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Abstract

With the rapid growth of social virtual reality platforms, an increasing number of people will be interacting with others as avatars in virtual environments. Therefore, it is essential to develop a better understanding of the factors that could impact initial personality assessments and how they affect the willingness of people to befriend one another. Thin-slice judgment constitutes a quick judgment of a personality based on an avatar, and it could be impacted by the avatar's appearance, particularly if the avatar elicits an uncanny valley effect that brings negative emotions such as eeriness. However, personality judgments and friendship decisions could also be influenced by social cues, such as conversational style. This experimental study investigated how these factors impact willingness to make friends with others in a virtual world. Drawing upon the uncanny valley effect and thin-slice judgment, this study examined how different levels of realism and conversational cues influence trustworthiness, likeability, and the willingness to be a friend. Furthermore, the current study tried to shed light on the interaction effects of realism and conversational cues to the dependent variables. In other words, this study investigated how this eventually influences one's willingness to be a friend under the thin-slice judgment when personality judgments result from the negative feeling (i.e., eeriness) of the uncanny valley effect and social cues are conflicted. To this end, a 2 (realism: cartoonish vs. hyper-realistic) x 2 (conversational cues: extroverted vs. introverted) between-subjects online experiment was conducted. The results showed that trustworthiness and likeability significantly impacted the willingness to be a friend. Furthermore, realism and conversational cues marginally affected the willingness to be a friend.

Keywords: uncanny valley effect, thin-slice judgment, avatar, personality judgment, willingness to be a friend

Whom Do You Want to Be Friends With: An Extroverted or an Introverted Avatar?
Impacts of the Uncanny Valley Effect and Conversational Cues

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Introduction

The metaverse refers to the three-dimensional (3D) virtual world that can serve as an alternative realm for human sociocultural interactions (Dionisio et al., 2013). The metaverse is not a simple online game or virtual space but a space accepted as a real world that allows users to have active interactions (Ondrejka, 2004). This type of virtual environment encourages more active human-human or human-computer interactions in virtual reality through user-created avatars. One of the key features of the metaverse is that people can leverage user-created avatars to make friends, do business, enjoy entertainment, and communicate with others (Ondrejka, 2004). As a virtual character, an avatar allows users to naturally communicate and interact with other users or computers. The use of an avatar entails the same function as communicating with a real human being, which allows users to interact with each other more intuitively (González et al., 2007). In light of the foregoing, it has become important to understand how the characteristics of an avatar impact people's willingness to engage and make friends in a virtual space.

Efforts to interact with others through user-created avatars in virtual space have largely been attempted in the context of various computer-mediated communication. iPhone (e.g., emoji) and Samsung Galaxy (e.g., my emoji), the world's best-selling smartphones, have started to provide functions for a user-created avatar. Many computer games can also be made more fun by reproducing the user's own face and appearance in virtual space through 3D scanning technology (e.g., NBA and FIFA series). Furthermore, proving the importance of the virtual environment market, cutting-edge products have been launched for head-mounted devices (e.g., Oculus Quest 2 of Facebook, Vive of HTC, HoloLens 2 of Microsoft), and the number of platforms is gradually expanding (e.g., Meta Horizon Worlds of Meta (previous Facebook) and Ryan's World of Roblox).

As the use of avatars in CMC (i.e., Computer Mediated Communication) continues to increase, expressions of personality and making friends in virtual space have become crucial processes in building a healthy avatar community. However, although the personalities of avatars in virtual space have a significant effect on making friends, personality judgments may be complicated by the characteristics of the avatar, especially the extent of its human-likeness. Many previous studies have examined the effects of near-human-likeness (i.e., anthropomorphism or realism of avatars). Research on how much a robot or avatar is similar to a human has been conducted from various perspectives, such as voice, behavior, appearance, size, tone, and even mood.

One important finding concerns the impact of hyper-realism, or the nearly (but not quite) human characteristics of artificial constructs. Hyper-realism refers to the reproduction or representation of daily objects (e.g., items, places, or people) as realistically as possible with highly realistic graphic technics to the extent that they become indistinguishable from reality, such as photos (Coulter, 2010). The uncanny valley effect was introduced by Mori (1970) to explain people's reactions to robots (i.e., avatars) that look and act almost like humans (Mori et al., 2012). Specifically, Mori (1970) noted that as the human likeness of human-like artifacts (e.g., avatars) increases, a significant relationship between human-likeness and positive emotion increases (Burleigh et al., 2013). However, when the level of human-likeness gets close to a real human, the emotional response becomes strongly negative at a certain point (Schneider et al., 2007). According to the uncanny valley effect, positive emotional responses, such as perceived familiarity, are elevated along with the increase of human-likeness of avatars only up until the point where eeriness occurs. In other words, artifacts' (e.g., robots or avatars) realism might increase negative emotions (e.g., eeriness) when it approaches but fails to resemble real human appearance. The abrupt decrease in the perceived attractiveness of avatars is called the uncanny valley. For instance, people might

react more positively to cartoon avatars with higher familiarity than hyper-realistic ones with low familiarity, inducing spooky, creepy, or eerie feelings.

Making friends in a virtual environment is also premised on observations of the various characteristics of the other person, similar to real life. Humans tend to attribute various characteristics to people they observe (Ambady & Rosenthal, 1992). Personality traits are significantly ascribed to these observations, and they are used when people make quick decisions on how to manage social interactions with others (Funder & Dornbroth, 1987). Thin-slice judgment, the opposite concept of thick-slice judgment, means evaluating the other person with relatively little information within a short timeframe. In other words, this quick evaluation or assessment occurs when there is a minimal amount of information and a limited amount of time (Ambady et al., 2000). This leads to immediate, superficial, and sometimes inaccurate judgments rather than in-depth and long-term judgments about the other person. Accordingly, since personality judgments are also dependent on other essential factors, such as interpersonal communication through avatars, the perceived eeriness induced by the uncanny valley effect could lead to negative personality assessments. Therefore, the negative emotion triggered by the uncanny valley effect could result in negative personality judgments when it goes through a thin slice.

In initial social interactions, people rely heavily on others' speech or conversation in making personality judgments (Nass et al., 1993). Similar to real-life interactions, people's personality judgments of avatars could also be impacted by those avatars' statements or their speech in virtual interactions. Two of the important characteristics of personality are extraversion and introversion. Usually, traits of extroverted personality have a higher social response than introversion (Funder & Dornbroth, 1987). While introversion is frequently associated with a shy or isolated personality, extraversion is an outgoing personality trait reflecting an eagerness to interact with others (Walther et al., 2009). Extroverts are usually

more successful in initial encounters, given their outgoing personality traits (Funder & Dornth, 1987). Thus, extroverts have a higher social orientation than introverts (Van Der Heide et al., 2012). However, both the similarity attraction theory (Byrne, 1971) and the complementary attraction theory (Winch, 1955) suggest that preferences for personality types are individualistic. Therefore, introverted or extroverted personalities may be a matter of preference. One's preference for a personality type could be subjective, and it is difficult to claim that there are absolute standards or criteria for personality preferences.

Furthermore, other characteristics, such as the perceived trustworthiness of the other person, are important factors in befriending decisions. Greater trustworthiness increases likeability and people's willingness to become friends. This could also apply to avatars. However, the uncanny valley effect could impact the perceptions of these characteristics in avatars. In particular, it is possible that perceptions of personality traits could also be impacted by the eeriness elicited by the uncanny valley effect. Such negative emotions elicited by the uncanny valley effect could influence people's perceptions of extraversion and introversion cues. For example, prior research has found that people are less likely to select "morphed" images of humans as avatars (e.g., hyper-realistic avatars) and those realistic avatars with high familiarity are viewed as more credible (Joosse et al., 2013; Nowak et al., 2008).

Unfortunately, there is not much prior research on how these effects could impact friendship decisions in a virtual environment. Notably, the uncanny valley effect in a virtual environment could hinder the growth of a healthy avatar community and the process of making online friends by disturbing user interactions and social connections. When the uncanny valley effect and social cues (i.e., introverted or extraverted personality traits) operate at the same time, it is unclear what personality judgments are made and how much this affects the willingness to be a friend.

Therefore, the current study tries to examine how a) the hyper-realism of avatars impacts the perceived trustworthiness and likeability of those avatars and whether those characteristics will impact willingness to befriend an avatar, b) if the conversational cues indicating the extraverted or introverted personality traits of an avatar influence the perceived traits of avatars, and c) to what extent those conversational cues are impacted by realism or uncanny valley effects.

The present study proposes the following hypotheses and research questions. Based on prior research on the uncanny valley effect, this study predicts that (H1) hyper-realistic (e.g., morphed) human avatars will be viewed as less (a) trustworthy and (b) likable than cartoon-style avatars. This research also predicts that (H2) higher levels of perceived (a) trustworthiness and (b) likeability will increase the likelihood of the participants being willing to befriend an avatar. In addition, this study predicts that (H3) the participants will be less willing to befriend hyper-realistic avatars than cartoon-style avatars. Next, based on the similarity attraction theory (Byrne, 1969, 1971) and the complementary attraction theory (Winch, 1955), this study tries to shed light on how the willingness to make friends changes as the avatar's personality matches the participant's personality (i.e., level of extraversion) (RQ1). In addition, the current study attempts to explore the role that conversational cues play in the uncanny valley effect. To be more precise, this research examines whether there is a possibility that the uncanny valley effect could impact personality judgments concerning extraversion. To this end, the present study will attempt to determine if there are any interactions between the visual and conversational characteristics of the avatar and the dependent variables (RQ2).

Literature Review

Uncanny Valley Effect and Avatars

Mori (1970) advocated the uncanny valley effect to describe how people react to robots (i.e., avatars) that have human-like looks and actions (Mori et al., 2012). Particularly, Mori (1970) mentioned that as the human likeness of human-like artifacts (e.g., avatars) increases (Burleigh et al., 2013), human-likeness brings a significantly positive emotion (i.e., perceived familiarity). However, the emotional response turns into a strongly negative emotion at a particular point when the level of human-likeness closely reaches perfection (i.e., hyper-realism) (Schneider et al., 2007). The sharp decline in the perceived familiarity or attractiveness of avatars is called the uncanny valley. Extensive scholarly work has been conducted on the uncanny valley effect to describe the emotional reactions toward avatars in contexts such as digital animation (MacDorman et al., 2009), video games (Schneider et al., 2007; Grimshaw, 2009), home appliances (Walters et al., 2008), and social networking services (Shin et al., 2019a, 2019b).

In the uncanny valley, where perceived familiarity is at the lowest point, eeriness is a critical emotional response in the uncanny valley effect (Moore, 2012; Burleigh et al., 2013; Ho et al., 2008). This refers to a negative affective state (e.g., creepy, spooky, strange, and frightening) that might be evoked when avatars fail to be perceived as possessing real human attributes (Shin et al., 2019a, 2019b). Many previous studies (see Burleigh et al., 2013; MacDorman et al., 2009; MacDorman & Chattopadhyay, 2016) have found significant results indicating inconsistent realism from avatars' anthropomorphic features enhances eeriness. That is, even though realism is a desirable aspect of an avatar (McMahan, 2003), a greater level of realism can result in negative emotions at a certain point in the uncanny valley context (Burleigh et al., 2013).

Several studies have attempted to undertake various comparisons and analyses relating to the increase of human likeness and realism to find the uncanny valley effect that exists somewhere between humans and avatars. A series of studies have found uncanny

valley effects for images showing phased spectrum variations from robots to humans (e.g., MacDorman, 2016; MacDorman & Ishiguro, 2006; Ho et al., 2008). MacDorman et al. (2016) conducted a study about changing the level of details in each human model based on photorealism. Hamilton and Nowak (2009) presented a variety of avatar images and measured the perceived anthropomorphism, realism, how much the participants trusted and liked the images, and finally, how much they wanted to choose the avatars as their own.

In addition, we can find that the uncanny valley effect is also applicable to 3-D avatars. Shin and colleagues (2019a, 2019b) conducted a series of online experimental studies that the uncanny valley effect induced by different levels of realism affected the accuracy of personality judgment, trustworthiness, and friendship decision. They compared cartoonish and hyper-realistic avatars applying realism and human likeness with differences in fidelity and movement. In their research, firstly, the eeriness from the uncanny valley effect interferes with adequate information processing of personality judgment. Eventually, it led to lower accuracy of extraversion and agreeableness judgments. Secondly, different levels of realism between cartoonish avatars and hyper-realistic avatars influenced perceived trustworthiness and friendship decision.

The human-likeness is a central element in the uncanny valley. To put it more accurately, the realism resulting from the human-likeness of anthropomorphic entities is the crucial cause of the uncanny valley effect (Ho et al., 2008). Human-likeness refers to a subjective judgment of the degree of human-like appearance and behavior (Burleigh et al., 2013). As an indicator of judgment toward avatars, human-likeness is related to several concepts, such as familiarity and realism.

First, familiarity is one of the emotions that correlates with human likeness (Burleigh et al., 2013; MacDorman et al., 2009). From the perspective of cognitive psychology and

neurophysiology, familiarity is conceptualized as a lack of novelty (MacDorman & Ishiguro, 2006). That is, it is a matter of how familiar people feel about an avatar. Of course, there is a limitation in the sense that it is difficult to define negative familiarity. A question has also been raised as to whether the concept of familiarity is the most suitable opposite concept for strangeness or eeriness (Ho et al., 2008). Nevertheless, perceived familiarity increases with human-likeness (Mori, 1970; see Figure 1). The higher the human likeness, the more people feel familiar with the avatar. However, at some point, people perceive subtle imperfections that come from a sensation of strangeness (MacDorman & Ishiguro, 2006). In other words, the degree of perceived familiarity tends to drop because of the perceived imperfection of near-humanlike forms, thereby producing a sensation of eeriness (Burleigh et al., 2013).

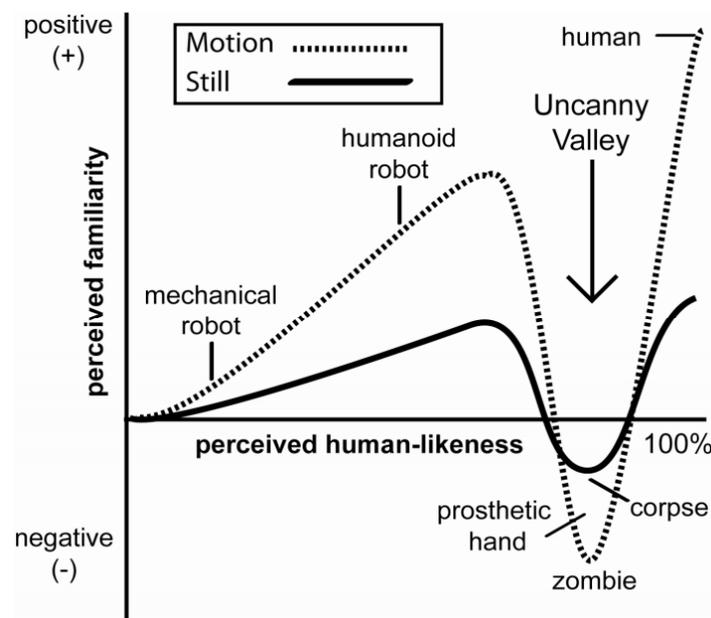
Second, realism refers to the plausibility of an anthropomorphic entity and its characteristics that seem to exist in reality; examples include movement and appearance, such as facial proportion, skin, and eyes (MacDorman & Chattopadhyay, 2016; Nowak et al., 2008). According to Nowak et al. (2008), anthropomorphism and realism not only look very similar but are significantly related to each other. However, anthropomorphism refers to the level of perceived human likeness, whereas the definition of realism is the plausibility that artifacts are likely to exist in the real world. Thus, perceived realism is affected by perceived anthropomorphism.

To elucidate, if we actively interact with an avatar with a high human likeness, the level of also realism increases (see MacDorman, 2006; MacDorman & Ishiguro, 2006; Shin, 2019a). However, in the area where the uncanny valley effect appears, increased human likeness with a high level of realism causes more serious eeriness through interactions with the motions of the avatar (i.e., unfamiliarity, see Figure 1). As the metaverse facilitates various movements and interactions through different levels of realism and human likeness for avatars, a problematic effect may emerge. Since different levels of perceived realism

affect information processing, such as personality judgments toward an avatar (Nowak et al., 2008), the various computer-mediated environments and user-created avatars provided by the metaverse may exacerbate the uncanny valley effect. Even though interactions accompanied by multiple motions and movements of avatars increase realism, under the uncanny valley effect, these can enhance the eeriness and, ultimately, interfere with making friends.

Figure 1

Mori's Illustration of the Uncanny Valley Effect (MacDorman, 2006)



Thin-Slice Judgment

Information processing, wherein we look at avatars and grasp their human-like features and judgment, can occur quickly. We call this thin-slice judgment, and it allows us to make swift and heuristic judgments in identifying the objects of communication and interaction. First impressions are highly crucial when it comes to human interactions and communications. It is human nature to observe others and then attribute various characteristics to the people observed (Ambady & Rosenthal, 1992). These observations effectively attribute personality traits and are used to form an important judgment of people's

daily lives when people make quick decisions on how to manage social interactions with others (Funder & Dorbroth, 1987). These quick decisions “with a minimal amount of information and a really short time limit” are considered relatively accurate in assessing the actual personality of that person (Ambady et al., 2000). An ample amount of evidence has proven that these types of judgments can accurately predict certain personality characteristics (e.g., Ambady & Weisbuch, 2010; Richeson & Shelton, 2005). Scholars have suggested that these judgments are impactful on initial relationship formation and could affect future behaviors (Borkenau et al., 2004).

Recent studies have extended the concept of initial personality trait observation and thin-slice judgment when people are not in a face-to-face communication environment, such as the CMC context (e.g., Back et al., 2008; Cornetto & Nowak, 2006). Instead of visual and audio cues from actual human beings when engaging in face-to-face communication, people base these thin-slice judgments on other computer-mediated cues, such as user profiles and writing styles (Ivcevic & Ambady, 2012). While fairly accurate, these thin-slice judgments are limited to secondary cues created by people behind the screens. Early studies on personality traits have established the importance of visible personality traits toward others (Watson et al., 2000) and underscored that trait relevance (Funder et al., 1995) has a stronger effect on people’s judgments. Therefore, these thin-slice judgments may not be considered as accurate as face-to-face interactions, but they are still impactful when assessing other people’s personalities.

On the other hand, avatars have the capability to increase visible traits, that is, they can be facilitated to make a more accurate personality judgment with richer information. These virtual representations of human beings provide direct visual cues to reflect the personality of the creators. Previous research has indicated that much of the information obtained in first encounters comes from physical appearance, gender, and ethnicity (Albright

et al., 1988). These exterior sources of information (Paunonen, 1991) comprise the fundamental constructs of an avatar. The specific cues of these avatars (e.g., eyes and facial expressions) could induce more accurate judgments of their personalities (Fong & Mar, 2015). By assessing these visible cues, people form a quick judgment of these avatars and, thus, relate these judgments to their creators.

Based on these features of thin-slice judgment, this study intends to focus on the situation of quick decision making under particular conditions such as minimal information and limited time rather than focusing on the accuracy of personality judgment. In other words, assuming that users of avatars meet various avatars in a virtual environment and deal with instantaneous communication and interactions, this study focuses on quick judgments with no prior acquaintance rather than the accuracy of those judgments.

Impressions and Personality Judgments

Facial first impressions have a close effect on personality judgment. Personality judgment through social inferences on facial appearance is a subject that has been studied for a long time (Oosterhof & Todorov, 2008) and found to be largely related (e.g., Back et al., 2008; Ivcovic & Ambady, 2012; Sutherland et al., 2015). From the perspective of evolutionary psychology, it has a mechanism of immediate and spontaneous face evaluation to avoid and reduce the threats and dangers surrounding oneself (Oosterhof & Todorov, 2008). Through lengthy discussions and research on conceptualization about how to assess, measure, and define the taxonomy of personality traits, a consensus in the personality psychology field regarding the big five personality traits has been reached. As an integrative function, the “big five personality judgments” contributed to organizing diverse personality traits and descriptions into a common framework (John & Srivastava, 1999). Although there are some differences among scholars and research, the big five personality judgment typically

consists of five dimensions: agreeableness, conscientiousness, extraversion, neuroticism (i.e., emotional stability), and openness (John & Srivastava, 1999; Sutherland et al., 2015). Specifically, many studies (e.g., Back et al., 2008; Ivcevic & Ambady, 2012; Sutherland et al., 2015) convincingly postulate that the accuracy of the big five personality judgment is acceptably high even though the results of each study are slightly different in the case of neuroticism. In particular, extraversion judgment is quite accurate (Sutherland et al., 2015). Through social inference, it can be confirmed that facial first impressions and personality judgments about facial cues and attributes are determined (Sutherland et al., 2015). One of the crucial factors determining sociability is how accessible and likable one is. According to Sutherland et al. (2015), personality judgments for agreeableness, extraversion, openness, and neuroticism are highly associated with approachability (e.g., trustworthiness or likeability) for facial first impressions. In addition, conscientiousness is significantly interrelated with approachability and dominance.

Likewise, in the context of CMC, big five personality judgments have been studied extensively, yielding significant results. Interestingly, three studies conducted experiments on personality judgment through profile pictures on Facebook, and they all confirmed that facial first impressions are associated with the big five personality judgments. First, Back et al. (2008) found that openness, conscientiousness, extraversion, and agreeableness accurately reflect facial first impressions, except for neuroticism. Next, in the study of Ivcevic and Ambady (2012) found that extraversion and conscientiousness were significant when people make personality judgments based on the Facebook Info pages. In addition, they found that the participants were highly dependent on Facebook profile pictures to make personality judgments. Lastly, Sutherland et al. (2015) found that facial first impression is highly related to openness, extraversion, emotional stability, and agreeableness. Accordingly, the big five personality judgment offers important implications for the study of trustworthiness or

likeability for artifacts with a high level of anthropomorphism, such as avatars in the context of CMC (e.g., Bartneck et al., 2009, Nowak et al., 2008; Shin et al., 2019b). On the basis of the discussions above, we can postulate that negative impressions (i.e., eeriness) induced by the uncanny valley effect could affect facial first impressions and ultimately lead to personality judgment.

Social Cues and Avatar Impressions

The CASA paradigm refers to Computers As Social Actors. In the Media Equation, Reeves and Nass (1996) argued that the media resemble real life. They said the media could have personalities called mediated personalities, that is, people can experience personalities via media (Nass & Moon, 2000). This point can be explained in more detail by applying it to computers, which constitute a type of media. Even though all computer users know that computers are not humans, they expect computers to have human-like personalities (Nass & Moon, 2000; Reeves & Nass, 1996). More precisely, if computers have human-like features (e.g., interactivity or voice), people tend to have a “mindless response to computers” (Langer, 1989; Nass & Moon, 2000, p. 83; Sundar, 2015). In other words, people unconsciously interact with computers as if they are communicating with humans. Accordingly, people treat computers as humans and then try to apply and expect social rules and behavior (Nass & Moon, 2000). What about people’s social reactions toward avatars? Likewise, we would expect human-like personalities from avatars, even in computer-mediated environments, because they have human-like characteristics.

According to Nass et al. (1993), one of the social cues characterized by human-likeness is “speech,” which can reveal personalities. In other words, interactions through speech can easily reveal one’s personality so people can get a social cue about the personality of the avatar (or the person behind the avatar). This can ultimately lead to social responses,

such as personality judgments. Therefore, in the context of making friends with other avatars online, the social cues that can make one guess the personality trait can be a significant clue to making personality judgments. In other words, the user makes a judgment about the personality trait through social cues that the avatar manifests, acting as a crucial factor in creating the personality impression.

Among the personality traits, extroverts and introverts have opposite characteristics. Introverts have a shy or isolated personality, whereas extroverts have an outgoing personality and are willing to interact with others (Walther et al., 2009). Thus, extroverted personality traits tend to have a higher social response than introversion (Funder & Dornow, 1987), and extroverts have a higher social orientation than introverts (B. Van Der Heide et al., 2012). Relatively speaking, higher extrovert traits are directly linked to social behavior (Funder & Dornow, 1987). In other words, an extrovert is more likely to interact with other persons than an introvert (Harkins et al., 1975). Moreover, since it is easy to distinguish the extroverted trait (Funder & Dornow, 1987), it may also seem more suitable for making friends.

Even in the context of the absence of facial expressions or body movement, studies have found that people still make these types of judgments based on still images and textual information on social media profiles. Several studies have been conducted on personality judgments toward zero acquaintances encountered on social media, especially on Facebook. They mainly adopted the big five personality judgment scale. Ivcevic and Ambady (2012) conducted a predictive validity of personality ratings on Facebook info pages and profiles and found that the personality ratings for info pages had a significant correlation with the profile pictures. Furthermore, Sutherland et al. (2015) investigated the relationship between facial first impressions and big five personality judgments using naturalistic face images on Facebook. Their results showed that personality judgments are significantly linked to facial first impressions, approachability, and dominance. Lastly, Van Der Heide et al. (2012)

conducted interesting experiments with cue-related social judgments toward extroverted or introverted personalities. They compared textual cues and photographic cues and found that if the two were combined as Facebook profiles at the same time, visual cues take primacy over text-based social information. Moreover, in this experiment, extraverted Facebook profiles lead to personality judgments of higher social orientation than introverted profiles.

Which of the two factors (i.e., negative information and positive information) has the primary influence on the process of making friends? According to the negativity effect, under the impression-formation process, people tend to rely more on negative information than positive information (Kellermann, 1984, 1989). Due to the informative nature of negative information, people tend to rely heavily on negative information to form impressions and consider that negative information can better describe a person's attributes. Observable cues related to introverted personality traits are considered negative information (Walther et al., 2009). Likewise, negative information from negatively valenced cues (i.e., introverted personality trait) can have a more significant impact on social judgment than positive information (i.e., extraverted personality trait) in the context of computer-mediated communication (Walther et al., 2009). This is because an extraverted personality trait is closely associated with positive judgments and higher social orientation than an introverted personality trait. As mentioned above, since interactions through speech or conversations elicit a social response, adjective expressions representing personalities can be exemplified, such as talkative and outgoing as extravert cues and quiet and shy as introverted cues.

However, the impressions (i.e., eeriness) induced by the uncanny valley effect under thin-slice judgments could affect personality judgments. In other words, the eeriness may conflict with the personality judgments invoked by the social cues (i.e., extraverted vs. introverted) of avatars. It is unclear what may occur when the uncanny valley effect and personality judgment toward social cues happen simultaneously. Although eeriness may have

a negative effect on personality judgment, personality judgments for extraversion and introversion personality traits as a social orientation judgment can come in conflict with eeriness. For example, extraverted conversational cues might ordinarily be viewed positively in initial encounters but could be viewed negatively if people are experiencing negative emotional responses elicited by uncanny valley effects. Moreover, suppose the willingness to be a friend to an extroverted avatar is high overall regardless of the different levels of realism of the avatar; such a case would indicate that expressing an active and sociable personality in a virtual environment is more conducive to making friends. In the end, rather than a matter of uncanny valley effect, an avatar's social cues can play a decisive role in making friends. In sum, it is difficult to predict what personality judgment is elicited by different social cues when eeriness occurs at the same time.

Willingness to be a Friend

Do you want to be friends with someone whose personality is similar to or different from yours? The personality of being introverted or extroverted could be a subjective preference and not a matter of good or bad. In other words, whether another person's personality is extraverted or introverted, it is a distinct point altogether that an individual might prefer one of those personality traits. Even though others have a high social orientation/behavior due to extraversion, it can be a different issue for one to accept and prefer an extroverted personality, which may lead to different results in making friends.

According to the similarity attraction theory (Byrne, 1969, 1971), people prefer robots with similar personalities to those opposed to their own. That is, extroverts prefer extroverted robots, while introverts prefer introverted robots. Bernier and Scassellati (2010) demonstrated that people felt more friendly to robots with similar personalities than those with different personalities. By contrast, the complementary attraction theory (Winch, 1955) asserts that

people prefer robots with opposite personalities to those with attributes similar to their own. In other words, extroverts prefer introverted robots, whereas introverts prefer extroverted robots. Isbister and Nass (2000) conducted an experiment with the participants divided into an introverted and an extroverted group. Despite the personality of the participants, they were found to prefer complementary personalities when interacting with computer characters with verbal/non-verbal cues. Likewise, Lee et al. (2006) found that people enjoyed interactions with social robots that were different from their personalities. These studies confirm the complementary attraction effect in the context of human-robot interactions.

In sum, in a thin-slice condition, where only limited information is allowed within a short period of time, two personality judgments can occur simultaneously. First, hyper-realism induced by the difference in avatar fidelity causes eeriness, which negatively affects personality judgments. On the other hand, the opposite social cues (i.e., extraversion and introversion) represented by avatars influence personality judgments. These two personality judgments from eeriness and personality cues may become conflicting, and it is unclear what final personality judgments they will make. Furthermore, depending on these conflicting personality judgments, the willingness to make friends may vary. For example, due to the negative effects of eeriness, people may be less willing to make friendships even though they judge avatars as extroverted. Besides, despite the effects of eeriness from the uncanny valley effect, they may have a high willingness to make friends because of their personality preferences. Therefore, the implications of this study explore how two conflicting personality judgments toward cartoonish and hyper-realistic avatars have an effect on making friends through avatars in a virtual environment.

Mediation Effect: Trustworthiness and Likeability

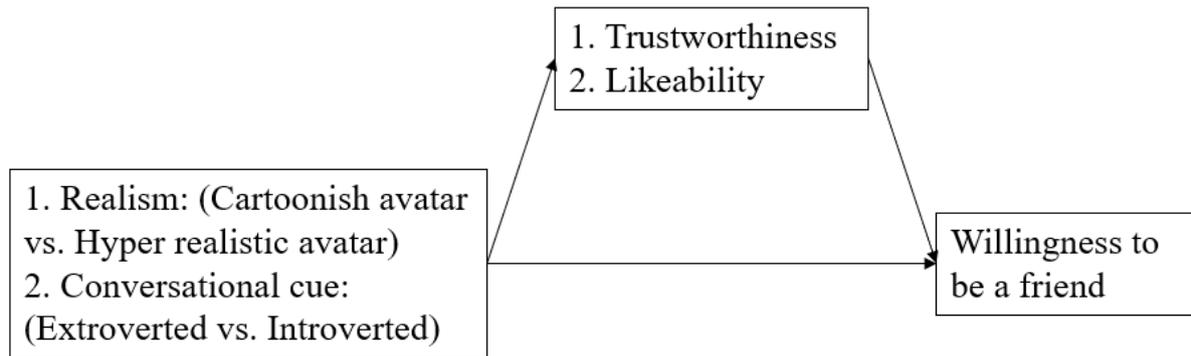
Since we can infer personality through facial appearance and its impression (Oosterhof & Todorov, 2008), it could be crucial how approachable and favorable zero acquaintances can act as an important factor in making friends. In the context of CMC, an avatar is considered a source and an object of communication. Thus, it starts with the question of how much we can trust an avatar (Joosse et al., 2013; Nowak et al., 2008). Moreover, since the realism of the avatar increases credibility (Hamilton & Nowak, 2009), befriending can be significantly related to credibility. Credibility is one of the essential factors that determine the approachability to a source of communication regarding personality traits. In the CMC context with an avatar, it refers to how reliable the other avatar can be. As a multidimensional construct, credibility includes trustworthiness and likeability (Nowak, 2004; Nowak et al., 2008). Research on avatars incorporating these variables has been conducted in various contexts (e.g., Bartneck et al., 2009; Nowak, 2004; Nowak et al., 2008; Shin et al., 2019b). Among the variables in the credibility category, trustworthiness and likeability are discussed here as mediators. As trustworthiness and likeability are closely related, an avatar's trustworthiness and likeability have been confirmed in many studies (see Ho & MacDorman, 2010; Joosse et al., 2013; Nowak, 2004; Nowak et al., 2008; Oosterhof & Todorov, 2008; Pickard et al., 2014; Schwind et al., 2015). To be more specific, when trustworthiness increases, likeability increases as well (Hamilton & Nowak, 2009; Nowak, 2004; Nowak et al., 2008). Besides, under the circumstances of zero acquaintance, befriending an avatar is influenced by trustworthiness (Shin et al., 2019b) and likeability (Cafaro et al., 2012; Nowak et al., 2008). In particular, the feeling of trust might increase as human likeness is enhanced. However, in near-perfect human likeness points (e.g., hyper-realistic avatar), people's trust in an avatar might decrease due to the activation of the uncanny valley effect (Burleigh et al., 2013; Shin et al., 2019b). Therefore, the current study postulates that trustworthiness and likeability influence willingness to be a friend and that

they play a mediating role between personality judgment and willingness to be a friend.

Based on the discussion above, Figure 2 shows the research design below.

Figure 2

Research Design



Hypotheses and Research Questions

This study proposes and will test the research questions and hypotheses below:

H1: Hyper-realistic avatars will be perceived as less (a) trustworthy and (b) likable than cartoonish avatars.

H2: Higher levels of perceived (a) trustworthiness and (b) likeability will increase the likelihood of the participants being willing to be friends with an avatar.

H3: The participants would be less willing to be friends with hyper-realistic avatars than cartoonish avatars.

RQ1: How does the personality match between the extraversion of participants and the avatars affect the dependent variables (i.e., trustworthiness, likeability, and willingness to be friends)?

RQ2: Do interaction effects occur between the realism (i.e., cartoonish avatar vs. hyper-realistic avatar) and conversational cues (extroverted vs. introverted) of the avatar toward the dependent variables? If so, how?

Method

Experimental Design

To examine the suggested research questions and hypotheses, a 2 (realism: cartoonish vs. hyper-realistic) x 2 (conversational cues: extroverted vs. introverted) between-subjects online experiment was conducted. After watching the avatar, the participants answered a questionnaire. The items in the questionnaire consisted of queries regarding eeriness, the Big Five Domain Scale, perceived trustworthiness, likeability, willingness to be friends, and demographics.

Participants

A total of 119 participants residing in the U.S. were recruited from Prolific (<https://prolific.co>), an online survey site. Data collection was conducted from July 18 to July 21 of 2022. Participants with an approval rate greater than or equal to 95% were recruited. Each participant was compensated \$3.75 for their participation in answering the online Qualtrics survey. The devices of the participants were controlled during the online experiment. To control the screen size, the participants were not allowed to use tablet computers or smartphones. Only participants using a desktop computer with a monitor were able to respond to this survey.

Experimental Stimuli

In the first stage, four avatars were created. Each cartoonish and hyper-realistic avatar was male or female. All of them were Caucasians. Actual pictures of male and female models

were used to make each cartoonish and hyper-realistic avatar. First, to make the cartoonish avatars, the Voilà AI Artist Cartoon Photo application (Wemagine.ai LLP, 2022) in App Store was facilitated. This application scanned each real picture of male and female models and made them caricatured as cartoonish avatars. Second, the hyper-realistic avatars were made through the computing software Crazy Talk 8 Pro (Reallusion Corp, 2021) developed by Reallusion Corp. To integrate a picture in a hyper-realistic avatar, frontal and lateral pictures of male and female models were inserted into the 3D scanning technology software. Since accompanying motions further increase eeriness (Mori, 1970; Shin, 2019a), casual and conversational motions with voices and texts expressing social cues were inserted in both the cartoonish and hyper-realistic avatars through the functions of “speech bubbles” and “vocal speech” in Crazy Talk 8 Pro. Specifically, the introverted personality avatars had speech bubbles and actual voices like “Hi, nice to meet you, I’m a shy and quiet person and I want to be your friend.” In contrast, the speech bubbles and actual voices of the extroverted personality avatars were “Hi, nice to meet you! I’m a talkative and outgoing person and I want to be your friend.”

Thus, the four avatars made above were combined with two social cues to produce eight avatars. To avoid compounds effect, particular facial expressions were excluded. In terms of animacy of the avatars, since positive facial responses or expressions (e.g., laughing and smiling) toward the other person can affect personality judgments, such as extraversion (Sutherland et al., 2015) or trustworthiness (Sutherland et al., 2013), neutral motions and gestures (e.g., blinking) were used.

A pilot test of the stimuli preceded the main test. Through the avatar creation process mentioned above, a total of 16 cartoonish and hyper-realistic avatars with two different levels of extraversion (i.e., introverted and extroverted personality) were created based on four different models (male = 2 and female = 2) (see Figure 3). And then, pilot tests were

conducted on them. The avatars based on one of the female models were used in this study as they received significantly higher ratings of eeriness and extraversion than the other avatars. Therefore, cartoonish and hyper-realistic versions of these avatars with two different conversational cues (four in total) were selected for use as stimuli in the online experiment (see Figure 4).

Figure 3

The sample of the avatars for the pilot test.

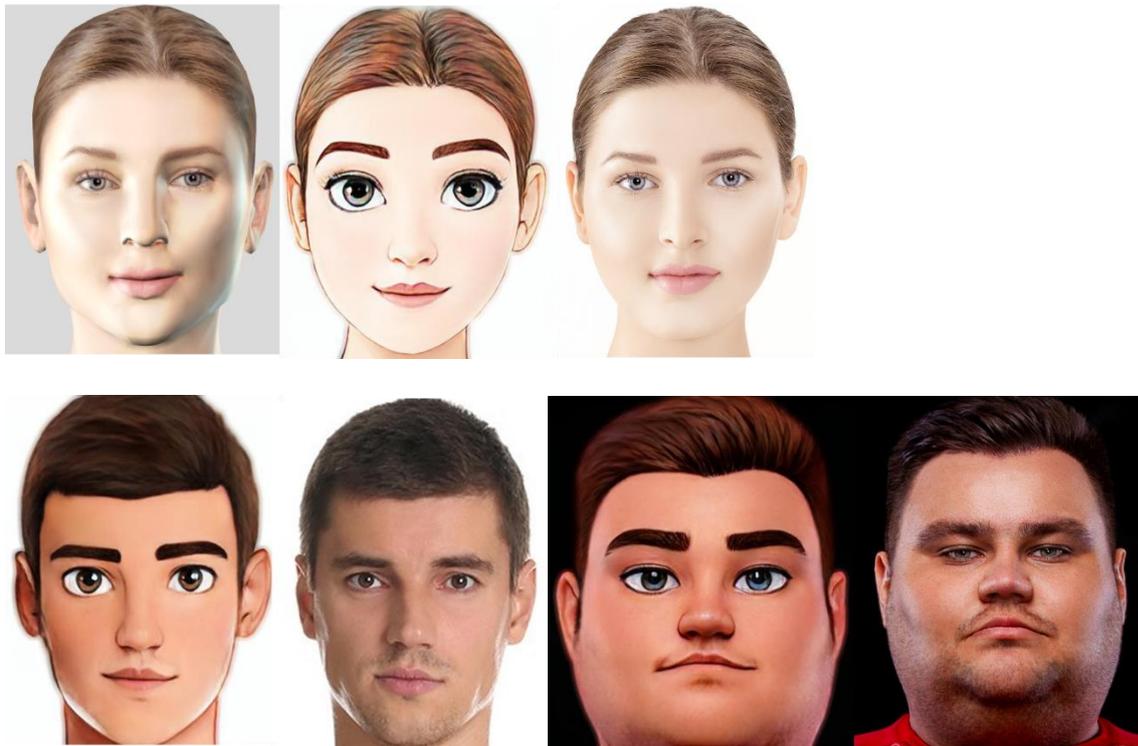
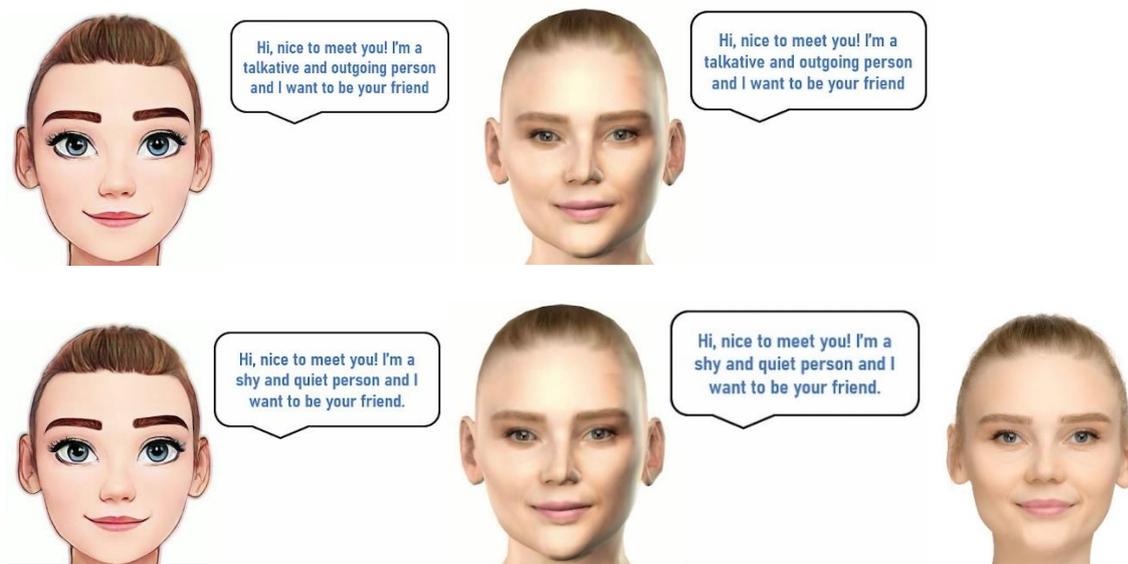


Figure 4

The final stimuli and the actual model's profile.



Note. The speech bubbles and actual voices were inserted for each avatar. The speech bubbles and actual voices of the introverted personality avatars = “Hi, nice to meet you, I’m a shy and quiet person and I want to be your friend.” The speech bubbles and actual voices of the extroverted personality avatars = “Hi, nice to meet you! I’m a talkative and outgoing person and I want to be your friend.”

Procedure

Since this study had a between-subject design, the participants were randomly assigned across conditions. To foster better understanding among the participants, a particular scenario was provided at the beginning of the survey. The scenario was as follows: “In the metaverse, you communicate and interact with other people through your avatar. The service provides a tool that enables you to create your avatars using their profile photos, or you can make your own avatar yourself. While browsing and hanging out there, a person using the following avatar suddenly sends you a friend request.” After reading the scenario, the participants were exposed to stimuli for 15 seconds and then asked to complete the online questionnaire.

Measures

Eeriness. To assess eeriness, the eight bipolar adjective items were adopted from Ho and MacDorman (2010) with a seven-point semantic differential scale. To examine the

validity of the constructs of eight eeriness scale items, Exploratory Factor Analysis (EFA) was conducted to extract potential factors. The sampling adequacy (KMO) was 0.773, indicating that this data is suitable for factor analysis. In addition, as a result of Bartlett's sphericity test, it can be said that factor analysis is possible overall because the correlation between the variables of the eeriness scale was recognized based on the significance level of 0.05 with $\chi^2 = 481.798$, $p < .001$. Accordingly, two sub-factors were extracted. Factor 1 was named the 'Uncanniness' scale (i.e., "Uninspiring: Spine-tingling," "Boring: Shocking," "Predictable: Thrilling," "Bland: Uncanny," and "Unemotional: Hair-raising."). Factor 2 was entitled the 'Freakiness' scale (i.e., "Reassuring: Eerie," "Numbing: Freaky," "Ordinary: Supernatural,") and respectively (see Table 1). The items were averaged ($\alpha = .807$) for each factor.

Table 1

The results of factor analysis for eeriness.

	Factor Loading	
	1	2
Boring: Shocking	.883	.026
Bland: Uncanny	.866	.156
Predictable: Thrilling	.838	.130
Uninspiring: Spine-tingling	.816	.124
Unemotional: Hair-raising	.750	-.028
Reassuring: Eerie	-.160	.897
Numbing: Freaky	.105	.809
Ordinary: Supernatural	.360	.680

Note. $N = 119$. Varimax with Kaiser Normalization rotation was conducted for the extraction. The values of factor loadings above .60 are in bold. Adapted from "Human emotion and the uncanny valley: a GLM, MDS, and Isomap analysis of robot video ratings," by C. C. Ho, K.

F. MacDorman, and Z. D. Pramono, 2008, March, 2008 3rd ACM/IEEE International Conference on Human-Robot Interaction (HRI), p. 169-176.

For *personality judgments*, previous researchers have largely adopted the Big Five Domain Scale (John & Srivastava, 1999) in the context of thin-slicing (e.g., Borkeau et al., 2004). Personality judgments of the avatar were measured using five sub-dimensions: (a) seven items of extraversion, (b) nine items of agreeableness, (c) nine items of conscientiousness, (d) eight items of neuroticism, (f) nine items of openness. In accordance with the hypotheses and research questions, since the stimuli were manipulated by the level of extraversion (i.e., conversational cues of avatar), the current study adopted seven items of extraversion ($\alpha = .965$). Likewise, participants were asked to answer their personality traits for extraversion ($\alpha = .910$). The items were averaged.

Perceived trustworthiness was measured by five seven-point Likert items adopted from McAllister (1995): “I can freely share my ideas, feelings, and hopes with the person behind the avatar,” “I can talk freely to the person behind the avatar about the difficulties I am experiencing at work and know that the person behind the avatar will want to listen,” “I would feel a sense of loss if one of us stopped using the SNS and we could no longer be together,” “If I shared my problems with the person behind the avatar, I know the person would respond constructively and caringly,” and “I will make considerable emotional investments in our working relationship.” An averaged score ($\alpha = .908$) was used for a single perceived trustworthiness variable.

Likeability. To evaluate a degree of likeability, participants were asked to indicate five bipolar adjectives with a seven-point semantic scale item from Bartneck et al. (2009): “Dislike: Like,” “Unfriendly: Friendly,” “Unkind: Kind,” “Unpleasant: Pleasant,” and “Awful: Nice.” The seven items were averaged for analysis ($\alpha = .940$).

Willingness to be a friend was measured by a seven-point Likert scale, wherein statements such as “I would like to be friends with this avatar” and “I will accept the friend request sent from the avatar user” were rated from 1 (*very unlikely*) to 7 (*very likely*). The two items for the willingness to befriend were averaged ($\alpha = .927$).

The *control variables* were gender, age, race, education level, and degree of previous experience with 3-D graphic avatars (i.e., “How much are you familiar with computer-generated 3D graphic avatars?”) and social networking sites with an avatar (i.e., “How much are you familiar with social networking sites with avatars?”) from 1 (*very unfamiliar*) to 7 (*very familiar*).

Manipulation Check

Before conducting the main analysis, manipulation checks were conducted on two variables: 1) realism (i.e., cartoonish avatar and hyper-realistic avatar) and 2) conversational cues (introverted trait and extroverted personality trait). The level of eeriness between the cartoonish avatars and the hyper-realistic avatars was manipulated. Accordingly, it was examined whether the difference in eeriness given by the two kinds of avatars was significant. Second, the conversational cues (i.e., introverted cues and extroverted cues), in which avatars reveal their personality traits, were examined to determine whether differences in participants' personality judgments for extraversion of the avatars were significant.

As to whether the level of eeriness for hyper-realistic avatars would be higher than that of cartoonish avatars, an independent samples t-test was conducted for the two sub-factors of Eeriness (i.e., Uncanniness and Freakiness). The results showed that the differences in ratings of both Uncanniness ($t = -3.47, p = .001$) and Freakiness ($t = -2.00, p = .048$) were significant between the cartoonish avatar and hyper-realistic avatar. Specifically, the mean values of Uncanniness for the hyper-realistic avatar ($M = 3.75, SD = 1.02$) was higher than

that of cartoonish avatar ($M = 3.04$, $SD = 1.21$). Likewise, the hyper-realistic avatar ($M = 4.11$, $SD = 1.28$) showed a higher level of Freakiness than the cartoonish avatar ($M = 3.69$, $SD = 1.00$) (see table 2).

Table 2

The results of the independent samples t-test for the eeriness

Variables	Cartoonish		Hyper-realistic		<i>df</i>	<i>t</i>	<i>p</i>	Cohen's <i>d</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>				
<i>Eeriness</i>								
Uncanniness	3.04	1.21	3.75	1.02	117	-3.47	.001	.63
Freakiness	3.69	1.00	4.11	1.28	117	-2.00	.048	.37

Note. $N = 119$.

Regarding whether participants rated avatars with extraverted conversational cues as more extroverted than avatars with introverted conversational cues, an independent samples t-test was conducted for conversational cues on the personality judgment of extraversion toward the avatars. The result was statistically significant ($t = -14.96$, $p = 0.000$). The mean value of the extroverted avatars ($M = 5.64$, $SD = .86$) for extraversion evaluation was higher than that of the introverted avatars ($M = 2.75$, $SD = 1.21$) (see Table 3). In other words, the participants rated avatars with extroverted conversational cues as more extroverted than avatars with introverted conversational cues.

Table 3

The results of the t-test for the extraversion judgment to the avatars

Variable	Introverted	Extroverted
	Avatar	Avatar

	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>df</i>	<i>t</i>	<i>p</i>	Cohen's <i>d</i>
Extraversion judgment	2.75	1.21	5.64	.86	117	-14.96	.000	2.75

Note. *N* = 119. Introverted avatar = 60, Extroverted avatar = 59.

Additionally, potential gender effects between the avatars and participants for extraversion judgment were conducted to determine if there was a significant difference in extraversion judgments to avatars by participant's gender. An independent samples t-test analysis of gender differences in extraversion judgments to avatars showed no significant differences across conditions (Male = 49, Female = 70, $t = 1.278$, $p = 0.204$) (see Table 4).

Table 4

The results of the t-test for the extraversion judgment to the avatars by gender

Variable	Male		Female		<i>df</i>	<i>t</i>	<i>p</i>	Cohen's <i>d</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>				
Extraversion judgment	4.43	1.59	4.01	1.90	117	1.28	.204	0.24

Note. *N* = 119. Male = 49, Female = 70.

Data Analysis

Multiple regression was conducted with covariates to test H1, H2, and H3. The covariates, gender, age, education level, and previous experience of 3-D graphic avatars and social networking sites with avatars were controlled. To be specific, the PROCESS Macro Model 4 in SPSS software (Hayes, 2015) was facilitated to examine the mediation effects (i.e., trustworthiness and likeability). The analyses were conducted with 5000 bootstrap samples at the 95% bias-corrected confidence level (Preacher & Hayes, 2008). For H4, an

independent samples t-test was conducted to assess differences in responses to conversational cues and the extraversion evaluations of the avatars.

For the testing of R1, this study examined how the personality matches between the extraversion judgment of the participant and avatars influence the dependent variables such as trustworthiness, likeability, and willingness to be a friend. To do this, firstly, absolute values were created by subtracting the values evaluated for the extraversion of the avatar from participants' self-evaluation for extraversion. That is, if the absolute value is 0, the participant and avatar have the same level of extraversion personality trait. Meanwhile, if the absolute value is 6, they have a disparate extraversion personality. Then, these values were analyzed through a simple linear regression analysis that looked at the relationship with the dependent variables.

To test RQ 2, a two-way analysis of covariance (ANCOVA) was conducted with a bias-corrected 5000 bootstrap sampling and covariates (i.e., gender, age, race, education level, degree of previous experience with 3-D technology and social networking sites with an avatar) and. Table 5 depicts the results of the means, standard deviations, and bivariate correlation coefficients for the key variables and covariates with 5000 bootstrap samples at the 95% bias-corrected confidence level (Preacher & Hayes, 2008).

Table 5*Means, Standard Deviations, and correlation coefficients for key variables.*

	<i>M</i>	<i>SD</i>	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Age	37.83	14.86	-								
2. Gender	1.59	.49	.11	-							
3. Race (White)	74.8%	-	-.18	.09	-						
4. Education (College)	47.1%	-	.09	.29	-.08	-					
5. 3-D avatar	4.38	1.75	-.02	-.16	-.02	.13	-				
5. SNS with avatar	4.21	1.97	-.07	-.13	-.02	.11	.72**	-			
6. Trustworthiness	3.14	1.38	.12	-.13	-.08	.26**	.09	.16	-		
7. Likeability	4.76	1.35	.17	-.01	-.09	-.02	.09	.09	.58**	-	
8. Willingness to befriend	3.38	1.85	.16	.12	-.12	.07	.08	.04	.56**	.54**	-

Note. $N = 119$. * $p < .05$. ** $p < .01$. Gender: Male = 1, Female = 2.

Results

Descriptive statistics

A total of 119 participants (49 male, 70 female) who ranged in age from 18 to 75 years ($M = 37.83$, $SD = 14.86$) were recruited. 74.8% ($N = 89$) of them were identified as White. 47.1% ($N = 56$) of them had a college degree. The participants were evenly assigned for the conditions (i.e., the cartoonish avatar = 59, the hyper-realistic avatar = 60, and the

introverted cues = 60, extroverted cues = 59). Table 6 illustrates the results of demographical information for each condition as percentages.

Table 6

Demographical Characteristics for Condition.

Characteristics	Total	Cartoonish		Hyper-realistic	
	Averaged (%), N=119	Introverted (%), N=30	Extroverted (%), N=29	Introverted (%), N=30	Extroverted (%), N=30
<i>Gender</i>					
Male	41.2	33.3	44.8	43.3	43.3
Female	58.8	66.7	55.2	56.7	56.7
<i>Age</i>					
18-29	40.3	46.7	48.3	40	26.7
30-39	22.7	20	55.2	33.3	16.6
40-49	11.8	13.3	10.3	6.7	16.7
50-59	14.3	16.7	3.5	10	26.7
60-69	9.2	3.3	17.2	3.3	13.3
70-79	1.7	0	0	6.7	0
<i>Race</i>					
White	74.8	70	82.8	86.7	60
Black or African	10.1	0	10.3	3.3	26.7
American	1.7	0	0	6.7	0
American					
Indian	7.6	16.7	3.4	0	10

/ Alaska Native	3.4	6.7	3.4	0	3.3
Asian	2.5	6.7	0	3.3	0
Multiracial					
Other					
<i>Education</i>					
High school	30.3	30	34.5	30	26.7
College degree	47.1	60	44.8	43.3	40
Graduate degree	15.8	10	17.2	26.7	13.3
Other	5.9	0	3.4	0	20

Note. $N = 119$.

To test H1, H 2, and H3, Model 4 of PROCESS Macro in SPSS software (Hayes, 2015) was conducted with covariates. In detail, through this process, the researcher examined both the effect of realism on willingness to be friends (H3) and the mediation effects on trustworthiness and likeability (H1 and H2). This analysis was conducted with 5000 bootstrap samples at the 95% bias-corrected confidence level (Preacher & Hayes, 2008). Table 7 shows how realism affected trustworthiness, likeability, and willingness to be a friend.

Firstly, there were no significant differences between the cartoonish avatars and the hyper-realistic avatars in ratings of trustworthiness ($B = 0.27, t = 1.48, p = 0.1408$) and likeability ($B = -0.08, t = -0.44, p = 0.6619$). That is, the hyper-realistic avatars were perceived as similarly trustworthy and likable as the cartoonish avatars. Thus, H1 (a/b) was not supported.

Next, after analyzing the impact of trustworthiness and likeability on the degree of the willingness to be a friend, it was found that both trustworthiness ($B = 0.41, t = 4.21, p < .01$) and likeability ($B = 0.30, t = 3.20, p < .01$) had significant effects on the level of the

willingness to be a friend. Specifically, since both trustworthiness and likeability have a positive relationship with the willingness to be a friend, higher levels of perceived trustworthiness and likeability increase the likelihood of a higher willingness to be a friend. Hence, H2 (a/b) was supported.

The present study investigated how eeriness, which occurred through the uncanny valley effect, eventually influenced the willingness to make friends. As a result of testing the effect of realism on willingness to be a friend, the different levels of realism between the cartoonish avatars and the hyper-realistic avatars showed no significant difference in the willingness to be a friend ($B = 0.16, t = 1.05, p = 0.2951$). The results indicated that the hyper-realistic avatars were not significantly higher in the degree of willingness to make friends than the cartoonish avatars. Accordingly, H3 was not supported.

Table 7

The results of Hypotheses 1, 2, and 3

Hypothesis / Variable	<i>B</i>	<i>SE</i>	<i>t</i>	<i>p</i>	95% CI	<i>R</i> ²	<i>F</i>
<i>H1</i>							
RL → TW	0.27	0.25	1.48	0.1408	[-0.1248, 0.8675]	0.13	2.34*
RL → Like	-0.08	0.26	-0.44	0.6619	[-0.621, 0.396]	0.05	0.82
<i>H2</i>							
TW → WB	0.41	0.13	4.21**	0.0001	[0.291, 0.8079]	0.44	9.44**
Like → WB	0.30	0.13	3.20**	0.0018	[0.1544, 0.6588]	0.44	9.44**
<i>H3</i>							
RL → WB	0.16	0.28	1.05	0.2951	[-0.2594, 0.8463]	0.44	9.44**

Note. CI = confidence interval; RL = Realism; TW = Trustworthiness; LB = Likeability; WB = Willingness to befriend. * $p < .05$. ** $p < .01$

To examine RQ1, a simple linear regression analysis was conducted with the absolute values created by subtracting the values of the avatar's extraversion from the participants' one. Table 8 shows that personality matches between the avatars and participants had no significant relationships with trustworthiness ($p = .14$), likeability ($p = .78$), and willingness

to be a friend ($p = .17$). However, personality mismatches had negative relations with trustworthiness ($\beta = -.14$) and willingness to be a friend ($\beta = -.13$), but slightly positive relationships with likeability ($\beta = .03$). Thus, the greater the differences between personality characteristics of participants and those of the avatars, the less likely they perceive them as trustworthy or to want to be their friend.

Table 8

The results of simple linear regression for the key variables

Dependent variables	<i>B</i>	<i>SE</i>	β	<i>t</i>	<i>p</i>
Trustworthiness	-.13	.09	-.14	-1.48	.14
Likeability	.03	.09	.03	.28	.78
Willingness to befriend	-.17	.12	-.13	-1.37	.17

Note. $N = 119$.

With respect to RQ2, the present research tested whether and how any interaction effects occur between the realism (i.e., cartoonish avatar vs. hyper-realistic avatar) and conversational cues (extroverted vs. introverted) of the avatar toward the dependent variables with covariates. The results of ANCOVA indicated that the interaction effect between realism and conversational cues for the perceived trustworthiness ($F = 0.38, p = 0.85$) and likeability ($F = 0.33, p = 0.57$) were not significant. However, willingness to be a friend was marginally significant ($F = 3.20, p = 0.074$) (see Table 9). With regard to the level of willingness to befriend, the remarkable point is that the introverted cartoonish avatar ($M = 3.38, SD = 1.99$) was rated higher than the extroverted cartoonish avatar ($M = 2.83, SD = 1.96$). In contrast, the extroverted hyper-realistic avatar ($M = 3.90, SD = 1.75$) was rated higher than the introverted hyper-realistic avatar ($M = 3.37, SD = 1.62$) for the degree of the willingness to be a friend

(see Figure 5). Therefore, the interaction effect between the realism and conversational cues of the avatar was marginally significant in the willingness to be a friend.

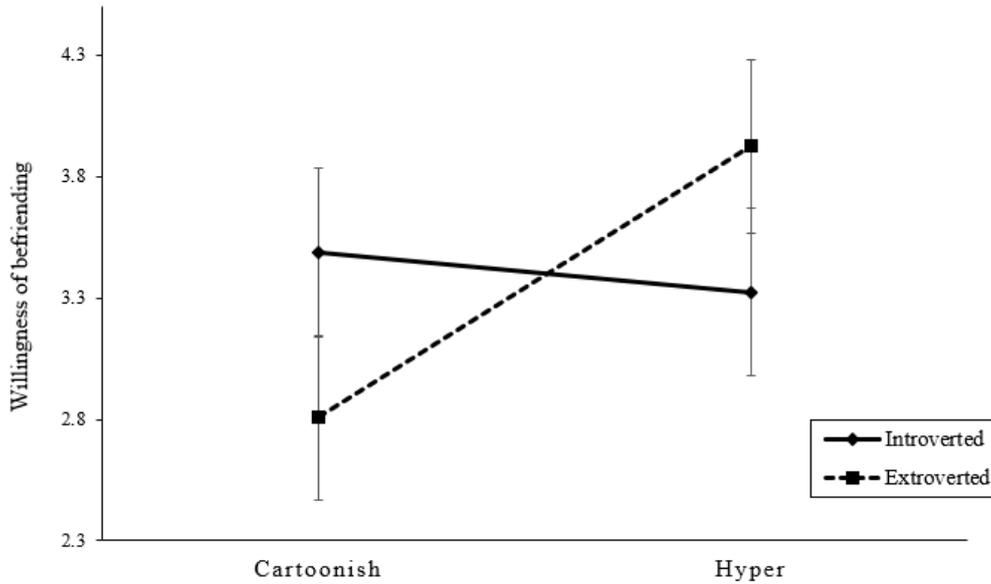
Table 9

The results of ANCOVA of realism and conversational cues for willingness to befriend

	<i>F</i>	<i>df</i>	η_p^2	<i>p</i>
Corrected Model	1.37	9	.10	.21
Intercept	3.42	1	.03	.07
Age	.95	1	.01	.33
Gender	2.16	1	.02	.15
Race	1.93	1	.02	.17
Education	.08	1	.00	.78
3-D avatar	.97	1	.01	.33
SNS with avatar	.06	1	.00	.81
Realism	1.74	1	.02	.19
Conversational cues	.10	1	.00	.75
Realism * Conversational cues	3.24	1	.03	.07

Note. *N* = 119.

Figure 5



Discussion

General Discussion

With the development of social networking services and 3D scanning technology, it has become easier to create an avatar based on one's appearance, and these are being used on various online social networking platforms. These are not simply used in games but are used in various social networking services such as the metaverse and help to form a community using avatars there. Based on this social phenomenon, this study investigated several factors that could affect online friendships and avatars.

The purpose of the current online experimental study was to investigate whether and how the uncanny valley effect and conversational cues of cartoonish avatars and hyper-realistic avatars affect the dependent variables. Specifically, by manipulating different degrees of eeriness (i.e., realism) and personality traits (i.e., conversational cues) of avatars, we learned how these factors affect trustworthiness, likeability, and the willingness to be friends.

In addition, the current study tried to shed light on how personality matches in extraversion between participants and avatars affect the dependent variables. Furthermore, this research examined whether and how the interaction effect of (i.e., realism and conversational cues) impacts the dependent variables (i.e., trustworthiness, likeability, and the willingness to be friends)

This research also found that trustworthiness and likeability influenced willingness to be a friend. These results were in accordance with the previous research. Notably, this study also confirmed that high trustworthiness leads to a high degree of willingness to be a friend (Shin et al., 2019b), and it is also noteworthy in this study that likeability has a significant effect on willingness to be a friend. The results of this study support the results of previous studies that a positive first impression acquired within a short time (i.e., thin-slice judgment) can shape positive evaluations of trustworthiness as major variables in making personality judgments (Nowak, 2004; Nowak & Hamilton, 2008; Nowak & Rauh, 2005).

Furthermore, a notable point of this study is that it does not simply identify trustworthiness, likeability, and the willingness to be a friend through the difference in realism of the avatars but also examines how these factors are influenced by social cues of the personality behind the avatars (i.e., the personality of the avatar user). In other words, it was intended to explore the evaluation and perception toward the avatar users by providing social cues about their introverted and extroverted personality traits.

The present research also demonstrated that the interaction effect of different degrees of realism and conversational cues on willingness to be a friend was marginally significant. That is, the level of willingness to be friends of the introverted cartoonish avatar ($M = 3.38$, $SD = 1.99$) was higher than that of the extroverted cartoonish avatar ($M = 2.83$, $SD = 1.96$). On the other hand, the degree of willingness to be friends of the extroverted hyper-realistic

avatar ($M = 3.93$, $SD = 1.75$) was higher than that of the introverted hyper-realistic avatar ($M = 3.37$, $SD = 1.62$). The degree of realism did not have any measurable impact on avatars with introverted characteristics. Most of the variance was explained by differences in the realism of extroverted avatars such that hyper-realistic avatars were viewed more positively than cartoonish avatars.

Theoretical Implications & Empirical Insight

Several studies have been conducted to avoid or overcome uncanny valley effect responses to avatars or embodied creatures. Specifically, recent studies examined how the uncanny valley effect has relations to a robot's appearance, personality, and behavior (Walters et al., 2008) and the emotional facial expression of virtual characters (Tinwell et al., 2011). In addition, we can find that the uncanny valley effect is also applicable to 3-D avatars. Shin et al. (2019a, 2019b) conducted an experimental study comparing cartoonish and hyper-realistic avatars applying realism and human likeness with differences in fidelity and movement. Firstly, they found that the uncanny valley effect caused by different levels of realism influenced the accuracy of extraversion and agreeableness judgments (Shin et al., 2019a). Secondly, two different levels of realism and animacy between cartoonish avatars and hyper-realistic avatars affected the degree of perceived trustworthiness and friendship decision. However, limited research has examined the effects of different levels of realism and personality characteristics of avatars simultaneously.

Thus, the results from RQ2 suggest that this study can be a clue to overcoming the uncanny valley effects in the context of befriending in virtual reality environments. When encountering new avatars of people with whom you have no prior acquaintance in a virtual environment, one way to avoid or overcome the uncanny valley effect could be to provide conversational cues that reveal one's extroverted personality traits. As Nass and Reeves

(1996) mentioned, the mediated personality can be revealed through 'speech' and it can be a basis for activating interaction and further overcoming the uncanny valley effect even if people use hyper-realistic avatars. This can contribute to overcoming negative emotions such as uncanniness and freakiness accompanying the uncanny valley effect and to promoting befriending and healthy virtual community on social networking services with avatars such as metaverse.

On the other hand, the results of RQ2 also indicated that when making friends on social networking services with avatars, realism played less of a role in determining friendship decisions when introversion cues were provided. The results showed that a cartoonish avatar with an extroverted personality might not be as helpful in expanding friendships. On the contrary, the willingness to be a friend with an introverted personality was relatively high in the case of the cartoonish avatar.

Considering the results of RQ2, this study can disprove the previous studies. The study suggests that although extraversion and introversion cues do seem to impact friendship decisions, these factors may operate differently when people are making these assessments of other' avatars in virtual social environments. As mentioned above, in many previous studies, a social judgment of extroverted personality traits induces more social interaction with others (Harkins et al., 1975) and a higher social response (Funder & Dobroth, 1987), orientation (B. Van Der Heide et al., 2012). However, in the current study, disparate results from the previous research on social cues of cartoonish avatars and hyper-realistic avatars should be counterevidence that we can disprove the previous study in the context of making friends online through mediated personality.

With respect to practical insights and contributions to the industrial field, the users of social networking services may choose friends through mediated personality and avatars that

they create based on criteria different from the traditional point of view. In conjunction with the results of this study, we can postulate particular online situations that involve many interactions simultaneously based on the personality judgment of avatars, such as in the metaverse, by going beyond the conventional viewpoint of personality judgments or evaluations. From the industrial perspective of social networking services such as Meta Horizon Worlds of Meta and Ryan's world of Roblox, this research can help overcome the uncanny valley effect and boost healthy and active user communities by encouraging more interactions and personality expressions with voice or text consistent with the results of this study.

Limitations and Future Research

It is worth describing some limitations of this study and suggesting recommendations for future research. The lack of statistically significant support for H1 and H3 could indicate that the manipulation of eeriness was not effective. That is, it may be because the hyper-realistic avatar did not show a sufficient level of the eeriness. It is not easy to find the lowest point of the uncanny valley that induces the highest level of eeriness. So many previous studies have tried to figure this out using various embodied creatures or photographs that cause the uncanny valley effect (see Ho & MacDorman, 2010; MacDorman & Chattopadhyay, 2016; Schneider et al., 2007; Walters et al., 2008). In the manipulation check, there was clearly a significant difference in the level of the eeriness of avatars using stimuli. Despite the significant differences in the eeriness between the cartoonish avatars and the hyper-realistic avatars, the fact that the factors of trustworthiness, likeability, and willingness to be friends were not found may indicate that the eeriness of the hyper-realistic avatars was not sufficiently manipulated. That is, even if the hyper-realistic avatars were perceived to have a relatively higher level of the eeriness compared to the cartoonish avatar, this could be a relative value or results of the stimuli employed in the current study. If an avatar who

elicited a greater level of eeriness was used as stimuli, the impact on trustworthiness and likability may have been significant. Thus, future studies should attempt to address this.

In addition, the fact that H3 was not supported may mean that other compound attributes may exist. We can assume this point from the results of H1. The R-squared values (the explanatory power of the model) were statistically small between realism and trustworthiness (13%) and realism and likeability (5%) (see Table 7). This means that not only personality judgments but also various factors can be additionally considered in making friends. In other words, it is a matter of how many and what kinds of ‘cues’ were used as a reference in judging the avatar and deciding to make friends. This cue can be subjective and individual, while it may be common and objective such as the Big Five Domain Scale. According to the Brunswik Lens Model (1956), we can have observable cues from our environment as a lens (i.e., cue validity), and it could be employed (i.e., cue utilization) about an object (e.g., avatars). However, in the context of evaluating 3-D avatars for befriending, the validity and utilization of cues given by avatars may differ from person to person, and this may not fit with the cue validity and cue utilization to assess trustworthiness, likeability, and willingness to be friends that this study tried to measure. Accordingly, the evaluation of the avatars may change depending on how people employ cue validity and cue utilization from the avatars and based on this, the decision to make friends may also vary: animacy, anthropomorphism, attractiveness, credibility, perceived intelligence, androgyny, homophily (see Bartneck et al., 2009; Nowak & Rauh, 2005; Nowak et al., 2008; Shin et al., 2019b). Another feasible explanation for this, if it is correct that the eeriness of hyper-realistic avatars is insufficient, another cause is pointed out that the influence on dependent variables was not significant because the eeriness of the avatar did not provide the participants with the appropriate cue validity and cue utilization.

In future studies, it is also expected that online experimental studies reflecting a more actual virtual environment can be conducted by developing stimuli that increase the interaction of humans and avatars. Of course, the present study tried to increase interaction between avatars and participants (e.g., animacy, actual voice, and speech bubble). However, our participants simply experienced the avatars expressing their personalities and showing a different level of realism. Such online experimental research may not meet the actual virtual environment level that requires various evaluations through immediate communication and judgment with diverse avatars. That being said, in the metaverse, more avatars and more diverse interactions can occur in a short time. In the process of human-avatar interaction, this is instantaneously done by heuristic processing, which may eventually change the final decision of making friends.

Next, to figure out other effects such as homophily or other interaction effects, the researcher conducted a series of independent samples t-tests or a two-way ANCOVA for demographic characteristics of the study sample and other dependent variables. According to the results of ANCOVA, there were interaction effects between 1) age and realism and 2) education level and realism. Specifically, age and realism showed marginally significant results for likeability ($F = 1.74, p = 0.061$) and willingness to be friends ($F = 1.65, p = 0.081$). Next, the interaction effect between education level and realism showed a significant result for trustworthiness ($F = 4.14, p < .01$). Therefore, with these results, it is possible to infer the significant points of the difference in realism (i.e., cartoonish avatar vs. hyper-realistic avatar) from the perspective of future research and industry. For example, sometimes, the default setting for avatar creation on recent social networking sites is based on the young. In addition, young people using 3-D scanning technology account for a large portion of users on recent social networking sites. Likewise, in this study, a young female was also used as a model for avatars. However, it is also necessary for future studies to study

avatars for middle-aged or senior avatars. This can be an opportunity to increase the frequency of use by analyzing avatars they mainly use from the industrial aspect as well as research to understand the characteristics of middle-aged users. This is the same for the education level, so it seems necessary as an industrial viewpoint to provide various avatars, from cartoonish to high realism avatars.

Furthermore, the avatars in the current study were modeled after only a female model. Because of the limited budget for data collection, the researcher had to pick one female model for the primary data collection after the pilot test. Accordingly, gender stereotypes and expectations could potentially have impacted the results of this study. The stereotypes and expectations we have for a particular gender can affect perceptions and judgments about avatars. There are a wide variety of gender stereotypes and their cues such as appearance, shape, cloth, voice, tone, mood, language usage, behavior, social role, and even name. According to previous studies on this, the gender and appearance of avatars can affect sociability and social behavior (Banakou & Chorianopoulos, 2010). Also, language use of gender-matched/mismatched avatars affects participants' language use (Palomares & Lee, 2010). In addition, the gender and behavior of avatars can have a significant effect on women's online math learning (Chang et al., 2019). Therefore, in future research, we need to analyze and compare female avatars and male avatars. For instance, in the case of extraversion judgment of avatars and homophily, the results may differ depending on male / female participants and male / female avatars. As such, it is necessary to explore how gender stereotypes of the participant and the avatar's gender can influence each other. That is, future research could find a significant difference in the study variables based on the different levels of masculinity or femininity that the avatar demonstrates.

Moreover, participants in the present study were primarily white (74.8%). This sampling result did not allow for an analysis of potential differences based on the race of

participants. However, given that there are race-based differences in potential willingness to befriend, future research needs to be balanced on the data collection for the race. Next, in compliance with the mentioned above, it is necessary to develop avatars representing various races in future research. The avatars in this study were created based on a white female, but they need to be made not only white but also black, Latin, and Asian avatars. If we have a balanced proportion of participants' races, we can have different results. In this study, three-quarters of the participants were of the same race as the avatar, but future research needs to examine how the results could vary when the races of participants and avatars are consistent or inconsistent.

Lastly, we may need larger samples for future online experimental studies with avatars. In this study, approximately 30 participants were collected for each condition. However, if we increase the sample size, more statistically significant results may be derived from variables that evaluate avatars. For instance, in RQ2, the interaction effect between the realism and conversational cues on willingness to be a friend was marginally significant. However, if sample size and power could allow us to better understand this interaction, we could collect more participants in future research.

Conclusion

Recent social networking services and 3-D scanning technologies have led people to make their own avatars and have more interaction on online social networking platforms. People on online social networking services like metaverse are using various services such as entertainment, education, and business and contributing to fostering healthy virtual communities. On the device side, the increasing growth and development of smartphones like the iPhone and Samsung Galaxy as well as various head-mounted display for virtual reality (e.g., Oculus Quest 2 of Facebook, Vive of HTC) and augmented reality (e.g., HoloLens 2 of

Microsoft) have been achieved. In addition, various online social networking platforms (e.g., Meta Horizon Worlds of Meta and Ryan's world of Roblox) have emerged.

In the aspect of the industrial field and business, what is important is that in order to attract more users to this virtual social networking platform and to maintain continuous service use. Hence, achieving a lot of interactions and expanding user relationships will be critical. However, the uncanny valley effect can prevent users using avatars in virtual environments from making more communication and friends. Therefore, the findings in this study may suggest that they can help in active communication and making many friends. Through online experiments with cartoonish and hyper-realistic avatars, this study confirmed that trustworthiness and likeability are significant factors in promoting a willingness to be a friend on online social networking services. In addition, the fact that these avatars with different levels of realism reveal their personality (i.e., introverted or extroverted traits) using voice or text helps overcome the uncanny valley effect and should be a valid clue to further boost online social networking services.

Appendices

1. Eeriness (Ho & MacDorman, 2010): A seven-point semantic scale.

1) Reassuring: Eerie, 2) Numbing: Freaky, 3) Ordinary: Supernatural, 4) Uninspiring: Spine-tingling, 5) Boring: Shocking, 6) Predictable: Thrilling, 7) Bland: Uncanny, 8) Unemotional: Hair-raising.

2. Big five personality judgment for a participant (John & Srivastava, 1999).

1) Extraversion

	Strongly Disagree				Strongly Agree		
1. Is talkative	1	2	3	4	5	6	7
2. Is reserved (R)	1	2	3	4	5	6	7
3. Is full of energy	1	2	3	4	5	6	7
4. Tends to be quiet (R)	1	2	3	4	5	6	7
5. Has assertive personality	1	2	3	4	5	6	7
6. Is sometimes shy, inhibited (R)	1	2	3	4	5	6	7
7. Is outgoing, sociable	1	2	3	4	5	6	7

2) Agreeableness

Strongly Disagree

Strongly Agree

1. Tend to find fault with others (R)	1	2	3	4	5	6	7
2. Is helpful and unselfish with others	1	2	3	4	5	6	7
3. Starts quarrels with others (R)	1	2	3	4	5	6	7
4. Has a forgiving nature	1	2	3	4	5	6	7
5. Is generally trusting	1	2	3	4	5	6	7
6. Can be cold and aloof (R)	1	2	3	4	5	6	7
7. Is considerable and kind to almost everyone	1	2	3	4	5	6	7
8. Is sometimes rude to others (R)	1	2	3	4	5	6	7
9. Likes to cooperate with others	1	2	3	4	5	6	7

3) Conscientiousness

	Strongly Disagree					Strongly Agree	
1. Does a thorough job	1	2	3	4	5	6	7
2. Can be somewhat careless (R)	1	2	3	4	5	6	7

3. Is a reliable worker	1	2	3	4	5	6	7
4. Tends to be disorganized (R)	1	2	3	4	5	6	7
5. Tends to be lazy (R)	1	2	3	4	5	6	7
6. Perseveres until the task is finished	1	2	3	4	5	6	7
7. Does things efficiently	1	2	3	4	5	6	7
8. Makes plans and follows through with them	1	2	3	4	5	6	7
9. Is easily distracted (R)	1	2	3	4	5	6	7

4) Neuroticism

	Strongly Disagree				Strongly Agree			
1. Is depressed, blue	1	2	3	4	5	6	7	
2. Is relaxed, handles stress well (R)	1	2	3	4	5	6	7	
3. Can be tense	1	2	3	4	5	6	7	
4. Worries a lot	1	2	3	4	5	6	7	
5. Is emotionally stable, not easily upset (R)	1	2	3	4	5	6	7	

6. Can be moody	1	2	3	4	5	6	7
7. Remains calm in tense situations (R)	1	2	3	4	5	6	7
8. Gets nervous easily	1	2	3	4	5	6	7

5) Openness

	Strongly Disagree				Strongly Agree		
1. Is original, comes up with new ideas	1	2	3	4	5	6	7
2. Is curious about many different things	1	2	3	4	5	6	7
3. Is ingenious, a deep thinker	1	2	3	4	5	6	7
4. Has an active imagination	1	2	3	4	5	6	7
5. Values artistic, aesthetic experience	1	2	3	4	5	6	7
6. Prefers works that is routine (R)	1	2	3	4	5	6	7
7. Likes to reflect, play with ideas	1	2	3	4	5	6	7
8. Has few artistic interests (R)	1	2	3	4	5	6	7

9. Is sophisticated in art, music, 1 2 3 4 5 6 7
 or literature

3. Big five personality judgment for an avatar (John & Srivastava, 1999).

1) Extraversion

	Strongly Disagree					Strongly Agree	
1. Is talkative	1	2	3	4	5	6	7
2. Is reserved (R)	1	2	3	4	5	6	7
3. Is full of energy	1	2	3	4	5	6	7
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5. Has assertive personality	1	2	3	4	5	6	7
6. Is sometimes shy, inhibited (R)	1	2	3	4	5	6	7
7. Is outgoing, sociable	1	2	3	4	5	6	7

2) Agreeableness

	Strongly Disagree					Strongly Agree	
10. Tend to find fault with others (R)	1	2	3	4	5	6	7

11. Is helpful and unselfish with others	1	2	3	4	5	6	7
12. Starts quarrels with others (R)	1	2	3	4	5	6	7
13. Has a forgiving nature	1	2	3	4	5	6	7
14. Is generally trusting	1	2	3	4	5	6	7
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17. Is sometimes rude to others (R)	1	2	3	4	5	6	7
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9. Is depressed, blue	1	2	3	4	5	6	7
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13. Is emotionally stable, not easily upset (R)	1	2	3	4	5	6	7
14. Can be moody	1	2	3	4	5	6	7

15. Remains calm in tense situations (R)	1	2	3	4	5	6	7
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16. Gets nervous easily	1	2	3	4	5	6	7
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5) Openness

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15. Prefers works that is routine (R)	1	2	3	4	5	6	7
16. Likes to reflect, play with ideas	1	2	3	4	5	6	7
17. Has few artistic interests (R)	1	2	3	4	5	6	7
18. Is sophisticated in art, music, or literature	1	2	3	4	5	6	7

4. Trustworthiness (McAllister, 1995).

- | | | | | | | | |
|-----------------------------|---|---|---|---|---|---|---|
| 1. I can freely share my | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| ideas, feelings, and hopes | | | | | | | |
| with the person behind the | | | | | | | |
| avatar. | | | | | | | |
| 2. I can talk freely to the | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| person behind the avatar | | | | | | | |
| about difficulties I am | | | | | | | |
| having at work and know | | | | | | | |
| that the person behind the | | | | | | | |
| avatar will want to listen. | | | | | | | |
| 3. I would feel a sense of | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| loss if one of us stopped | | | | | | | |
| using the SNS and we | | | | | | | |
| could no longer be | | | | | | | |
| together. | | | | | | | |
| 4. If I shared my problems | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| with the person behind the | | | | | | | |
| avatar, I know the person | | | | | | | |
| would respond | | | | | | | |
| constructively and | | | | | | | |
| caringly. | | | | | | | |

5. I will make considerable 1 2 3 4 5 6 7
emotional investments in
our working relationship.

5. Likeability (Bartneck et al., 2009): A seven-point semantic scale

1) Dislike: Like 2) Unfriendly: Friendly 3) Unkind: Kind 4) Unpleasant: Pleasant 5) Awful:
Nice

6. Willingness to be a friend: A seven-point Likert scale from 1 (*very unlikely*) to 7 (*very likely*).

“How much are you willing to be friends with this avatar?”

“How much are you willing to accept the friend request from this avatar?”

7. Demographic information.

1) Age: ()

2) Sex: Male () Female ()

3) Education

(1) High School Diploma; (2) College Degree; (3) Graduate Degrees; (4) Others (please specify below).

4) Race/Ethnicity check all that apply

(1) White (2) Hispanic (3) Black/African American (4) Asian (5) Native American/Alaska Native (6) Pacific Islander/Native Hawaiian (7) Multiracial (8) Other (please specify below).

5) Previous experience with 3-D graphic avatars

“How much are you familiar with computer-generated 3D graphic avatars?” from 1 (*very unfamiliar*) to 7 (*very familiar*).

6) Previous experience with social networking sites with an avatar:

"How much are you familiar with social networking sites with avatars?" from 1 (*very unfamiliar*) to 7 (*very familiar*).

7) Media Device use: What device did you use to complete this survey?

(1) Mobile Devices (e.g., cell phone); (2) Tablet PC (e.g., iPad or Galaxy Tab); (3) Personal Computer (e.g., Laptop or Desktop); (4) Others (please specify below).

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