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Fake human but real influencer: the interplay of authenticity and humanlikeness in Virtual Influencer communication?

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Abstract

Recently, there has been a lot of interest in industry and academia in virtual influencers (VIs). This study aimed to augment the understanding of VI marketing by exploring the relationship between VI's characteristics (i.e., their humanlikeness level and operator type), their social media post characteristics (i.e., emotional expression, use of pronouns, use of punctuation marks), and consumer engagement. The analysis of three popular VIs' Instagram profiles and posts revealed that VIs with less humanlike appearances tend to exhibit stronger positive emotional expressions. Interestingly, the level of humanlikeness in appearance was not associated with VI's other post characteristics, suggesting other intrinsic factors (e.g., the VI's character and virtual universe) may play a pivotal role. Whether a brand operates the VI or not made a statistically significant difference in the VI's post characteristics. Assessment of user engagement metrics (i.e., number of likes and comments) showed that users prefer hyper-realistic VIs and VIs operated by non-brand agencies, underscoring the importance of perceived authenticity in the digital realm. The emotions expressed by VIs, along with their use of punctuation, were positively related to user engagement.

Keywords: Virtual Influencer, Humanlikeness, Digital communication, Operator type, User engagement

Introduction

During the past few years, social media influencers (SMIs) have attracted a large audience by posting opinions about their lives, experiences, brands, and products on social media platforms. As more people follow and are influenced by SMIs, influencer marketing, a method of promoting products through these SMIs who influence potential buyers on social media (Audrezet et al., 2020), is also increasing. According to the Influencer Marketing Hub, the number of firms offering or specializing in influencer marketing services grew by 26% in 2021 alone and is set to reach a staggering 18,900 worldwide (Geyser, 2023).

One of the most interesting emerging categories of SMIs is virtual influencers (VIs), "3D, computer-generated personalities" that can emulate human behavior and appearance (da Silva Oliveira & Chimenti, 2021; Deng & Jiang, 2023; Miao et al., 2022). VIs

grew in popularity among consumers very quickly. From 2017 to 2019, the number of VIs on social media grew from just 27 to 125. Recently, VIs have become trusted tastemakers just as human influencers are (De Veirman et al., 2017; Moustakas et al., 2020). Moreover, VIs started to become mainstream as their huge popularity with consumers prompted partnerships with global brands (Hiort, 2022). Interestingly, brands and advertising agencies consider VIs as an attractive alternative to SMIs for several reasons. According to Conti et al. (2022), VIs are an intriguing option with the potential to harness human influencers' positives with additional control over content and expression. VIs provide further advantages in terms of increased productivity due to the flexibility of work schedule, not getting old, not making human mistakes, and giving complete control over the content and presentation of content (Bradley, 2020). Moreover, brands can avoid concerns caused by human influencers' unpredictable behaviors including scandals and ethical violations (Moustakas et al., 2020; Thomas & Fowler, 2021). As a result, a wide variety of brands (e.g., Samsung, Balmain, Louis Vuitton, Tommy Hilfiger, Marc Jacobs) are already partnering with VIs (Baklanov, 2022; Fraser, 2022). Some brands also develop and manage their own VIs with the ultimate goal to create influential spokespersons (Wibawa et al., 2022). For example, retailers Yoox and Magalu created their own VIs, Daisy and Lu, respectively. Puma, on the other hand, launched Maya, its first South-east Asian VI, and NARS launched three VIs in the US, UK, and China respectively, in response to the growing importance of influencers familiar with the cultures, heritages, and ethnicities of business target consumers (Kim & Choo, 2023). Consumers are also responding to VIs positively. Influencer Marketing Factory's survey of 2022 found that 58% of respondents in the US follow at least one VI and 35% have purchased products endorsed by VI (Bringé, 2022).

Despite the growing popularity and importance of VIs, research on VI is still in its infancy. Most previous studies on VIs have focused on their humanlike appearance and its impact, and the results are inconsistent. For instance, Arsenyan and Mirowska (2021) found that consumers responded significantly less favorably to highly humanlike VIs whereas Ahn et al. (2022) found that consumers positively evaluated humanlike VIs. While the humanlike appearance is an important characteristic of recent VIs, it is likely that the humanlike appearance alone is not enough to understand how consumers respond to VIs.

We believe there is a need to investigate multiple factors comprehensively to understand how the VIs engage and influence consumers. Firstly, the way VIs express themselves on social media could be an important factor. In previous research, linguistic expressions have also been shown to aid in recognizing human similarity (Newton et al., 2017; Wen Wan et al., 2017), in addition to physical similarity (Frank, 2019). Influencers shape their identity, characteristics, images, and influence through content that contains linguistic expressions (Hu et al., 2020; Leung et al., 2022). In the same way, VI's linguistic expressions in social media posts will also contribute to VI's influence. Therefore, it is critical to understand how the structure and content of social media posts contribute to VIs' influence. Secondly, the appearance of the VIs is a known factor. The range of VIs' form and appearance is broad from extremely realistic humanlike appearance to non-human objects. Thirdly, VIs' operators are also becoming increasingly diverse, from individuals and independent developers to brands to global corporations. In the context

of SMIs, content creators or operators control influencer decisions, such as what content they will post or which brands they will partner with (Sands et al., 2022a, 2022b). Thus, the intention of the operator behind the VIs would be an influential factor to determine how the social media posts are made. However, previous studies have neglected this aspect.

In this study, we focus on the analysis of Instagram profiles and the social media posts of VIs because of the popularity of Instagram in influencer marketing and the availability of data such as user engagement, VI posts, and VI profiles. To contribute to the literature on VI marketing, this study is to identify factors that influence consumer engagement through a comprehensive analysis and modeling which includes popular VIs' appearance, the structure and communication style of social media contents, and the type of operators. In doing so, we intend to respond to the call to explore the appeal of emerging VIs and probable boundary conditions of their success in social media marketing (Vrontis et al., 2021).

This study can provide crucial insights for the fashion and textiles industry, a field deeply influenced by visual trends and digital innovation, in creating customized digital personas through Virtual Influencers (VIs). The results of this study highlights how specific aspects of a VI's appearance, personality, and communication style can significantly enhance user engagement, guiding brands or individuals to tailor these elements to meet their unique market demands and strengthen their identity. This is particularly vital in fashion industry where differentiation and a strong brand image are essential. Moreover, the emergence of VIs marks a new era in marketing, merging creativity with technology, and redefining brand-consumer interactions. Understanding the impact of VIs' attributes on audience resonance is key for fashion brands to maximize social media engagement, develop effective marketing strategies, and produce compelling content. Thus, this study may provide valuable insights into maintaining relevance and competitiveness in the rapidly changing, digitally driven fashion sector.

Literature Review

Virtual influencers (VIs)

Influencers inherently assume a role as a marketing collaborator such as participation in social media campaigns (Moustakas et al., 2020) and sharing social media contents and interacting with consumers (Mouritzen et al., 2023). As VIs are a new and evolving phenomenon, the term, 'virtual influencers', was only recently coined in academic literature. In early VI studies, terms such as computer-generated imagery (CGI) influencers (Ahn et al., 2022; Baumgarth et al., 2021; Mrad et al., 2022) and artificial intelligence (AI) influencers (Alboqami et al., 2023; Sands et al., 2022a, 2022b; Thomas & Fowler, 2021) appeared most often. These terms reflect the researchers' interests when studying VIs. Research focusing on the visual realism of computer-generated images of the VIs often used CGI influencers (Ahn et al., 2022; Mrad et al., 2022) whereas research investigating the VI's capabilities to create content and interact with consumers using artificial intelligence technologies used AI influencer (Sands et al., 2022a, 2022b; Thomas & Fowler, 2021). Thus, CGI and AI influencers are subtypes of VIs, which have unique characteristics and capabilities (Appel et al., 2020; Conti et al., 2022). As recent VIs are created with both CGI and AI, focusing on the virtual nature of these virtual influencers has become

most appropriate. For example, Franke et al. (2023) used the term “virtual influencers” and defined them as technology-generated influencers that exist in the virtual world. Following the previous research, we adopt the term VIs. However, we define VIs with the added emphasis on the social media influencer status because being virtual alone is not sufficient to be an influencer. Thus, we define VIs as digital characters created by software that gain influence among consumers by sharing content and interacting with them through social media.

Humanlikeness strategy of VI

To ascertain a non-human influencer, users gauge the extent of authenticity and functionality the influencer exhibits, essentially evaluating its humanlike qualities. As a result, computers and robots have been often designed to possess humanlike visuals and linguistics, aiming to enhance consumer interaction and acceptance (Aggarwal & McGill, 2007; Duffy, 2003; Nass & Moon, 2000). Similarly, humanlikeness of VIs is usually perceived based on humanlikeness of their visual representations (Zhou et al., 2019) or linguistic representations (Wen Wan et al., 2017). The visual humanlikeness of VIs exhibit a wide spectrum, ranging from non-human fictional characters to hyper-realistic entities that closely resemble humans (Mouritzen et al., 2023). Based on their similarity to humanlike appearance, VIs can be categorized into three groups: human VIs (HVIs), animated human VIs (AVIs), and non-human VIs (NHVI) (Arsenyan & Mirowska, 2021; Choudhry et al., 2022). HVIs exhibit lifelike human characteristics, closely resembling actual humans in appearance and personality. AVIs possess human body shapes but incorporate unrealistic features (e.g., oversized eyes or doll-like bodies). NVIs encompass personified foods, toys, and fantastical creatures, characterized by their non-humanlike appearance (Arsenyan & Mirowska, 2021; Choudhry et al., 2022). In general, consumers are more likely to connect deeply with nonhuman entities if they appear more human, resulting in stronger, long-lasting, positive relationships (Yang et al., 2020). In addition, Epley et al. (2007) found that distinctly human characteristics helped consumers better understand nonhuman entities. Likewise, given that the humanlikeness of VIs can enhance interactions with consumers, influencers who possess less humanlike appearance are likely to enhance this aspect through the use of more humanlike communication styles.

Use of emotion expression as humanlike communication strategy

In the VI literature, there is no consensus regarding whether humanlikeness of VIs facilitates or constrains users' use intention. Humanlike VIs, for instance, receive significantly lower positive reactions from consumers since they invoke feelings of eeriness (Arsenyan & Mirowska, 2021). However, Ahn et al. (2022) found that perceived human likeness enhances a sense of reality and drives positive consumer evaluations. Upon reviewing previous studies on physical robots, chatbots, and other AI, Blut et al. (2021) concluded that when non-human entities have characteristics like humans, humans interact and respond favorably with them.

Unlike traditional endorsers such as celebrities or public figures who have gained their fame or popularity via traditional media, SMIs are individuals who have achieved high visibility among their followers by creating valuable content on social media (Garcia, 2017). In social media platforms, human influencers often use emotional content to build emotional bonds and relationships with users and ultimately gain followers and increase their visibility and online status (Hwang & Zhang, 2018). Emotions play a

crucial role in interactions involving nonhuman entities, including human–robot interactions (Breazeal, 2003; Picard, 2003). Previous studies found that the specific emotions expressed by a nonhuman entity (i.e., sadness or joy) can significantly shape its perceived likability, intelligence, and credibility during initial interactions (Breazeal, 2003; Picard, 2003). Thus, VIs can utilize emotional content to achieve similar results as their communication strategy. Miquela, one of the most successful VIs, openly conveys her emotions while sharing her daily life and detailing dramatic events in her personal relationships (e.g., emotional turmoil following a breakup, confusion about her identity). This disclosure of her emotions has contributed to fostering the engagement of the followers, solidifying her status as a prominent VI (Block & Lovegrove, 2021). In other words, even in the context of VI, emotional expression can play a crucial role in increasing interaction with users and driving popularity.

As explained above, we anticipate that VIs with less humanlike appearance will adopt communication strategies that enhance their humanlikeness through linguistic expressions in their social media posts. Thus, we expect that VIs with lower levels of humanlike appearance express more emotion in order to appear more intelligent and credible. Formally, H1 is developed:

H1. VIs which have non-humanlike appearance express emotions more than humanlike VIs.

Use of pronouns as humanlike communication strategy

The use of first and second person pronouns and punctuations is another effective humanlike communication strategy (Derks et al., 2008a, 2008b; Tausczik & Pennebaker, 2010). Personal pronouns are useful linguistic elements that can help identify the attentional focus and show the quality of a close relationship (Tausczik & Pennebaker, 2010). Additionally, people can perceive nonhuman entities as more humanlike when they use first person pronouns (Newton et al., 2017; Zhou et al., 2019). According to Labrecque et al. (2020), it has been shown that priming social identity through the use of first person pronouns (e.g., "we", "us") causes people to perceive others as more similar to themselves than when they are primed with third person pronouns (e.g., "they", "them"). Fitzsimons and Kay (2004) also found that the use of the word "we" suggests a closer relationship. On the other hand, using second-person pronouns (e.g., you, your, and yours) can be regarded as an invitation to directly engage individuals in interpersonal conversations (Pollach, 2005), which could encourage interactions and increase the perceived humanlikeness of the VI. Thus, we expect that VIs with a lower level of humanlike appearance will likely use more first-person and second-person speech to strengthen their position as an interaction partner and establish a closer relationship with their followers. Thus, we hypothesize that:

H2. VIs with non-humanlike appearance uses person plural pronouns ("we", "you") more than a humanlike VIs.

Use of punctuation marks as humanlike communication strategy

People often express themselves using both verbal and nonverbal cues in interactions. In text-based communication, people frequently add punctuation marks as a method of compensating for the inability to use nonverbal cues (Derks et al., 2008a, 2008b). For

instance, punctuation marks such as exclamation and question marks can add emotional qualities to written words that may sound dry and distant (Busch, 2021; Jackson, 2005). Therefore, punctuation marks are considered effective methods to contextualize text-based communications, and have become especially important in digital interactions (Busch, 2021; Jackson, 2005). In digital writing, among many punctuation marks, exclamation marks, and question marks are extensively used (Crystal, 2015). These punctuation marks are already an important communication tool for SMIs to impress their followers, and could be a driver of perceived influencer authenticity (Audrezet et al., 2020). As influencers on social media, VIs are also likely to use question marks and exclamation marks as a communication strategy.

Humans use punctuation in digital writing to convey emotions as well as prosodic indicators like voice tone and accentuation of words (Brody & Diakopoulos, 2011). According to Naveed et al. (2011), question marks indicate questions in all types of text, and are by their nature intended to elicit responses from others. By using question marks, human influencers actively invite comments and responses from their audience and engage with them by answering. These two-directional conversational interactions can help influencers alleviate levels of uncertainty, leading to increased affection for the influencers (Berger & Calabrese, 1974). The question mark is also used to denote doubt, bewilderment or amazement (e.g., “huh?”) (Lukyanova & Martyanov, 2021). Multiple question marks in the text can denote stronger emotions such as anger and dissent (e.g., “WTF is happening???”). On the other hand, exclamation marks could add expressiveness and emotions to the writing. An exclamation mark can indicate emphatic agreement (exactly!), enthusiasm (let’s go!), or urgency (help!) (Marge et al., 2022). Li et al. (2023) observed that the exclamation mark not only shows happiness or anger but also expresses the arousal level of the emotion (e.g., “yes!!!!” vs. “yes!”). Thus, exclamation marks and their repetition are considered socially appropriate means of expressing emotions (Tannen, 2013).

According to Liebman and Gergle (2016), the use of punctuation marks in digital writing helps develop positive social relationships between users. Lee et al. (2020) found that punctuation marks used by non-humans enhance closeness and co-presence between humans and non-humans. Specifically, when a non-human being uses question marks or exclamation marks to convey its emotional state and to indicate that it is actively listening to the other person’s opinion, humans feel that the non-human counterpart actually exists and that they are close to them. Since question marks and exclamation marks can be used to stimulate user response and express emotions in digital writing, it is likely that non-humanlike VIs will use more punctuation (question marks and exclamation marks) in social media posts to enhance a sense of co-presence and closeness. Thus, we hypothesize that:

H3. VIs which have non-humanlike appearance use a punctuation mark (“?”, “!”) more than a humanlike VIs.

The operator types of VI and communication strategy

One important factor that determines VIs’ communication strategy is whether a brand operates them. The operator or agency of a VI is a creator and/or a manager of the VI. Operators determine how much the VI is humanized, from a mere suggestion to a fully

developed specific personality such as a spokesperson, a friend, or an old flame (Aggarwal & McGill, 2007). They also decide on VI activities such as creating and posting contents, the frequency of posts, the way the VI communicates with the audience, and so on. For example, the two Instagram influencers with the most followers at the time of writing —Lu (@magazineluiza, 5.6 million followers) and Miquela (@lilmiquela, 3 million followers)— share some similarities (e.g., They have humanlike appearance and are interested in fashion and social issues, and often feature real people in their posts), but their content differs widely. Compared with Miquela, Lu, who is operated by a brand and an official brand spokesperson, frequently uploads posts about business-oriented brand communication (e.g., promotions, brand events). In contrast, Miquela, who is not operated by a brand, posts on a variety of topics focusing on her daily and professional lives including brand endorsements, social issues, movies, friends, and travel. In addition to the contents, it is natural that the operator type (brand-operated vs. non-brand-operated) determines the communication strategy as the operator of the VI will set the intention and motivation of the VIs' activities. Among communicative strategies, we are particularly interested in whether there are differences in VI's emotional expression and strategic use of pronouns and punctuation depending on operator type.

It is likely that the VIs operated by a brand mostly express positive emotions through social media posts whereas VIs not operated by a brand express a wider range of emotions, both positive and negative. According to previous studies, SMIs express negative emotions freely such as disappointment, frustration, and anger regarding a variety of issues, possibly because such negative emotions help their audience resonate with and feel connected with the SMIs. Therefore, VIs who are not associated with brands are likely to mimic SMIs strategies and use both negative and positive emotions to communicate with their followers. Meanwhile, previous research on corporate/brand social media messages revealed that brand posts rarely show negative emotional cues or language and are generally positive in nature (Lin & Peña, 2011; Oliveira et al., 2022). This may be because consumers tend to respond more favorably to positive emotional messages than to negative or mixed ones (Eckler & Bolls, 2011). Thus, brands are likely to focus on presenting the brands positively and mostly rely on positive emotions. Likewise, VIs operated by a brand are likely to emphasize positive emotions. Thus, we hypothesize that:

H4. Brand-operated VIs express more positive emotion than non-brand-operated VIs among the overall emotional expressions.

SMIs communicate directly with their followers, giving the impression that they are more accessible (Baker, 2022). In particular, SMIs refer to their followers as friends, family, and folks, and use inclusive and the first person plural pronouns (“us” and “we”) to unite their audience. Because SMIs are not directly associated with any brand, VIs that are not operated by a brand are likely to adopt a similar strategy. Enke and Borchers (2019) also indicated that VIs operated by an independent agency are expected to initiate and encourage direct interactions like SMIs to build strong relationships and a sense of belonging. Thus, we expect that VIs which are not operated by a brand will use “we” more frequently than VIs operated by a brand. On the other hand, brand spokespersons or brand-associated SMIs focus on raising brand awareness or generating social buzz to

improve brand value and revenue (Sudha & Sheena, 2017), and are likely to treat consumers as a target to deliver messages or to persuade rather than a member of a community. As a result, they are more likely to use “you” to address consumers directly because second-person pronouns (e.g., “you”) can demand consumer attention and enhance consumer involvement and brand attitude (Cruz et al., 2017). Hanc (2016) also stated that second-person pronouns (“you”) have power to generate a sense of immediacy and connection, thus it can be a way for brands to effectively communicate with consumers (Hanc, 2016). Thus, brand-operated VIs who act as spokespersons represent the brand separated from the general consumers and may use the second-person pronoun “you” more. Thus, we hypothesize that:

H5. There are differences in the use of personal plural pronouns depending on the operator types of VIs (branded-operated vs. non-branded-operated).

Use of punctuation marks could signal the intentions behind the VIs’ communication. Many studies have demonstrated that social media brand communications are focused on entertainment and attention-grabbing elements, aiming to effectively captivate consumers (Manthiou et al., 2014; Merrilees, 2016; Walsh et al., 2013). The use of exclamation marks in the content of brand-operated VIs is likely to be a powerful tool to capture customers’ attention and convey strong emotions, which could reinforce brand recognition and recall. As consumers are exposed to these engaging elements on social media brand pages, the strategic incorporation of exclamation marks in the post content is likely to heighten their excitement and ultimately improve brand recognition (Taylor et al., 2011).

Question marks can increase online interaction and trigger greater engagement (Abitbol & Lee, 2017; Tausczik & Pennebaker, 2010). In contrast to influencers who are operated by brands and created explicitly for promotional purposes (Rundin & Colliander, 2021), VIs who are not operated by brand often face higher uncertainty since their concept is relatively novel to many users (Block & Lovegrove, 2021). Thus, it is likely that these influencers implement effective strategies to alleviate uncertainty and increase likability among their followers. During social interactions, people naturally seek to gather information about others to form impressions, reduce uncertainty, and predict attitudes and behavior (Tidwell & Walther, 2002). One highly effective interactive strategy to achieve this is by directly asking questions to their audience (Berger & Calabrese, 1974; Berger et al., 1976). Therefore, it is likely that influencers not operated by brands use more question marks than influencers operated by brands. The literature on online communication demonstrates that increased use of question marks in social media channels tend to exert greater conversationality and elicit more online participation (Abitbol & Lee, 2017; Tausczik & Pennebaker, 2010). Therefore, VIs are expected to use punctuation patterns differently depending on the type of operator to strengthen brand awareness and recall, or increase follower participation online.

H6. There are differences in the use of punctuation marks (“?”, “!”) depending on the operator types of VIs (branded-operated vs. non-branded-operated).

User engagement

Influence is the ability to drive action and receive people's engagement on a post on social media or in real life (Freberg et al., 2011). According to Hearn and Schoenhoff (2015) and Brooks et al. (2021), SMIs work to generate a form of celebrity capital or sociocultural currency by cultivating as much attention as possible and building a loyal community, which companies subsequently can reach for marketing purposes. SMI influence can be assessed with four indicators—total engagement, total reach, total sentiment, and total growth (Aggrawal et al., 2018). In the context of social media and online media, engagement has been widely viewed as the most significant indicator because it reflects actual behaviors (e.g., viewing, liking, sharing, and commenting) (Barger et al., 2016; Coelho et al., 2016; Erkan, 2015). Increasing user engagement has become a universal goal in social media marketing communication (De Vries et al., 2012). Prior research that measured user engagement with Instagram posts used the liking and commenting metrics to assess user engagement (Coelho et al., 2016; Erkan, 2015). Therefore, it seems suitable to adopt the metrics of liking and commenting to measure the degree of engagement for the current study.

Predictors of user engagement with VIs on social media

As VIs have gained increasing attention in recent years, scholars began to investigate the mechanism through which VIs engage and influence their followers (Arsenyan & Mirowska, 2021; Faddoul & Chatterjee, 2020). Many of these scholars attempted to identify factors that increase user engagements with influencers. One fruitful approach is the studies that identified the influencer factors and the content factors. For example, Lou and Yuan (2019) identified source (influencer-related) and content (post-related) factors as crucial drivers of user engagement with SMIs. Xie-Carson et al. (2023) corroborates these findings in the context of non-human influencers, revealing that source and content factors exert a comparable influence on user engagement.

The most prominent influencer factor for non-human entities (e.g., VIs) is humanlikeness. The visual humanlikeness of non-human entities has significantly impacted human–computer and human–robot interactions by facilitating people to form deeper, more meaningful, and positive connections with entities (Yang et al., 2020). Yang et al. (2023) also found that people perceive VIs with humanlike appearances as more trustworthy, knowledgeable, and attractive, which positively influences user engagement. Therefore, humanlikeness level of a VI, can be an important factor affecting user engagement. Taken together, we hypothesize that:

H7. The humanlikeness level of VIs will be positively related to user engagement

The identity of the Virtual Influencer (VI) operator, such as a brand, sponsor, or manager, significantly impacts consumer engagement (Xie-Carson et al., 2023). These operators control the influencer's actions, like social media posts and brand collaborations (Sands et al., 2022a, 2022b). Brand-operated influencers act as brand spokespersons, with their social media activities closely monitored for brand promotion, while non-brand-operated influencers enjoy more creative freedom (Hudders et al., 2021; Rundin & Colliander, 2021). Users are particularly sensitive to VI operators, driven by curiosity

about the human curating the content, affecting their perception of authenticity and engagement with the VI's posts (Moustakas et al., 2020; Xie-Carson et al., 2023).

H8. The operator types of VIs (brand-operated, non-brand-operated) will affect user engagement

Previous research investigating consumer reactions to social media messages uncovered several content-related factors associated with user engagement (Stieglitz & Dang-Xuan, 2013; Walker et al., 2017). In particular, message content and post characteristics appear to be crucial drivers of engagement behavior (Ko et al., 2022; Leung et al., 2017; Rietveld et al., 2020). Research to date showed that the emotion expressed in the social media post (i.e., the degree and the valence of emotion expressed in the posts) and communication/linguistic style (i.e., use of pronouns, punctuation marks) make a significant impact on user engagement. Revealing emotions in social media posts could enhance user engagements because VI's emotions evoked strong interest from users, making them more likely to "Like" and "Comment" on posts (Shin & Lee, 2020). Moreover, negative emotions could attract even more user attention and promote consumer engagement (Naveed et al., 2011). Additionally, evidence is growing that use of pronouns and punctuation marks (i.e., question and exclamation marks) can affect user engagement. Labrecque et al. (2020) found that the use of first-person plural pronouns ("we") and second-person pronouns ("you") have a positive effect on social media user engagement, especially on the number of comments. Pronouns have the power to directly involve the message receiver or not. For example, while first person singular pronouns ("I") only make reference to the message sender, first person plural pronouns ("we", "us", "our", etc.) and second person pronouns ("you", "yours", etc.) implicate the receiver (Noguti, 2016). Using second-person pronouns (e.g., you, your, and yours) can invite individuals to engage in interpersonal conversations (Pollach, 2005). Furthermore, punctuation marks are relevant to the interactivity of social media messages (Yuen et al., 2023), affecting the user engagement. For example, by using question marks, influencers can actively invite comments and responses from their audience and engage with them by answering. Influencers also use exclamation marks when expressing their opinions to grab followers' attention and get them to listen to them. Punctuation marks may signal that something is remarkable or peculiar, and hence call attention (Noguti, 2016). Indeed, Ko et al. (2022) and Yuen et al. (2023) found that having either question marks or exclamation marks is associated with more user engagement on Instagram. Thus, we hypothesize that:

H9. The post characteristics will affect user engagement (i.e., likes, comments). Specifically, expressing (H9a) positive emotion and (H9b) negative emotions; using (H9c) first-person pronoun ("we") and (H9d) second-person pronouns ("you"); and using (H9e) question marks and (H9f) exclamation marks in the post will increase the user engagement.

Methods

Data collection

To identify appropriate VIs for the study, we referenced *virtualhumans.org*, a website that offers comprehensive information about existing VIs including their biographies,

news articles, and interviews (Choudhry et al., 2022). We first collected the active VIs from the website and then reviewed and collected information from the VIs' Instagram accounts. This resulted in a profile list of 200 VIs which includes the year of first appearance, country of origin, types of operator, the number and frequency of postings, the number of followers, and the number of followers, and the Instagram biography (as of April 17, 2023).

As VIs can vary greatly in terms of how realistic and humanlike in their physical appearance, we categorized them into 3 groups based on humanlikeness of their appearance, following a recent research on VIs: Human VIs (HVI), animated human VIs (AVIs), and non-human VIs (NHVIs) (Choudhry et al., 2022). Two researchers separately coded the 200 VIs and agreed with 95.5% of the categorization. Then, the third coder examined the disagreements and three coders discussed and resolved disagreements. As a result, 107 were classified as HVIs, 48 as AVIs, and 45 as NHVIs.

Because we were interested in the operator type and humanlikeness level as factors influencing post characteristics and consumer engagement, we selected 6 VIs that represent different operator types (brand-operated vs. non-brand-operated) and humanlikeness levels (HVI/AVI/NHVI). To determine the 6 VIs, the VIs in each humanlikeness category were sorted by their followers' numbers because the number of followers is an important measure of an influencer's network size and popularity (De Veirman et al., 2017). Then, we examined the activity level of the VIs and removed the VIs that did not post within the past 4 months. Next, we selected one brand-operated and one non-brand-operated VI from each category who showed a relatively comparable level of activities assessed with the frequency and the total number of posts. Previous research shows that content volume describes how much content social media influencers share on their accounts (Casaló et al., 2020; Colliander & Marder, 2018). Content volume measures how active influencers are on social media (Casaló et al., 2020). The final selected 6 VIs are: Lu of Magalu (HVI, brand-operated), Miquela (HVI, non-brand-operated), CB of Casas Bahia (AVI, brand-operated), Noonnoouri (AVI, not brand-operated), Gecko (NHVI, brand-operated), and Guggimon (NHVI, non-brand-operated).

For HVIs, Lu of Magalu and Miquela were selected for each brand-operated and non-brand-operated VI with their highest number of followers. Magazine Luiza (@maga-zineluiza; 6 M followers) has utilized Lu, a female HVIs, in its advertising for almost a decade and features her prominently on its YouTube channel. Miquela (@lilmiquela; 2.9 M followers), a 19-year-old VI, has grown in popularity since 2016 posting regularly about her daily life on social media. She was nominated as one of the 25 most influential people on the internet by TIME Magazine (Time, 2018). For AVIs, CB of Casas Bahia and Noonnoouri were selected for each brand-operated and non-brand-operated VI. CB of Casas Bahia (@casasbahia; 3 M followers), a highest ranked AVI, represents one of the most prominent Brazilian retail brands Casas Bahia. This two-dimensional boy character has been used for decades and transformed into the 3D teenage character in 2020. Noonnoouri (@noonnoouri; 404 K followers), a 19-year-old VI, has been frequently researched as a representative influencer actively collaborating with fashion brands and raising voices on social issues such as environmental protection. For NHVIs, Gecko and Guggimon were selected for each brand-operated and non-brand-operated VI. Although Gecko (@thegeicogecko; 30 K), a spokesperson of the car insurance company Geico for

more than 20 years, is lower in the number of followers than Guggimon (@guggimon; 1.5 M followers), Gecko was selected due to its similarity with Guggimon such as comments and behavior in the Instagram postings. Guggimon is a fashion horror artist and mixtape producer with an obsession with handbags, axes, and designer toys. Created from the entertainment brand Superplastic, Guggimon has been collaborating with fashion brands and gaming platforms.

Table 1 presents the main characteristics of the 6 VIs' profiles as well as the number of their Instagram followers, the operator type, the country of origin, the year of Instagram account creation, the total number of likes and comments for all posts, and followers engagement (total number of comments and likes divided by number of followers).

In Instagram, users and brands create, edit, and share photos or videos with short descriptions and often hashtags (Silva et al., 2020). Instagram has more than 1.28 billion users (Statista, 2022) and more than 50 billion posts (Müngen et al., 2021), thus providing the researchers with rich data for analyses. Prior research that measured user engagement with Instagram posts used the liking and commenting metrics to assess user engagement (Coelho et al., 2016; Erkan, 2015). Therefore, it seems suitable to adopt the metrics of liking and commenting to measure the degree of engagement for the current study. To analyze the post characteristics and the engagement metrics, the research team created a crawler using Python to collect the post texts and related data from the 6 VIs' Instagram accounts. A total of 8,429 Instagram posts of 6 VIs were collected. The collected data also includes timestamps, locations, the number of likes, the number of comments, comment texts, and hashtag. 37 posts using only emoticons were excluded from the analysis as they were inappropriate for text analysis. The final data included 8392 posts. To analyze the post texts, we preprocessed them using Python (removing non-English words, emoticons, numbers, and stop words) and then used Linguistic Inquiry and Word Count (LIWC-15) software.

Table 1 Characteristics of 6 VIs

Operator	Brand-operated			Non-brand-operated		
Name	Lu of Magalu (@magazineluiza)	CB of Casas Bahia (@casasbahia)	GEICO Gecko (@thegeicogecko)	Miquela Sousa (@lilmiquela)	Noonnoouri (@noonnoouri)	Guggimon (@guggimon)
# Of followers	6 M	3 M	30 K	2.9 M	404 K	1.5 M
Operator type	Brand (Magazine Luiza)	Brand (Casas Bahia)	Brand (Geico)	Media agency (Brud)	Media agency (Opium Effect)	Entertainment agency (Superplastic)
Country of Origin	Brazil	Brazil	USA	USA	Germany	USA
Year the account created	2014	2012	2013	2016	2017	2018
Likes total	112,390,347	164,182,794	3,649,927	261,686,083	24,640,304	7,517,063
Comments total	1,280,520	1,286,627	10,318	1,088,673	200,676	44,157
Follower engagement	18.95	55.16	122.01	90.61	61.49	5.04

Analysis

LIWC is a textual analysis software program designed to study emotional components present in text (Pennebaker et al., 2015). LIWC analyzes the given text and assesses how much the text corresponds with 90 output variables. Some of them are general descriptors (e.g., words per sentence), others are standard linguistic elements (e.g., pronouns, articles, adverbs, prepositions and auxiliary verbs), and still others are emotional and psychological variables (“Psychological Processes” group) which include 53 variables. LIWC uses the predefined dictionaries which contain words associated with each variable. For example, the ‘Positive Emotion’ includes words such as love, loyalty, and fun whereas the ‘Negative Emotion’ includes words such as hate, dislike, and boring. LIWC scans the text and assigns scores for each variable by counting the relevant words found in the text. According to Humphreys and Wang (2018), automated text analysis such as LIWC may lead to discoveries of relationships overlooked by researchers and is compatible with both theory testing and discovery-oriented designs.

LIWC has been widely used for text analysis, and the results of the analysis show a high agreement rate when compared to other lexical-based methods (e.g. PANAS-t, SASA, SentiWordNet, etc.) (Gonçalves et al., 2013). Over 100 studies have been published using LIWC as a content analysis tool (Ludwig et al., 2013) and internal and external validity have been repeatedly established (Pennebaker et al., 2015). Due to its established accuracy, internal and external validity, and suitability for theory testing, LIWC-15 was also used in this study to test the hypotheses. Because two of the selected VIs were Brazilian (Lu and CB) and most of their posts were written in Portuguese, the LIWC-15 Portuguese dictionary was used to analyze those posts. The LIWC-15 English dictionary was used for English contents. Emotions, pronouns (you, we), and punctuation marks (question mark, exclamation mark) scores were used among 90 variables as they are associated with our hypotheses. After analyzing all the posts with LIWC software, the data was transferred to SPSS 27 and an independent sample t-test and one-way Welch’s ANOVA were used to test the hypotheses.

Results

Descriptive results

Of 8,392 posts, 96.54% were uploaded from 2018 to 2023 and 74.74% contained at least one hashtag. The number of words per post ranged between 1 and 342 and the average number of words in a post was 28.09 ($SD=30.24$). 14.80% of posts contained a video. The number of likes per post ranged between 87 and 2,341,000 with the mean of 26,354.02 ($SD=66,646.104$). The number of comments per post ranged between 0 and 58,000 and the mean number of comments was 466.70 ($SD=1,526.775$). Table 2 summarizes the engagement metrics of 6 VIs.

Hypothesis testing for H1 ~ H6: VI effects on post characteristics

A series of ANOVAs was used to test the effects of humanlikeness on post characteristics. As Levene’s test for homogeneity of variances revealed that the assumption was violated ($p<0.05$), Welch’s ANOVA results were used for hypothesis testing. Table 3

Table 2 Engagement metrics

Operator		Brand-operated			Non-brand-operated		
Name		Lu of Magalu	CB of Casas Bahia	GEICO Gecko	Miquela Sousa	Noonoouri	Guggimon
# Of posts using only emoticons		5	0	0	31	0	1
# Of posts		2789	2196	543	1221	1479	164
# Of video posts(%)		390 (13.98)	320 (14.57)	61 (11.23)	112 (9.17)	303 (20.49)	56 (34.15)
No hashtag		170	961	80	674	31	130
Hashtag		2619	1235	463	547	1448	34
Avg likes per post	Mean	15,694.05	35,370.53	5,096.14	68,814.46	6,841.07	17,139.81
	SD	43,564.22	99,721.33	6,010.33	73,189.56	4,794.99	16,306.19
Avg comments per post	Mean	459.13	587.06	19	891.62	135.68	286.43
	SD	1,555.26	1,592.06	21.49	2,338.44	92.95	479.14
Avg length of post	Mean	71.56	43.38	25.55	23.92	30.08	28.54
	SD	52.04	27.94	13.61	31.73	30.71	18.15
Avg likes per followers		18.73	54.73	121.66	90.24	60.99	5.01
Avg comments per followers		0.21	0.43	0.34	0.38	0.50	0.03
Post frequency in days		1.05	1	2	2	1.2	5.57

presents the results of a one-way Welch's ANOVA. In all cases, the ANOVA test calculates high values of F-statistics that were statistically significant for p -values < 0.001 , providing evidence of the validity of the estimated models (Kennedy, 2008).

A one-way Welch's ANOVA revealed that there were differences in the linguistic characteristics of their Instagram posts and user engagement depending on the humanlikeness of VIs. First, the VIs with low (vs. high) humanlikeness expressed more emotions ($M_{HVI}=4.518$, $SD=6.556$; $M_{AVI}=5.046$, $SD=5.319$; $M_{NHVI}=5.460$, $SD=5.774$, $F=11.720$, $p<0.001$). Therefore, hypothesis 1, which stated that VIs which have non-humanlike appearance more express emotion than humanlike VIs, was supported. Although we did not have specific hypothesis for subcategories of emotions, we further tested whether the humanlikeness of VIs would make a difference in their expression of positive or negative emotions in the posts. The result revealed that the lower the humanlikeness level of appearance, the greater the expression of positive emotions. However, for negative emotions, HVI and NHVI showed no difference in negative emotional expression while AVI expressed less negative emotions than the other two

Table 3 One-way Welch's ANOVA results for the VI humanlikeness effects

		HVI	AVI	NHVI	Welch's F	Multiple comparisons
Emotion	M (SD)	4.518 (6.556)	5.046 (5.319)	5.460 (5.774)	11.720***	NHVI > (AVI & HVI)
Posemo	M (SD)	3.553 (5.692)	4.392 (5.030)	4.393 (5.321)	25.471***	(NHVI & AVI) > HVI
Negemo	M (SD)	0.883 (3.248)	0.553 (1.617)	1.002 (2.364)	19.375***	(NHVI & HVI) > AVI
Pronoun (we)	M (SD)	0.513 (2.014)	0.358 (1.240)	0.596 (2.094)	10.375***	(NHVI & HVI) > AVI
Pronoun (you)	M (SD)	2.377 (3.347)	1.997 (2.754)	3.354 (4.421)	55.569***	NHVI > HVI > AVI
Qmark	M (SD)	9.152 (32.391)	1.642 (3.195)	2.292 (3.564)	113.507***	HVI > NHVI > AVI
Exclamation	M (SD)	2.652 (4.484)	1.826 (3.345)	2.386 (4.253)	41.079***	(HVI & NHVI) > AVI

HVI: Human Virtual Influencer, AVI: Animated-human Virtual Influencer, NHVI: Non-human Virtual Influencer

* $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$

($M_HVI=0.883$, $SD=3.248$; $M_AVI=0.553$, $SD=1.617$; $M_NHVI=1.002$, $SD=2.364$, $F=19.375$, $p<0.001$).

In terms of use of pronouns, HVIs and NHVIs used the first person plural pronoun (“we”) more than AVIs ($M_HVI=0.513$, $SD=2.014$; $M_AVI=0.358$, $SD=1.240$; $M_NHVI=0.596$, $SD=2.094$, $F=10.375$, $p<0.001$). A further investigation of the post contents showed that our specific examples of HVI and NHVI, especially Miquela and Guggimon, used “we” often to refer to their VI friends Bermuda and Janky and themselves rather than the VI and the audience/followers. NHVIs used the second person pronoun (“you”) more than HVIs and AVIs ($M_HVI=2.377$, $SD=3.347$; $M_AVI=1.997$, $SD=2.754$; $M_NHVI=3.354$, $SD=4.421$, $F=55.569$, $p<0.001$). Thus, hypothesis 2, which stated that VIs which have non-humanlike appearance uses person plural pronouns (“we”, “you”) more than a humanlike VIs, was rejected.

Regarding the use of punctuation marks, it was hypothesized that less humanlike VIs would use a punctuation mark (“?”, “!”) more than humanlike VIs. Inconsistent with the hypothesis, the results indicated that the HVIs used more question marks than the other two VI types ($M_HVI=9.152$, $SD=32.391$; $M_AVI=1.642$, $SD=3.195$; $M_NHVI=2.292$, $SD=3.564$, $F=113.507$, $p<0.001$). On the other hand, HVIs and NHVIs used more exclamation marks than AVIs while the difference between HVIs and NHVIs was not statistically significant ($M_HVI=2.652$, $SD=4.484$; $M_AVI=1.826$, $SD=3.345$; $M_NHVI=2.386$, $SD=4.253$, $F=41.079$, $p<0.001$). Thus, hypothesis 3 was rejected.

Hypothesis 4–6 posits that VI’s operator type (brand-operated vs. non-brand-operated) will be related to their Instagram post characteristics. Table 4 presents results of the independent-samples *t*-test. There were some statistical differences in emotion expression, use of pronouns, and use of punctuation marks between the operator type conditions. Contrary to H4, which stated that VIs which are operated by brands more express positive emotion than VIs which are not operated by brand, it was found that the VIs which are not operated by brand expressed more positive emotions ($M_brand=3.611$, $SD=3.655$; $M_non-brand=4.726$, $SD=7.663$, $t=-7.363$, $p<0.001$) (H4 rejected). In addition, VIs not operated by brands also express more negative emotion than VIs operated by brands ($M_brand=0.597$, $SD=1.520$; $M_non-brand=1.041$, $SD=3.874$, $t=-5.906$, $p<0.001$). Thus, the results suggest that VIs who are not associated with a brand express emotions more than the ones operated by a brand.

H5 stated that the use of personal plural pronouns will be differed based on the type of operator operating VIs (branded-operated vs. non-branded-operated). The VIs not

Table 4 *t*-test results comparing brand-operated VIs and non-brand-operated VIs

		Brand-operated VI	Non-brand-operated VI	<i>t</i>
Avg posemo	M (SD)	3.611 (3.655)	4.726 (7.663)	− 7.363***
Avg negemo	M (SD)	0.597 (1.520)	1.041 (3.874)	− 5.906***
Avg pronoun (“we”)	M (SD)	0.389 (1.174)	0.574 (2.465)	− 3.802***
Avg pronoun (“you”)	M (SD)	2.518 (2.781)	1.859 (3.927)	7.995***
Avg of Qmark	M (SD)	2.096 (2.964)	11.442 (38.092)	− 13.110***
Avg of Exclamation	M (SD)	2.828 (3.465)	1.186 (4.743)	16.400***

Bold numbers indicate a significantly higher value between the two conditions

*** $p<0.001$

operated by brands used the pronoun “we” more than the VIs operated by brands ($M_{\text{brand}} = 0.389$, $SD = 1.174$; $M_{\text{non-brand}} = 0.574$, $SD = 2.465$, $t = -3.802$, $p < 0.001$). It is consistent with previous research showing that influential people strengthen their influence by using collective pronouns such as “we” when communicating with their audiences (Crystal, 2011). On the other hand the VIs operated by brands used the pronoun “you” more than their counterpart ($M_{\text{brand}} = 2.518$, $SD = 2.781$; $M_{\text{non-brand}} = 1.859$, $SD = 3.927$, $t = 7.995$, $p < 0.001$). Therefore, the results confirmed that there are differences in the use of pronouns depending on who operates the VI, supporting H5. This finding is consistent with the results of Cruz et al. (2017) that brands use the second-person pronouns (“you”) in brand communication because it helps improve consumer engagement and brand attitudes. Finally, H6, which stated that there are differences in the use of punctuation marks (“?”, “!”) depending on the operator types of VIs (branded-operated vs. non-branded-operated), were tested. The findings provide mixed support for H6. While non-brand-operated VIs used more question marks than brand-operated VIs ($M_{\text{brand}} = 2.096$, $SD = 2.964$; $M_{\text{non-brand}} = 11.442$, $SD = 38.092$, $t = -13.110$, $p < 0.001$), brand-operated VIs used more exclamation marks than non-brand-operated VIs ($M_{\text{brand}} = 2.828$, $SD = 3.465$; $M_{\text{non-brand}} = 1.186$, $SD = 4.743$, $t = 16.400$, $p < 0.001$). This is because brands use exclamation marks more when announcing information such as new product launches and discounts. Therefore, H6 was partially supported.

Hypothesis testing for H7~H9: VI and post characteristics effects on user engagement

Hypothesis 7–9 proposed that characteristics of VIs and posts influence user engagement. To test the influence of the various factors on user engagement, a mathematical predictive model for the two dependent variables (number of likes and comments) was created. Because these dependent variables are count data that follow a Poisson distribution (Cameron & Trivedi, 2005; Hill et al., 2001), the regression model to explain the number of likes and the number of comments can be expressed as:

$$y_{ij} = \alpha + \exp \left(\sum_{a=1}^2 \beta_a hl_a + \beta_b operator_{bj} + \beta_c posemo_{cj} + \beta_d negemo_j + \beta_e we_j + \beta_f you_j + \beta_h qmark_j + \beta_i exclamation_j \right) + \varepsilon_{ij}$$

where

y_{ij}	y_{1j} or y_{2j} ; the number of likes per VI post j or the number of comments per VI post j , respectively,
hl_{aj}	dummy variables representing the level of humanlikeness a of the appearance of the VI that created post j (baseline category is NHVI),
$operator_{bj}$	dummy variables indicating whether the operator characteristic b at VI post j is present or not (baseline category is non-brand operator),
$posemo_{cj}$	indicating the percentage of words related to positive emotions in the VI post j ,
$negemo_j$	indicating the percentage of words related to negative emotions in the VI

	post j ,
we_j	indicating the percentage of pronoun (“we”) in the VI post j ,
you_j	indicating the percentage of pronoun (“you”) in the VI post j ,
$qmark_j$	indicating the percentage of punctuation (“?”) in the VI post j ,
$exclamation_j$	indicating the percentage of punctuation (“!”) in the VI post j ,
ε_{ij}	ε_{1j} or ε_{2j} ; normally distributed error terms for dependent variable y_{1j} and y_{2j} respectively.

The variance inflation factor (VIF) values for all the variables in all models were significantly lower than the critical value of 10, and the mean VIF value is close to 1.16, for two models, which that indicates the absence of multicollinearity (Greene, 2012; Kennedy, 2008). Table 5 shows the estimation results from the analysis. Both models for the number of likes ($R^2=0.170$, $R^2_{adj}=0.169$) and comments ($R^2=0.294$, $R^2_{adj}=0.294$) were statistically significant and explained the variance of these two engagement variables relatively well.

According to our study, not all determinants that drive likes are also responsible for driving comments. Similarly, De Vries et al., (2012) also found that liking and commenting have different determinants of activity.

The level of humanlikeness was significantly related to the number of likes ($\beta_{AHI}=0.260$, $p<0.001$; $\beta_{HVI}=0.699$, $p<0.001$) and comments ($\beta_{AHI}=2.178$, $p<0.001$; $\beta_{HVI}=2.552$, $p<0.001$). The VIs’ operator type also was significantly related to the number of likes ($\beta_{brand}=-1.109$, $p<0.001$) and comments ($\beta_{brand}=-0.057$, $p<0.001$). Thus, hypothesis 7 and 8 were supported. The VIs’ expression of positive (H9a) and negative emotions (H9b) in a post partially explained the user engagement. The percentage of positive emotion expressed was not significantly related to the number of likes

Table 5 Estimation results for VI post popularity

		Log likes	Log comments
Humanlikeness	No (NHVI, baseline)	—	—
	Low (AHI)	0.260***	2.178***
	High (HVI)	0.699***	2.552***
Operator Characteristics	VI not operated by brand (baseline)	—	—
	VI operated by brand	− 1.109***	− 0.057*
Emotions	Percentage of positive emotion	0.001	− 0.008***
	Percentage of negative emotion	0.026***	0.028***
Pronouns	Percentage of “we”	0.012	0.029***
	Percentage of “you”	0.012*	0.017***
Punctuation	Percentage of “?”	0.007***	0.004***
	Percentage of “!”	0.017***	0.017***
Constant		9.108	3.058
	N	8392	8392
	F-value	190.132***	388.528***
	R^2	0.170	0.294
	R^2_{adj}	0.169	0.294

We report unstandardized coefficients

NHVI Non-human Virtual Influencer, AHI Animated Virtual Influencer, HVI Human Virtual Influencer

* $p<0.05$. ** $p<0.01$. *** $p<0.001$

($\beta_{\text{posemo}} = 0.001$, N.S) but negatively related to the number of comments although the coefficient is very small ($\beta_{\text{posemo}} = -0.008$, $p < 0.001$). Thus, hypothesis 9a was rejected. On the other hand, the percentage of negative emotion expressed was positively related to the number of likes ($\beta_{\text{negemo}} = 0.026$, $p < 0.001$) and comments ($\beta_{\text{negemo}} = 0.028$, $p < 0.001$). Thus, hypothesis 9b was supported. The percentages of second-person pronouns (“you”) and punctuation marks (“?”, “!”) were significant and positively related to both the number of likes ($\beta_{\text{you}} = 0.012$, $p < 0.05$; $\beta_? = 0.007$, $p < 0.001$; $\beta_! = 0.017$, $p < 0.001$) and comments ($\beta_{\text{you}} = 0.017$, $p < 0.001$; $\beta_? = 0.004$, $p < 0.001$; $\beta_! = 0.017$, $p < 0.001$). All in all, we found support for hypothesis 9d, 9e, and 9f. However, the percentage of first-person plural pronouns (“we”) was only significantly related to the number of comments ($\beta_{\text{we}} = 0.029$, $p < 0.001$) but not to the number of likes ($\beta_{\text{we}} = 0.012$, N.S). Thus, hypothesis 9c was partially supported. The summary of results is presented in Table 6.

Discussion

Utilizing the extensive user base and rich data available on Instagram, a platform central to influencer marketing, the research employs a data-driven approach. By analyzing profiles and posts of popular VIs on Instagram, it provides empirical insights into factors that drive consumer engagement in a real-world context. The study responds to recent calls in the literature to explore the appeal and success conditions of emerging VIs in social media marketing, offering timely and relevant analysis in the rapidly evolving digital marketing landscape. Overall, this research paper enriches the understanding of VI marketing by providing a more comprehensive and data-driven analysis of the factors that contribute to the success and appeal of VIs on social media platforms. The findings offer several intriguing insights into the world of VIs and their interaction with users.

An interesting finding was the variance in emotional expression contingent upon the VIs’ humanlike appearance. VIs with a less humanlike appearance were found to exhibit a heightened emotional expression, predominantly of a positive nature. This trend aligns with prior studies that underscore the pivotal role of emotions in human–human and human–robot interactions. Breazeal (2003) and Picard (2003) have previously emphasized the significance of emotions in these interactions. Further supporting this, Craig and Edwards (2021) posited that robots, when perceived as more joyful or content, are often viewed as more likable, intelligent, credible, and socially present. The current

Table 6 Summary of hypothesis test results (H7–H9)

Hypotheses	Number of likes	Number of comments
H7: humanlikeness → Engagement	Supported	Supported
H8: operator type → Engagement	Supported	Supported
H9a: emotion (positive) → Engagement	Rejected	Rejected
H9b: emotion (negative) → Engagement	Supported	Supported
H9c: pronouns (“we”) → Engagement	Rejected	Supported
H9d: pronouns (“you”) → Engagement	Supported	Supported
H9e: punctuation (“?”) → Engagement	Supported	Supported
H9f: punctuation (“!”) → Engagement	Supported	Supported

findings echo this sentiment, suggesting that VIs with lesser humanized features might strategically employ positive emotions to bolster their likability and social presence.

Contrary to expectations, there was no difference in VI's communication style depending on the level of humanlike appearance. This suggests that other factors, possibly the character and universe created by the VI, play a more significant role in determining their communication style. For instance, VIs like Miquela and Guggimon, who have established their unique virtual worlds and connections, might employ distinct communication styles irrespective of their humanlikeness levels. The current study did not find a relationship between negative emotional expression and the level of humanlikeness. The result may indicate that VIs, regardless of their humanlikeness, might be avoiding negative emotions to maintain a positive image and user engagement. On the other hand, the percentage of negative emotion expressed was positively related to the number of likes and comments. These results are consistent with the results of a previous study that negative emotions can further attract users' attention and promote consumer participation (Naveed et al., 2011).

There were differences in VIs' communication style and emotional expression depending on the type of VIs operator. Non-brand-operated VIs mimic human social media influencers and seem to express a broader spectrum of emotions in their posts compared to brand-operated VIs. This observation aligns with Ge and Gretzel's (2018) study, which highlighted that social media influencers use both positive and negative emotions to evoke strong user interest. In contrast, brand-operated VIs predominantly expressed positive emotions, albeit with a lower overall emotional intensity. This finding is consistent with previous studies (Lin & Peña, 2011; Oliveira et al., 2022) which reported that corporate social media messages are generally positive and rarely contain negative emotional cues. The use of pronouns also varied based on the operator type, with non-brand-operated VIs using "we" more frequently and brand-operated VIs favoring "you". This distinction in pronoun usage is consistent with previous research, emphasizing the different communication strategies employed by brand-operated and non-brand-operated entities. For instance, to elevate self-reference to persuade consumers and reach directly to them (Burnkrant & Unnava, 1995; Cruz et al., 2017), VIs which are operated by brands can use second-person pronouns ("you"). On the other hand, independent VIs use the first-person pronouns ("us" and "we") to build a strong relationship with their followers (Enke & Borchers, 2019). The operator types of VIs are also related to punctuation marks ("?", "!"). Further analyses revealed that brand-operated VIs frequently used exclamation marks, especially when announcing sales, new products, or events. On the other hand, non-brand-operated VIs used more question marks which were used to engage followers on a variety of topics, such as social issues and personal experiences.

Lastly, several determinants of user engagement with VIs were identified. Posts by hyper-realistic VIs, exhibiting the highest degree of humanlikeness, encouraged more likes and comments. While our study could not directly assess the closeness or perceived quality of the interactions, this presents a possibility that the enhanced engagement might have been a result of feeling of improved closeness to the humanlike VIs. The operator type was a significant antecedent of user engagement. Non-brand-operated VIs gained a higher number of likes and comments than brand-operated VIs. The finding is in line with the previous studies which underscored the importance of perceived

authenticity in the digital realm (Moustakas et al., 2020; Xie-Carson et al., 2023). The emotions expressed by VIs, along with their use of punctuation marks, were found to correlate positively with user engagement. Because punctuation marks were often used to emphasize or exaggerate emotional expression in written posts, these findings together imply the significance of emotional expression in increasing consumer engagement. This finding resonates with previous findings which emphasized the impact of emotional expression and punctuation marks on user interactions (Ko et al., 2022; Noguti, 2016; Shin & Lee, 2020; Yuen et al., 2023).

Theoretical and practical implications

First of all, this research extends the existing knowledge of VI marketing through a comprehensive analysis that includes the VI appearance, communication style, as well as the types of VI. Most previous studies have focused solely on the appearance of VIs (Ahn et al., 2022; Arsenyan & Mirowska, 2021) to explain how the extent to which their appearance resembles that of a human affects consumer participation and perceptions of VIs. However, existing research has not adequately explained how other characteristics of VIs and their communication styles influence consumer responses to VIs. Incorporating previous research suggesting message content and post characteristics (Ko et al., 2022; Leung et al., 2017; Rietveld et al., 2020) and the operators behind the VIs (Sands et al., 2022a, 2022b) as crucial drivers of engagement behavior, we investigated all these factors together and built a model to assess how they together predict engagement metrics (i.e., likes and comments). This paper offers an alternative perspective on the relationship between the characteristics of VIs, their communication style, and user engagement rates, with a focus on the analysis of Instagram profiles and social media posts by VIs. This research stands out for its innovative approach, employing Python to gather 8,392 Instagram posts, coupled with the application of the Linguistic Inquiry and Word Count (LIWC) methodology. This methodological choice is significant as it leverages linguistic cues to discern variations attributable to Virtual Influencers (VIs) and to forecast user engagement on Instagram. By doing so, the study addresses a notable gap in existing literature, offering enhanced insights into the optimal design and structuring of VIs and their posts to augment user engagement. This methodological excellence not only underscores the study's rigor but also contributes substantially to the understanding of digital influencer strategies in social media contexts.

Managerially, we offer practical guidelines across different VI categorizations for constructing messages that are more likely to result in desired consumer actions. For instance, humanlike appearance is still very important in eliciting likes and comments, providing support for investing in developing hyper-humanlike virtual influencers. For developing social media posts, strategically expressing negative emotions in the post could be a particularly effective strategy to increase user engagements. It is advisable that VI developers focus on developing convincing narratives that reflect and express VIs' diverse emotions. While our results showed that positive emotion does not increase the number of likes and minimally reduces the number of comments, the readers should use caution in interpreting the results. The positive emotions were generally expressed in day-to-day, pleasant activities of VIs whereas negative emotions tend to be associated with more unusual and somewhat controversial events. For example, the post about Miquela's break-up with her human boyfriend attracted a lot of attention and brought

about controversial reactions among the users. These posts could be effective in increasing exposures and making the posts successfully go viral, but a long-term implication of such controversy on brands should be also carefully assessed along with the momentary engagement. Lastly, using punctuations, especially the exclamation marks, appropriately was shown to be an effective way to increase user engagement. Exclamation marks could increase the excitement level and encourage the users to engage. It is recommended that VI developers consider this communication strategy when designing the social media posts.

Conclusions

As non-human characters such as VIs, fictional characters, and avatars gain popularity on social media and shift the dynamics of online interaction and marketing, understanding user engagement with non-human influencers is vital for both consumer researchers and marketers. The study revealed several noteworthy findings. First, differences in emotional expression were observed depending on the level of humanlike appearance of the virtual influencer (VI), with VIs that appeared less human-like showing enhanced positive emotional expression. This aligns with previous research emphasizing the role of emotions in human–robot interactions. On the other hand, no differences were found in VI's communication style depending on the level of humanlikeness, suggesting that factors such as VI's characters and virtual world play a more important role in shaping VI's communication style. The study also found that brand-operated VIs tended to avoid expressing negative emotions, possibly to maintain a positive image and user engagement. Meanwhile, non-brand-operated VIs exhibiting a broader spectrum of emotions in their posts compared to brand-operated VIs.

Overall, emotional expression, humanlikeness, operator type, and punctuation marks were found to positively correlate with user engagement, highlighting their significance in digital interactions. Interestingly, the use of negative emotions was positively related to the number of likes and comments, suggesting that they can attract user attention and participation. Posts by hyper-realistic VIs received more likes and comments, possibly due to enhanced perceived closeness to these humanlike VIs. With non brand-operated VIs receiving higher engagement, underscoring the importance of perceived authenticity in the digital realm. Punctuation marks also positively correlated with customer engagement. This is because punctuation is used in digital communication to emphasize and exaggerate emotional expressions.

This research paper significantly advances the understanding of VIs in social media marketing, particularly on Instagram, by offering a comprehensive analysis that addresses gaps in existing literature. Unlike previous studies that primarily focused on the humanlike appearance of VIs, this research extends its scope to include a holistic examination of multiple factors influencing consumer engagement. It places a unique emphasis on the linguistic expressions in VIs' social media posts, exploring how these contribute to shaping the VIs' identity and impact on consumers, an aspect less emphasized in earlier research. The study also acknowledges the broad spectrum of VIs' appearances, ranging from highly realistic humanlike figures to non-human objects, allowing for a nuanced understanding of consumer perceptions and engagement across different types of VIs. This research focuses on the operators behind VIs, exploring their

communication strategies and effects on user engagement based on different objectives and strategies. This factor has been largely overlooked in previous studies.

Limitations and future study suggestions

This study, limited to six Virtual Influencers (VIs), cannot be generalized to all VIs or the digital influencer landscape. Thus, readers must recognize that our VIs represent unique characteristics and circumstances that may mask some hypothesized effects. For example, our results might have masked the effects of using “we” in the posts because 2 of the VIs, Miquela and Guggimon, have VI friends (Bermuda, Blawco, and Janky), and often use “we” to refer to their friends and themselves rather than the VI and their followers as we hypothesized. This VI-specific factor could have diluted the effects of “we” which would have contributed to creating the sense of belonging and community. While we hypothesized various relationships among the VI and post characteristics and user engagement in a generalized term using previous literature, our findings should be understood and interpreted with this VI-specific context in mind. To further enhance the generalizability of findings, it would be prudent for future studies to analyze posts of a broader and more varied sample of VIs and validate the relationships among the proposed variables.

Previous studies have indicated that perceptions of closeness, relatedness, and interactivity with an influencer significantly influence the perceived authenticity and emotional attachment to the influencer (Jun & Yi, 2020; Marwick & Boyd, 2011). Thus, future research focusing on whether these perceptions vary based on the characteristics of VIs could offer a more thorough understanding of the dynamics involved in VI interactions. To date, the majority of VIs have the appearance of young women, and each reproduces the existing aesthetic standards of our society with small faces, white skin, and high noses (Shin & Lee, 2023). In recent years, however, various VIs, such as those depicting Down syndrome and vitiligo, have emerged in the digital realm. According to prior research, the humanlikeness of non-human entities can profoundly influence interactions, fostering interpersonal closeness and smoother interactions (Müller et al., 2014, 2015; Nijssen et al., 2019). Exploring the potential impact of these VIs on promoting awareness of diversity and inclusion could be a pivotal area of study. By understanding if and how these VIs can influence societal perceptions, researchers can gauge their potential in fostering a more inclusive digital environment. Lastly, the findings of Lorenzo-Romero et al. (2023) indicate that co-creation activities enhance a company's performance and improve its commitment and connection with customers. Therefore, conducting research on antecedent variables (such as collaborative creation value, types of collaborative creation activities, etc.) that influence user satisfaction, participation, and intention to sustain collaborative creation activities, as well as research on collaborative creation activities VI can engage in with users in the future, may provide valuable insights for designing VIs with high user satisfaction and participation.

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Author contributions

Dr. NJ led the project and drafted the manuscript. THK contributed to data coding, organization of the results, and the writing of the manuscript. Dr. HI contributed to the design and execution of the research project and edited the manuscript. All authors read and approved the final manuscript.

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Availability of data and materials

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Declarations

Ethics approval and consent to participate

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Competing interests

The authors declare that they have no competing interests.

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