

## The Marketing Effects and Mechanisms of Virtual Influencers in the Context of AI Technology

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### Abstract

[Purpose] This study aims to investigate the marketing effects of virtual influencers, including their antecedents, mechanisms of action, and key moderating factors. [Method] Through a systematic review of existing research, this paper dialectically examines the impact of virtual influencer marketing applications on consumer psychological and behavioral responses from both positive and negative perspectives. [Results] Companies can design virtual influencers along two dimensions of authenticity: formal authenticity and behavioral authenticity, thereby attracting consumers through novelty, enhancing brand innovation perception, and avoiding scandals and behavioral risks associated with human endorsements. However, virtual influencer marketing still exhibits negative effects such as algorithm aversion, the uncanny valley effect, and authenticity concerns, with its marketing effectiveness being influenced by factors including source transparency, product category, application scenario, and individual consumer differences. [Limitations] This study has not yet validated the specific effects of virtual influencer marketing with empirical data, and the findings still require verification and refinement with larger or different samples. [Conclusion] This study not only reviews the current status and trends of virtual influencer marketing but also provides guidance and recommendations for marketing practitioners.

### Full Text

## Marketing Effect of Virtual Influencers and Its Mechanisms in the Context of AI Technology

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**Abstract:**

**[Objective]** This study aims to explore the marketing effects of virtual influencers, including their antecedents, underlying mechanisms, and key moderating factors.

**[Method]** Through a systematic review of existing research, this study critically examines the impact of virtual influencers' marketing applications on consumer psychology and behavioral responses from both positive and negative perspectives.

**[Results]** Companies can design virtual influencers along two dimensions: form realism and behavioral realism, leveraging novelty to attract consumers, enhance brand innovation perception, and mitigate the risks of scandals and misconduct associated with human influencers. However, virtual influencer marketing also exhibits negative effects such as algorithm aversion, the uncanny valley effect, and authenticity concerns, with its effectiveness influenced by factors like source transparency, product categories, application scenarios, and consumer individual differences.

**[Limitations]** This study has not yet incorporated empirical data to validate the specific effects of virtual influencer marketing, and the findings require further verification and refinement across larger or different samples.

**[Conclusion]** This study not only reviews the current landscape and trends in virtual influencer marketing but also provides guidance and recommendations for marketing practitioners.

**Keywords:** virtual influencer, artificial intelligence, influencer marketing, brand endorsement

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## Introduction

With the advancement of science and technology and the emergence of new technologies, corporate marketing strategies and consumer behaviors are being transformed [?]. Empowered by AI, virtual influencers have become new actors on social media, capable not only of attracting attention through shared content but also of directly promoting products or services to followers to facilitate transactions, thereby exerting profound influence on consumer behavior [?]. Like human influencers, virtual influencers can attract fan attention through staged photos and behavioral performances, thereby increasing their reputation and influence. A significant number of young people follow virtual influencers on social media despite knowing they are not real. Data shows that consumers' engagement with virtual influencers on Instagram is nearly three times that with human influencers [?]. In recent years, the application of virtual influencers in marketing campaigns and advertising scenarios has continued to emerge. Some companies have begun selecting non-human virtual influencers as marketing communication channels for products or services, profoundly impacting brand communication approaches [?]. In digital environments, companies often employ virtual agents to complete customer service tasks [?, ?], such as answering

consumer questions and guiding them through the shopping process. Unlike task-oriented virtual agents, virtual influencers focus more on creating consumer experiences [?]. This study specifically examines virtual influencers that can be applied in advertising and brand endorsement contexts.

To date, research on AI in marketing has primarily focused on leveraging technology to create customized advertising copy, product recommendations, or provide customer service [?, ?, ?, ?]. As AI's influence gradually extends into the domain of social media influencers, an increasing number of brands are utilizing virtual influencers to promote products and connect with audiences, including well-known brands such as Tmall, KFC, Louis Vuitton, Bulgari, Tiffany, and Nike. Virtual influencers can leverage AI technology to mimic human characteristics and personalities, thereby attracting specific market segments [?]. The application of virtual influencers in the advertising industry has already shown initial success. For example, virtual influencer Rozy secured over 100 sponsorships and endorsements within a single year, earning nearly one million dollars in 2021 alone. Even more notably, virtual influencer Lil Miquela earns approximately \$8,500 per sponsored post and nearly \$11 million annually, far exceeding the average income of social media influencers.

The internet has entered a stage where traffic dividends are exhausted. To break through bottlenecks, companies must be led into a completely new digital era. Virtual digital humans are regarded as concomitant products of society's digital transformation, bringing new momentum to socio-economic development. Market research institution Quantum Bit Think Tank (2021) [?] points out that China's virtual digital human market will reach 270 billion yuan by 2030. Currently, the practical applications of virtual influencers in marketing are becoming increasingly diverse, such as virtual anchors, virtual endorsers, and virtual idols. Many brands have already selected virtual influencers as their brand ambassadors, such as TANG Xiaomei for Chando, AYAYI for Alibaba, and NAYUKI for Nayuki. These virtual influencers not only possess human-like appearances but also exhibit extremely human-like behavioral responses. Empowered by AI technology, virtual humans are increasingly equipped with a human-like "core," possessing an intelligent-driven mental kernel. As an emerging marketing approach, virtual influencer marketing has achieved certain effectiveness in practice. Through a systematic review of existing research, we can not only organize and evaluate the current state and development trends of virtual influencer marketing but also summarize practical experience to provide beneficial guidance and recommendations for marketing practitioners.

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## 2.1 Concept and Connotation of Virtual Influencers

In the social media era, companies often select suitable online influencers to endorse their products or brands. These influencers actively publish personal-related content and interact with other users, thereby accumulating social cap-

ital and popularity to influence audience opinions or behaviors [?]. Virtual influencers are one type of online influencer; they are entities autonomously controlled by artificial intelligence and can be presented in digital environments in an interactive, real-time rendered manner [?]. Virtual influencers present themselves similarly to human influencers, possessing unique personas and storylines, and other consumers can interact with them in virtual environments [?]. They continuously engage in self-narrative through textual expression and visual presentation to build specific personas [?]. If a virtual influencer “uses software and algorithms to perform tasks like humans,” it can be considered an AI influencer [?]. There is also a special category of virtual influencers that are virtual characters controlled by humans [?]. These are referred to by netizens as “avatar virtual humans,” which have digital human appearances but are controlled by real people whose language, movements, and facial expressions are captured through devices.

The reason virtual influencers are constructed with distinct personalities is to increase their interpersonal attractiveness to better interact with consumers. Virtual influencers with clearly defined personas tend to have better market responses [?]. For example, the virtual idol and singer “Hatsune Miku” —companies used computer synthesis to create a vivid digital human and pleasant singing voice, even holding live concerts using holographic projection technology that attracted large numbers of devoted fans. Thomas and Fowler (2021) [?] argue that as digitally created artificial humans, virtual influencers typically possess certain online fame. They often have considerable followings on social networks and can be considered “trusted fashion leaders in one or several niche markets” [?]. Currently, virtual humans can not only visually approach real humans but also, with AI assistance, demonstrate strong interactive attributes, enabling them to provide natural communication experiences closer to real humans, bringing users stronger senses of interaction and immersion. This means virtual humans can provide not only functional value in specific domains but also emotional value.

Virtual influencers can create socio-emotional connections similar to those formed with real people. Research shows that people’s social, emotional, cognitive, and behavioral responses to virtual humans are similar to their responses to humans [?]. When interacting with virtual humans, not only can interpersonal interaction needs be met [?], but brain regions related to emotion and interpersonal experience are also activated [?]. These regions include the amygdala related to emotion recognition, the fusiform gyrus related to facial recognition, and the insular cortex related to subjective feelings [?]. Like human influencers, individuals choose to interact with more persuasive virtual influencers and may consume promotional or advertising products that appear during interactions [?]. The more followers a virtual influencer has, the more their creators can charge businesses to promote their products [?].

Virtual influencers can overcome many limitations of real humans, even surpassing human influencers in social media performance [?]. The advantages of

virtual influencers in corporate marketing activities mainly manifest in several aspects: First, low risk. Virtual influencers' behaviors and performances are completely controllable and predictable, effectively avoiding risks of scandals or misconduct. Second, high customizability. Virtual influencers' appearances, personalities, and personas can be customized according to brand or customer needs, enabling more precise market positioning. Third, low cost. Virtual influencers do not require high remuneration, travel expenses, or venue costs associated with traditional human influencers, and their content creation can be efficiently completed through AI, voice synthesis, real-time rendering, and other technologies, significantly reducing operation and maintenance costs. Finally, high flexibility. Virtual influencers can be active 24/7, posting content and interacting with fans at any time, ensuring brands remain in the public eye.

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## 2.2 Classification of Virtual Influencers

Today, many virtual influencers on social media platforms have increasingly realistic appearances, making the distinction between virtual humans and real humans smaller. For example, virtual influencer AYAYI attracted netizens' attention to hyper-realistic virtual humans in 2021 with an "ID photo." She joined Alibaba as the digital manager for Tmall Super Brand Day, becoming Alibaba's first virtual digital employee. AYAYI's image is extremely realistic, almost indistinguishable from real humans, and her skin texture even changes with lighting and environment like real humans. Miao et al. (2022) [?] point out that virtual influencers can influence consumer reactions along two dimensions: form realism and behavioral realism. Form realism reflects the visual similarity between virtual influencers and humans, while behavioral realism reflects the similarity in interactive capabilities [?]. Increases in both form realism and behavioral realism can enhance the anthropomorphism of virtual influencers, affecting consumers' perceptions and reactions.

### (1) Form Realism

Based on form realism, virtual influencers can be divided into three categories: human-like virtual influencers, cartoon-like virtual influencers, and non-human virtual influencers. Human-like virtual influencers are visually most similar to humans. Their anthropomorphic appearance enhances consumers' perception of their humanization, generating positive consumer reactions [?]. However, consumer responses to high levels of form realism are not always positive. Human-like virtual influencers mostly display unrealistic beautiful appearances and body types [?]. Virtual influencers' overly perfect and realistic appearances can affect people's perceptions of beauty and self-expectations. Some research suggests that virtual influencers represent a potential future risk for culture and media because they influence unrealistic expectations regarding beauty, style, and culture [?]. Additionally, evidence shows that as virtual humans become more human-like in visual cues and cognitive abilities, some consumers feel uneasy about this uncanny similarity [?]. This leads to decreased affinity and

negative consumer reactions. This negative effect may result from the deliberate demonization of virtual humans and advanced technology in popular culture, sci-fi movies, or books [?].

Some scholars argue that virtual influencers are not necessarily better when more human-like. Therefore, some virtual influencer designers are attempting to avoid this potential negative effect by designing another type—cartoon-like or animated virtual influencers. These virtual influencers have moderate human similarity, and people can recognize they are not real. For example, French virtual idol Noonouri belongs to the cartoon-like virtual influencer category, being closer to 3D animated characters. Cartoon-like virtual influencers can circumvent some negative effects that human-like virtual influencers may trigger, such as distorted aesthetics and the uncanny valley effect. Arsenyan and Mirowska (2021) [?] point out that virtual humans should retain certain “virtuality” elements to some extent rather than attempting to maximize human characteristics. Their study compared human-like virtual influencers, cartoon-like virtual influencers, and real human influencers, finding that human-like virtual influencers trigger the uncanny valley effect, resulting in worse endorsement effectiveness. However, completely removing human characteristics reduces anthropomorphism, leading to a lack of personal connection. Therefore, companies need to achieve a delicate balance when designing virtual influencers.

Non-human virtual influencers typically have low anthropomorphism and realism, with various forms including animals (e.g., John Pork), unreal creatures (e.g., Nobody Sausage), and anthropomorphized objects (e.g., Good Advice Cupcake). Since these virtual influencers usually appear as 3D or 2D cartoon characters, they are less likely to be perceived as real. Similar to many traditional brand mascots, non-human virtual influencers can effectively influence consumer behavioral responses. Nevertheless, research findings on non-human virtual influencers are somewhat controversial: some studies show that users may have negative reactions to entities with low relevance or low human-like features [?] and tend to prefer virtual images with high anthropomorphism [?]. However, some non-human virtual influencers (e.g., Nobody Sausage) can generate extremely high user engagement and emotional dependence [?]. Additionally, consumers typically seek entertainment and authenticity from cartoon-like and non-human virtual influencers, while seeking informational benefits from human-like virtual influencers [?].

## (2) Behavioral Realism

Due to current technological limitations, virtual influencers cannot achieve full automation and require supervision or control by specialized teams or individuals [?]. Therefore, virtual influencers typically rely on AI technology assistance, with carefully designed distinct personalities, rich emotions, personas, or narrative backgrounds that collectively shape their behavioral realism. Higher behavioral realism means virtual influencers exhibit more human-like behavioral characteristics, such as displaying daily “life” or interacting with real humans in photos. Sorosrungruang et al. (2024) [?] classified virtual influencers into

five categories based on form relevance and content relevance: spokesperson humanlike virtual influencers, influencer humanlike virtual influencers, evangelist anime-like virtual influencers, mascot nonhumanlike virtual influencers, and storyteller nonhumanlike virtual influencers. This study draws on Sorosrungruang et al. (2024) [?] and further subdivides the three types of virtual influencers into six categories based on behavioral realism, as shown in Figure 1 [Figure 1: see original paper]. The main difference between this classification and Sorosrungruang et al. (2024) [?] is that this study further refines the classification of cartoon-like virtual influencers.

*Source: Compiled by the authors*

### **Figure 1 Classification of Virtual Influencers**

If virtual influencers appear only as brand spokespersons in endorsement scenarios without distinct personality shaping or persona stories, they will affect consumer emotional attachment due to lack of behavioral realism, such as spokesperson-humanlike virtual influencers. Although these virtual influencers possess highly anthropomorphic appearances, their behaviors differ significantly from real human behaviors due to lack of effective interaction strategies, resulting in low interactivity and engagement. Typical examples include Lu do Magalu and Candy Prada. In contrast, influencer-humanlike virtual influencers mimic the personalities and behaviors of real influencers to carefully craft their virtual images. These virtual influencers typically do not belong to any brand but exist as free agents. Therefore, they often share emotional or lifestyle-related content on social media, establishing deep emotional connections with followers, enhancing interactivity and brand association, such as Lil Miquela and Imma.

In comparison, spokesperson-cartoonlike virtual influencers exhibit moderate anthropomorphic features (e.g., cartoon or anime style), with content primarily focused on brand promotion. These virtual influencers' storylines and character images are semi-developed, typically lacking deep emotional expression and coherent narrative structures, resulting in weaker interactivity, such as Noonouri and Baribe. However, if these virtual influencers are enriched with more creative background stories, talent displays, or biographical elements, their content appeal will be significantly enhanced, potentially making them idols in audiences' minds, similar to cartoon-like virtual influencers Luo Tianyi and Hatsune Miku. Research shows that even virtual influencers with moderate or low anthropomorphic appearances can successfully attract audiences when combined with creative content and well-developed character settings [?].

Additionally, mascot-nonhuman virtual influencers typically have low anthropomorphic appearances (e.g., animal or non-biological images) with relatively simple content lacking deep emotional expression, resulting in weaker interactivity. The core function of mascots is to embody brand values and anthropomorphize the brand, thereby enhancing social interaction between the brand and audiences [?]. Therefore, these virtual influencers tend to serve as brand mascots rather than true influencers, with typical examples including Good Advice Cupcake and Guggimon. In contrast, storyteller-nonhuman virtual influencers, de-

spite low anthropomorphic appearances, exhibit high and attractive behavioral realism. These virtual influencers typically attract audiences through humorous or life-oriented content, significantly enhancing audience engagement and memorability through creatively rich narratives and emotional resonance, such as Nobody Sausage and John Pork.

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### 3 Mechanisms and Moderating Factors of Virtual Influencer Marketing Effects

An increasing number of companies are choosing virtual influencers for marketing activities because they generate more positive marketing effects than human influencers. In specific contexts, advertisements endorsed by virtual influencers (compared to human influencers) can generate more positive consumer attitudes toward advertising, and consumers are more willing to select and consume products recommended or endorsed by virtual influencers. In social networks, many consumers prefer to follow virtual influencers with distinct personalities, interesting personas, and the ability to provide positive emotional experiences. Consequently, the marketing application of virtual influencers promotes deep contact and interaction between brands and consumers, effectively enhancing brand influence and audience coverage. However, virtual influencer marketing does not always yield more positive consumer reactions and may sometimes be counterproductive. For example, Zhou et al. (2024) [?] found that when virtual influencers (compared to real people) endorse products or services focusing on proximal sensory experiences (e.g., taste, smell, touch), consumers exhibit lower purchase intentions. Some scholars argue that people may hold negative views about virtual influencers' human-like capabilities [?, ?]. Others point out that virtual influencers, like their human counterparts, may engage in illegal or deviant behaviors, causing negative impacts on brand perception [?].

Because the marketing application effects of virtual influencers are not always positive, it is necessary to deeply explore why virtual influencers trigger positive or negative marketing effects and consumer reactions, as well as the important moderating factors that trigger different mechanisms. Therefore, this study conducts in-depth discussion and analysis from three perspectives: the positive effects and their mechanisms, negative effects and their mechanisms, and moderating factors of virtual influencer marketing.

#### 3.1 Positive Effects and Mechanisms of Virtual Influencer Marketing

Like human influencers, virtual influencers can satisfy people's needs in identity, entertainment, social relationships, and autonomy on social media [?]. Thomas and Fowler (2021) [?] demonstrate that virtual influencers can produce brand endorsement effects similar to human influencers, an effect that can be explained by the associative network model of memory. This model proposes that information stored in memory is connected through pathways, allowing activation

from one node to the next [?]. In marketing contexts, this model has been used to explain the formation of consumer brand associations. In scenarios where human influencers serve as advertising endorsers, brands become associated with their endorsers in consumers' memories over time [?]. Similarly, virtual influencers can become associated with the brands they endorse in consumers' minds, indicating that virtual influencers with positive perceptions can trigger positive brand associations.

Some research suggests that the emergence of virtual influencers can connect the real world with the imaginary world, providing consumers with an escapist scenario [?]. Virtual influencers give consumers opportunities to immerse themselves in alternative realities based on the real world [?]. For consumers, this immersion is a unique social interaction because their conversations can change virtual influencers' subsequent behaviors and generate perceptions of mutual connection [?]. This is because machine learning technology enables virtual influencers to continuously learn during consumer contact, achieving continuous improvement in details and insights [?]. Some consumers even imitate virtual influencers' behaviors [?]. Therefore, virtual influencers can increase connection during interactions with consumers, satisfying consumers' needs for social interaction and emotional support [?].

As exemplars of tastemakers, virtual influencers possess positive attributes that gain consumer affection and act similarly to human influencers and celebrity endorsers [?]. The emergence of virtual influencers and their resonance with consumers can bring enormous benefits to marketers and brands, benefits that even exceed those achieved through human influencers [?]. The main reasons more companies are beginning to apply virtual influencers include higher control over virtual influencers, lower marketing costs, and zeitgeist motives [?]. The primary mechanisms through which companies achieve positive effects by applying virtual influencers (compared to human influencers) are as follows:

### **(1) Positive Mechanism 1: Brand Fit**

Marketers can autonomously design desired virtual influencers as brand ambassadors, control their specific digital behavioral performances, and utilize AI technology to achieve automatic generation of behavioral performances. By using virtual influencers to provide customer service, brands can better control influencers' behaviors and customer service responses, minimizing the risk of "human error" [?]. Companies can also use natural language generation technology to give virtual influencers voice. Existing research points out that one benefit of natural language generation is maintaining consistency in brand voice [?], which may be difficult to achieve with human influencers. Additionally, AI technology can both seek single optimal solutions for problems and allow identification of various possible solutions, promoting divergent problem-solving [?]. For example, virtual influencers can use problem-solving technology to post responses to fans' comments or questions. Virtual influencers can also make adjustments to adapt to follower personalities, thereby engaging in more positive and effective interactions with followers [?]. Moreover, AI technology can evaluate social in-

interaction behaviors and numerous varied responses, helping virtual influencers achieve real-time self-optimization [?].

Most virtual influencers have constructed their own storylines with distinct personalities [?]. Virtual influencers' personalities are expressed through the products they promote and the experiences they publish. Attractive biographies, interesting storylines, and relevant characters are key to ensuring virtual influencers and their content remain interesting and maintain high-level interaction [?]. For example, Lil Miquela, the world's first virtual influencer created with computer-generated imagery, frequently shares her daily fashion choices and life online, attracting millions of followers. For advertising endorsers, the fit between endorser characteristics and the brand is a key factor affecting endorsement effectiveness [?]. The match-up hypothesis proposes that there must be fit or congruence between products and endorsers, which affects consumer attitudes toward advertising and purchase intentions [?]. This congruence is mainly reflected in perceived expertise or consistency. For instance, when companies select brand ambassadors, the fit between athletes and sports-related products is higher than that with actors [?]. Overall, compared to human influencers, virtual influencers can better align with brand personality.

## **(2) Positive Mechanism 2: Attention Attraction and Innovation Perception**

Yap (2018) [?] points out that the phenomenon of virtual influencers has the opportunity to stand out because human influencers are too common in the brand communication field. Consequently, virtual influencers can effectively help brands attract people's attention, especially young people's attention, which is highly valuable for brands whose target customers are primarily young. In brand communication, the novelty and uniqueness of advertising and its content are crucial, and this perception of differentiation can significantly enhance brand attractiveness [?]. Individuals' choices of which groups or users to interact with and how to interact reflect the social identity and relational identity they wish to shape [?]. Virtual influencers may provide additional signal value regarding their followers' innovativeness, open-mindedness, or alignment with the latest trends [?]. Therefore, consumers deliberately follow and interact with virtual influencers to express their desired personal identity and image.

Franke et al. (2023) [?] found that although consumer preference for virtual influencers is not particularly pronounced, the novelty factor may also be beneficial in advertising applications because perceived advertising novelty can positively change consumers' brand innovation perception. Some scholars believe that brands actively adopt virtual influencers because they can bring freshness, with novelty driving the success of these marketing campaigns [?, ?]. By adopting novel virtual influencers as brand ambassadors, companies and brands can effectively attract consumer attention. Moreover, when companies use virtual influencers in advertising, they can effectively spill over consumers' perceived novelty evaluations of the advertising to positive evaluations of brand innovation perception [?]. Including virtual influencers in advertising can to some extent

indicate that a company and brand are innovators in culture and technology [?].

### **(3) Positive Mechanism 3: Controllable PR Risks**

Human influencers serving as advertising endorsers may experience scandal events that cause serious negative impacts on brand image, whereas virtual influencers generally do not have scandals. Human endorsers' occasional misconduct poses potential risks to brand image [?]. Some scholars point out that companies selecting virtual influencers as endorsers can not only save costs but also reduce the risk of endorser scandals tarnishing brand image [?]. The main reason some companies choose virtual influencers or models is the controllability of PR risks, because all behaviors of these virtual influencers are carefully formulated by a group of behind-the-scenes planners, so they will not make politically incorrect statements or statements inconsistent with brand image [?].

In social media, many human influencers excessively beautify their photos, leading consumers to question the authenticity of influencers' appearances and behaviors. Many influencers' real physical attractiveness is far lower than their online photos, causing fans to complain about "false advertising" and resulting in public relations disasters. However, virtual influencers do not have this risk because they have no offline behaviors or states, so their "behaviors" and images can be effectively calibrated backstage to consistently maintain beauty [?]. Virtual influencers can maintain their influence and persuasive effectiveness through physical attractiveness, human-like functions, and audio-visual features [?, ?], while also avoiding audience concerns about authenticity because virtual influencers are "truly fake," and audiences clearly understand they are dealing with virtual characters.

Researchers have confirmed that virtual humans' appearances affect people's attitudes and behaviors [?]. Visually attractive virtual influencers are more likely to trigger positive social reactions and behavioral changes [?]. Given stereotypes regarding physical attractiveness, appearance can enhance virtual influencers' persuasiveness and influence [?]. Therefore, many virtual influencers are designed with idealized appearances. Selecting endorsers with outstanding appearances in advertising may trigger consumers' appearance anxiety. Existing research finds that although both human and virtual influencers can induce consumer appearance anxiety, the level of appearance anxiety triggered in virtual influencer contexts is lower than that in human influencer contexts [?].

## **3.2 Negative Effects and Mechanisms of Virtual Influencer Marketing**

### **(1) Negative Mechanism 1: Algorithm Aversion**

Once virtual influencers make mistakes, they are more likely to trigger consumer aversion. Individuals tend to hold a general aversion to algorithms, a phenomenon known as algorithm aversion [?], especially when algorithms make errors [?]. Research finds that although people recognize algorithmic predictions are superior to human predictors, they are more likely to lose trust in algorithmic

mic predictions than in human predictions [?]. When actual performance is poor, people accept real humans more than virtual humans controlled by algorithms [?]. When identity motives drive consumption, people exhibit stronger algorithm aversion [?]. Research shows that compared to AI mistakes, people are more likely to forgive human mistakes [?]. A virtual influencer's deviant behavior will lead consumers to develop stronger aversion toward alternative virtual influencers, meaning the emergence of alternative virtual influencers cannot alleviate the negative impact of the initial virtual influencer's misconduct on the brand [?].

The reasons for algorithm aversion may include: people feel their identity as humans is threatened by algorithms or artificial intelligence [?]. Schmitt (2020) [?] proposes that algorithm aversion may be due to speciesism, a bias that prioritizes the human species over all non-human species, including robots and other AI technologies. Some scholars point out that people believe algorithms have difficulty understanding users' emotions and are therefore willing to accept algorithm recommendations for utilitarian rather than hedonic products [?]. Some people may be unwilling to choose companies using algorithmic platforms due to privacy concerns about algorithmic platforms [?]. Other research suggests that algorithm aversion arises from people's overconfidence, as overestimating their own abilities makes them believe they do not need algorithmic support [?, ?]. People believe AI lacks autonomous goals and intentions, so when AI algorithms articulate high-level construal persuasive statements, it causes greater distrust [?].

## (2) Negative Mechanism 2: Uncanny Valley Effect

Virtual influencers with extremely human-like portraits may trigger consumer discomfort, a phenomenon known as the uncanny valley effect [?, ?]. Arsenyan and Mirowska (2021) [?] explored consumer responses to real human influencers, human-like virtual influencers, and anime-like virtual influencers. Results showed that compared to the other two types, consumers had significantly lower positive responses to human-like virtual influencers, and the uncanny valley effect could explain this phenomenon. The uncanny valley effect proposes that as non-human entities like avatars or robots become more human-like, they may trigger negative user reactions because users feel they are startlingly similar to humans [?, ?, ?]. When a virtual human looks almost human, its affinity decreases because this excessive similarity makes people feel uncomfortable [?, ?].

Existing research points out that whenever an entity transitions between categories, it triggers categorical uncertainty [?]. When people struggle to determine the nature of an ambiguous entity, it likely triggers negative evaluations [?]. Therefore, not knowing or being unable to determine whether a current figure is real or virtual causes discomfort. Some scholars explain the uncanny valley effect from a physiological perspective. Rosenthal-von der Pütten et al. (2019) [?] used functional magnetic resonance imaging (fMRI) technology to find that when viewing human-like figures, significant changes were observed in subjects' ventromedial prefrontal cortex (VMPFC), a region believed to reflect sympa-

thy. Moreover, the more human-like the figure, the more VMPFC activity increased, but when subjects faced extremely human-like beings, VMPFC activity decreased.

### **(3) Negative Mechanism 3: Awareness of Falsity and Distrust**

Trust is the cornerstone of artificial intelligence; only when humans trust this technology can they confidently and fully obtain AI's benefits [?]. Previous research suggests that the fundamental reason consumers dislike virtual humans compared to real people lies in the existence of distrust. Researchers found in a qualitative study that consumers find it difficult to develop trust in virtual influencers because these virtual beings cannot truly try products and provide genuine recommendations [?]. Compared to virtual influencers, consumers often show more affinity, credibility, and preference for human influencers.

When people know advertisements are AI-generated, their attitudes toward the advertisements change. People develop awareness of falsity toward AI-generated faces in public service advertisements, negatively affecting donation intentions [?]. This study manipulated awareness of falsity by informing subjects that “the face images in the advertisement are AI-generated,” with researchers believing informed subjects would develop stronger awareness of falsity. Robinson (2020) [?] argues that if real influencers mislead others by exaggerating or falsifying personal identity, then virtual influencer creators using Photoshop to make them more attractive is no different. Therefore, consumers' doubts about virtual influencers' motives and moral responsibility may trigger consumer aversion, resulting in negative impacts.

According to Theory of Mind, mental perception of various entities depends on two independent abilities: agency related to cognitive functions and experience related to emotional functions [?]. People feel that AI has strong thinking abilities but no feelings whatsoever, which is part of the reason they consider AI untrustworthy [?]. People do not question AI's sophistication and advancement but trust it far less. The reason people are willing to trust others is not because they are as smart as AI but because they can have emotional connections with them. Under normal circumstances, AI can indeed make faster and better decisions, wiser decisions than humans. However, for life-and-death important decisions, AI cannot gain sufficient trust from people. It can be inferred that virtual influencers controlled by AI will also be considered by people as lacking perceptual abilities and emotional intelligence, thereby reducing trust.

## **3.3 Moderating Factors of Virtual Influencer Marketing Effects**

### **(1) Source Transparency**

Thanks to technological development, virtual influencers now have visual images sufficient to confuse them with real people, causing people to lose the ability to distinguish between virtual and real influencers [?]. Some virtual influencers are so realistic and indistinguishable from real people that it is difficult to differentiate them from real humans. An analysis of Twitter posts found that

approximately 30% of user-generated content has already been created by bots using AI technology to impersonate humans [?]. It is evident that AI technology applications in the virtual influencer field have reached a level of verisimilitude. Source transparency refers to whether virtual influencers are clearly labeled with their digital identity (i.e., non-human identity) when they appear. For example, in Thomas and Fowler (2021) [?], participants were informed that the influencer was artificial, indicating high source transparency.

Some consumer protectionists argue that virtual influencer creators should clearly label on social media posts or advertisements that the influencer is not a real person but a digitally generated virtual human [?]. If virtual influencers are not labeled as “digitally generated,” some consumers may be misled into thinking the influencer’s product recommendations are based on their experience and personal evaluation [?]. However, some scholars believe that consumers should be able to identify that virtual influencers are computer-generated through careful observation [?]. When consumers discover that seemingly objective content from human influencers is actually an advertisement, they are usually angered [?]. Similarly, when consumers mistakenly believe virtual influencers are real people, discovering they are virtual may cause negative impacts. In summary, virtual influencers’ source transparency affects consumer attitudes toward them, thereby influencing reactions to endorsed brands or products.

## **(2) Product Category/Characteristics**

When endorsed products are items like lotion or perfume that need to be applied to the body to be effective, the product category clearly mismatches with virtual influencers because virtual endorsers, as advertising presenters, cannot become credible endorsers for this product category [?]. However, if endorsed products are technical or electronic products, selecting virtual influencers as advertising endorsers may be a better choice because technical products need to highlight innovation, which is precisely what virtual influencers represent. Innovative technical products, like virtual influencers, represent futuristic appeal [?]. As virtual influencer Lil Miquela said when discussing her collaboration with Samsung: “I am a product of technology myself, so I can connect with Samsung in a way that is more authentic than most people.”

Virtual influencers may also differ as endorsers for tangible products or services. For example, the tourism industry is quite suitable for virtual influencers because virtual influencers are not subject to physical limitations and can nominally “travel” anywhere, making them perfect tourism endorsers [?]. Since video game characters and virtual influencers are based on the same technology, virtual influencers are also very suitable as advertising endorsers. Conversely, the food industry may be less suitable for virtual influencers. As Zhou et al. (2024) [?] found, virtual influencers are not suitable for endorsing products or services focusing on proximal sensory experiences (taste, smell, touch), as their endorsement behavior results in lower purchase intentions compared to real human endorsers. To endorse food, endorsers need to convey strong naturalness, which virtual influencers likely lack.

There may be other factors behind product categories affecting consumer preferences. For example, a product's "essential" components being more natural or technical may have a greater impact on consumer preferences beyond the product category itself [?]. When considering whether a product category is suitable for applying virtual influencers as brand endorsers, companies need to consider the product's more essential attribute characteristics. This study argues that not all electronic products are necessarily more suitable for virtual influencers, but rather products representing the forefront of technological development or the spirit of the times are more suitable for virtual influencers as endorsers. For example, if a new cosmetic product is developed using advanced technology, selecting a virtual influencer as endorser may stimulate more positive consumer reactions than a real person; for electronic products without any innovative attributes, real human endorsement may be more attractive.

### (3) Application Scenario Factors

In corporate marketing activities, virtual influencers can appear in many different application scenarios. For example, virtual influencers can publish brand promotional content on social media platforms like Weibo, Douyin, and Instagram, conduct live commerce like real anchors, or appear as brand endorsers in online or offline advertising. However, if virtual influencers promote proximal sensory products in social media scenarios, it may lead to negative consumer reactions. In Zhou et al. (2024) [?], experiments primarily used scenarios where virtual influencers interacted with consumers on social media, confirming that virtual influencers are less effective than real influencers when endorsing proximal sensory products. Zhou et al. (2024) [?] conducted their research design in social media scenarios, which provide consumers with opportunities for deeper interpersonal interaction with influencers, such as liking, commenting, and discussing.

The social media scenario has high interpersonal interactivity [?], involving not only interaction between influencers and consumers but also among consumers. This may lead to a perception of parasocial relationships, where consumers feel connections or friendships with influencers and may even position themselves as part of the influencer's social circle [?, ?]. In highly interactive scenarios like social media, language communication is important information in the interaction process. If endorsed products belong to proximal sensory products, influencers' endorsement content on social media must inevitably include "strongly experiential" language. For example, when mentioning perfume products, influencers must praise their pleasant smell. Such language creates strong expectancy violation [?], reducing perceived endorsement credibility.

In contrast, in traditional advertising scenarios, consumers have no opportunity to interact with influencers or other consumers. Virtual humans appear to use their perfect images or popularity to attract consumer attention and enhance advertising memory effects, with a mechanism similar to hiring real celebrity endorsers. Thomas and Fowler (2021) [?] show that virtual influencers can produce brand endorsement effects similar to human influencers, an effect explained

by the associative network model of memory. Over time, brands become associated with their endorsers in consumers' memories [?]. Virtual influencers with positive perceptions can trigger positive brand associations. Therefore, in traditional advertising scenarios, even if virtual influencers endorse proximal sensory products, they can still bring relatively positive marketing effects.

#### (4) Consumer Factors

Consumer characteristics such as gender, age, personality, prior experience, and technology acceptance affect virtual influencer marketing effects [?]. For example, men typically prefer video games and may be more familiar with the concept of virtual influencers because they are very similar to 3D game characters. Some companies believe that virtual influencers are more likely to gain attention from younger generations. For instance, luxury brand Prada launched a virtual model, Candy, in 2021 for marketing activities for Prada Candy perfume. Prada's intention was to better conduct digital interactions with young consumers, focusing advertising placement on media platforms where Generation Z is active, such as Twitch, Snapchat, and TikTok.

Virtual influencers' endorsement effects are often highly related to consumer personality; consumers who prefer the fusion of virtual and reality and like mystery are more likely to favor virtual influencers [?]. Consumers with high curiosity may prefer virtual influencers [?]. For example, Prada stated that Candy perfume aims to interpret the brand's core spirit of intellectual exploration, fashion-forwardness, and ethereal playfulness, reshaping reality and breaking stereotypes through perfume. This brand core is consistent with virtual influencers' essential characteristics of breaking tradition and embracing innovation, thereby attracting consumers full of creative imagination and passionate about exploring virtual worlds.

Furthermore, consumers' cultural values or prior experiences related to virtual humans affect their acceptance of virtual influencer marketing. For example, anime culture is deeply rooted in Japanese society, and virtual characters created in Japanese anime or games are much more common and influential than in Western countries, with virtual singers or idols like "Hatsune Miku" first appearing in Japan. Similarly, international renowned comic conventions like Seoul International Cartoon and Animation Festival (SICAF) demonstrate South Korea's strong influence and audience base in two-dimensional culture. It is evident that the higher a country's consumer acceptance of two-dimensional culture or virtual characters, the higher their acceptance of virtual influencer marketing activities, generating more positive virtual influencer marketing effects.

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## 4 Summary and Discussion of Virtual Influencer Marketing Effects

Artificial intelligence is profoundly transforming the marketing field, making it urgent for marketers to understand how virtual influencers affect target con-

sumers' psychological perceptions and behavioral responses. Through a systematic review of the current state of virtual influencer marketing research, this study clarifies the concept and connotation of virtual influencers, proposes key factors affecting virtual influencer marketing effects at the character design level, and innovatively proposes six specific classifications of virtual influencers. On this basis, this study deeply explores the mechanisms and moderating factors of both positive and negative marketing effects of virtual influencers, which will help marketers maximize positive effects and reduce potential negative impacts when applying virtual influencers. Overall, virtual influencer marketing research remains in the exploratory stage, with many research topics urgently needing further deepening. Simultaneously, virtual influencers have positive development prospects in marketing applications but also face multiple potential challenges. Companies need to fully evaluate these challenges and develop corresponding coping strategies to ensure virtual influencers can be successfully applied in marketing scenarios and achieve expected effects.

#### 4.1 Summary of Virtual Influencer Marketing Effects

Based on existing research on virtual influencers, this study compiles and organizes a model framework diagram of virtual influencer marketing effects and their mechanisms, as shown in Figure 2 [Figure 2: see original paper].

*Note: Bold solid arrows in the figure represent direct effects; dashed arrows represent moderating effects.*

#### Figure 2 Model Framework of This Study

Integrating academic literature and business practice, this study proposes a 2 $\times$ 3 classification method for virtual influencers based on form realism and behavioral realism. With AI technology support, virtual influencers exhibit varying degrees of realism in appearance, personality, persona, and emotion, which collectively affect their marketing effectiveness. Academics and managers can use this classification method to identify different elements of virtual influencers to develop more precise marketing strategies for achieving specific marketing objectives.

According to this study' s analysis, virtual influencers have the opportunity to bring more positive marketing effects to companies compared to human influencers for the following reasons: First, companies can effectively control virtual influencers' behavioral performances to ensure high brand fit. Second, using virtual influencers can attract audience attention and generate freshness, improving consumers' innovation perception of advertising and brands. Third, selecting virtual influencers ensures controllable PR risks for brand endorsers, effectively avoiding potential risks such as human endorser scandals and inappropriate statements. Simultaneously, virtual influencer applications also have potential negative effects for the following reasons: First, consumers are unwilling to accept algorithm-controlled virtual humans due to algorithm aversion, especially when algorithms make errors or produce poor results. Second, according to the

uncanny valley effect, virtual humans with overly human-like appearances may trigger consumers' negative psychological reactions. Third, consumers develop awareness of falsity toward virtual influencers, triggering distrust that negatively affects endorsement effectiveness. It should be noted that positive and negative effects, as two ends of a dimension, may share common influence mechanisms. For example, if consumers have strong distrust toward virtual influencers compared to human influencers, they will be less willing to select or consume products endorsed by virtual influencers. However, virtual influencers may also generate higher consumer trust than human influencers in specific scenarios. Research shows that compared to real humans, automated social presence reduces consumers' perception of social judgment [?]. This means that in scenarios with high perceived social risk, consumers may develop higher trust in virtual influencers because they will not socially judge consumers, cause embarrassment, or leak private information like real people. Therefore, distrust (or trust) may not be limited to negative mechanisms but may also be an important mechanism triggering positive effects.

This study further analyzes moderating factors affecting virtual influencer marketing effects from advertising design and audience levels: First, unlabeled virtual influencers, once discovered by consumers to be non-human, easily trigger consumers' negative emotions and behavioral reactions, especially for hyper-realistic virtual humans that are difficult to identify. Clear virtual human labeling is necessary when virtual influencers engage in marketing activities. Second, the applicability of virtual influencer marketing differs across product categories, and companies should further consider ingredient factors behind product categories, such as naturalness and technicality. Third, virtual influencers can be applied in diverse marketing scenarios, such as advertising endorsement and social media interaction. However, for different product types, virtual influencer marketing effects differ across application scenarios. This demonstrates that companies must carefully consider the interaction between product characteristics and application scenarios when deploying virtual influencers. Fourth, consumer individual differences significantly influence virtual influencer marketing effectiveness, including demographic characteristics, personality traits, cultural background, and prior experience with virtual characters. Companies should segment their target audiences and tailor virtual influencer strategies accordingly to maximize marketing impact.

*Note: Figure translations are in progress. See original paper for figures.*

*Source: ChinaXiv – Machine translation. Verify with original.*