Research on the Impact of Anthropomorphism on User Engagement: Using Meta-Human as an Example

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Abstract: It has been demonstrated that user engagement is a useful predictor of a company's financial performance. As a result, marketers are engaging in the investigation of all kinds of innovative strategies for the improvement of user engagement. In light of the aforementioned considerations, this paper employs the emerging technology of meta-human as a starting point of investigation, with the objective of illustrating the process in which different categories of anthropomorphism influence user engagement, and the conditions that constrain this phenomenon. The findings indicated that both human nature traits and uniquely human traits can have a positive influence on user engagement, with affective presence exerts a partial mediating effect on the relationship between human nature traits and user engagement, and cognitive presence exerts the same influence between uniquely human traits and user engagement. Additionally, the study validated the moderating role of application scenarios in the process of anthropomorphism affecting social presence. These findings will not only enhance the comprehension of anthropomorphism in future research, but also furnish enterprises with direction on how to incorporate anthropomorphism in different scenarios.

Keywords: Anthropomorphism; User Engagement; Social Presence; Application Scenarios; Meta-Human

1. Introduction

In the current era of pervasive internet usage, there is a wide range of empirical evidence to demonstrate that user engagement is a pivotal determinant of a company's financial performance [1]. This finding is not exclusive to the domain of academic research. As indicated in the analysis report released by CMB International on Bilibil, increasing user engagement can maintain the platform's long-term monetization and promote its self-operation. Similarly, a research report on the esports industry also indicates that an increase in user engagement can effectively convert existing players into paying players, thereby increasing a company's revenue. Furthermore, in the context of intense competition in digital platforms, user engagement can help to mitigate the rate of decline in the number of subscribers, foster growth in brand loyalty and thereby ensure the platform's competitiveness in the market. Therefore, enterprises with higher user engagement are more likely to achieve commercial success.

In order to fully benefit from the development of technologies and seize market opportunities, marketers are constantly exploring new marketing models and activities to attract users, with the goal of achieving a substantial increase in user engagement. In existing research, scholars have conducted extensive analyses of the impact of different platform models on user engagement. These include gamified marketing models [2] and interactive models of likes and comments [3]. However, the majority of academic research concentrates on the factors associated with the Internet 2.0 era. There is a notable lack of attention directed towards the new tools that have emerged in the Internet 3.0 era, including but not limited to meta-human. This undoubtedly presents a significant challenge for enterprises seeking to enhance user engagement since almost everyone is familiar with the existing business model. As a result, it is evident that investigating the potential utility of emerging technology like meta-human in enhancing user engagement will not only assist enterprises in accomplishing their marketing objectives, but also achieve these goals in a more

cost-reduction and enhanced-efficiency ways.

The objective of this paper is to identify the most effective methods for designing meta-humans, with the aim of positively influencing user engagement and understanding the psychological processes that users undergo after interacting with different types of anthropomorphism. Moreover, this paper considers the potential applications scenarios of meta-human, with a view to offering guidance to future researchers and enterprises on the appropriate usage of anthropomorphism. In order to achieve this objective, the paper initially presents two distinct categories of anthropomorphism. It then employs anthropomorphism theory and social presence theory to construct a theoretical model, with social presence acting as a mediator and application scenario as a moderator. Finally, the paper provides a comprehensive demonstration for enterprises seeking to enhance user engagement by analyzing the differentiated impact, mechanism, and boundary conditions of anthropomorphism on user engagement.

2. Anthropomorphism and User Engagement

The anthropomorphism theory posits that when anthropomorphism cues are applied and can be perceived by humans, we will exhibit a tendency to anthropomorphize [4]. Therefore, whether the agent exhibits characteristics that can differentiate it from a machine or from an animal [5], user will subconsciously exhibit anthropomorphism after encountering these two distinct anthropomorphism cues. This process will continue until the anthropomorphism of the agent is complete. Upon completion of this process, users will inherently perceive the anthropomorphic agent as a genuine human being and interact with it in accordance with the norms and conventions of human society [6]. For example, when the object is endowed with anthropomorphic cues, people no longer regard the product as an unemotional objective existence. Instead, they will produce emotional and cognitive fluctuations because of the anthropomorphic cues, which in turn reduces the user's destructive behavior towards the anthropomorphic product [7]. It can be seen that anthropomorphic cues can effectively motivate users to interact with agent with the rules of human society.

If we take enterprise as the starting point for the study of anthropomorphism, we can infer that the attribution of anthropomorphic characteristics to an agent may compel users to adhere to the social norms related to social interactions. This includes the procedures to engage in and complete a conversation, which including greeting at the beginning, conversation at the middling, and farewell at the ending. Conversely, in the absence of anthropomorphism, the three phases mentioned before will not be fully executed by user. For example, when a user interacts with an intelligent customer service that is not given anthropomorphism cues, the user tends to directly express their intention and hopes that the agent can quickly solve their problems, but skips the beginning and ending parts of the conversation [8]. This demonstrates the potential for anthropomorphism to enhance user engagement.

Accordingly, this paper employs a classification method that differentiates between anthropomorphism as human nature traits and uniquely human traits, with the objective of elucidating its influence on user engagement. Among these traits, human nature traits represent the common characteristics of humans and animals. These include, but are not limited to, the emotions that humans have, as well as the anthropomorphic appearance and behavior that emotion drives, such as "cute" and "friendly." Uniquely human traits represent characteristics that are exclusive to the human species. These include, but are not limited to, the rationality that is inherent to humans and the anthropomorphic appearance and behavior that are driven by rationality. Examples of this include modesty and rigidity. The application of human nature traits or uniquely human traits allows enterprises to imbue anthropomorphism with sophisticated human characteristics, thereby facilitating the completion of the anthropomorphism process in a more efficient manner. This is achieved on the basis of anthropomorphism tendencies, which exert an unconscious influence on subsequent interactions between users and anthropomorphism agents. Furthermore, it encourages users to interact with anthropomorphism agent in accordance with

the obligated social norms of human society, thereby enhancing user engagement. In summary, this paper puts forth the following hypothesis:

H1: Human nature traits lead to greater user engagement.

H2: Uniquely human traits lead to greater user engagement.

3. The Role of Social Presence

The social presence theory posits that the degree of social presence is determined by the medium's capacity to convey the information that users require [9]. In the context of user interaction with anthropomorphic agent, the varying types of anthropomorphism inherent to these agents result in users receiving information that is tailored to their specific needs. Additionally, based on user feedback, new information is continuously generated to facilitate ongoing communication with users. Accordingly, this paper employs the existing research classification of social presence into affective presence and cognitive presence. Affective presence, in this context, refers to the strength of the emotional connection between the user and the agent due to interaction [10]. In order to establish a robust emotional connection between anthropomorphic agent and users, thereby attaining a high level of affective presence, it is essential that these agents exhibit a certain degree of emotions that leaves a lasting impression on users. The human nature traits of anthropomorphism are precisely what users expect. These traits not only reflect the uniqueness of human beings by creating anthropomorphism agent with emotions, but also effectively distinguish anthropomorphism products from machines that implement fixed procedures. Furthermore, they are able to establish emotional connections with users by meeting their emotional needs.

A high-level sense of affective presence represents the user's self-perception of establishing a close emotional connection with the agent. This connection fosters active involvement in the conversation and a willingness to share information and ideas [11], as well as encouraging users to participate in the operation and maintenance [12]. Furthermore, it plays a role in helping users engage in altruistic behavior [13]. All these positive effects associated with affective presence can be conceptualized as an increase in user engagement. In the context of user interaction with anthropomorphic agent, affective presence may also exert a beneficial influence on user engagement. This is because the emotional connection between users and such agent can still be seen the same from the cases in existing research which focused on the emotional connection between users. In summary, this paper puts forth the following hypothesis:

H3: The effect of human nature traits on user engagement is mediated by affective presence.

Cognitive presence is defined as the level of user identification with the thoughts and logic of the anthropomorphic agent [10]. In order to achieve a strong cognitive connection between anthropomorphic agent and user, and thus achieve a high level of cognitive presence, it is essential that the enterprise ensures anthropomorphic agent presents a rational and convincing argument to user. The uniquely human traits of the anthropomorphic agent serve as a way to meet the aforementioned requirement. There traits of the anthropomorphic agent reflect the uniqueness of human beings, establishing it as an agent with rational thinking. This effectively distinguishes anthropomorphic agent from those of other animals and establishes a cognitive connection with users by satisfying their cognitive needs.

Prior research has demonstrated that cognitive presence can effectively encourage user engagement in online discussions [14]. This is because people are inclined to compare their thoughts and logic with those of others [15]. However, as everyone desires acceptance of their ideas, users must actively engage in discussions to enhance their cognitive presence [16]. This also applies to interactions with anthropomorphic agents. As human beings are not entirely rational, the anthropomorphic agent with uniquely human traits can be seen as representing the existence of rational thinking. When users interact with these agents, they will recognize the difference between themselves and the agent in terms of thought and logic. Therefore, the user, as the party with the initiative in the interaction process, will proactively engage in communication with the anthropomorphic agent to align their thought processes and logical reasoning. In summary, this paper puts

forth the following hypothesis:
H4: The effect of uniquely human traits on user engagement is mediated by cognitive presence.

4. Potential Moderators

Application scenarios can be divided into two categories: certain scenario and uncertain scenario [17]. In certain scenarios, the characteristics of product and service in question are fixed, and the primary challenge for users is to identify suitable options. In order to optimize the customer experience, it is possible to utilize an anthropomorphic agent to filter a substantial quantity of data in accordance with consumer requirements, subsequently presenting it in a format that is easily comprehensible. Subsequently, users are required to make a binary decision regarding the options presented to them.

In accepting the service of certain scenarios, the user's central route is activated solely when user makes a judgement based on the options provided by the anthropomorphic agent. During the remainder of the time, the user is disinclined to engage in their own rational thinking and instead prefers the peripheral path, which is perceived as more relaxing and enjoyable. It can be reasonably argued that the utilization of human nature traits represents a highly pragmatic approach for enterprises seeking to engage with users via the peripheral path. Human nature traits can serve to distinguish anthropomorphic agent from machines, and are committed to satisfying users' emotional needs through the language, expressions and movements of anthropomorphic agent [18]. When users are exposed to human nature traits that reflect the uniqueness of human beings, the prominence of the anthropomorphic agent as a real human being begins to increase, and the interpersonal relationship between the user and the anthropomorphic agent begins to emerge. Concurrently, the perceptual cues conveyed by the human nature traits facilitate an emotional connection between the user and the anthropomorphic agent, thereby producing a sense of affective presence. In a certain scenario, the user is inclined to allocate greater energy and attention to the peripheral path, which in turn enhances the user's capture and perception of the human nature traits. This, in turn, fosters a closer emotional connection between the user and the anthropomorphic agent, ultimately leading to a heightened sense of affective presence. In summary, this paper puts forth the following hypothesis:
H5: Compared with uncertain scenarios, the influence of human nature traits on affective presence is stronger in certain scenes.

The definition of uncertainty scenarios is more complex, encompassing scenarios in which consumers can reduce product uncertainty through the application of knowledge and skills, and scenarios in which the acquisition of a desirable product is contingent on chance [17]. In the first sub-scenario, the primary challenge for the user is to minimize product uncertainty to the greatest extent possible. Consequently, the quality of the enterprise's service is contingent upon the extent to which the user's perceived uncertainty is reduced. This paper focuses on the first component of uncertainty scenarios, namely scenarios in which product uncertainty can be reduced.

In the process of interacting with an anthropomorphic agent endowed with uniquely human traits, user can derive information from various aspects of the agent's appearance, language, and actions that suggest the agent possesses rational thoughts and meticulous logic. To illustrate, the anthropomorphic agent will initially identify the user's requirements as the foundation for reducing product uncertainty. It will then elucidate the user's desired outcomes and subsequently derive the advantages and disadvantages of the pertinent products through the application of professional expertise and an analysis of historical data. Finally, it will provide recommendations based on the user's preferences and needs as discerned throughout the communication. In this process, the user will be fully aware of how their needs will be met, the extent to which product uncertainty will be reduced, and the rationale behind the proposed solution. It can therefore be proposed that, upon concluding their interaction with the anthropomorphic agent endowed with uniquely human traits, the user will agree with the proposed solution due to the rationality demonstrated by the agent, thus generating a high level of cognitive presence that differs

from that observed in other scenarios. In summary, this paper puts forth the following hypothesis:

H6: Compared with the certain scenario, the influence of uniquely human traits on cognitive presence is stronger in the uncertain scenario.

The theoretical model presented in this paper is outlined as follows (see Figure 1.)

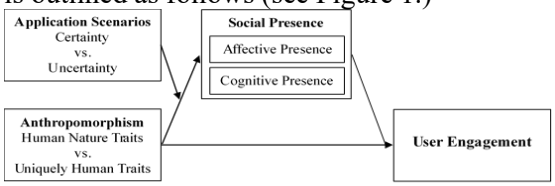

Figure 1. Theoretical Model

5. Empirical Overview

The experiments presented in this paper comprise a total of three studies. The first of these study focuses on the direct and mediating effects of anthropomorphism on user engagement, while the second and third studies focus on the moderating effects of application scenarios in anthropomorphism's impact on social presence. In all experiments, this paper employed the "Credamo" to distribute a seven-point Likert scale as a means of collecting experimental data.

The results of Study 1 indicated that both human nature traits and uniquely human traits can positively influence user engagement, with the underlying process of social presence. Study 2 and 3 examine the moderating influence of application scenarios on the impact of anthropomorphic factors on social presence. Taken together, these experiments support our theorizing and suggest that the anthropomorphism is robust in different scenarios and across various operationalizations in the marketplace.

6. Study 1

Study 1 has two objectives. First, it aims to provide evidence of whether inducing an anthropomorphism affects user engagement. Second, the study aims to ascertain whether social presence serves as a mediating factor in the relationship between anthropomorphism and user engagement.

6.1 Design, Participants, and Procedure

Study 1 employed a between-subject design. A total of 300 participants were requested from the Credamo. While all participants completed all outcome variables, those who failed an attention check were excluded. In this study, 31 participants were excluded due to a failed attention check, resulting in a final sample of 261 for analysis (168 women, 101 men). Participants were randomly assigned to one of the following conditions, in which they were asked to watch a video of meta-human's introduction. Please refer to the transcripts and screenshots of the video below (see Figure 2. and 3.).

Human Nature Traits Condition:

Good day, my name is XiaoTong, a meta-human. I am a cheerful and optimistic person. I love to listen to all kinds of wonderful stories in people's lives. No matter what you need, I will be enthusiastic to help you solve your problems. You are welcome to talk to me anytime.

Figure 2. Screenshot of Meta-Human with Human Nature Traits

Uniquely Human Traits Condition:

Good day. I am XiaoTong, a meta-human. I am a methodical and rational individual. I am excel at analyzing large data sets to identify patterns and relationships. Furthermore, I am interested in exploring complex philosophical concepts. Please do not hesitate to contact me at any time.

Figure 3. Screenshot of Meta-Human with Uniquely Human Traits

Subsequently, participants were asked to rate their likelihood of continuing to interact with the meta-human. In addition, the degree of anthropomorphism and the extent of participants' social presence were measured. The order in which the variables were presented was randomized. Please refer to Table 1. for a list of all measurements.

Table 1. Measurements for All Variables.

Concept	Items
Human Nature Traits [18]	Meta-human is friendly.
	Meta-human is emotional.
	Meta-human is energetic.
Uniquely Human Traits [18]	Only humans can have the traits of meta-human.
	Meta-human has traits that animals cannot have.
	Meta-human has traits that are unique to humans.
Affective Presence[10, 19]	I will be emotionally affected by meta-human.
	Interactions with meta-human will leave me with an impression.
	Interaction with meta-human affects my emotions.
Cognitive Presence[10, 19]	I am aware of the meaning of the meta-human 's existence.
	I can understand how the meta-human thinks.
	I can describe ways of using the meta-human.
User Engagement [20]	I will share my thoughts with meta-human.
	I will share interesting stories to the meta-human.
	I will praise meta-human to others.

6.2 Results

6.2.1 Reliability

The results showed that the internal consistency reliability of human nature traits, uniquely human traits, affective presence, cognitive presence and user engagement are all greater than 0.7, indicating that the measurement tools selected in this study have acceptable reliability.

6.2.2 Manipulation Check

The efficacy of the independent variable was evaluated through the measurements of anthropomorphism to a smaller sample of participants. In the group of human nature traits, the participants' perceptions of these traits were found to be significantly higher than the group of uniquely human traits(M_{nature}=5.676, M_{unique}= 5.152, t=2.399,p<0.05). And in the group of uniquely human traits, the participants' perceptions of these traits were found to be significantly higher than the group of human nature traits (M_{unique}= 5.829, M_{nature}=5.171, t=2.802,p<0.01). It can be deduced that the manipulation of meta-human is effective.

6.2.3 User Engagement

This paper first tested the direct effects through a hierarchical regression model. Regression analysis showed that after controlling participants' gender, age and education, both human nature traits(β=0.354, p<0.001) and uniquely human traits(β=0.226, p<0.01) had a significant positive impact on user engagement. H1 and H2 have been validated.

6.2.4 Social Presence

In order to verify the mediating role of social presence between anthropomorphism and user engagement, we employed bootstrapping procedures with 5000 iterations and 95% confidence interval. In the group of human nature traits, this analysis revealed a significant indirect effect (β=0.1135, CI =0.0386, 0.2168); that is, the human nature traits increased user engagement through affective presence. The mediation analysis also revealed a significant direct effect (CI=0.1580, 0.5655), revealing a partial mediating effect of affective presence. Meanwhile, in the group of uniquely human traits, the indirect effect of cognitive presence was also significant (β=0.0555, CI =0.0063, 0.1239), as well as a significant direct effect of uniquely human traits on user engagement (CI =0.0193, 0.2896). H3 and H4 have been validated.

7. Study 2

Study 2 has two objectives. Firstly, it aims to assess the robustness of direct impact of anthropomorphism on user engagement, while also evaluating the mediation of social presence. Second, the study aims to ascertain whether there is a moderating effect of application scenarios in the process of anthropomorphism affecting social presence.

7.1 Design, Participants, and Procedure

Study 2 employed a between-subject design. A total of 600 participants were requested from the Credamo Platform. While all

participants completed all outcome variables, those who failed an attention check were excluded. In this study, 76 participants were excluded due to a failed attention check, resulting in a final sample of 524 for analysis (313 women, 211 men). Firstly, participants were randomly assigned to one of the following conditions, in which they were asked to imagine themselves located in a certain or uncertain scenario. In the certain scenario, the objective is to get some product recommendations. In order to accomplish this, the participants must provide information such as price and needs. In the uncertain scenario, the objective is to make a medical decision. In order to accomplish this, participants must discuss the surgery plan with the doctor, but there are certain risks in both plans.

Subsequently, the participants were informed that a meta-human could assist them in addressing the issue, specifically the one with human nature traits or uniquely human traits. This was followed by a video presentation of the meta-human's introduction. Please refer to the transcripts and screenshots of the video below for further details (see Figure 4. and 5.).

Human Nature Traits Condition:

Good day. I am Xuan Yu, a meta-human. I am an optimistic individual with a cheerful character. I am passionate about listening to the fascinating stories of others' lives. I am eager to assist you in finding solutions to your problems. Please do not hesitate to contact me at any time.

Figure 4. Screenshot of Meta-Human with Human Nature Traits

Uniquely Human Traits Condition: Good day. I am Xuan Yu, a meta-human. I am a contemplative and rational individual, adept at analyzing large data sets to discern patterns and relationships. Additionally, I am intrigued by complex philosophical matters. I welcome communication at any time.

Finally, participants were asked to rate their likelihood of continuing to interact with the meta-human. In addition, the degree of anthropomorphism and the extent of participants' social presence were measured. The order in which the variables were presented was randomized.

Figure 5. Screenshot of Meta-Human with Uniquely Human Traits

7.2 Results

7.2.1 Reliability

The results showed that the internal consistency reliability of human nature traits, uniquely human traits, affective presence, cognitive presence and user engagement are all greater than 0.7, indicating that the measurement tools selected in this study have acceptable reliability.

7.2.2 Manipulation Check

The efficacy of the independent variable and moderation variables were evaluated in the same procedure in Study 1. In the group of human nature traits, the participants' perceptions of these traits were found to be significantly higher than the group of uniquely human traits(M_{nature}=5.695, M_{unique}= 5.143, t=3.167,p<0.01). And in the group of uniquely human traits, the participants' perceptions of these traits were found to be significantly higher than the group of human nature traits (M_{unique}= 6.029, M_{nature}=5.610, t =2.234,p<0.05). It can be deduced that the manipulation of meta-human is effective.

The measurement of application scenarios contains a total of six items. Items that measure certain scenarios are: I am the final decision maker in the scenario; The agent in the scenario is not involved in the final decision; The agent in the scenario is in a supporting role. Items measuring uncertain scenarios are: I may not get the outcome I expect; I cannot decide what the final outcome of the scenario will be; The task in this scenario involves uncertainty. In the group of certain scenario, the participants' perceptions of certainty were found to be

significantly higher than the group of uncertain scenario ($M_{certain}$=5.848, $M_{uncertain}$= 5.295, t=2.483,p<0.05). And in the group of uncertain scenario, the participants' perceptions of uncertainty were found to be significantly higher than the group of certain scenario ($M_{uncertain}$=5.276, $M_{certain}$=3.991, t =4.800,p<0.001). It can be deduced that the manipulation of application scenarios is effective.

7.2.3 User Engagement

Regression analysis showed that after controlling participants' gender, age and education, both human nature traits(β=0.461, p<0.001) and uniquely human traits(β=0.680, p<0.001) had a significant positive impact on user engagement. H1 and H2 have been verified again.

7.2.4 Social Presence

The paper employed bootstrapping procedures again with 5000 iterations and 95% confidence interval. In the group of human nature traits, this analysis revealed a significant indirect effect (β=0.1660, CI =0.0806, 0.2547); that is, the human nature traits increased user engagement through affective presence. The mediation analysis also revealed a significant direct effect (CI=0.2322, 0.5321), revealing a partial mediating effect of affective presence. Meanwhile, in the group of uniquely human traits, the indirect effect of cognitive presence was also significant (β=0.1209, CI =0.0541, 0.1919), as well as a significant direct effect of uniquely human traits on user engagement (CI =0.0258, 0.2406). H3 and H4 have been verified again

7.2.5 Application Scenarios

This study used Stata 17.0 to conduct between-group coefficient difference test on theoretical models. Firstly, the study examined whether there is a significant difference in the impact of human nature traits on affective presence in two different application scenarios. The influence coefficient of human nature traits on affective presence in certain scenes was 0.6037, which was significantly greater than its influence of 0.3057 in uncertain scenes (p<0.05). H5 was validated. Secondly, the study tested whether there is a significant difference in the impact of uniquely human traits on cognitive presence in two different application scenarios. The results showed that the influence coefficient of uniquely human traits on cognitive presence in uncertain scenes is 0.3665, which was significantly greater than its influence of 0.1596 in certain scenarios (p<0.05). H6 is validated.

To verify whether the theoretical model in this paper has a moderated mediating effect, the Bootstrapping procedures was conducted with 5000 iterations and 95% confidence interval. In the process of human nature traits influencing user participation, no matter the application scenarios were varied across conditions, the mediating effect of affective presence were both significant in the certain scenario (β=0.1884, CI =0.0915, 0.2919) and in the uncertain scenario (β=0.1360, CI =0.0573, 0.2249). In the process of uniquely human traits influencing user participation, the mediating effect of cognitive presence was only significant in the uncertain scenario (β=0.1514, CI =0.0829, 0.2286) but not in the uncertain scenario (CI =-0.0045, 0.1741).

8. Study 3

Study 3 only has one objective which is assessing the robustness of direct impact of anthropomorphism on user engagement, mediation effect of social presence and moderation effect of application scenarios.

8.1 Design, Participants, and Procedure

Study 3 employed a between-subject design. A total of 600 participants were requested from the Credamo Platform. While all participants completed all outcome variables, those who failed an attention check were excluded. In this study, 145 participants were excluded due to a failed attention check, resulting in a final sample of 455 for analysis (285 women, 170 men). Firstly, participants were randomly assigned to one of the following conditions, in which they were asked to imagine themselves located in a certain or uncertain scenario. In the certain scenario, the objective is to reserve a table for a family dinner in the near future. In order to accomplish this, the participant must provide information regarding the desired time and the number of people in their party. In the uncertain scenario, the objective is to invest in a bank account. In order to maximize the return on their savings, the participant must consider a range of investment options.

Subsequently, the participants were informed

that a meta-human could assist them in addressing the issue, specifically the one with human nature traits or uniquely human traits. This was followed by a video presentation of the meta-human's introduction. Please refer to the transcripts and screenshots of the video below for further details. (see Figure 6. and 7.)

Human Nature Traits Condition:

Hello, I am Meng Ying, a meta-human. I am a kind and emotional girl. I like to make more friends by helping others and spread kindness. I will do my best to help you solve any problems in your life. You are welcome to talk to me anytime.

Figure 6. Screenshot of Meta-Human with Human Nature Traits

Uniquely Human Traits Condition: Hello, I am Meng Ying, a meta-human. I am a thoughtful and committed girl. I am very familiar with the classics and the latest discoveries in various fields, also good at using logical thinking to analyze problems. Feel free to communicate with me anytime.

Figure 7. Screenshot of Meta-Human with Uniquely Human Traits

Finally, participants were asked to rate their likelihood of continuing to interact with the meta-human. In addition, the degree of anthropomorphism and the extent of participants' social presence were measured. The order in which the variables were presented was randomized.

8.2 Results

8.2.1 Reliability

The results showed that the internal consistency reliability of human nature traits, uniquely human traits, affective presence, cognitive presence and user engagement are all greater than 0.7, indicating that the measurement tools selected in this study have acceptable reliability.

8.2.2 Manipulation Check

The efficacy of the independent variable and moderation variables were evaluated in the same procedure in Study 2. In the group of human nature traits, the participants' perceptions of these traits were found to be significantly higher than the group of uniquely human traits(M_{nature}=5.752, M_{unique}= 5.276, t=2.337,p<0.05). And in the group of uniquely human traits, the participants' perceptions of these traits were found to be significantly higher than the group of human nature traits (M_{unique}= 6.143, M_{nature}=5.533, t =3.348,p<0.01). It can be deduced that the manipulation of meta-human is effective.

In the group of certain scenario, the participants' perceptions of certainty were found to be significantly higher than the group of uncertain scenario ($M_{certain}$=5.733, $M_{uncertain}$= 5.276, t=2.777,p<0.01). And in the group of uncertain scenario, the participants' perceptions of uncertainty were found to be significantly higher than the group of certain scenario ($M_{uncertain}$=5.238, $M_{certain}$=4.095, t =4.272,p<0.001). It can be deduced that the manipulation of application scenarios is effective.

8.2.3 User Engagement

Regression analysis showed that after controlling participants' gender, age and education, both human nature traits (β=0.623, p<0.001) and uniquely human traits(β=0.255, p<0.001) had a significant positive impact on user engagement. H1 and H2 have been verified again.

8.2.4 Social Presence

The study employed bootstrapping procedures again with 5000 iterations and 95% confidence interval. In the group of human nature traits, this analysis revealed a significant indirect effect (β=0.0780, CI =0.0061, 0.1612); that is, the human nature traits increased user engagement through affective presence. The mediation analysis also revealed a significant direct effect (CI=0.6066, 0.9158), revealing a partial mediating effect of affective presence. Meanwhile, in the group of uniquely human

traits, the indirect effect of cognitive presence was also significant (β=0.1285, CI =0.0700, 0.2025), as well as a significant direct effect of uniquely human traits on user engagement (CI =0.0068, 0.2810). H3 and H4 have been verified again.

8.2.5 Application Scenarios

The study used Stata 17.0 again to conduct between-group coefficient difference test on theoretical models. Firstly, the study examined whether there is a significant difference in the impact of human nature traits on affective presence in two different application scenarios. The influence coefficient of human nature traits on affective presence in certain scenes was 0.5776, which was significantly greater than its influence of 0.3318 in uncertain scenes (p<0.05). H5 was validated. Secondly, the study tested whether there is a significant difference in the impact of uniquely human traits on cognitive presence in two different application scenarios. The results showed that the influence coefficient of uniquely human traits on cognitive presence in uncertain scenes is 0.3965, which was significantly greater than its influence of 0.1846 in certain scenarios (p<0.05). H6 was validated.

To verify whether the theoretical model in this paper has a moderated mediating effect, the Bootstrapping procedures was conducted with 5000 iterations and 95% confidence interval. In the process of human nature traits influencing user participation, no matter the application scenarios were varied across conditions, the mediating effect of affective presence were both significant in the certain scenario (β=0.1591, CI=0.0630, 0.2705) and in the uncertain scenario (β=0.1175, CI=0.0442, 0.2100). In the process of uniquely human traits influencing user participation, the mediating effect of cognitive presence was only significant in the uncertain scenario (β=0.1649, CI=0.0913, 0.2549) but not in the uncertain scenario (CI=-0.0054, 0.1695).

9. General Discussion

This paper presents the results of three between-group experiments to test the hypotheses proposed in this paper. The experiment showed that anthropomorphism has a positive effect on user engagement and that social presence plays a partial mediating role in this process. Furthermore, the hypothesis of a moderating effect is confirmed by the analysis of the experimental data in this paper, which examining how anthropomorphism of human nature traits affects affective presence and how uniquely human traits affect cognitive presence. Regarding the moderated mediation effect, the results of this study indicated that, the cognitive presence exerts a mediating effect between uniquely human traits and user engagement only in uncertain scenarios, whereas the affective presence variable can mediate the relationship between human nature traits and user engagement in both certain and uncertain scenarios. This phenomenon can be attributed to the influence of first impressions in both certain and uncertain scenarios. When exposed to human nature traits such as friendliness, individuals tend to reciprocate with friendly behaviors in order to provide feedback. Thus, it can be posited that affective presence will induce and subsequently enhance user engagement, even in cases where the tasks at hand require a greater degree of rationality than sensitivity.

9.1 Theoretical Implications

This paper makes a significant theoretical contribution through the verification of direct, mediating, and moderating effects within the theoretical model. Firstly, this paper finds that the anthropomorphism theory is supported by evidence indicating that both human nature traits and uniquely human traits have a positive impact on user engagement. By employing the recently developed classification for anthropomorphism, this study successfully establishes a link between the novel classification of anthropomorphism and user engagement, thereby paving the way for further research on anthropomorphism in the future.

Secondly, based on the theory of social presence, this paper identifies the psychological processes that occur in users after they are exposed to anthropomorphism. The research demonstrates that affective presence partially mediates the positive impact of human nature traits on user engagement, and cognitive presence partially mediates the positive impact of uniquely human traits on user engagement. The discovery of this mediating effect not only

provides further inspiration for scholars to study social presence, but also deepens people's understanding of social presence to a certain extent.

Thirdly, this paper identified the boundary conditions of different application scenarios in the process of anthropomorphism affecting social presence. The findings indicate that human nature traits exert a more pronounced influence on affective presence in certain scenarios, whereas uniquely human traits have a more pronounced impact on cognitive presence in uncertain scenarios. The discovery of this boundary condition will assist scholars in identifying the marketing strategies associated with different types of anthropomorphism.

Fourth, this paper extends the scope of both anthropomorphism and social presence theories. Experiments conducted on the topic of meta-human, an emerging technology, have successfully applied both the anthropomorphism theory and the social presence theory. Furthermore, the results of the statistical data have provided additional support for the theoretical assumptions, thereby verifying the effectiveness of both theories in the context of artificial intelligence. This will also encourage researchers to test traditional theories in more emerging technologies.

9.2 Practical Implications

First of all, with the accelerated development and increasing sophistication of emerging technologies, it is imperative for companies to move from a simple anthropomorphic view to a more comprehensive one that encompasses both external and internal characteristics. The characteristics of human nature and uniqueness are the starting points. This classification not only assists companies in designing anthropomorphic products from a more macro perspective, but also encompasses all human characteristics for use in anthropomorphic marketing.

Secondly, the discovery of the mediating effect of anthropomorphism on user engagement provides guidance for companies who seeking to clarify the psychological mechanism of consumers. However, it is certain that affective presence and cognitive presence are not only influenced by human nature traits and uniquely human traits. This, in turn, makes it possible to improve user engagement from multiple perspectives, ranging from Internet to artificial intelligence and bringing an increasing number of variables that are more efficient.

Thirdly, a company can determine whether its products are in certain or uncertain scenarios by examining their usage contexts. This enables the selection between human nature traits and uniquely human traits. The use of application scenarios as a moderating variable can facilitate not only the optimization of anthropomorphic elements, but also the guidance of companies at the beginning of their anthropomorphic design. This approach can also lead to the cost savings and efficiency gains in marketing activities.

9.3 Limitation and Future Research

The present study is limited by three factors that could be addressed and improved upon in future research. Firstly, the measurement of anthropomorphism requires further refinement. A review of the existing research on anthropomorphism revealed a dearth of scale development papers pertaining to human nature traits, and uniquely human traits. Although previous quantitative studies have demonstrated reliability, it remains unclear whether their research has fully passed the validity test. In light of these observations, it becomes evident that the research process of this paper shares a common limitation with previous studies on anthropomorphism: the measurement of anthropomorphism remains a challenge, and there is a need for further refinement and expansion of the items included in the measurement tool.

Secondly, further verification is required concerning the moderating effect of application scenarios. In examining the moderating effect, this paper presents the results of only two experiments. However, as application scenarios pertain to all aspects of our daily lives, the presented experiments are insufficient to prove the exact moderating effect. The experiments presented in this paper only provide preliminary evidence that application scenarios exert moderating effects on the process by which anthropomorphism affects social presence. Additionally, this paper does not address the construction of the "luck scenarios". It would be a valuable avenue of future research to investigate

whether people also exert similar effects on social presence through anthropomorphism in lucky scenarios.

Thirdly, the experimental design and methodology require further enhancement. The data for this study were collected via electronic questionnaires throughout the experimental process. Despite the imposition of limitations on user credit scores and adoption rates on the questionnaire collection platform, the quality and efficacy of the data remain inferior to those obtained from offline questionnaires. Additionally, the experimental methods in this paper lacked diversity. All three experiments in this paper were between-group experiments and did not involve within-subjects design or other experimental methods. Therefore, in future research, more experimental design can be used to collect questionnaires. For example, if the moderating effect of the application scenario can still be confirmed through within-subjects design, then this conclusion will be very convincing.

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