Impact of Virtual Influencers on Brand Attachment: A multigroup analysis

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Abstract
This study explores the impact of virtual influencers on brand marketing by examining their unique attributes—identity appeal, persona identification, AI-generated content, and interaction quality—on consumer brand attachment. Using data from 358 Chinese followers, multigroup analysis (MGA) reveals that identity attractiveness and perceived anthropomorphism enhance persona identification, while content and interaction quality drive parasocial interactions. However, persona identification does not significantly influence brand attachment. These findings fill a gap in virtual influencer literature, providing practical insights for marketers to leverage virtual influencers more effectively in brand strategies to boost consumer engagement.

Keywords: Virtual Influencer; Brand Marketing; Brand Attachment; Multigroup Analysis.

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1.0 Introduction

In brand marketing, virtual influencers offer unique advantages by projecting a positive brand image through adaptable and carefully crafted personas (Kim & Park, 2023; Li et al., 2023). Advancements in both artificial intelligence (AI) and virtual reality (VR) have enhanced their realism, evolving them from simple avatars to complex virtual identities (Yu et al., 2024). This progression enables brands to create customised virtual representatives, aligning with their brand strategies to engage audiences more effectively (Kim & Park, 2024).

For example, Lil Miquela has become a digital fashion icon with an estimated value of $125 million, leveraging AI to enhance her influence (Block & Lovegrove, 2021). Similarly, the Chinese beauty brand "Hua Xizi" utilised a virtual persona to embody classical beauty, strengthening its brand identity. However, challenges remain regarding authenticity and trust, which can directly impact brand perception (Ozdemir et al., 2023).

Therefore, it is vital to establish emotional connections with followers, as current interaction levels are often insufficient (Park & Sung, 2023). In addition, defining authentic attributes and enhancing AI-driven interactions are crucial for expanding the acceptance of virtual influencers as brand ambassadors.

Despite their growing influence, research on virtual influencers remains limited. Most studies compare them to human influencers, often emphasising a perceived credibility gap (Lim & Lee, 2023). The previous perspective does not fully capture the distinct identity traits of virtual influencers (Kim & Park, 2024). Emerging AI and natural language processing have reshaped these virtual personas, highlighting the limitations of anthropomorphism alone in understanding their impact (Gerlich, 2023).

Research thus far has not sufficiently explored the diverse types of virtual influencers (Xie-Carson et al., 2023). This study addresses that gap by examining how specific attributes and identities of virtual influencers influence brand attachment. Drawing on human influencer characteristics (Kim & Park, 2023), the study employs the parasocial interaction theory to examine the emotional bonds between followers and virtual entities (Stein et al., 2022). It also assesses the impact of AI-driven content quality and interaction on followers' trust.

By integrating social identity theory, the study examines how virtual influencer attributes influence follower identification and brand attachment and introduces the concept of virtual persona recognition. Parasocial relationship theory helps define new mechanisms for user-brand interactions. Additionally, it distinguishes between two types of virtual influencers—computer-generated imagery (CGI) and avatar-based—based on technological advancements, validating the uniqueness of these categories. The findings offer actionable

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insights for brands to refine their digital marketing strategies, enhancing theoretical and practical perspectives on leveraging virtual influencers.

2.0 Literature Review and Hypothesis Development

2.1 Virtual Influencers

The characteristics of virtual influencers significantly shape users' behavioural intentions. Their attributes are categorised into identity and interaction components, which are further distilled into four key elements: identity attractiveness, perceived anthropomorphism, AI-generated content quality, and AI-driven interaction quality.

Among various attributes, attractiveness has been identified as crucial in virtual influencers, encompassing physical appeal, visual characteristics, and linguistic style (Deng & Jiang, 2023). Familiarity and likeability drive follower attraction (Frank & Mitsumoto, 2023), while visual appeal enhances followers' perceptions and content sharing (Park & Sung, 2023). Attractiveness influences consumer perceptions and boosts purchase intentions and brand attachment.

Anthropomorphism, attributing human-like qualities to non-human entities, fosters emotional connections. Followers tend to bond with personified virtual celebrities, which enhances engagement and brand loyalty (Park & Sung, 2023). This human-like interaction helps virtual influencers align with followers' emotional needs, thereby enhancing brand credibility and attachment (Alabed et al., 2022).

Contnt quality is pivotal in brand marketing, as it influences purchase intentions and brand awareness. High-quality, AI-generated content can drive engagement and trust (Cao et al., 2023). In addition, AI advancements enable virtual influencers to generate content that often rivals human-created material, enhancing consumer engagement and fostering a more profound attachment.

Moreover, interaction quality focuses on user experiences with virtual entities. Enhanced interaction quality increases user satisfaction and acceptance, particularly with AI-driven platforms. Social media interactions with virtual influencers simulate human-like engagement, fostering deeper parasocial relationships (Lim & Lee, 2023). The interactivity, combined with creative and authentic storytelling, positively influences brand engagement and loyalty (Sands et al., 2022).

2.2 Types of Virtual Influencers

The classification of virtual influencers is still developing, with no universally accepted framework. Initial studies categorise virtual idols based on their visual design into four main types: non-human figures, animated human representations, life-like CGI humans, and realistic CGI humans. Other approaches categorise them by anthropomorphism, ranging from hyper-realistic non-human entities to human-like virtual influencers. From a brand perspective, this study categorises virtual influencers into two primary categories: CGI virtual influencers and avatar virtual influencers.

CGI virtual influencers are computer-generated personas crafted with advanced graphics that blur the line between virtual and real through life-like motions and expressions (Koles et al., 2024; Miyake, 2022). They possess distinct personalities, engage on social platforms, endorse products, and participate in cultural events (Yu et al., 2024). On the other spectrum, Avatars, originally denoting a form of incarnation, now refer to digital representations users create to express themselves in virtual spaces. These digital proxies reflect individuality and are often associated with celebrities who utilise avatars to expand their online presence, leveraging existing fan bases.

2.3 Persona Identification of Virtual Influencers

"Persona," derived from the Latin term for "mask," refers to an individual's outward identity or role in social contexts. In digital spaces, it refers to the virtual identity users create on platforms, encompassing user names, avatars, profiles, and backstories. Digital persona enables self-expression, fostering social interaction in online forums and gaming environments.

For virtual influencers, "persona" refers to a carefully crafted digital identity to establish a strong online presence. The constructed persona influences the representation of virtual entities and users' interactions with them. According to social identity theory, individuals seek recognition and validation, motivating them to align with virtual influencers who reflect their social identities.

Virtual influencers drive consumer engagement by strategically constructing their personas, enabling identity transfer and brand alignment (Sands et al., 2022). Identifying with a virtual influencer's persona enhances users' emotional attachment to the brands they endorse. Recognition of a virtual persona can translate into a social endorsement for the associated brand. Based on this understanding, the study proposed the following hypotheses:

H1: The identity attractiveness of virtual influencers positively correlates with persona identification.
H2: The perceived anthropomorphism of virtual influencers positively correlates with persona identification.

2.4 Parasocial Interaction with Virtual Influencers

Parasocial interaction (PSI) refers to the one-sided emotional relationships audiences develop with media personas. Human influencers use social media to share their lives, fostering a sense of social connection with followers. In the context of virtual influencers, the dynamics of PSI are complex. While responses to human and virtual influencers are similar, the latter is perceived as less human, which may reduce their relational impact (Stein et al., 2022). However, personalised interactions can deepen engagement and strengthen emotional bonds.

Whether from influencers or user-generated content (UGC), content quality is crucial for influencing consumer behaviour through PSI (Kim, 2022; Lou & Kim, 2019). High-quality content enhances audience perception and encourages deeper interactions. The quality of VI and PSI content on Instagram significantly boosts brand endorsements and social commerce. Superior content can elicit emotional responses, fostering strong PSI (Nguyen et al., 2023). Considering the previously outlined attributes of AI-driven interaction quality and AI-generated content quality of virtual influencers, the research advances the following hypotheses:

H3: The quality of AI-generated content positively correlates with parasocial interaction.
H4: The quality of AI-driven interaction positively correlates with parasocial interaction.

2.5 Brand Attachment Endorsed by Virtual Influencers

Brand attachment refers to the deep emotional connection consumers form with brands, fulfilling their needs for security and identity. Rooted in attachment theory, strong brand attachment can enhance consumers' behavioural intentions. When users resonate with a virtual influencer's identity, this emotional link can transfer to the endorsed brand, deepening brand loyalty (Na et al., 2023).

Brand credibility significantly influences engagement, with parasocial interaction (PSI) enhancing brand attachment, regardless of the level of product involvement. Studies show that PSI with social media influencers boosts purchase intentions, driven more by social connections than content credibility. Virtual influencers operate under similar mechanisms, where PSI and persona identification can strengthen consumer attachment. Based on these insights, the study formulates the following hypotheses:

H5: Parasocial interaction has a positive correlation with brand attachment.
H6: Persona identification has a positive correlation with brand attachment.

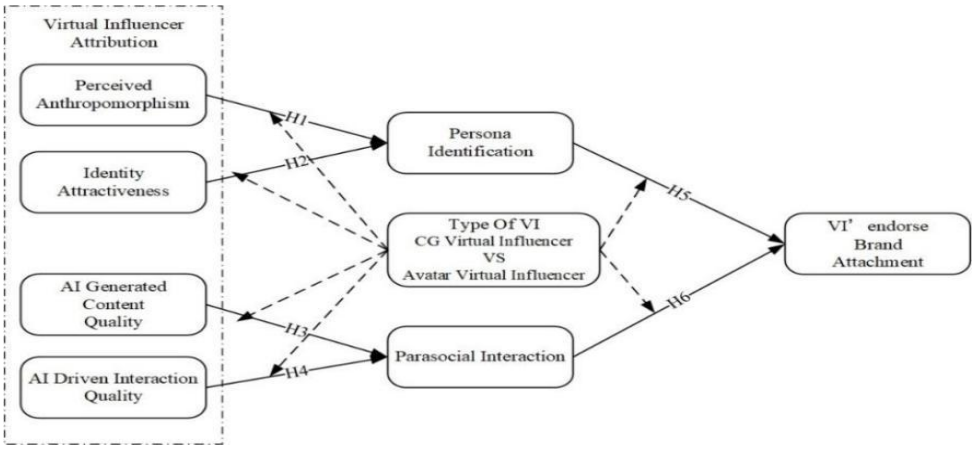

Figure 1: Conceptual Framework

3.0 Research Methodology

3.1 Research Design

The study employed a quantitative approach using a survey instrument. The measurement constructs were adapted from established scales and assessed on a seven-point Likert scale, ranging from 1 (Strongly Disagree) to 7 (Strongly Agree). The constructs assessed included virtual influencer attributes such as identity attractiveness, perceived anthropomorphism, AI-generated content quality, and AI-driven interaction quality.

Items were drawn from validated scales (Aw & Chuah, 2021; Kim & Park, 2024), while constructs for parasocial interaction and persona identification were adapted from recent studies (Hsieh, 2023). Brand attachment was measured using the established scale (Kim & Park, 2023). A pilot test refined the survey, eliminating non-relevant items for accuracy.

3.2 Data Collection and Sample Demographic

The survey targeted participants familiar with virtual influencers, focusing on social media users. Screening questions ensured sample relevance, such as “Are you aware of virtual influencers? List any known.” A survey was distributed digitally across China, using social media, forums, and email to reach diverse regions. Out of 598 responses, 535 were retrieved. After filtering out 149 invalid responses due to unfamiliarity and removing 35 outliers, 358 valid responses were analysed.

Table 1. Demographic Profile

Characteristics	Description	Count	Percentage
Gender	Male	170	47.5%
	Female	188	52.5%
Age	18-24 years old	78	21.8%

	25-29 years old	133	37.2%
	30-34 years old	93	26.0%
	35-44 years old	43	12.0%
	45-49 years old	9	2.5%
	50 years old and above	2	0.6%
Marital Status	Single	156	43.6%
	Married	202	56.4%
	Under RMB1500	28	7.8%
	1501- 3000	48	13.4%
	3001- 5000	102	28.5%
Personal Total Income (per month)	5001- 8000	121	33.8%
	8001- 12000	38	10.6%
	12001- 15000	13	3.6%
	15000 and above	8	2.2%
	Primary/Middle School	1	0.3%
	High School	18	5.0%
Education Background	College degree	94	26.3%
	Bachelor's degree	202	56.4%
	Master's / PhD degree	43	12.0%

Based on Table 1, the sample was diverse in gender, age, income, and education, with a primary skew towards females aged 18-34. Most respondents were employees or academics, with a significant portion holding bachelor's degrees, indicating that virtual influencers primarily appeal to younger, educated demographics. The largest income segment was RMB 5,001-8,000 (33.8%), indicating that the core audience falls within the middle-income bracket. The diversity of the sample provides a robust foundation for analysing the impact of virtual influencers.

3.3 Data Analysis

Data analysis was conducted using the partial least squares structural equation modelling (PLS-SEM) method with Smart PLS v4.0 software. The study focused on path model estimation and verification, analysing measurement and structural models to assess fit and parameter estimates (Hair et al., 2012). A multigroup analysis (MGA) was performed to divide the sample into two groups—CGI and Avatar virtual influencer followers—to examine differences in their responses.

4.0 Research Findings

4.1 Common Method Variance and Measurement Model Assessment

Using a single data source, the study tested for potential bias using the variance inflation factor (VIF). VIF detects collinearity, complicating the interpretation of regression (Hair et al., 2019). Results showed VIF values of 2.115 (content quality to parasocial interaction) and 1.513 (identity attractiveness to parasocial interaction), indicating weak collinearity. However, the VIF value for the relationship between parasocial interaction and brand attachment was 3.771, which is slightly elevated but still acceptable.

The measurement model was assessed for indicator reliability, convergent validity, and discriminant validity. Indicator reliability was confirmed with factor loadings >0.8, Cronbach's alpha >0.8, composite reliability (CR) >0.8, and AVE >0.6, indicating strong internal consistency. Discriminant validity was tested using the heterotrait-monotrait ratio (HTMT <1), confirming construct distinction. All measurement items and factors were within acceptable ranges, supporting further structural model evaluation (See Tables 2 and 3).

Table 2. Results of Factor Analysis

Item	Loading	Alpha	CR	AVE
Perceived Anthropomorphisms		0.921	0.927	0.809
The VI seems to have a person's feelings.	0.913			
The VI seems to have a person's mind.	0.910			
The VI seems to have a personality.	0.867			
The VI seems to have emotions.	0.907			
Identity Attractiveness		0.833	0.844	0.748
The VI has a very attractive identity.	0.854			
I like the VI because it is different from other VI.	0.895			
The VI makes me feel good, and they understand me.	0.845			
AI-Generated Content Quality		0.883	0.895	0.811
The content generated by the VI is accurate.	0.874			
The content generated by the VI is interesting.	0.900			
The content generated by the VI is valuable.	0.927			
AI-Driven Interaction Quality		0.898	0.9	0.713
Interacting with the VI was like having a real conversation.	0.792			
I perceive the VI to be sensitive to my needs for information.	0.800			
The VI would respond to me quickly and efficiently.	0.882			

Table 2. Results of Factor Analysis

Item	Loading	Alpha	CR	AVE
The VI allows me to communicate directly with it.	0.836			
The VI will talk back to me if I post a message.	0.905			
Persona Identification		0.869	0.874	0.793
My self-identity is based in part on being a follower of the VI	0.920			
Being a follower of VI is very important to my sense of self.	0.848			
My sense of self overlaps with the identity of the VI	0.902			
Parasocial Relationships		0.93	0.932	0.641
VI makes me feel comfortable as if I am with a friend.	0.877			
I would like to have a friendly chat with VI	0.816			
If VI were not a famous person, we would have been good friends.	0.743			
I think I understand VI quite well.	0.783			
When VI behaves in a certain way, I know the reasons for his/her behaviour.	0.791			
I can feel VI's emotions in certain situations.	0.813			
The VI seems to understand the kinds of things I want to know.	0.804			
The VI reminds me of myself.	0.784			
I can identify with VI.	0.785			
Brand Attachment		0.884	0.897	0.687
The brands that the VI endorses make me happy.	0.859			
The brands that the VI endorses make me pleased.	0.785			
The brands that the VI endorses elicit positive feelings and emotions.	0.713			
The brands that the VI endorses create positive emotional branding.	0.853			
I feel good when I use the brands that the VI endorses.	0.917			

Table 3: Discriminant Validity (HTMT)

Constructs	BA	CQ	IA	IQ	PA	PI	PR
BA							
CQ	0.72						
IA	0.70	0.727					
IQ	0.734	0.71	0.677				
PA	0.689	0.715	0.661	0.612			
PI	0.734	0.687	0.647	0.775	0.671		
PR	0.748	0.726	0.663	0.794	0.702	0.754	

4.2 Structural Model Assessment

The structural model evaluation involved path coefficients, means, STDEV, T-statistics, and p-values (Hair et al., 2019). As shown in Table 4, the path coefficient of identity attractiveness (IA) to persona identification (PI) is 0.317, with a p-value of 0.000, indicating that IA positively impacts PI. Additionally, the path coefficient of perceived anthropomorphism (PA) for PI is 0.419, with a p-value of 0.000, indicating that PA positively impacts PI. Therefore, both H1 and H2 were established.

The path coefficient of AI-generated content quality (CQ) to parasocial relationships (PR) is 0.147, which is statistically significant (p-value: 0.007), indicating that CQ has a positive impact on PR. The path coefficient of IQ for PR is 0.714, and the p-value is 0, indicating that IQ has a statistically significant positive impact on PR; therefore, H3 and H4 are supported.

The path coefficient of persona identification (PI) for brand attachment (BA) is -0.02, which is not statistically significant (p-value: 0.732). This indicates that the impact of PI on BA is not statistically significant, and therefore, H5 is not established. In addition, the path coefficient of PR for BA is 0.882, and the p-value is 0, indicating that PR has a strong positive impact on BA, and thus H6 is established.

Table 4: Hypothesis Testing

	Path coefficient	Mean (M)	(STDEV)	T statistics	P-values	Supported
CQ -> PR	0.147	0.148	0.055	2.695	0.007	Yes
IA -> PI	0.317	0.317	0.072	4.426	0	Yes
IQ -> PR	0.714	0.714	0.053	13.555	0	Yes
PA -> PI	0.419	0.419	0.074	5.639	0	Yes
PI -> BA	-0.02	-0.024	0.06	0.343	0.732	No
PR -> BA	0.882	0.886	0.049	17.836	0	Yes

4.3 Multigroup Analysis (MGA)

A multigroup analysis (MGA) was conducted to compare followers of CGI and Avatar virtual influencers. The analysis ensured model configuration invariance between the two groups (Henseler, 2015). Compositional invariance, equal means, and variance assessments

were performed (Cheah et al., 2023). Results in Table 5 revealed significant differences in Identity Attractiveness parameters between the groups, while other constructs showed no significant variance.

Next, we compared the research hypotheses between the two groups (Table 6), mainly including whether the path coefficients are equal and the significance of the difference between the two groups. Using Permutation and Henseler's MGA test resulted in H1 being significant under both test methods, but H2, H3, H4, H5, and H6 are not significant under both test methods.

Table 5. Results of Invariance Measurement Testing

Items	Config. invariance (step1)	Compositional invariance (Step 2)		Partial Measurement Invariance	Equal Mean Assessment (Step 3a)		Equal variance Assessment (Step 3b)		Full Measurement Variance
		Original Correlation	5.00%		Original difference	Confidence interval	Original difference	Confidence interval	
BA	Yes	1	0.999	Yes	0.087	(-0.172,0.164)	-0.141	(-0.219,0.225)	Yes
CQ	Yes	0.999	0.998	Yes	-0.028	(-0.176,0.174)	-0.094	(-0.241,0.242)	Yes
IA	Yes	0.995	0.995	No	0.035	(-0.174,0.175)	-0.038	(-0.224,0.237)	No
IQ	Yes	0.999	0.999	Yes	0.063	(-0.182,0.17)	-0.196	(-0.245,0.234)	Yes
PA	Yes	1	0.999	Yes	0.264	(-0.174,0.173)	-0.019	(-0.213,0.232)	No
PI	Yes	1	0.999	Yes	0.098	(-0.178,0.165)	-0.01	(-0.196,0.183)	Yes
PR	Yes	1	1	Yes	0.093	(-0.174,0.168)	-0.11	(-0.206,0.215)	Yes

Table 6. Results of Hypothesis Testing and Multigroup Analysis

		Path coefficient		Confidence interval		Path Coefficient	P value		Supported
Hypothesis	Relationship	Avatar	CGI	Avatar	CGI	Difference	Permutation	Henseler's bootstrap MGA	
H1	IA -> PI	0.503	0.101	(0.34,0.633)	(-0.113, 0.358)	0.401	0.003	0.008	Yes/Yes
H2	PA -> PI	0.323	0.555	(0.158,0.479)	(0.3, 0.777)	-0.232	0.061	0.125	No/No
H3	IQ -> PR	0.696	0.73	(0.567,0.828)	(0.564,0.861)	-0.034	0.396	0.712	No/No
H4	CQ -> PR	0.148	0.151	(-0.018,0.302)	(0.026,0.295)	-0.003	0.496	0.993	No/No
H5	PI -> BA	0.016	-0.04	(-0.207,0.213)	(-0.183,0.089)	0.056	0.336	0.655	No/No
H6	PR -> BA	0.823	0.924	(0.644,1.014)	(0.821,1.033)	-0.101	0.157	0.352	No/No

5.0 Discussion

Analysis revealed that identity attractiveness and perceived anthropomorphism significantly enhance persona identification. However, this identification does not necessarily increase brand attachment, highlighting the need to further explore persona as a unique psychological construct in virtual influencer marketing.

Findings also indicate that the quality of AI-generated content and AI-driven interaction are critical in fostering parasocial relationships, which positively impact brand attachment. This aligns with the understanding that virtual influencers, like human influencers, effectively drive user engagement and brand promotion. The results highlight the importance of conducting further research on the role of virtual influencers in digital marketing, particularly in fostering authentic user connections and promoting brand loyalty. Additionally, the study examined differences between CGI and avatar virtual influencer followers, suggesting potential variances in their impact on user engagement and brand attachment.

Fig 2: CGI Influencer & Avatar Influencer

The study employed multigroup analysis to investigate differences in model structure and parameter estimates across subgroups, thereby enhancing the understanding of the model's applicability across diverse user segments. The analysis showed significant differences in how Identity Attractiveness influences Persona Identification between the groups, while other mechanisms remained consistent. This suggests the model is generally applicable across different virtual influencer types, though variations in user recognition mechanisms may stem from distinct persona characteristics.

6.0 Conclusion and Recommendations

6.1 Conclusion

This research makes substantial theoretical contributions by integrating social identity theory with parasocial interaction to examine how virtual influencers shape users' social identities. It highlights the role of social identity in forming parasocial relationships, thereby expanding the application of social identity theory within the context of virtual influencers. By introducing the concept of persona recognition, the study presents a new theoretical framework for understanding how virtual influencer identities impact brand perception. Multigroup analysis expands methodological approaches in studying virtual influencers, providing insights into the varied impacts of different influencer types on users.

This study comprehensively examines how virtual influencers shape brand attachment through the dual lenses of Social Identity Theory and Parasocial Interaction Theory. The findings reveal that identity attractiveness and perceived anthropomorphism are foundational drivers of Persona Identification. At the same time, AI-generated content quality and AI-driven interaction quality significantly enhance parasocial relationships, ultimately strengthening brand attachment. Notably, the weak connection between persona identification and brand attachment suggests that while users may recognise and relate to a virtual influencer’s persona, this does not inherently translate into emotional loyalty toward the brand they endorse. The application of MGA further clarifies the nuanced dynamics between different types of virtual influencers. While avatar-based influencers benefit more strongly from identity attractiveness in fostering persona identification, the overall model remains robust across CGI and avatar categories, demonstrating its broad applicability. By tailoring anthropomorphic design elements for CGI influencers or emphasising identity-driven appeal for avatars, brands can more effectively align virtual spokespersons with their target audiences.

6.2 Recommendation

For brands seeking to maximise the effectiveness of virtual influencers, the findings suggest prioritising AI-enhanced interaction capabilities and content quality as foundational elements. Given the significant impact of AI-driven interaction quality and AI-generated content quality on parasocial relationships, marketers should develop sophisticated natural language processing systems that enable more human-like, responsive engagements while maintaining content authenticity through dynamic personalisation and real-time adaptation to user preferences.

The research highlights the importance of differentiated design approaches for distinct virtual influencer archetypes, with Avatar-based influencers benefiting more from strong identity attractiveness. In contrast, CGI influencers require a greater emphasis on anthropomorphic features. Marketing teams should carefully consider their campaign objectives and target demographics when selecting or creating virtual influencers, ensuring that Avatar types are developed with distinctive, relatable personalities and backstories. At the same time, CGI characters focus on achieving optimal human-like appearance, movement, and emotional expression. This strategic alignment between influencer type and design characteristics can significantly enhance persona identification and overall campaign effectiveness.

6.3 Limitations and Future Research

Despite its depth, the study faces limitations, such as a sample predominantly from China, which may introduce cultural bias. The online survey method and niche knowledge requirements may have resulted in a modest sample size, potentially leading to selection bias. While the study establishes a theoretical model encompassing Identity attractiveness, social identity, parasocial interaction, and brand attachment, other factors, such as the congruence between a virtual influencer's persona and endorsements, may also influence outcomes, requiring further exploration.

Future research should integrate advanced theories and methodologies to deepen the understanding of virtual influencers' impact on brand communication. Textual and sentiment analysis of user comments can shed light on the emotional bonds between users and virtual influencers. As AI technology evolves, future research will likely become increasingly interdisciplinary, drawing on computer science, sociology, and cultural studies. Researchers should stay attuned to technological advancements better to understand the societal and cultural implications of virtual influencers.

References

Alabed, A., Javornik, A., & Gregory-Smith, D. (2022). AI anthropomorphism and its effect on users' self-congruence and self–AI integration: A theoretical framework and research agenda. *Technological Forecasting and Social Change*, *182*, 121786.

Block, E., & Lovegrove, R. (2021). Discordant storytelling,‘honest fakery’, identity peddling: How uncanny CGI characters are jamming public relations and influencer practices. *Public relations inquiry*, *10*(3), 265-293.

Cao, Y., Li, S., Liu, Y., Yan, Z., Dai, Y., Yu, P. S., & Sun, L. (2023). A comprehensive survey of ai-generated content (aigc): A history of generative ai from gan to chatgpt. *arXiv preprint arXiv:2303.04226*.

Cheah, J. H., Amaro, S., & Roldán, J. L. (2023). Multigroup analysis of more than two groups in PLS-SEM: A review, illustration, and recommendations. *Journal of Business Research*, *156*, 113539.

Deng, F., & Jiang, X. (2023). Effects of human versus virtual human influencers on the appearance anxiety of social media users. *Journal of Retailing and Consumer Services*, *71*, 103233.

Frank, B., & Mitsumoto, S. (2023). An extended source attractiveness model: the advertising effectiveness of distinct athlete endorser attractiveness types and its contextual variation. *European Sport Management Quarterly*, *23*(4), 1091-1114.

Gerlich, M. (2023). The power of virtual influencers: Impact on consumer behaviour and attitudes in the age of AI. *Administrative Sciences*, *13*(8), 178.

Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European business review*, *31*(1), 2-24.

Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the academy of marketing science*, *43*, 115-135.

Hsieh, J.-K. (2023). The impact of influencers' multi-SNS use on followers' behavioural intentions: An integration of cue consistency theory and social identity theory. *Journal of Retailing and Consumer Services*, 74, 103397.

Kim, H. (2022). Keeping up with influencers: exploring the impact of social presence and parasocial interactions on Instagram. *International Journal of Advertising*, *41*(3), 414-434.

Kim, H., & Park, M. (2023). Virtual influencers' attractiveness effect on purchase intention: A moderated mediation model of the Product–Endorser fit with the brand. *Computers in Human Behavior*, *143*, 107703.

Koles, B., Audrezet, A., Moulard, J. G., Ameen, N., & Mckenna, B. (2024). The authentic virtual influencer: Authenticity manifestations in the metaverse. *Journal of Business Research*, *170*, 114325.

Li, H., Lei, Y., Zhou, Q., & Yuan, H. (2023). Can you sense without being human? Comparing virtual and human influencers endorsement effectiveness. *Journal of Retailing and Consumer Services*, *75*, 103456.

Lim, R. E., & Lee, S. Y. (2023). "You are a virtual influencer!": Understanding the impact of origin disclosure and emotional narratives on parasocial relationships and virtual influencer credibility. *Computers in Human Behavior*, *148*, 107897.

Miyake, E. (2023). I am a virtual girl from Tokyo: Virtual influencers, digital-orientalism and the (Im) materiality of race and gender. *Journal of Consumer Culture*, *23*(1), 209-228.

Mouritzen, S. L. T., Penttinen, V., & Pedersen, S. (2024). Virtual influencer marketing: the good, the bad and the unreal. *European Journal of Marketing*, *58*(2), 410-440.

Na, Y., Kim, Y., & Lee, D. (2024). Investigating the effect of self-congruity on attitudes toward virtual influencers: mediating the effect of emotional attachment. *International Journal of Human–Computer Interaction*, *40*(18), 5534-5547.

Nguyen, P. M. B., Pham, L. X., Tran, D. K., & Truong, G. N. T. (2024). A systematic literature review on travel planning through user-generated video. *Journal of Vacation Marketing*, *30*(3), 553-581.

Ozdemir, O., Kolfal, B., Messinger, P. R., & Rizvi, S. (2023). Human or virtual: How influencer type shapes brand attitudes. *Computers in Human Behavior*, *145*, 107771.

Park, S., & Sung, Y. (2023). The interplay between human likeness and agency on virtual influencer credibility. *Cyberpsychology, Behavior, and Social Networking*, *26*(10), 764-771.

Sands, S., Ferraro, C., Demsar, V., & Chandler, G. (2022). False idols: Unpacking the opportunities and challenges of falsity in the context of virtual influencers. *Business Horizons*, *65*(6), 777-788.

Stein, J. P., Linda Breves, P., & Anders, N. (2024). Parasocial interactions with real and virtual influencers: The role of perceived similarity and human-likeness. *New Media & Society*, *26*(6), 3433-3453.

Xie-Carson, L., Magor, T., Benckendorff, P., & Hughes, K. (2023). All hype or the real deal? Investigating user engagement with virtual influencers in tourism. *Tourism Management*, *99*, 104779.

Yu, J., Dickinger, A., So, K. K. F., & Egger, R. (2024). Artificial intelligence-generated virtual influencer: Examining the effects of emotional display on user engagement. *Journal of Retailing and Consumer Services*, *76*, 103560.