Investigation of How Animal Avatar Affects Users' Self-Disclosure and Subjective Responses in One-on-One Interactions in VR Space

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ABSTRACT

In social VR, users can communicate with others through their avatars, and their appearance can be customized. In communication using avatars, previous research revealed that avatars with dissimilar appearances to the user encourage greater self-disclosure than avatars with similar appearances. This study focused on non-humanoid animal avatars because they have dissimilar appearances to users and also have other positive effects (e.g., promoting intimacy), so they are expected to promote self-disclosure. In our previous research, we propose a one-on-one communication system in which the user and the interlocutor use animal avatars in a VR space to investigate the effects of animal avatars on the users' self-disclosure. The system converts the users' movements acquired by the sensors mounted on the HMD and the controllers into the movements of the animal avatar and transmits them to the interlocutor. In this study, we conducted an experiment using the proposed system to investigate the effect of the avatars' appearance on users' self-disclosure and subjective responses. Experimental results showed that the proposed system did not promote users' self-disclosure, which was expected as an effect of the animal avatars. However, in the other items, intimacy with the interlocutor and perceived attractiveness of their own avatars were improved.

CCS CONCEPTS

• **Computer systems organization** → **Embedded systems**; *Redundancy*; Robotics; • **Networks** → Network reliability.

KEYWORDS

Computer-mediated communication, virtual reality, embodiment, self-disclosure

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1 INTRODUCTION

The social VR application allows multiple users to interact with each other through a shared virtual space. In recent years, social VR has attracted significant research interest as a remote communication tool and has been used for various purposes [8, 14, 28]. In social VR, users can communicate with others by expressing their appearance by customizing an avatar. To support rich communication through avatars, several studies have investigated the effect of avatars' appearance on users' self-disclosure [16, 26, 34].

Self-disclosure is the process of verbally revealing to others about oneself [9]. Self-disclosure plays an important role in building trust, relationships, mental health, and well-being [16]. Previous studies showed that avatars with dissimilar appearances to the user encourage greater self-disclosure than avatars with similar appearances [12, 16]. However, these studies were conducted on humanoid avatars. The effect of non-humanoid avatars on users' self-disclosure has not been sufficiently researched. In this study, we choose animal avatars among these non-humanoid avatars and investigate the effect of their appearance on users' self-disclosure.

We chose animal avatars because interaction with animals has been shown to have a positive effect on humans. For example, it has been shown that animal-assisted activities (AAA) and animal-assisted therapy (AAT) have positive psychological effects and social effects on humans [35]. Furthermore, animal robots and insubstantial digital animals have also been shown to have similar effects to those. [3, 10, 23, 29].

Based on these findings, we expected animal avatars to promote users' self-disclosure due to their dissimilar appearance to the user and their psychological and social effects on users. Furthermore, using animal avatars may have a positive effect on the users' subjective responses (e.g., increased interactional enjoyment and satisfaction). In our previous research [13], we implemented a one-on-one communication system in which the user and the interlocutor use animal avatars in a VR space. In this research, we conducted an experiment to investigate users' self-disclosure and subjective responses using the proposed system. We conducted a one-on-one laboratory experiment in which one side was the experimenter. We compared the proposed method with humanoid avatars. To evaluate self-disclosure, we used self-disclosure scores based on verbal behavior analysis during interaction and subjective evaluation of own self-disclosure as evaluation items. To evaluate the subjective evaluation, we used impression evaluation of own avatar and own perception and impression evaluation of the interlocutor and the interaction itself as evaluation items.

2 RELATEDWORK

In this section, we first describe self-disclosure in interpersonal behavior and explain its function. Next, we describe related research on the effects of avatar appearance in online communication. Finally, we describe the effects of animals on humans.

Self-disclosure is the process of verbally revealing personal information about oneself, such as thoughts, feelings, and experiences to others [9]. Its functions include the emotional expression and the development of relationships [7], and it plays an important role in building trust, relationships, mental health, and well-being [16]. Factors that influence self-disclosure include the impressions of attitude, behavior, and appearance of the interlocutor [17]. This study focuses on users' self-disclosure in a VR space where avatars' appearance can be freely customized and aims to investigate the impact of the appearance of VR avatars on users' self-disclosure.

Hooi et al. [12] showed that the similarity between avatar and user appearances is negatively correlated with user self-disclosure. Ichino et al. [16] showed that avatars with dissimilar appearances to the user encourage greater self-disclosure than avatars with similar appearances. Thus, the effects of humanoid avatars' appearances on self-disclosure in online communication have been investigated. On the other hand, studies on the effects of non-humanoid avatars on self-disclosure are limited and insufficient, for example, those that investigated only interlocutors using images or videos [10, 21, 32], or those that investigated only the effects of the avatar's appearance on anxiety [26]. To address this gap, this study investigates the effects of the appearance of the user's own avatar and the interlocutor's avatar on self-disclosure during interactive communication in a VR space using non-humanoid avatars.

In this study, we focus on animal avatars among non-humanoid avatars and investigate the effect of animal avatars on users' self-disclosure. We chose animal avatars because previous research has shown that interactions with animals have a positive effect on humans. Animal-Assisted Activities (AAA) and Animal-Assisted Therapy (AAT) have been shown to have psychological effects on humans who interact with animals, such as promoting relaxation, intimacy, and emotional expression, and social effects, such as facilitating interpersonal relationships [35]. Additionally, research has shown that gazing at a dog releases oxytocin, a hormone that promotes prosocial behavior [22]. Dizon [11] showed that when rabbits participate in psychological interviews, interviewees are more likely to self-disclose. In addition to real animals, interaction with animal robots has been shown to increase conversation and smiles, and animated animal characters have been shown to increase enjoyment in simulated interactions [10, 29]. Based on these findings, we expect that using animal avatars in a VR space can replicate the positive effects of animals on humans and that animal avatars may promote self-disclosure among users.

3 PROPOSED SYSTEM

In this section, we describe the proposed system in our previous research [13]. We first describe the design of the proposed system. We then describe the appearance and movement of the animal avatar. To verify the effects of animal avatars, we proposed a system that converts the user's nonverbal behaviors into appropriate animal behaviors and transmits them to the interlocutor.

3.1 System Configuration

In our previous research [13], we implemented a one-on-one communication system in which the user and the interlocutor use animal avatars in a VR space (Fig. 1). The system configuration is shown in Fig2. We used the Meta Quest 2 [19] as the VR headset and implemented the software by Unity (Version 2021.3.0f1) [31]. To enable remote interaction, we used the Unity asset Photon Pun2 [2] and implemented a voice call function. This system utilizes sensors mounted on the HMD and controller to capture the user's nonverbal information, including head, arm, and mouth movements. This information is then mapped onto the corresponding animal avatar's movements and transmitted to the interlocutor.

Figure 1: Animal avatars in a one-on-one interaction in a VR space using the proposed system in our previous research. The user's movements are mapped onto the corresponding animal avatar's movements and transmitted to each other.

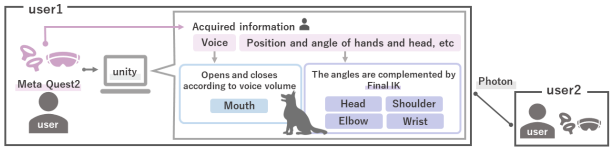

Figure 2: Configuration of the proposed system in our previous research.

3.2 Appearance and Movement of Animal Avatars

In this system, we used the Labrador Retriever dog model [6] as the animal avatar. This is because dogs are one of the typical animals used in AAA and AAT. The model used in this system was designed to resemble a real dog in appearance closely. In robot therapy using animal robots, it is important to evoke the emotions felt when interacting with animals in order to replicate the positive effects of animals on humans [30]. This system converts the user's head, arm, and mouth movement into the movement of the animal avatar and transmits them to the interlocutor. This allows the transmission of nonverbal information, such as nodding and pointing to the interlocutor in addition to the user's voice. For head and arm movement conversion, the Unity asset FinalIK [20], which uses inverse kinematics, is used to supplement joint movements based on information acquired from the user's HMD and controller. Then, to make the animal avatar's movement more like a real animal, we limit the range of motion of the animal avatar's joint based on the range of motion of a real dog[5]. For the transformation of the mouth movement, the user's voice is acquired through the microphone on the user's HMD, and the avatar's mouth is opened and closed based on the volume of the user's voice.

4 EXPERIMENT

In this study, we conducted an experiment using the proposed system in our previous research [13] to investigate the effect of the avatar's appearance on users' self-disclosure and subjective responses. In this section, we describe the hypotheses, conditions, procedures, participants, evaluation items, and results of this experiment.

4.1 Hypotheses

For the evaluation, we set two hypotheses about the effects of the proposed system.

- **H1.** The proposed system promotes self-disclosure.
- **H2.** The proposed system improves impressions of the interlocutor and the interaction itself.

We considered that the proposed system would promote the user's self-disclosure, according to the dissimilar appearance between the user and the animal avatar and the effects of the animal on the emotional expression and facilitation of interpersonal relationships of the humans it interacts with (H1). In addition, we considered that the proposed system would improve impressions of the interlocutor and the interaction itself, according to the effects of the animals on the humans, such as the promotion of intimate feelings, the increase in the enjoyment of interaction, and the promotion of rapport with the interlocutor through gazing at the dog (H2).

4.2 Conditions

To test the hypothesis, we set the following two experimental conditions.

- **C1. animal avatar condition** Both the participant and the interlocutor use the same dog avatar (Fig. 3a).
- **C2. human avatar condition** Both the participant and the interlocutor use the same human avatar (Fig. 3b).

In C1 condition, we used the proposed system in this study. In C2 condition, to avoid differences in the similarity of appearance between the user and the avatar, we use an avatar model that looks neutral gender [25]. There are no limitations on the range of motion of the human avatar's joint. In both conditions, the experimenter, who remained anonymous, acted as the participant's interlocutor to avoid the effects of the relationship between the participant and the interlocutor on self-disclosure. To maintain the anonymity of the experimenter, the experimenter used the voice changer software iMyFone MagicMic [1] to change his voice to a neutral one. Because the size of the avatars affects communication [33], we made the animal and the human avatars about the same size. In addition, participants could see the appearance of their own arms as avatars by looking at their hands.

4.3 Procedure

In the experiment, the experimenter first explained the purpose and content of the study, how to use the system, and conducted a pre-questionnaire. Next, the participants checked their own avatars while freely moving their bodies for one minute in front of a virtual mirror in a VR space using Meta Quest 2. After that, the participants conducted the experimental task. We adopt the task "to introduce oneself to a first-time interlocutor in a VR space" [34]. During the task, participants faced the interlocutor one-on-one in a VR space across a desk. First, participants were asked to introduce themselves freely by their interlocutor. After that, the interlocutor asked them to give additional information. Finally, the interlocutor introduces himself. The interlocutor's self-introductions were selected from imaginary contents (e.g., hobbies, personality, recent joys, etc.), which were controlled to include the same amount of "information," "thoughts," and "feelings" categories of self-disclosure [7], and which were not common with the participants. After completing the task, the experimenter asked the participants to conduct impression evaluation questionnaires, open-ended questionnaires, and interviews.

(a) The animal avatar used in the animal avatar condition.

(b) The human avatar used in the human avatar condition.

Figure 3: The two conditions used in this experiment.

4.4 Participants

The experiment followed a within-subject design. Total of 20 undergraduate and graduate students (19 males and 1 female, mean age = 23.5 years) participated in the experiment. We recruited the participants from our laboratory. Prior to the experiment, we conducted a mental health test (K6: Kessler Psychological Distress Scale), and all participants scored less than 13, which is considered not having severe mental illness [24]. Each participant and the interlocutor were placed in two separate rooms to experiment. They used Meta Quest 2 HMDs, controllers, and headphones. We also placed PCs in both rooms for voice calls and voice recordings.

4.5 Evaluation Items

This study used the following four evaluation items to test the hypotheses.

- Self-disclosure score based on verbal behavior analysis during interaction
- Subjective evaluation of own self-disclosure
- Impression evaluation of own avatar and own perception
- Impression evaluation of the interlocutor and the interaction itself

To test H1, we conducted the evaluation of participants' self-disclosure scores based on an analysis of their verbal behavior during the interaction. We analyzed the data of participants' voice recordings during the task. We used the total number of self-disclosure information from the participants' self-introduction as the self-disclosure score. We counted as self-disclosure statements about themselves, about people related to themselves, and about themselves as a member of a group [27]. The author and the collaborator counted the number of self-disclosures, and the average agreement rate between them was 85%. The disagreements were discussed and decided with the collaborator. Additionally, to test H1, we conducted a subjective evaluation of participants' own self-disclosure

during the interaction. We used a questionnaire to evaluate participants' perception of their own self-disclosure during the interaction (e.g., "I can speak to interlocutor frankly and candidly."), based on Lee et al. [18]. A seven-point Likert scale was used to answer the questionnaire.

To evaluate impressions of participants' own avatars and own perceptions, we used a questionnaire to evaluate the attractiveness of their avatars based on Yee et al. [34] and a questionnaire to evaluate their private and public self-awareness based on Joinson [15]. A seven-point Likert scale was used to answer the questionnaire about the attractiveness of the avatar, and a five-point Likert scale was used to answer the questionnaire about private and public self-awareness. We found that a state in which the user's private self-awareness is high and the user's public self-awareness is low promotes self-disclosure.

To test H2, we conducted the impression evaluation of the interlocutor and the interaction itself. We used a questionnaire to evaluate intimacy with the interlocutor (e.g., "I developed a sense of familiarity with the interlocutor."), trust with the interlocutor (e.g., "The interlocutor is trustworthy."), interactional enjoyment (e.g., "The conversation with the interlocutor is exciting."), and satisfaction (e.g., "Interacting with the interlocutor was a pleasant and satisfactory experience.") based on the Lee et al. [18]. We also used a questionnaire to evaluate co-presence (i.e., "How easy was it for you to tell how your partner felt ?") based on the bailsenson et al. [4]. A seven-point Likert scale was used to answer each questionnaire.

4.6 Results

In this section, we describe the results for each evaluation item of the experiment. For each test, a p value of less than 0.05 was considered statistically significant.

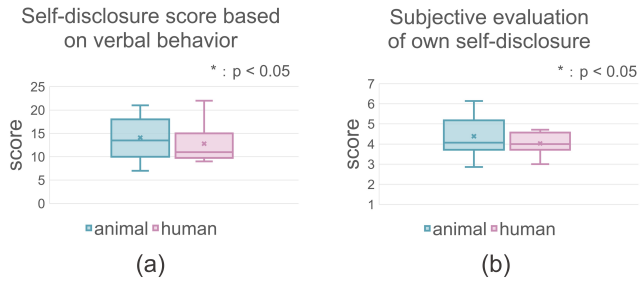

Figure 4: Results of self-disclosure. (a) The result of self-disclosure scores based on an analysis of verbal behavior. (b) The result of the subjective evaluation of own self-disclosure.

Figure 4 (a) shows the mean self-disclosure scores of the participants in each experimental condition based on the verbal behavior analysis during the interaction. Results of the Wilcoxon signed rank test showed no significant difference between conditions ($W = 61.5, p = 0.40$). In the subjective evaluation of own self-disclosure during the interaction, the mean value of the score of each item for each participant in the questionnaire was used as the score. Figure 4 (b) shows the mean scores for each experimental condition. Results of Welch's t-test showed no significant difference between conditions ($df = 13.22, p = 0.36$). These results showed that the use of animal avatars did not significantly promote users' self-disclosure.

In the impression evaluation of own avatar and own perception, we used the mean value of the score of each item for each participant in the questionnaire as the score for each scale. We removed the scale of private self-awareness from the evaluation for insufficient reliability (α <0.7) in Cronbach's α. Figure 5 (a) and 5 (b) show a graph of the mean scores for each experimental condition for each scale. Results of Welch's t-test showed a significant difference in attractiveness of participants' own avatar ($df = 17.51, p = 0.011$ <0.05). However, there was no significant difference in public self-awareness ($df = 17.85, p = 0.93$).

In the impression evaluation of the interlocutor and the interaction itself, we used the mean value of the score of each item for each participant in the questionnaire as the score for each scale. The scale of trust with the interlocutor and copresence were removed from the evaluation for insufficient reliability (α <0.7) in Cronbach's. Figure 6 shows a graph of the mean scores for each experimental condition for each scale. Results of Welch's t-test showed that the intimacy with the interlocutor was significantly different ($df = 14.91, p = 0.0031$, <0.05). The results showed that the use of animal avatars significantly promotes intimacy with the interlocutor. However, there were no significant differences in interactional enjoyment ($df = 14.94, p = 0.91$) and satisfaction ($df = 17.63, p = 0.49$).

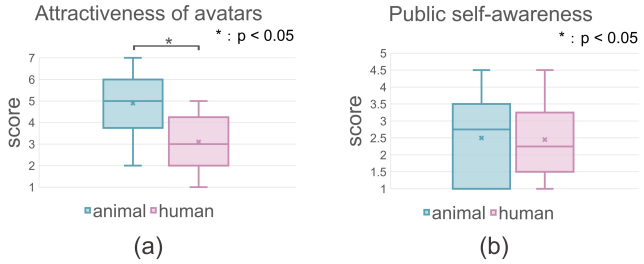

Figure 5: Result of impression evaluation of own avatar and own perception. (a) The result of attractiveness of avatar. (b) The result of public self-awareness.

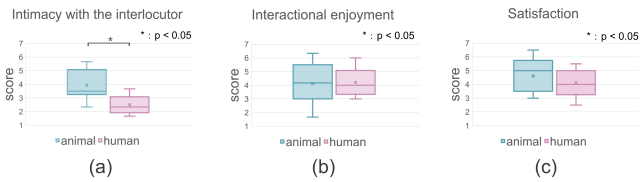

Figure 6: Results of impression evaluation of the interlocutor and the interaction itself. (a) The result of intimacy with the interlocutor. (b) The result of interactional enjoyment. (c) The result of satisfaction.

5 DISCUSSION

In this section, we discuss the effect of the proposed system in our previous research [13] and describe the limitations and the future work of this study.

5.1 Self-Disclosure

The results for self-disclosure were not significantly different between conditions. This could be because participants did not care about the appearance of their own avatars and the limitations of experimental design. First, the answers of the open-ended questionnaire revealed that the participants did not care about the appearance of their own avatars ("I did not feel that I was the avatar (P8)", "I was not aware of my own appearance during the interaction (P7)", "I forgot that I was the appearance of a dog (P5)"). In such cases, even though the participants use low similarity avatars, self-disclosure would not be promoted. These findings suggest that the system needs to be improved to enhance the user's perception of their own avatar's appearance in future studies.

Second, as a limitation in the experimental design, the participants had difficulty for introducing themselves due to a lack of information about their interlocutor and the interaction situations. In the open-ended questionnaire, the participants answered, "I was not certain what to say (P6)" and "I did not know what topic the interlocutor wanted to talk about. It might have been easier to introduce myself if I had known what the situation was (P9)". These results suggest that the participants were conservative and negative in their interaction, and the contents of their self-introductions were stay general, which may have caused the no significant differences in self-disclosure between conditions.

In real-world scenarios, such as user interactions in VRChat, remote classes, business meetings, and counseling sessions, the interaction situation and information about the other interlocutors are not controlled unlike our experimental design. In such situations, interaction with other interlocutors would be easier and developed actively. Therefore evaluation in a more realistic environment will be necessary in future studies.

5.2 Impression Evaluation of the Interlocutor and the Interaction Itself

Participants' intimacy with their interlocutor was significantly improved in the animal avatar condition. All participants in the animal avatar condition answered, "I like dogs" and "I have interacted with dogs" in the pre-survey. In the free response questionnaire, the participants also answered that they felt the animal avatars were "charming" (P16). These results suggest that the use of animal avatars may have significantly increased the participants' intimacy with their interlocutor due to their positive impressions of dogs and their experience interacting with dogs.

No significant differences were found in interactional enjoyment and satisfaction between conditions. This may be due to the limitations of the experimental design in which the interlocutor's responses during the interaction were controlled. Specifically, the interlocutor only performed the hammering and nodding actions during the interaction and did not ask any questions to the participant or respond to the participant's questions. As a result, it is possible that there were no differences in the development and excitement of the interaction in the task, leading to no significant differences in interactional enjoyment. In the open-ended questionnaire, the participants answered, "I wanted to have more conversations that would allow me to catch up" (P11), "The conversation was one-sided and there was no room for excitement" (P4), "I felt a little uncomfortable talking because of the relatively small response from the partner" (P5), and "I felt a little uncomfortable talking because of the relatively small response from the partner" (P6). "I felt a little uncomfortable talking because of the small response from the interlocutor" (P14). In a more realistic environment, the response of the interlocutor is not consistent, and interaction is expected to develop through questions and empathy from the interlocutor. In this case, interactional enjoyment and satisfaction may be influenced.

5.3 Limitations and Future Work

In this study, the user's perception of their own avatar's appearance was found to be insufficient. One design guideline to improve this problem is to display the user's own avatar so that it is always visible during the interaction. This is considered to be effective according to the following comments: "Because I could not see my avatar, I was not aware of my avatar and did not feel that I was the avatar" (P8) and "If my avatar is always visible, like in a video call, I will be more aware that I have the appearance of a dog" (P5). Improving the user's perception of their own avatar's appearance may promote self-disclosure due to the dissimilar appearance between the avatar and their.

In this experimental design, there were many limitations, such as the lack of information about the interaction situations, the limited responses from the interlocutor, the short interaction time (approximately 5 minutes), and the disruption of the participants' awareness due to the naturalness of the interlocutor's voice. To address these limitations, it is necessary to conduct an additional investigation in a more realistic environment and evaluate the effects appropriately in future studies. In a more realistic environment, it is expected that interaction develops freely without any restrictions on the interlocutor and the interaction situation, which may influence the self-disclosure as well as the impression of the interlocutor and the interaction itself.

This system was limited in transmitting the user's facial expressions and gaze. Regarding facial expressions, we obtained the opinion that "The lack of facial expressions and blinking of the interlocutor's avatar made it difficult to read the emotions and interact" (P1). To address this issue, we will plan to incorporate blinking and eye gaze, and the method of transmitting the user's emotions using animal-specific nonverbal information, such as tail wagging and ear movement. In addition, it is necessary to improve the impression of the avatar by using a model with a deformed appearance as animal avatars and by improving the movements of them, because we obtained the comment, "The avatars are too realistic and creepy" (P3). These improvements are expected to promote self-disclosure and improve impressions of the interlocutor and the interaction itself.

In this experiment, we measured self-disclosure based solely on the number of information in the participant's self-disclosure to evaluate self-disclosure. However, to conduct a more detailed

evaluation of self-disclosure, it is necessary to evaluate according to the category, level, and depth of self-disclosure in future studies. Furthermore, in this experiment, the interaction was one-sided due to the limitations of the experimental design. In future studies, it will be necessary to evaluate the reciprocity of self-disclosure in a more realistic environment where the interaction is mutual.

In this experiment, the number of participants was limited, and they were similar in their characteristics. In future studies, it will be necessary to include a more diverse and larger group of participants.

6 CONCLUSION

Based on the knowledge that similarity in appearance between the user and avatar can affect self-disclosure and the positive effect that animals have on the people they interact with, we proposed a one-to-one communication system in which the user and the interlocutor use animal avatars to investigate the effect of using animal avatars on the user's self-disclosure. The experiment using the proposed system showed the following results.

- The use of the animal avatar did not significantly promote users' self-disclosure.
- The use of the animal avatar significantly increased the user's intimacy with the interlocutor.

These results indicate that the animal avatar did have the expected effect of promoting users' self-disclosure. For the other items, intimacy with the interlocutor and attractiveness of their own avatars were improved, but not for the other items. These results may be attributed to several factors, including that the participants did not care about the appearance of their own avatars and the limitations of the experimental design. We plan to improve the system and conduct additional experiments in actual environments in the future study.

REFERENCES

[1] 2023. iMyFone MagicMic. https://jp.imyfone.com/voice-changer. (Accessed on 02/25/2023).

[2] 2023. PUN 2 - FREE | Network | Unity Asset Store. https://assetstore.unity.com/packages/tools/network/pun-2-free-119922. (Accessed on 02/25/2023).

[3] Sato Akinaga and Kito Tsuneo. 2009. Healing effect of virtual pet. *Kurume University psychological research* 8 (03 2009), 39–44. (in Japanese).

[4] Jeremy N Bailenson, Nick Yee, Dan Merget, and Ralph Schroeder. 2006. The effect of behavioral realism and form realism of real-time avatar faces on verbal disclosure, nonverbal disclosure, emotion recognition, and copresence in dyadic interaction. *Presence: Teleoperators and Virtual Environments* 15, 4 (2006), 359–372.

[5] Barbara Bockstahler, David Levine, Darryl Millis, Kazuya Edamura, and Tadashi Sano. 2010. *Essential facts of physiotherapy in dogs and cats : rehabilitation and pain management.* interzoo. https://ci.nii.ac.jp/ncid/BB0519802X

[6] CGTrader. 2023. Dog - Labrador Retriever Rig 3D model rigged | CGTrader. https://www.cgtrader.com/3d-models/animals/mammal/labrador-retriever-dog-rig. (Accessed on 02/25/2023).

[7] Gordon J Chelune. 1979. *Self-disclosure: Origins, patterns, and implications of openness in interpersonal relationships.* Jossey-Bass.

[8] HIKARI CLINIC. 2023. HIKALY. https://hikaly.jp. (Accessed on 02/25/2023).

[9] V.J. Derlega, S. Metts, S. Petronio, and S.T. Margulis. 1993. *Self-Disclosure.* SAGE Publications.

[10] Anna Flavia Di Natale, Stefano Triberti, Federica Sibilla, Chiara Imperato, Daniela Villani, Tiziana Mancini, and Giuseppe Riva. 2022. Behind a digital mask: users' subjective experience of animated characters and its effect on source credibility. *Interacting with Computers* 33, 5 (2022), 499–510.

[11] Marivic R. Dizon. 2008. *Creature comfort: The effect of an animal -assisted intervention on anxiety and self -disclosure among youth exposed to community violence.* Ph. D. Dissertation. Stanford University.

[12] Rosalie Hooi and Hichang Cho. 2013. The Virtual "Me" is the Actual Me: Self-Disclosure in Virtual Environment. In *2013 46th Hawaii International Conference on System Sciences.* 883–892. https://doi.org/10.1109/HICSS.2013.546

[13] Ayumi Ichikawa, Keiichi Ihara, Aoto Tanokashira, and Ikkaku Kawaguchi. 2022. Investigating the Effect of Animal Avatars on Users' Self-disclosure During Interaction in VR space. In *ICAT-EGVE 2022 - International Conference on Artificial Reality and Telexistence and Eurographics Symposium on Virtual Environments - Posters and Demos*, Theophilus Teo and Ryota Kondo (Eds.). The Eurographics Association. https://doi.org/10.2312/egve.20221308

[14] VRChat Inc. 2023. VRChat. https://hello.vrchat.com/. (Accessed on 02/25/2023).

[15] Adam N Joinson. 2001. Self-disclosure in computer-mediated communication: The role of self-awareness and visual anonymity. *European journal of social psychology* 31, 2 (2001), 177–192.

[16] Ichino Junko, Ide Masahiro, Yokoyama Hitomi, Asano Hirotoshi, Miyachi Hideo, and Okabe Daisuke. 2022. Self-Disclosure and Reciprocity through Physical Avatar -I was talking unintentionally-. In *Proceedings of Interaction 2022.* 21–30. (in Japanese).

[17] Ryoko Koshi, Ryota Tsukawaki, and Naoko Hirayama. 2009. Relationships between disclosures' motives and receivers' characteristics. *Bulletin of Joetsu University of Education* 28 (2009).

[18] SeoYoung Lee and Junho Choi. 2017. Enhancing user experience with conversational agent for movie recommendation: Effects of self-disclosure and reciprocity. *International Journal of Human-Computer Studies* 103 (2017), 95–105.

[19] Meta. 2023. Meta Quest 2 | Meta Store. https://store.facebook.com/jp/quest/products/quest-2. (Accessed on 02/25/2023).

[20] Root Motion. 2023. Home - RootMotion. http://root-motion.com/. (Accessed on 02/25/2023).

[21] Ian Mull, Jamie Wyss, Eunjung Moon, and Seung-Eun Lee. 2015. An exploratory study of using 3D avatars as online salespeople: The effect of avatar type on credibility, homophily, attractiveness and intention to interact. *Journal of Fashion Marketing and Management* (2015).

[22] Miho Nagasawa, Shouhei Mitsui, Shiori En, Nobuyo Ohtani, Mitsuaki Ohta, Yasuo Sakuma, Tatsushi Onaka, Kazutaka Mogi, and Takefumi Kikusui. 2015. Oxytocin-gaze positive loop and the coevolution of human-dog bonds. *Science* 348, 6232 (2015), 333–336. https://doi.org/10.1126/science.1261022 arXiv:https://www.science.org/doi/pdf/10.1126/science.1261022

[23] Hazuki Niyama and Tomoyasu Sano. 2021. Mood Changes in University Students after Watching Animal Videos. *Journal of School Mental Health* 24, 1 (2021), 52–57.

[24] Judith J Prochaska, Hai-Yen Sung, Wendy Max, Yanling Shi, and Michael Ong. 2012. Validity study of the K6 scale as a measure of moderate mental distress based on mental health treatment need and utilization. *International journal of methods in psychiatric research* 21, 2 (2012), 88–97.

[25] RenderHub. 2023. Tiffany Howarth - 3D Model by TheBeachMarket. https://www.renderhub.com/thebeachmarket/tiffany-howarth. (Accessed on 02/25/2023).

[26] Anna Rivas, Xavi Navarro, Domna Banakou, Ramon Oliva, Veronica Orvalho, and Mel Slater. 2021. The Influence of Embodiment as a Cartoon Character on Public Speaking Anxiety. *Frontiers in Virtual Reality* 2 (10 2021). https://doi.org/10.3389/frvir.2021.695673

[27] Zen Shobi. 2010. Contrastive Study in Japanese and Korean of Self-Disclosure on First-Acquaintance with Strangers : the Feature of Self-Disclosure Examining through Content Classification. *The Japanese journal of language in society* 13, 1 (2010), 123–135.

[28] Doghead Simulations. 2023. Rumii-Doghead Simulations. https://www.dogheadsimulations.com/rumii. (Accessed on 02/25/2023).

[29] Shibata Takanori. 2003. Robot and Healing. *The Journal of the Institute of Image Information and Television Engineers* 57, 1 (2003), 38–42. (in Japanese).

[30] Shibata Takanori and Wada Kazuyoshi. 2012. Robot Therapy : Mental Health Care by Using Animal Type Robot. *The journal of the Institute of Electronics, Information and Communication Engineers* 95, 5 (05 2012), 442–445. (in Japanese).

[31] Unity Technologies. 2023. Unity Real-Time Development Platform | 3D, 2D VR & AR Engine. https://unity.com/. (Accessed on 02/25/2023).

[32] Kense Todo, Masaki Kitazawa, Satoshi Takahashi, Atsushi Yoshikawa, Masayuki Yamamura, Yuto Taiga, Motoki Sato, Masaki Okamoto, and Yuhei Maruyama. 2021. Analysis of the effect of appearance attributes of dialogue agents on self-disclosure. *The 38th Annual meeting of the Japanese Cognitive Science Society* (2021), 538–543.

[33] Michael E Walker, Daniel Szafir, and Irene Rae. 2019. The influence of size in augmented reality telepresence avatars. In *2019 IEEE Conference on Virtual Reality and 3D User Interfaces (VR).* IEEE, 538–546.

[34] Nick Yee and Jeremy Bailenson. 2007. The Proteus effect: The effect of transformed self-representation on behavior. *Human communication research* 33, 3 (2007), 271–290.

[35] Akimitsu Yokoyama. 1996. *What is Animal Therapy.* NHK Publishing, Inc. (in Japanese).