

THE IMPACT OF AI-GENERATED VIRTUAL INFLUENCERS ON HUMAN BRAND LOYALTY: A NEURO-MARKETING STUDY

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ABSTRACT

This study explores the influence of virtual influencer characteristics on brand loyalty among digital consumers. Specifically, it investigates how perceived realism (PR), emotional engagement (EE), trust in virtual influencers (TVI), content relevance (CR), and influencer-brand fit (IBF) affect consumer loyalty towards brands endorsed by virtual influencers. A structured questionnaire was distributed to 183 respondents, and responses were analyzed using multiple linear regression in R Studio. The findings indicate that perceived realism and content relevance have a significant positive impact on brand loyalty, while emotional engagement, trust, and brand fit did not show statistically significant effects. The model explained approximately 52% of the variation in brand loyalty. These results suggest that consumers respond more favourably to virtual influencers they perceive as realistic and relevant. The study provides valuable insights for marketers seeking to enhance customer engagement and loyalty through virtual influencer marketing strategies.

Keywords: Virtual Influencers, Brand Loyalty, Perceived Realism, Content Relevance.

INTRODUCTION

In today's rapidly evolving digital economy, artificial intelligence (AI) continues to redefine the boundaries of consumer engagement, branding, and marketing communications. One of the most intriguing and transformative developments in this space is the emergence of AI-generated virtual influencers (VIs)—computer-generated personas that emulate human-like behavior, appearance, and communication. These VIs have carved a niche in modern marketing strategies by engaging consumers through hyper-personalized, immersive, and emotionally resonant content across social media platforms. With the rise of these AI-based avatars, there is a critical need to examine how they influence human brand loyalty, particularly through a neuro-marketing lens that emphasizes emotional, cognitive, and sensory responses to marketing stimuli.

The notion of customer experience as a holistic construct has gained increasing attention in recent literature. Abid et al. (2025) emphasize the dynamic interplay between retail experience quality, customer emotion valence, and in-store involvement, reinforcing the importance of emotional states in shaping consumer behavior. This aligns well with the premise that AI-generated virtual influencers, by virtue of their highly curated personas and emotionally engaging content, may significantly affect customers' psychological engagement and long-term loyalty toward brands. Furthermore, Hilken et al. (2022) explore the cutting-edge potential of reality-enhanced services, including neuro-enhanced and virtual realities, highlighting the growing importance of immersive technologies in modern marketing communication.

The advent of VIs also coincides with an increasing emphasis on gamification and innovative customer engagement strategies, as noted by Behl et al. (2024). Gamification and AI-driven content strategies both aim to increase interactivity, attention, and emotional resonance—

all of which are precursors to brand loyalty. Similarly, Dadwal et al. (2024) introduce the concept of market grooming through AI, where consumers are strategically nudged toward favorable attitudes and behaviors through personalized content and predictive algorithms.

From a broader perspective, scholars such as Hollebeek et al. (2022) highlight the growing body of work on customer engagement as a cornerstone of contemporary brand management. Their bibliometric analysis shows a shift toward technology-enabled, co-creative forms of engagement—such as those facilitated by VIs—which transcend traditional one-way communication. Moreover, Nazemi et al. (2024) discuss the complexity of service ecosystems, which increasingly include AI agents, suggesting that VIs may play a structural role in the co-creation and sustenance of brand communities.

Adding further depth, Fernando et al. (2025) investigate emerging intersections between metaverse environments and consumer behavior, suggesting that virtual representations and immersive interactions—like those with VIs—will become even more influential in shaping brand perception and loyalty. This is particularly significant from a neuro-marketing standpoint, where visual stimuli, emotional arousal, and memory encoding play vital roles in influencing decision-making. The challenges and success factors (CSFs) in implementing technological innovations, especially in startups and international firms, have been explored by Shojaei et al. (2025). Their study underlines the necessity of strategically navigating digital transformation—something that includes adopting VIs as part of integrated marketing strategies.

Against this backdrop, this study seeks to explore how specific psychological and perceptual factors—such as perceived realism, emotional engagement, trust, content relevance, and influencer-brand fit—affect brand loyalty in the context of AI-generated virtual influencers. By adopting a neuro-marketing approach, the study aims to go beyond traditional behavioral metrics to uncover deeper, unconscious drivers of loyalty and brand affinity. This research contributes to the emerging discourse on AI-human interaction in marketing and provides practical insights for marketers aiming to leverage virtual influencers as effective brand ambassadors.

LITERATURE REVIEW

The growing intersection between artificial intelligence (AI), virtual reality, and digital marketing has catalyzed a transformative shift in how consumers engage with brands. As AI-generated virtual influencers (VIs) become increasingly prevalent across social media and digital platforms, understanding their impact on brand loyalty through a neuro-marketing lens is gaining scholarly importance. AI's role in enhancing user experience and engagement has been widely explored across multiple contexts. Saxena and Mishra (2025) discuss how AI-driven personalization and real-time feedback mechanisms can revolutionize employee engagement in corporate India. This aligns with similar mechanisms used by VIs to personalize brand communication and deepen emotional resonance with consumers. Meanwhile, Panigrahy and Verma (2025) explore the use of computer vision technologies in enhancing tourist experiences at smart destinations, revealing the growing significance of immersive AI technologies in crafting memorable and engaging user journeys—an aspect central to VIs as well.

Roopak and Chakrabarti (2024) examine the structure of customer engagement, highlighting both emotional and cognitive dimensions, which are highly relevant in the context of AI-generated influencers. These VIs not only disseminate branded content but also create emotionally engaging, story-driven narratives that can mimic human warmth and empathy. This emotional engagement, coupled with perceived realism and trustworthiness, are core variables influencing brand loyalty in the VI landscape. Chanda et al. (2024) examine the behavioral

intention of learners toward the metaverse in education, highlighting the importance of user attitude, trust, and immersive environments—factors equally pertinent to virtual influencer-brand interactions. These immersive experiences created by VIs often simulate human interactions so closely that they can impact neural pathways associated with trust and familiarity, as studied through neuro-marketing approaches.

Cognitive load and consumer convenience in online shopping contexts have also been studied using neuroscientific tools such as EEG. Mirhoseini et al. (2024) find that reduced cognitive load enhances shopping experiences, pointing to the importance of simplified, engaging interactions—a strategy frequently employed by virtual influencers. Their content is typically designed to be visually appealing and emotionally stimulating, facilitating easy information processing and deeper brand recall. Florido-Benítez (2024) emphasizes how digital channels amplify promotional effectiveness, especially when integrated with storytelling and tailored communication. VIs, being digital natives, epitomize this integration and have emerged as powerful tools in executing dynamic and effective communication campaigns.

Barone et al. (2024) explore decision-making in digital financial consumers and highlight how AI influences perception and trust, two fundamental constructs for virtual influencer effectiveness. When consumers perceive VIs as authentic and aligned with brand values, it leads to stronger brand trust and loyalty. These studies highlight a critical research gap at the intersection of AI, neuro-marketing, and brand loyalty, especially in the context of virtual influencers. While AI has been widely adopted for personalization and engagement, its application through VIs in fostering long-term loyalty and emotional brand attachment remains underexplored. This study aims to fill that gap by investigating how factors like perceived realism, emotional engagement, trust, content relevance, and influencer-brand fit interact to shape human loyalty toward brands endorsed by AI-generated personas.

The proliferation of artificial intelligence (AI) in marketing has introduced a new paradigm in how consumers interact with brands. One such advancement is the rise of AI-generated virtual influencers (VIs)—computer-generated personas that engage audiences via digital platforms, simulating real human interactions. Understanding the neuro-marketing implications of these VIs on brand loyalty remains a critical and underexplored dimension in marketing scholarship. AI adoption has been extensively reviewed across industries. Shahzadi et al. (2024) highlighted how AI transforms supply chain management, emphasizing operational agility and real-time decision-making. This systemic integration of AI underscores a broader shift toward trust in autonomous systems—an attitude that transfers into consumer interactions with VIs. Similarly, Kong et al. (2023) and Doborjeh et al. (2022) provide comprehensive reviews of AI in hospitality and tourism, noting the emotional and behavioral impacts of AI-assisted services, which parallel the personalized engagement offered by virtual influencers.

The influence of AI interfaces like ChatGPT on behavioral intentions has also been examined. Solomovich and Abraham (2024) found that AI-driven communication significantly alters tourist behaviors through the Technology Acceptance Model (TAM). These findings support the notion that consumer willingness to engage with AI-based agents—like VIs—is mediated by perceived usefulness and ease of interaction. Srivastava and Bag (2024) focus directly on neuro-marketing and face recognition, emphasizing how visual cues trigger subconscious emotional and cognitive responses. These elements are central to the success of virtual influencers, whose visual designs and interactive storytelling are crafted to optimize attention, memory retention, and emotional resonance. Rancati and Maggioni (2023) further investigate neurophysiological

responses to robot-human interaction, revealing that emotional triggers and mirror neuron activations can occur even with non-human agents—a core mechanism behind VI engagement.

The role of sensory and immersive experiences in digital marketing has also been studied. Wörfel et al. (2022) discuss how multisensory marketing shapes brand perception, and while VIs cannot stimulate physical senses, their audio-visual content can simulate realistic experiences that create strong memory cues. Wang and Uysal (2024) explore AI-assisted mindfulness in hospitality, showing how virtual agents can foster psychological well-being—another potential avenue through which VIs can foster deeper emotional bonds with consumers. Azman et al. (2023) argue that big data and neuro-marketing in tourism unlock deeper consumer insights, which can be leveraged by VIs to dynamically adapt their messaging and behavior. This personalization enhances emotional engagement and loyalty—key outcomes measured in this study. Peng and Wan (2023) support this by showing how automated text analysis can shape corporate image, suggesting that VIs can play a pivotal role in constructing and reinforcing brand narratives.

Wei (2024) contrasts human celebrity endorsers with VIs, highlighting the vulnerabilities of the former to scandals. VIs offer scandal-free, brand-controllable personas, increasing their appeal as long-term brand ambassadors. Jin and Eastin (2023) demonstrate how chatbot personality matching affects user experience, reinforcing the idea that consumers respond more positively to virtual agents with personalities similar to their own—a critical insight for designing effective VIs. Gupta et al. (2023) explore how luxury consumer behavior is influenced by curated experiences and emotional arousal. These principles are reflected in how VIs construct aspirational identities and exclusive brand associations. Behera et al. (2020) support this with findings on automated machine learning in recommendation engines, which echo the adaptive, data-driven architecture of VIs that continuously refine their engagement strategies.

In sum, this literature reveals a convergence of AI, neuro-marketing, and digital branding, positioning virtual influencers as powerful tools for building trust, emotional resonance, and brand loyalty. However, while the functional capabilities of AI in marketing are well-documented, the neuroscientific underpinnings of VI-induced consumer behavior remain underexplored. This study bridges this gap by examining how emotional engagement, trust, and perceived authenticity in VI interactions influence consumer loyalty on a cognitive and emotional level.

RQ1: *How do AI-generated virtual influencer characteristics affect consumer brand loyalty in the context of neuro-marketing?*

RESEARCH METHODOLOGY

The present study adopted a quantitative research methodology to investigate the impact of perceived realism, emotional engagement, trust in virtual influencers, content relevance, and influencer-brand fit on brand loyalty. A structured questionnaire was developed using validated scales from previous literature and was administered to 183 respondents using a convenience sampling technique. The survey collected responses on a 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5). The target population included social media users who engage with virtual influencers across digital platforms.

Objectives

- To examine the influence of perceived realism, emotional engagement, and trust in virtual influencers on brand loyalty.

- To assess the impact of content relevance and influencer-brand fit on brand loyalty among consumers exposed to AI-generated virtual influencers.

Hypothesis

H₁: There is a significant positive relationship between emotional engagement and brand loyalty in the context of AI-generated virtual influencers.

H₂: Influencer-brand fit significantly predicts consumer brand loyalty.

Regression Line

$$\text{Brand Loyalty (BL)} = \beta_0 + \beta_1 \cdot \text{Perceived Realism (PR)} + \beta_2 \cdot \text{Emotional Engagement (EE)} + \beta_3 \cdot \text{Trust Virtual Influencer (TVI)} + \beta_4 \cdot \text{Content Relevance (CR)} + \beta_5 \cdot \text{Influencer Brand Fit (IBF)} + \varepsilon$$

Data collection focused on five key independent variables: perceived realism (PR), emotional engagement (EE), trust in virtual influencers (TVI), content relevance (CR), and influencer-brand fit (IBF), and one dependent variable: brand loyalty (BL). The dataset also included demographic factors such as gender, age, education, occupation, and income to provide additional context. Data was analyzed using R Studio for statistical analysis, including linear regression to assess the strength and significance of the relationships among variables. Diagnostic plots (Q-Q plot, histogram, and residual vs fitted) were employed to validate model assumptions. The methodology ensured reliability and validity through consistent scaling and a sample size adequate for regression analysis, offering generalizable insights into digital consumer behavior.

Analysis

The demographic analysis of the 183 respondents reveals a balanced gender distribution, with 49% male and 51% female participants. A significant portion (70%) falls within the 18–34 age group, highlighting a youthful and digitally active audience. Educationally, 82% have attained undergraduate or higher qualifications, indicating a well-educated sample. In terms of occupation, the majority (55%) are full-time employees, followed by students (22%). Income levels suggest that 71% earn between ₹2,00,000 and ₹10,00,000 annually, reflecting a middle to upper-middle-class demographic. These characteristics underscore a tech-savvy, educated, and economically active population likely to engage with virtual influencers and brand loyalty behaviors.

The regression model for Brand Loyalty (BL) was fitted using five predictors: Perceived Realism (PR), Emotional Engagement (EE), Trust in Virtual Influencer (TVI), Content Relevance (CR), and Influencer-Brand Fit (IBF). The overall model is statistically significant, with an F-statistic of 38.33 and a p-value less than 2.2e-16, indicating that the model explains a substantial portion of the variance in Brand Loyalty. The multiple R-squared value of 0.5199 suggests that approximately 52% of the variability in Brand Loyalty is explained by the predictors. The adjusted R-squared value of 0.5063 accounts for the number of predictors and is also significant.

Among the predictors, Perceived Realism (PR) has a highly significant positive relationship with Brand Loyalty (coefficient = 0.43925, $p < 0.001$). Emotional Engagement (EE), Trust in Virtual Influencer (TVI), and Influencer-Brand Fit (IBF) were found to be statistically insignificant, with p-values greater than 0.05. Content Relevance (CR) showed a marginally significant positive effect on Brand Loyalty (coefficient = 0.15637, $p = 0.0969$). The residuals

indicate a relatively good fit with a standard error of 0.5672, and the residuals show minimal deviation from normality, suggesting that the model assumptions are reasonably met Figures 1-3.

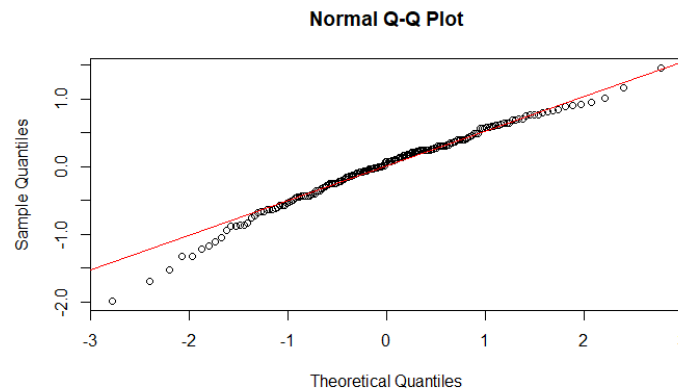


FIGURE 1
NORMAL Q-Q PLOT

The Normal Q-Q plot visually assesses the normality of the residuals in the regression model. In this plot, if the points lie close to a straight line, it suggests that the residuals are approximately normally distributed. For this model, the points generally follow the line, indicating that the assumption of normality is reasonably met. Minor deviations from the line do occur, but they are not severe enough to raise concerns about the model's validity, supporting the reliability of the regression analysis.

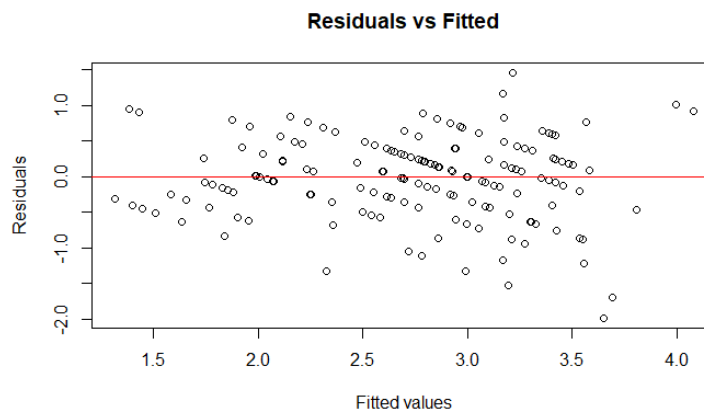


FIGURE 2
RESIDUALS VS FITTED PLOT

The Residuals vs Fitted plot helps evaluate the homoscedasticity of the residuals, which refers to whether the residuals have constant variance across all levels of the fitted values. In this plot, the residuals should be randomly dispersed around the horizontal axis without any patterns. For this model, the plot shows a random distribution of residuals, indicating no systematic structure, which suggests that the assumption of homoscedasticity holds. There are no clear trends or patterns, indicating that the model is appropriate for the data.

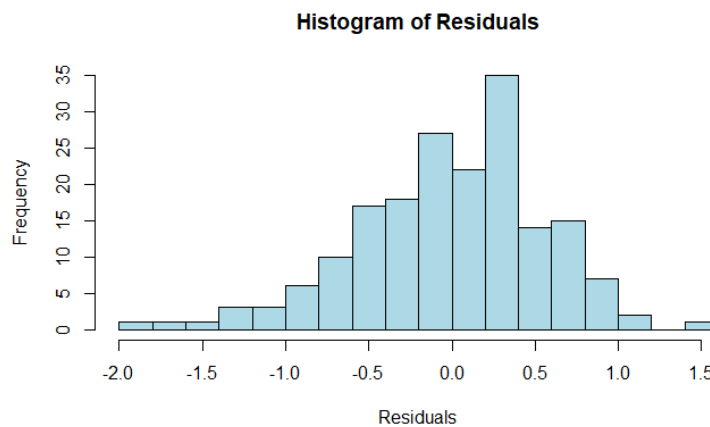


FIGURE 3
HISTOGRAM OF RESIDUAL

The histogram of residuals provides a visual representation of the distribution of residuals. It helps assess the normality of the residuals by comparing the shape of the histogram to a normal distribution curve. In this case, the histogram appears roughly symmetrical, with the distribution centered around zero, which supports the assumption of normality. However, a slight skewness is visible, but it is not significant enough to invalidate the regression results. Overall, the histogram suggests that the residuals are sufficiently close to normal for the analysis presents the regression results for the model assessing the factors influencing Brand Loyalty (BL) provides the estimated coefficients for each predictor variable, along with their standard errors in parentheses. The variable "Perceived Realism" (PR) has a positive and statistically significant effect on Brand Loyalty (0.439), with a p-value of less than 0.01 (**), *indicating strong evidence that perceived realism enhances brand loyalty*. "Content Relevance" (CR) also shows a positive relationship with BL (0.156) and is statistically significant at the 10% level, suggesting that more relevant content contributes to higher brand loyalty. On the other hand, "Emotional Engagement" (EE), "Trust in Virtual Influencers" (TVI), and "Influencer Brand Fit" (IBF) do not have statistically significant effects on Brand Loyalty, as their p-values are greater than 0.05 (Solomovich & Abraham, 2024; Srivastava & Bag, 2024). (Behera, et al. 2020); (Kong et al., 2023); (Shahzadi et al., 2024; Samara et al., 2020).

The constant term, representing the baseline level of Brand Loyalty when all predictors are zero, is 0.822 and statistically significant at the 0.01 level. The model has 183 observations, with an R-squared value of 0.520, indicating that approximately 52% of the variability in Brand Loyalty is explained by the predictors. The adjusted R-squared value of 0.506 accounts for the number of predictors in the model. The F-statistic (38.328) is highly significant, suggesting that the model is a good fit for the data (Wang & Uysal, 2024).

CONCLUSION

The study explores the key determinants of Brand Loyalty (BL) in the context of consumer interactions with virtual influencers. Through regression analysis, the research identifies that Perceived Realism (PR) and Content Relevance (CR) significantly influence brand loyalty, while Emotional Engagement (EE), Trust in Virtual Influencers (TVI), and Influencer Brand Fit (IBF) did not show a statistically significant relationship. The findings suggest that consumers'

perception of realism in the content and its relevance to their needs plays a crucial role in fostering loyalty towards brands promoted by virtual influencers. This supports prior studies emphasizing the importance of content-related factors in shaping consumer behaviour.

The study's results align with the growing body of literature on the role of digital influencers and AI in marketing, highlighting how virtual environments can influence real-world consumer behaviour. Moreover, the insignificant influence of Emotional Engagement and Trust in Virtual Influencers suggests that these aspects may need further exploration to understand their nuanced roles in different consumer segments and contexts. Future research should delve deeper into the individual effects of these variables across diverse demographic groups to better understand how different consumer profiles react to virtual influencers. Additionally, studies could explore how cultural differences might affect the relationship between virtual influencer characteristics and brand loyalty. From a global implementation perspective, brands should focus on creating highly relevant and realistic content to enhance loyalty, particularly in regions where virtual influencers are gaining significant traction in industries like tourism and retail. As virtual influencers become more prevalent globally, these insights can guide marketing strategies, ensuring that brands effectively utilize digital platforms to build and maintain consumer trust and loyalty across diverse markets.

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