report insufficient interaction depth, while a significant proportion indicate that the information pressure exceeds their tolerance.

The most severe challenge is the suspension of digital human rights. When virtual models claim "digital labor rights" and endorsement revenue sharing, the absence of legal definitions regarding the rights attribution of virtual subjects leads to a surge in dispute resolution costs.

These traps point towards the construction of a next-generation technological ethical framework: neural interface technology regulates the stability of virtual personalities via brainwave feedback[22]; federated learning systems balance the demands for data privacy and interaction depth; and governance models based on Decentralized Autonomous Organizations (DAOs) explore new mechanisms for the distribution of rights and interests regarding virtual endorsers[23]. This evolutionary path corroborates the core argument of Edward Castronova[24] in The Synthetic Social Contract: "The ultimate compensation of virtual endorsement requires embedding human ethical codes into the underlying layer of the technical architecture."

6. CONCLUSION

The developmental trajectory of virtual endorsers is, in essence, a technology-driven reconstruction of media functions. From "personified" symbols endowed by 2D animation to hyper-realistic intelligent agents spawned by AIGC, generational technological leaps have continuously broken through the boundaries of old media. This process validates the foresight of Levinson's Media Compensation Theory—that technology invariably evolves in a spiral of "solving old problems" while "triggering new contradictions."

The moral hazards, cultural barriers, and efficiency bottlenecks of human endorsers have been systematically overcome. Virtual humans are reshaping the fundamental logic of brand communication through their controllability, malleability, and intelligence. However, their pursuit of verisimilitude has also spawned new dilemmas: as the boundaries between the virtual and the real increasingly blur, consumers oscillate between emotional resonance and cognitive vigilance; capital engages in a game between commercial dividends and technological bubbles; and policy seeks a balance between innovation incentives and risk control.

Currently, virtual endorsers are gradually fulfilling the mission of the "Mirror Stage,"

continuously maximizing functional value while exploring the threshold of the "Art Stage." AIGC technology endows them with both informational expertise and emotional appeal, leading to a consumer decision-making mechanism characterized by dual-pathway synergy.

The technological surge has triggered a commercial boom: conversion rates in livestreaming are approaching those of human streamers; Metaverse marketing is constructing immersive experiences; and small and medium-sized enterprises (SMEs) are utilizing low-cost tools to achieve the integration of brand building and sales performance.

However, latent concerns lurk behind this exuberance: affective computing has not yet broken through the "empathy ceiling," and the programmatic nature of interactions exposes technological limitations. The abuse of Deepfake technology threatens social trust, and ethical controversies regarding virtual identities demand urgent responses. Furthermore, policy frameworks lag behind the speed of innovation, and a global consensus on the regulation of digital humans remains in a nascent stage. These unresolved issues constitute both gaps in academic research and challenges for industrial practice.

This study represents more than a mere linear survey of the technological history of virtual endorsers; it constitutes a profound inquiry into "how media reshapes humanized communication."

As virtual humans infinitely approximate real humans, perhaps we ought to ponder: Is the ultimate mission of technology to replace humanity, or to empower it? The answer may lie within the next stage of evolution—a realm that demands both the precision of algorithms and the warmth of humanity.

REFERENCES

[1] Zhou F, Ran M, Chen C. Empirical research on the relationship between perceived authenticity of virtual endorsers and consumer brand attachment[J]. Soft Science, 2018, 32(05): 112-115.

[2] Belch G E, Belch M A. Introduction to advertising and promotion: An integrated marketing communications perspective[M]. Irwin: 1993.

[3] 愛・おぼえていますか(Do you remember yourself)[EB/OL]. (2024-05-18)[2025-06-22]. https://ja.wikipedia.org/wiki/%E6%84%9B%E3%83%BB%E3%81%8A%E3%81%BC%E3%81%88%E3%81%A6%E3%81%84%E3%81%BE%E3%81%99%E3%81%8B.

[4] Max Headroom[EB/OL]. (2025-06-05)[2025-06-22]. https://en.wikipedia.org/wiki/Max_Headroom.

[5] Frieze. The AI of a TV Star: Remembering max headroom[EB/OL]. (2020-10-09)[2025-06-22]. https://www.frieze.com/article/ai-tv-star-remembering-max-headroom.

[6] Friedman H H, Friedman L. Endorser effectiveness by product type[J]. Journal of Advertising Research, 1979, 19(5): 63-71.

[7] Menache A. Understanding motion capture for computer animation[M]. Morgan Kaufmann, 2000.

[8] Itoh H. The possibilities of vocaloid software and community: Focused on hatsune miku[C]//Proceedings of the 2010 International Computer Music Conference. 2010: 1-4.

[9] Li Y. Chinese Virtual idol phenomenon: An analysis of Luo Tianyi[D]. University of Birmingham, 2016.

[10] Wang S, Liu Y. Research on the application of virtual characters in advertising communication[J]. Journal of Advertising Research, 2013, 53(4): 432-445.

[11] Chen J, Zhang M, Ma L. Challenges and opportunities of 3D model interoperability in virtual advertising[J]. Journal of Virtual Reality and Broadcasting, 2010, 7(3): 1-12.

[12] Gao J, He X, Zhang L. Multi-Turn dialogue management for conversational agents[C]//Proceedings of the 2012 ACM International Conference on Intelligent User Interfaces. 2012: 247-256.

[13] Jenkins H. Convergence Culture: Where old Media and new media collide[M]. New York University Press: 2006.

[14] Van der Heide B, D'Angelo A, Schumaker C. The effects of anthropomorphism on perceptions of virtual agents[J]. Computers in Human Behavior, 2012, 28(5): 1773-1782.

[15] Park E J, Kim K H. Effects of avatar's human-likeness and expertise on user perception and behavioral intention in virtual environments[J]. Computers in Human Behavior, 2014, 38: 156-166.

[16] Burrell J. How the machine 'thinks': Understanding opacity in machine learning algorithms[J]. Big Data & Society, 2016, 3(1): 2053951715622512.

[17] Wu J. Legal issues of virtual idols' copyright and endorsement activities in china[J]. Intellectual Property, 2018, (11): 78-83.

[18] Gunning D, Stefik M, Choi J, et al. XAI—Explainable artificial intelligence[J]. IEEE Transactions on Systems, Man, and Cybernetics: Systems, 2019, 49(7): 1655-1664.

[19] Castells M. The rise of the network society: The information age: Economy, society, and culture [M]. Blackwell Publishing, 2014.

[20] McKinsey & Company. The economic potential of generative AI: The next productivity frontier[EB/OL]. (2023-06-14)[2025-06-22]. https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/the-economic-potential-of-generative-ai-the-next-productivity-frontier.

[21] Marketing Dive. PepsiCo's Lay's teams with Lil Miquela to drive NFT, metaverse campaign[EB/OL]. (2023-09-18)[2025-06-22]. https://www.marketingdive.com/news/pepsico-lays-lil-miquela-nft-metaverse-campaign/694086/.

[22] Neuralink. Neuralink Show & Tell[EB/OL]. (2023-11-08)[2025-06-22]. https://neuralink.com/blog/show-and-tell/.

[23] World Economic Forum. Digital assets and the future of the decentralized economy[EB/OL]. (2024-01-16)[2025-06-22]. https://www.weforum.org/agenda/2024/01/digital-assets-decentralized-economy-davos-2024/.

[24] Castronova E. The synthetic social contract[M].Virtual Economies: Design and Analysis. The MIT Press, 2023: 13-30.