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# How Uncanny Are Virtual vs. Human Influencers: A Text Mining Approach

## ABSTRACT

This paper uses the uncanny valley theory to examine how users react to different development levels of human-like avatars on social media. Three virtual avatars with different human-like appearances are compared with a human influencer from the same peer group on Instagram. The methodology is based on the evaluation of user comments on the posted content of the subjects. Text mining is used to evaluate the comments and calculate a sentiment score for each influencer. The results indicate that users react positively to the human influencer and negatively to the most human-like avatar. The study shows users follow the uncanny valley curve when dealing with virtual influencers. When users deal with virtual influencers who try to imitate humans but have low CGI quality, the results are positive. However, when virtual influencers are close to human-like appearance, there are adverse effects on their satisfaction.

**Keywords**: Social media, Sentiment analysis, Virtual influencers

## INTRODUCTION

In today's digital world, virtual agents are becoming more common in our daily lives. They can be found on telephone helplines or as interactive holograms at transportation hubs. Famous examples include Amazon's Alexa on IoT devices and Apple's Siri on smartphones (Purington et al., 2017). However, a new trend is human-like avatar influencers on social media platforms such as Instagram, Facebook, and TikTok (Arsenyan & Mirowska, 2021).

One of the most well-known virtual influencers is Lil Miquela, an AI-driven teenager who debuted on Instagram in 2016 and now has around 3 million followers (Block & Lovegrove, 2021). But “she” is just the beginning. By 2022, the number of virtual influencers on social media platforms had increased from nine in 2015 to over 200, making their designs increasingly challenging to distinguish from humans (Hiort, 2022). This growing category of influencers is now part of a booming industry, with global revenue surging from $1.7 billion in 2016 to $16.4 billion in 2022, marking an 800% growth in just seven years (Statista, 2022a). As a result, influencer marketing has become a crucial component of digital marketing strategy, allowing brands to connect with their target audiences more personally (Kim & Kim, 2021).

Despite the popularity of virtual influencers, there is still a lack of understanding about how audiences perceive and interact with them in the long run. This study seeks to address this gap by exploring the following research questions: (1) How do virtual influencers' posting behaviors differ from human influencers, and what effect does this have on audience engagement? (2)

How does the audience's perception of authenticity differ between human influencers and virtual avatars at different developmental stages of human likeness? These research questions are based on previous studies about digital influencers but focus on the under-researched area of virtual avatar influencers (Kitterman, 2021). This study aims to shed light on the dynamics between virtual influencers and their audiences, expanding on previous research on influencer marketing. This research aims to identify unique engagement patterns and perceptions arising from this new digital personality category by comparing virtual avatars with human influencers. The findings will offer insights into evolving digital marketing strategies and contribute to the broader discussion on human-machine interactions in the era of advanced digitalization.

## BACKGROUND

### From Human to Artificial and virtual influencers

During the last decade, communication with social media influencers has become an essential topic in strategic communication (Kim & Kim, 2021). As a result, many organizations have identified social media influencers as relevant intermediaries, primarily because they can provide access to hard-to-reach audiences, such as teenagers and young adults or specific interest groups (Enke & Borchers, 2019). Another aspect is that social media enables bidirectional communication, where recipients can participate in activities posted by the sender in a bottom-up manner, as opposed to traditional media, where communication is top-down. (Dijkmans, Kerkhof, Buyukcan-Tetik, & Beukeboom, 2015). Even though influencers have become increasingly important in the literature, there has been little focus on defining the concept and reaching a consensus. The current study uses a concept developed by Enke and Borchers (2019) that uses a strategic communication perspective to define social media influencers "as third-party actors who have established a significant number of relevant relationships with a specific quality to influence on organizational stakeholders through content production, content distribution, interaction, and personal appearance on the social web" (Enke & Borchers, 2019, p. 8).

Social media influencers should be seen as trustworthy, credible, and knowledgeable in the field of the advertised product to be persuasive (Djafarova & Rushworth, 2017). However, social media influencers can also hurt a brand's reputation. Khamis, Ang, and Welling (2016) argue that there is an inherent ethical problem with the idea of branding an individual. In addition, influencers can also have a negative reputation for being overly demanding, which could scare off brands or specific user groups (Arsenyan & Mirowska, 2021). Consumers are also beginning to question the authenticity and credibility of influencers - especially those with a large audience and many followers (Kim & Kim, 2021).

A solution to this dilemma is to use virtual avatars and influencers. Using virtual avatars offers full control over the content communicated. For example, the American teenager *Miqueal Sousa*, in this paper introduced as *Lil Miquela*, is one of the first virtual computer-generated image (CGI) influencers that have already built up significant influence and socio-economic power, followed online by over 8 million users on various platforms (Block and Lovegrove, 2021). Aspects describing *Lil Miquela* success can be found in users' need for distraction, according to Arsenyan and Mirowska (2021), as virtual influencers offer a glimpse into another world. The authors argue that the perception of a para-social relationship, where the user feels a mutual sense of friendship, can apply to human influencers and artificial avatars. Block and Lovegrove (2021) identify another explanation for the popularity of avatars like *Lil Miquela* in

the uncanny duality, dissonant polymedia story, and transmedia narrative worlds of digital avatars.

**Digital Avatars on the Internet and the Uncanny Feeling**

Social media users are familiar with virtual avatars such as bots and virtual agents (Purington et al., 2017). Fueled by macroenvironmental aspects like advances in computing capabilities and the rapid development of technology, computer-generated images (CGI) are becoming more human-like, and virtual agents are increasingly capable of simulating human content (Arsenyan & Mirowska, 2021). Due to the rapid development of avatars in marketing, there is no consensus on the exact definition. Academics have used several terms synonymously for avatars, such as automated shopping assistants, chatbots, virtual customer service agents, or digital assistants (Miao, Kozlenkova, Wang, Xie, & Palmatier, 2021). According to Nowak and Fox (2018), this variance makes it difficult for researchers to compare and conceptualize empirical findings and draw conclusions from different studies. Therefore, Miao et al. (2021) developed a definition that incorporates all aspects and suggests that avatars are digital entities with anthropomorphic appearance that have the ability to interact and be controlled either by humans or by software. Given that anthropomorphized representations of virtual agents, especially visually appealing ones, elicit social responses and behavioral changes in people, these virtual influencers present a particularly interesting context (Khan & Sutcliffe, 2014).

According to Hanus and Fox (2015), they cannot be considered digital avatars as they are not mere representations of the users and are not driven by user-oriented tasks. The authors state that these virtual influencers are presented similarly to human influencers, with their public personas and stories that allow for more significant interaction between users and influencers in the virtual environment. Miao et. al. (2021) distinguishes four different categories of avatars: the first is simplistic, the second is superficial, the third is intelligent and unrealistic and the fourth is a digital (or virtual) human avatar. This classification provides a basis for predicting the success or failure of digital avatars in business practice and will be used as a reference for this study. This characterization of digital avatars is very close to the different types of robots proposed by the uncanny valley theory.

In the early 1970s, robotics professor Mashario Mori hypothesized that humanoid robots may be disadvantaged. According to his theory, a robot's perceived familiarity is proportional to its human likeness. This continues until the robot is almost indistinguishable from a human in appearance and behavior, which causes the emotional response of humans to quickly diminish and become strongly negative through feelings of unease and creepiness. A phenomenon he called the uncanny valley (Mori, 1970; Mori, MacDorman & Kageki, 2012). Mori (1970) describes human perception of different developmental stages from robots to humans along a series of examples and assigns them to a level of affinity. This starts with an industrial robot, which humans are neither repelled nor attracted to, and continues to a toy robot, which humans consider appealing. When a robot attempts to imitate human behavior but falls short, it creates a sense of unease known as the uncanny feeling. This can occur when there is a noticeable discrepancy between the robot's behavior and that of a human. (Mori, 1970).

Comparing Moris' uncanny valley robots with digital avatars is possible because there are different levels of anthropomorphic avatars online: first, the virtual-anime influencer (VAI), where an animated character represents the digital avatar and does not try to emulate a human being; second, the virtual sims-like influencer (VHI) with a visual identity that is most

comparable to that of *The Sims*, a popular computer game from the 2000s; third, the virtual human-like influencer (VHI) where the goal is to be as close as possible to a human in appearance. Given that the digital avatars can have different anthropomorphic representations ranging from more simplistic to more human-like and that robots can elicit an uncanny feeling on humans, we suggest that can also occur in this case. Therefore, we posit that:

> ***H1**: Virtual avatar influencers have a lower sentiment score than human influencers from the same peer group on Instagram.*
>
> ***H2**: Virtual human-like influencers (VHI) have a lower sentiment score than Virtual Anime influencer (VAI) and virtual sims-like influencer (VSI).*

## METHODOLOGY

Due to the visual content and the rapidly growing number of human and virtual influencers (Casaló et al., 2021), Instagram was chosen as the focal social media platform for data collection. Since influencers became known primarily through Instagram and the attractive visual representation of virtual avatars is an important aspect of human-agent interaction (Khan and Sutcliffe, 2014), this platform is well suited to analyze users' reactions. In 2020, Instagram users posted more than 80 million pictures every day, contributing to the network's rapid growth (Pagan et al., 2021). Posts from influencers and a sample of all public comments on these posts (followers and non-followers) were collected. Because Instagram is a global social network, the languages in which users comment on content vary. Nevertheless, the language of the analysis will be English. Now that the platform has been determined, the subjects of the study must be defined. To test the hypotheses, we refer to Mori's uncanny valley theory and want to prove that the decrease in likeness is related to avatars' appearance. The scope ranges from the described toy robot to avatars that are as human-like as possible (Mori, 1970).

(1) For the first stage, comparable to Mori's toy robot, we refer to our character as an anime-like virtual influencer and give it the encoding VAI (virtual anime influencer). The proportions of this avatar should be intentionally different from those of a human body and face.
(2) The second stage of the human-like avatar already has human proportions and a humanoid appearance but is still clearly distinguishable from real humans. In addition, this character should have a rougher polygon mesh than the more developed avatar described in the third phase. The visual identity is most comparable to that of *The Sims*, a popular computer game from the 2000s. That's why we refer to this avatar as VSI (virtual sims-like influencer).
(3) The third and last stage before an actual human is only recognizable as artificial at a second glance and is coded by us as VHI (virtual human-like influencer). When selecting this avatar, it is essential that the skin already has human-like structures, such as moles or freckles. The goal is to come as close as possible to a human in appearance.
(4) The three categories of virtual avatars are compared with a human influencer from the same peer group. Therefore, the specifications for the selection of this human are a similar age, comparable content, and the same gender.

In addition to the external characteristics already described, the following requirements are added. Micro-influencers with less than 100,000 followers are excluded due to their low reach. We also want to exclude all influencers who are considered celebrities. Therefore, macro

influencers with more than 3 million followers were also excluded. In addition, the influencers should publish content several times a week on average, to which users respond not only with likes but also with comments.

VAI – To start with the virtual anime influencer, we wanted to make sure that people do not have any associations with the character, so it speaks for itself that all the well-known cartoon characters, such as those from Disney (e.g., Mini Mouse) and Mattel (Barbie) could not be considered. Nevertheless, the Influencer should be identified by the audience as distinctly non-human and yet be perceived more as developed anime and less as a two-dimensional cartoon character. That's why we have chosen *Noonoouri* (Instagram, 2023a).

VSI – The virtual sims influencer was the most difficult to define of all four influencers. Today, most virtual avatars are either graphically more advanced or too cartoony to fit into this category. In addition, there is the requirement for regular publication of posts and a sufficiently large number of followers. *Leyalovenature* (Instagram, 2023b) meets all our criteria, even if her content revolves around spiritual themes, among others.

VHI – With more than 3 million followers on Instagram, *Lil Miquela* was already part of a study examined by Arsenyan and Mirowska (2021). Her audience, stage of development, and English content make her particularly suitable for scientific research. According to VirtualHumans.org, only *Lu from Magalu*, a Brazilian virtual influencer, has a larger audience with 6 million followers. However, *Lu from Magalu* has a commercial focus, and her limited reach in Brazil makes the avatar unsuitable for this study. From the perspective of *Lil Miquela* as an average influencer focused on fashion, lifestyle, and music, she is best suited to be defined as our VHI. *Lil Miquela* (Instagram, 2023c) is an avatar created by *Brud*, an animation studio based in Los Angeles (Rasmussen, 2021).

HI – Various possibilities arise for the character of the human influencer. *Madison.Headrick* (Instagram, 2023d) resembles our avatars the best by the content of her posts, the size of her audience, and the number of comments she receives on her posts. Therefore, we define her as HI. Nevertheless, it should be mentioned here that there would have been many possibilities for the character of HI.

An overview of the four defined characters can be seen in Figure 1.

Figure 1. Images of the selected influencers



*Noonoouri as VAI* *Leya as VSI* *Lil Miquela as VHI* *Madison as HI*

Once the subjects of the study have been defined, the next step was to determine the study period for this data-mining project. The period under study begins on the 1st of January 2022 and lasts until the 30th of June the same year. During this time, all public posts, and a sample of comments (followers and non-followers) by the named influencers were collected and analyzed. The links to the postings were collected after the study period and the study subjects

were defined. This includes all interactions on a post: the number of likes, comments, views, and the time at which the post was published.

As shown in Table 1 below, the four influencers have between 300,000 and 3 million followers and published a total of 317 posts during the study period. These 317 posts were liked about 5.4 million times and commented on almost 50,000 times. As Table 1 shows, the largest share of comments and likes goes to *Lil Miquela*, as she has the largest audience. Statistically, however, this will make no difference, as all groups are large enough to produce significant results.

Table 1. The selected influencers and their interactions during the data collection period

| Source | Code | Followers | Posts | Comments | Likes |
|---|---|---|---|---|---|
| Noonoouri | VAI | 406.212 | 102 | 8.714 | 745.102 |
| Leyalovenature | VSI | 338.468 | 81 | 6.339 | 934.010 |
| Lil Miquela | VHI | 3.043.508 | 61 | 29.413 | 3.256.521 |
| Madison.Headrick | HI | 538.680 | 73 | 4.825 | 458.274 |
| Total | | 4.326.868 | 317 | 49.291 | 5.393.907 |

The commercial tool *Instagram Post Commenters Export* from Phantombuster.com was used to collect data. In a pretest, this tool proved to be very reliable and collected all the required data. This includes the username, the profile URL of the commenter, the comment itself, the time the comment was posted, the number of likes the comment has received from other users, and the query. We have limited the maximum number of comments to be downloaded per post to 300. To minimize spam in the data and increase the relevance of the content, we only collected comments that were uploaded up to seven days after the post was published. Through this process, we could data-mine a total of 24,089 comments. This corresponds to 48.89% of the total 49,291 user comments during the study period.

## RESULTS AND DISCUSSION

After cleaning the data, we proceed with sentiment analysis. Generally, the analysis of feelings and emotions is very diverse and can be performed using different methods. Nandwani and Verma (2021) describe three types of sentiment and emotion analysis methods: The first is lexicon-based, the second is based on machine learning and the third is based on deep learning. Each has its own advantages and drawbacks. Common to all methods is the goal of determining whether the writer has a negative, positive, or natural attitude toward the annotated content (Nandwani and Verma, 2021).

For this paper, MeaningCloud was used to perform a lexicon-based sentiment analysis (MeaningCloud, 2022). MeaningCloud is a software product that integrates with Python, PHP, and Microsoft Excel. MeaningCloud categorizes the comments into five levels. The sentiments can be either very positive (P+), positive (P), neutral (NEU), negative (N), or very negative (N+). Comments can additionally be classified as 'NONE' if the content does not represent a statement. As mentioned earlier, 24,098 of all 49,291 comments were extracted. As broken down in Table 2, 11,874 of these comments were considered valid and classified into the 5-level sentiment classification, representing 24.09% of the total comments.

Table 2. Overview of the extracted comments

| Code | N | Comments Analyzed | Valid Comments |
|---|---|---|---|

| | | N | % | N | % |
|---|---|---|---|---|---|
| VAI | 8,714 | 4,409 | 50.6 | 2,536 | 29.1 |
| VSI | 6,339 | 2,770 | 43.7 | 1,998 | 31.52 |
| VHI | 29,413 | 13,119 | 44.6 | 4,880 | 16.59 |
| HI | 4,825 | 3,800 | 78.76 | 2,460 | 50.98 |
| Total | 49,291 | 24,098 | 48.89 | 11,874 | 24.09 % |

With 2,460 comments, more than 50% of the total posted comments were evaluated for HI, while with 4,880 comments analyzed, just 16.59% of all comments were evaluated for VHI. The other two influencers had an almost identical percentage of comments evaluated, 29.1% for VAI and 31.52% for VSI. Table 3 shows the listing of users' interactions with each influencer, grouped by sentiment levels.

Table 3. Sentiment Analysis: Number of interactions per each Sentiment level

| | P+ | | P | | NEU | | N | | N+ | |
|---|---|---|---|---|---|---|---|---|---|---|
| Source | n | % | n | % | n | % | N | % | n | % |
| VAI | 318 | 12.54 | 2088 | 82.33 | 30 | 1.18 | 90 | 3.55 | 10 | 0.39 |
| VSI | 186 | 9.31 | 1735 | 86.84 | 17 | 0.85 | 53 | 2.65 | 7 | 0.35 |
| VHI | 433 | 8.87 | 3035 | 62.19 | 209 | 4.28 | 1024 | 20.98 | 179 | 3.67 |
| HI | 420 | 17.07 | 1974 | 80.24 | 38 | 1.54 | 26 | 1.06 | 2 | 0.08 |
| Total | 1357 | 11.95 | 8832 | 77.90 | 294 | 1.97 | 1193 | 7.06 | 198 | 1.12 |

Most of all comments evaluated were positive, with 77.9% receiving a ‘P’ and 11.95% receiving an even stronger ‘P+’. Only 1.79% of comments were rated Neutral (NEU), while 7.06% were rated negative (N) and 1.12% were rated very negative (N+). However, the data varies from influencer to influencer, as can be clearly seen. VHI achieves the lowest value with 62.19% positively rated comments, while VSI achieves the highest value with 86.84% in the same category. On the other hand, for comments rated as negative, VHI scores the highest at 20.98%, while HI receives the fewest comments rated ‘N’ in this case at 1.06%.

Table 4. Sentiment Analysis: Sentiment 5-level scale classification

| Sentiment | Abbreviation | Value |
|---|---|---|
| Very positive | P+ | 2 |
| Positive | P | 1 |
| Neutral | NEU | 0 |
| Negative | N | -1 |
| Very Negative | N+ | -2 |

Results show a decrease in ‘likeness’ as avatars’ appearance becomes more human-like. To further explore the initial hypothesis, we calculated each influencer's sentiment score. To do this, the classifications of each post were multiplied by the values in Table 4 and divided by the number of valid comments on the post. Through this process, a sentiment score was calculated for each of the 317 posts. To obtain the average sentiment score of the influencers for the study period, the values of the individual were summed up and divided by the number of posts.

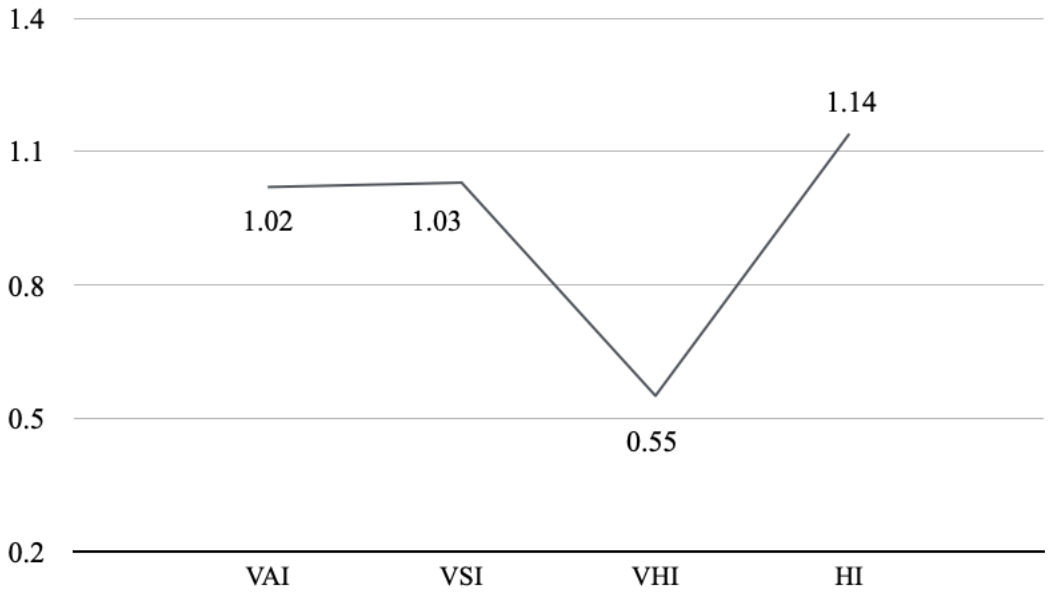
Table 5. Sentiment Analysis: Sentiment Score per Influencer

| Influencer | Nr. of Interactions | Sentiment Score |
|---|---|---|
| VAI | 2,536 | 1.02 |
| VSI | 1,998 | 1.03 |

| | | |
|---|---|---|
| VHI | 4,880 | 0.55 |
| HI | 2,460 | 1.14 |
| Total | 11,874 | 0.94 |

Recalling *H1*, which states that *Virtual avatar influencers have a lower sentiment score than human influencers from the same peer group on Instagram*, results show that VAI, VSI, and VHI, with an average sentiment value of 0.87 are below HI's score of 1.14. Therefore, we provisionally support hypothesis *H1*, but will investigate it further statistically in the fourth part of this paper. In addition, it can be observed that VHI has by far the lowest sentiment score among all three virtual influencers, which shows a decrease of 'likeness' of users towards the character. Since our second hypothesis assumed that *VHI has a lower sentiment score than VAI and VSI,* we can also confirm *H2*. With a value of 1.14, *HI* is the best rated influencer, while VAI and VSI have an almost identical sentiment score of 1.02 and 1.03. At this stage, however, we cannot say whether the differences between the study subjects are significant. An ANOVA and Post-Hoc test are conducted to support the hypotheses. Nevertheless, a first visualization of the sentiment score is already possible, with the Y-axis describing the affinity of the recipients to the avatar, as in Mori et al. (2012), and the X-axis mapping the development of the avatars.

Figure 2. Mean Plot of Sentiment Score




With the help of SPSS, One-way ANOVAs and Bonferroni Post-Hoc tests were conducted for the sentiment score and engagement of the four influencers. Table 7 and 9 show the ANOVA (which shows there is a significant difference between the groups) and the Post-Hoc test.

Table 5. ANOVA with Sentiment Score

| | Sum of Square | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Between Groups | 13.33 | 3 | 4.45 | 133.93 | 0.000 |
| Within Groups | 10.39 | 313 | 0.03 | | |
| Total | 23.72 | 316 | | | |

Table 6. Bonferroni Post-Hoc Test with Sentiment Score as Dependent Variable

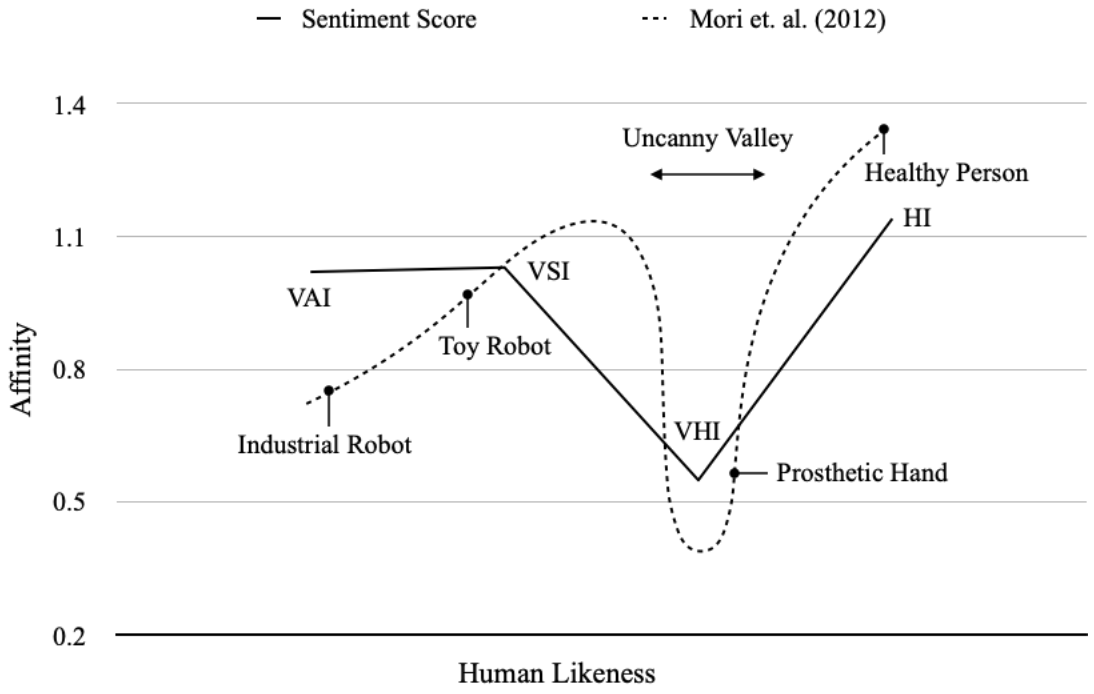
| | | | | | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| | | Mean Diff. | Std. Error | Sig. | Lower Bond | Upper Bond |
| VAI | VSI | -0.00972 | 0.02713 | 1.000 | -0.0181 | 0.0623 |
| | VHI | 0.46718* | 0.02951 | 0.000 | 0.3888 | 0.5455 |
| | HI | -0.12232* | 0.02795 | 0.000 | -0.1965 | -0.0481 |
| VSI | VAI | 0.00972 | 0.02713 | 1.000 | -0.0623 | 0.0818 |
| | VHI | 0.47690* | 0.03090 | 0.000 | 0.3949 | 0.5590 |
| | HI | -0.11260* | 0.02942 | 0.001 | -0.1907 | -0.0345 |
| VHI | VAI | -0.46718* | 0.02951 | 0.000 | -0.5455 | -0.3888 |
| | VSI | -0.47690* | 0.03090 | 0.000 | -0.5590 | -0.3949 |
| | HI | -0.58951* | 0.03162 | 0.000 | -0.6735 | -0.5055 |
| HI | VAI | 0.12232* | 0.02795 | 0.000 | 0.0481 | 0.1965 |
| | VSI | 0.11260* | 0.02942 | 0.001 | 0.0345 | 0.1907 |
| | VHI | 0.58951* | 0.03162 | 0.000 | 0.5055 | 0.6735 |

At 1.02 and 1.03, the average sentiment score of VAI and VSI are very close to each other. The Bonferroni test also shows no significant differences in this case, as would be expected. However, and more importantly, VHI and HI show significant differences. These two influencers are significantly different from all others in terms of the mean of the sentiment score. With the lowest average sentiment score during the study period, VHI also shows the highest average mean differences from the other influencers. All statistically significant values are marked with an asterisk in Table 8 to indicate which influencers have significant differences in sentiment score. As can also be seen in Table 8, the only two subjects between which a significant difference in sentiment score does not exist are VAI and VSI. With this result, we can statistically support H1.

In his first publication in 1970, Mori describes his theory as a relationship between the human resemblance of a being and the observer's affinity to that being (Mori, 1970). The curve illustrates that the affinity rises steeply at first and tips at the point where robots or avatars are only minimally distinguishable from a human in appearance and behavior, causing people's emotional response to quickly decrease and become strongly negative due to feelings of creepiness. This slight degree of imperfection causes humans to be skeptical.

Figure 4 shows an overlay of the current study results and Moris' uncanny valley curve (Mori, 1970; Mori, MacDorman, and Kageki, 2012). Since our character VAI is not an industrial robot compared to Mori's first subject of comparison but looks more like an anime and thus much more human, it is not surprising that the degree of affinity in our study is already higher. Furthermore, we can see that VAI and VSI are much closer in terms of external appearance than a machine and a toy robot. Therefore, it is not surprising that the slope in our graph is much lower than in Mori's visualization. Nevertheless, both graphs show a positive slope at this point, which allows us to confirm Moris's hypothesis up to this point.

Figure 4. Mean Plot of Sentiment Score and Mori's Graph of the Uncanny Valley (2012)




As the minimum of the curve, Mori defines an artificial prosthetic hand. According to his publication, this is because the hand looks real but is cold and technical. This discrepancy leads to the perception of the uncanny valley. In our case, the valley corresponds to VHI. Brud, the company behind *Lil Miquela*, tries to make the appearance human-like. However, internet users perceive a discrepancy here as well. In general, we can see that our sentiment score results are consistent with Mori's 1970 hypothesis and graph. The slopes of the curve are lower in our case, and our results swing less because the appearance of our study participants is closer together.

## CONCLUSIONS AND IMPLICATIONS FOR THEORY AND PRACTICE

### Theoretical contributions

The objective of this study was to further explore the uncanny valley theory in the context of advanced technological capabilities and social networks. In addition, this paper extends the current state of the literature on Mori's hypothesis (Thepsoonthorn, Ogawa, & Miyake, 2021; Arsenyan, & Mirowska, 2021) and goes a step further by examining avatars in social media. We recall that Mori (1970) describes a robot's perceived familiarity as directly proportional to its human likeness. This continues until the robot is barely distinguishable from a human in appearance and behavior, causing the emotional response of humans to quickly diminish and become strongly negative due to feelings of discomfort and creepiness (Mori, MacDorman, & Kageki, 2012). Although Mori's Uncanny Valley hypothesis dates to the 1970s, this study shows that humans still exhibit this described reaction to human-like avatars today.

### Managerial contributions

Now that we have shown the existence of the uncanny valley in the context of virtual avatars in social media, the question of how to prevent these figures from being perceived as uncanny by the audience must be addressed. The answer to this problem is not only relevant to academia but also offers great potential for brands, organizations, and companies that already use virtual avatars as testimonials, brand ambassadors, or advertisers on social media and want to improve their performance. (e.g., Travers, 2020; Griffiths, 2018). Looking at the different mean values

of the sentiment scores, avatars with less human-like appearance achieve a higher rating than the more human-like avatars. The solution to the problem is to dehumanize the avatars in their appearance and communication so that people respond to them more positively. Like in the case of VAI, it may be sufficient not to adhere to human proportions in developing the character. As a result, the avatar is perceived as childlike and cute due to its disproportionately large eyes and triggers people's affection rather than creepiness. Or, as in the case of VSI, sticking to the proportions but being sufficiently different from humans in the texture of the character's skin. This way, the avatar is clearly distinguishable from humans and does not give us the feeling of pretending something, leading to skepticism and mistrust.

## Limitations and future research

One of the biggest challenges in this work was the limited number of active virtual avatars on social media. In databases such as VirtualHumans.org, the number of virtual influencers has increased recently, but the selection is still limited. In addition, most virtual avatars are female, so a representative study of male or diverse avatars in terms of our hypotheses has not yet been possible. If the number of virtual avatars on social media continues to grow, it remains to be noted that a replication of this study based on a broader and more diverse selection of virtual influencers is recommended. In addition, we must assume that a younger target group primarily uses Instagram. According to Statista (2022b), 53.2% of all Instagram users in the United States were between 18 and 34 years old in June 2022, the last month of our data collection. The 45+ age group has a share of only 21.8%. Therefore, the results of this study cannot be automatically generalized to other demographic groups. In addition, Western social networks like Instagram are not freely accessible to citizens in countries like China and Russia. In addition, we can assume that technological progress will lead to CGI characters looking even more authentic and human-like in the future. Under this assumption, it remains relevant to investigate whether the hypotheses of this study continue to hold true or if humans consequently evaluate more advanced avatars than *Lil Miquela* identical to human influencers such as *Madison.Headrick*.

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