OPEN ACCESS

Belitung Nursing Journal

E-ISSN: 2477-4073 | P-ISSN: 2528-181X

Volume 8 , Issue 2
March - April 2022

Edited by Assoc. Prof. Dr. Yupin Aungsuroch & Dr. Joko Gunawan

The Official Publication of
Belitung Raya Foundation
Department of Publication, Indonesia

Case Study

Open Access

Characteristics of interactive communication between Pepper robot, patients with schizophrenia, and healthy persons

Belitung Nursing Journal
Volume 8(2), 176-184

https://doi.org/10.33546/bnj.1998

Feni Betriana[1], Ryuichi Tanioka[1], Tomoya Yokotani[1], Kazuyuki Matsumoto[2], Yueren Zhao[3], Kyoko Osaka[4], Misao Miyagawa[5], Yoshihiro Kai[6], Savina Schoenhofer[7], Rozzano C. Locsin[8,9], and Tetsuya Tanioka[10]*

[1] Graduate School of Health Sciences, Tokushima University, Tokushima, Japan
[2] Graduate School of Technology, Industrial and Social Sciences, Tokushima University, Tokushima, Japan
[3] Department of Psychiatry, School of Medicine, Fujita Health University, Aichi, Japan
[4] Department of Clinical Nursing, Kochi Medical School, Kochi University, Kochi, Japan
[5] Department of Nursing, Faculty of Health and Welfare, Tokushima Bunri University, Tokushima, Japan
[6] Department of Mechanical Engineering, Tokai University, Kanagawa, Japan
[7] Anne Boykin Institute, Florida Atlantic University, Boca Raton, FL 33431–0991, USA
[8] Tokushima University, Tokushima, Japan
[9] Florida Atlantic University, Boca Raton, FL 33431, USA
[10] Department of Nursing Outcome Management, Institute of Biomedical Sciences, Tokushima University, Tokushima, Japan

Abstract

Background: Expressing enjoyment when conversing with healthcare robots is an opportunity to enhance the value of human robots with interactive capabilities. In clinical practice, it is common to find verbal dysfunctions in patients with schizophrenia. Thus, interactive communication characteristics may vary between Pepper robot, persons with schizophrenia, and healthy persons.

Objective: Two case studies aimed to describe the characteristics of interactive communications, 1) between Pepper as a healthcare robot and two patients with schizophrenia, and 2) between Pepper as a healthcare robot and two healthy persons.

Case Report: The "Intentional Observational Clinical Research Design" was used to collect data. Using audio-video technology, the conversational interactions between the four participants with the Pepper healthcare robot were recorded. Their interactions were observed, with significant events noted. After their interactions, the four participants were interviewed regarding their experience and impressions of interacting with the Pepper healthcare robot. Audio-video recordings were analyzed following the analysis and interpretation protocol, and the interview data were transcribed, analyzed, and interpreted.

Discussion: There were similarities and differences in the interactive communication characteristics between the Pepper robot and the two participants with schizophrenia and between Pepper and the two healthy participants. The similarities were experiences of human enjoyment while interacting with the Pepper robot. This enjoyment was enhanced with the expectancy of the Pepper robot as able to entertain, and possessing interactive capabilities, indicating two-way conversational abilities. However, different communicating characteristics were found between the healthy participants' impressions of the Pepper robot and the participants with schizophrenia. Healthy participants understood Pepper to be an automaton, with responses to questions often constrained and, on many occasions, displaying inaccurate gaze.

Conclusion: Pepper robot showed capabilities for effective communication pertaining to expressing enjoyment. The accuracy and appropriateness of gaze remained a critical characteristic regardless of the situation or occasion with interactions between persons with schizophrenia, and between healthy persons. It is important to consider that in the future, for effective use of healthcare robots with multiple users, improvements in the areas of the appropriateness of gaze, response time during the conversation, and entertaining functions are critically observed.

Keywords

communication; delivery of health care; robotics; schizophrenia

***Corresponding author:**
Tetsuya Tanioka, RN, PhD, MA, MSN, FAAN
Professor, Department of Nursing Outcome Management, Institute of Biomedical Sciences, Tokushima University, Graduate School, 18-15 Kuramoto-cho 3, Tokushima, 770-8509, Japan
Phone and Fax: +81-88-633-9021
Email: tanioka.tetsuya@tokushima-u.ac.jp

Article info:
Received: 13 December 2021
Revised: 17 January 2022
Accepted: 12 March 2022

E-ISSN: 2477-4073 | P-ISSN: 2528-181X

Background

Schizophrenia is a mental illness characterized by distortions in thinking, emotions, behavior, language, perception, sense of self (World Health Organization, 2019), and impairment in communication. These impairments can be observed through verbal and non-verbal communications. In verbal communication, impairments as a manifestation of thought disorder include unintelligible and disorganized speech, problems expressing thought through language, problems in differentiating verbalized and external speech, and difficulty interpreting long and complex sentences (Kuperberg, 2010). In non-verbal communication, impairments involve poor social perception, impaired gesture production, deficit tool use, and poor gestural knowledge (Walther et al., 2015).

Schizophrenia can be treated with pharmacotherapeutics and psychosocial supports, which are considered effective (Kahn et al., 2015; World Health Organization, 2019), such as social skills training and cognitive-behavioral therapy. One of the ways to support the treatment of patients with schizophrenia, particularly for communication problems, is using healthcare robots (Ozeki et al., 2020; Ujike et al., 2019). A study found that patients with schizophrenia conversed with robots well, whether robots were talkative or not. When the robot did not talk, the patients themselves initiated the conversation with these robots (Ozeki et al., 2020). Through conversing, answering, and asking questions to healthcare robots, patients with schizophrenia showed improvements toward establishing communication progress (Ujike et al., 2019).

Van Wynsberghe (2013) clarified that care robots are used for patient care in healthcare settings. Different types of healthcare robots were used for different purposes, for example, PALRO robot for communication use (Ozeki et al., 2020), PARO robot for behavioral therapy (Sabanovic et al., 2013), and Pepper for interactive dialogue and physical exercise guidance.

Pepper (SoftBank Robotics, n.d.) is a humanoid robot designed to interact with humans through conversation and touch screen with a tablet attached to its chest. Pepper can recognize faces and identify basic emotions while engaging with humans (SoftBank Robotics, n.d.). Attempts are being made to provide patients with schizophrenia the opportunity to enjoy talking to Pepper. However, it is relatively common to find verbal dysfunctions in patients with schizophrenia in clinical practice. Thus, they might have different interactive communication characteristics: 1) to make his/her speech clearer, more comprehensible, more informative; 2) to summarize a part of his/her own speech; 3) to choose the appropriate meaning of an ambiguous polysemic word on the basis of the context provided by the sentence or the conversation; and, 4) the difficulty describing or recognizing other people's intentions (Bazin et al., 2005).

In the highly demanding technological world involving nursing and healthcare, nurses need to be aware that it is important to understand disruptive information with technologies to serve nurses and patients well in nursing practice (Aungsuroch & Gunawan, 2019). Nursing in the technologically-demanding world of healthcare requires technologically competent nursing practice (Locsin, 2005). When healthcare robots, such as Pepper, are used for patient care, especially for communication purposes, nurses should understand how robots can function as interactive technologies.

Previous case studies had examined Pepper interaction with an older person with a mental health condition (Tanioka, Betriana, et al., 2021). In that study, Pepper conversed only with one patient, and the interaction resulted on the occasion of joy (Tanioka, Betriana, et al., 2021). However, how Pepper would function during the interaction with more than one person at one time and how the interaction would be different between patients with a mental health condition and those who are healthy are not well studied and known.

Understanding the characteristic of communication between Pepper and multiple persons at the same time is important in the human-robot interaction. This information can inform nurses and roboticists to design and program healthcare robots based on the expected communication characteristics according to different users. Therefore, this study aimed to describe the characteristics of interactive communication between Pepper as a healthcare robot with patients with schizophrenia and healthy persons.

Case Presentation

Study Design

This is a descriptive case study involving two cases that employed the Intentional Observational Research Design (IOCRD) (Tanioka, Locsin, et al., 2021). The IOCRD is a research design for simultaneous data generation using advanced technological devices intended for clinical phenomena involving healthcare robots. IOCRD combined quantitative, qualitative, and intentional observation approaches for data generation (Tanioka, Locsin, et al., 2021). However, in this study, data were collected using intentional observation and interviews, which are essential parts of the IOCRD. The interaction of the two cases—two patients with schizophrenia with Pepper and the interaction of two healthy persons with Pepper—was observed and audio-video data were recorded simultaneously. After the conversations, participants were asked about their experiences, including feelings and impressions during their interactions with Pepper. All data, including researchers' notes, were analyzed and interpreted.

Description of Participants

Four participants were selected for inclusion in the study: Patient A was a female patient in her 70s who was diagnosed with schizophrenia; Patient B was a female patient in her 40s who was also diagnosed with schizophrenia. In addition, healthy person C was a woman in her 60s; and healthy person D was a woman in her 50s. All the participants were consented and signed the Informed Consent Form.

Patients' information

Patient A was diagnosed with paranoid schizophrenia, parkinsonism, and an affective disorder. Her current symptoms included active grandiose delusions, paranoia, and a mild hand tremor. She has been admitted to the hospital for seven years, and she was independent in performing activities of daily living (ADL), such as having meals, bathing, and using the toilet. She was prescribed olanzapine 20 mg, lithium carbonate 200 mg, and biperiden hydrochloride 2 mg per day.

Patient B was diagnosed with schizophrenia and epilepsy. She had symptoms of autism spectrum or disorganized schizophrenia. She could not keep her personal belongings tidy, and when nurses tried to keep things tidy, she got angry. She has been admitted to the hospital for 14 years. Her ADL, including having meals, bathing, and using the toilet, is independent. Her prescribed medications were sodium valproate 800 mg, risperidone 3 mg, and biperiden hydrochloride 3 mg per day.

Setting and Data collection

The experiment was set in the situation of a conversation between Pepper and two participants at the same time. In this situation, researchers would be able to confirm whether Pepper could interact appropriately with more than one person. Meanwhile, a different room was set for the operator and assistant operator so that participants did not see the operators and were not distracted by other activities while conversing with Pepper. Data were collected in July and December 2020. The length of each conversation time with Pepper was about 20 to 30 minutes.

In the case where patients were involved, the setting of the experiment was a ward in a psychiatric hospital in Western Japan. In the ward, a room was set for conversation interaction, while the other part of the room was set where the operator and assistant could hear and see patients' interaction and control the Pepper.

In the case of interaction with healthy persons, the setting was a university laboratory. Inside the laboratory, two rooms were prepared for the conversation room and the operators' room. Since the setting of the environment did not enable the operator and assistant to see and hear participants clearly, monitors and the video conferencing software developed by Zoom Video Communications, Inc. were used in both rooms to display the live interaction so that the operator and assistant could see and hear the conversation clearly (see **Figure 1** and **Figure 2**).

The interaction between Pepper and the two participants was recorded by two digital cameras, and three observers intentionally observed and noted significant events occurring during the conversation. Pepper was set in the middle facing the two participants. On Pepper's chest, a tablet was attached by default for Pepper's operating functions, but it did not show the contents of the conversation. The situation of Pepper interacting with participants is presented in **Figure 1**.

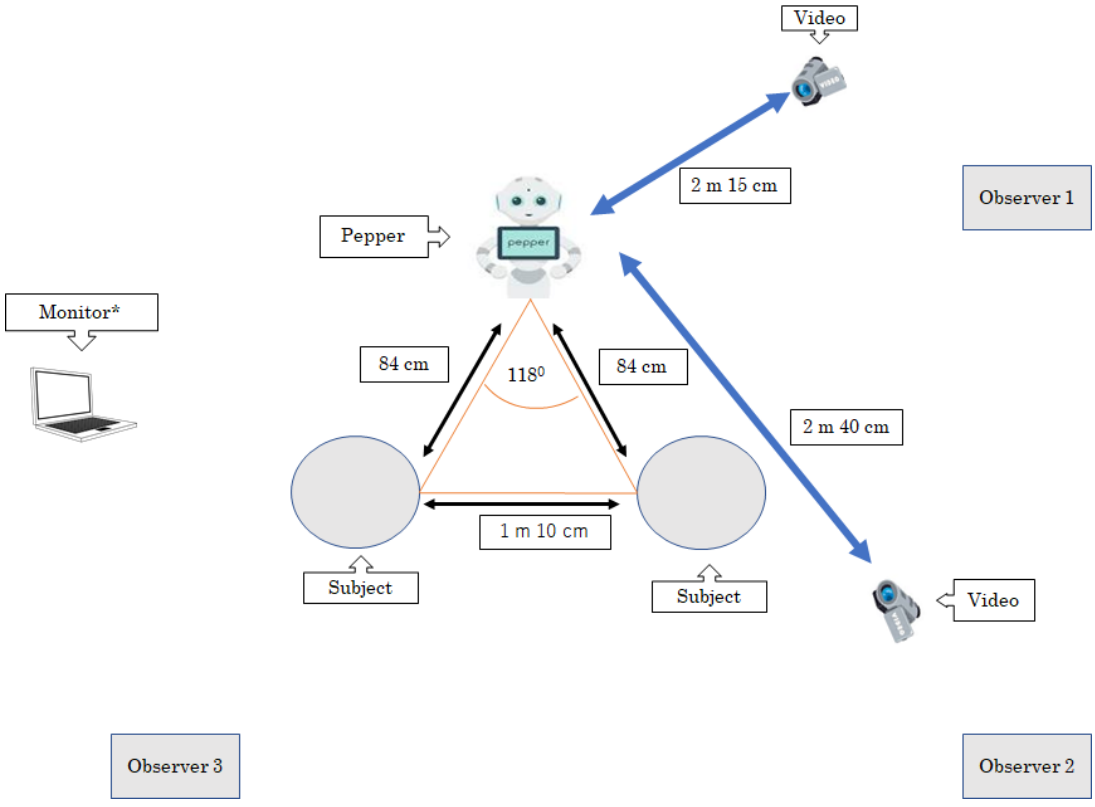

Figure 1 The situation of Pepper interacting with participants

Note: *Monitor is used for the case of healthy participants to display live interaction that could be seen by the operator and assistant from a different room

In the operator's room, computer tablets and keyboards were prepared. They monitored Pepper and the conversation with the participants. In order for participant conversational activities to operate accurately and appropriately, the operator could synchronize technologies involved in the methodology (**Figure 2**). The operator role was to insert the text to be uttered by Pepper by typing in the keyboard. The operator's assistant role was inputting Pepper's nodding movement, conversation backchannel, acknowledgment gestures, and turning Pepper's face to the front during the conversation. These were also inputted by typing in the keyboard or clicking the functions on the tablet.

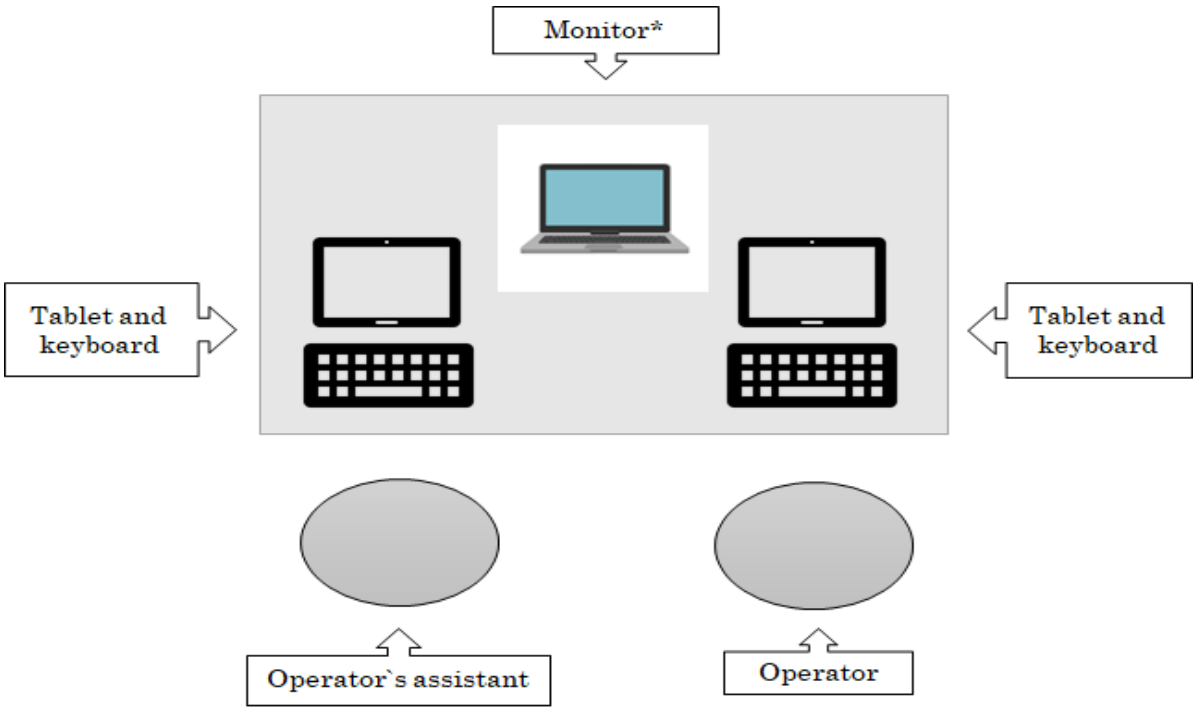

Figure 2 Situation in operator's room

Note: *Monitor is used for the case of healthy participants to display live interaction in the participants' room

Ethical Considerations

Approvals from the Ethics Committee of the Tokushima University Hospital (#3046) and the Mifune Hospital Clinical Research Ethics Review Committee (#201180502) were obtained. Information about the study was provided to all participants before data collection started. Informed consent was obtained from the guardians (for patients with Schizophrenia) and the participants (for healthy participants). In reporting this study, images of participants' faces were blurred to prevent identification.

Results

Patients with Schizophrenia

Significant observations of the conversational situations between Pepper and patients with schizophrenia were identified and grouped into four categories. These observations include the conversation, Pepper's gaze, Pepper's response time, and patients' impression of Pepper.

Conversation

The conversation started with Pepper greeting the two patients by saying "Hello," and asking about several topics, such as favorite food, trouble in hospitalization, and favorite entertainers. The two patients answered Pepper's questions appropriately and asked Pepper some questions. When Pepper said, "Tell me more," Patient A told Pepper about food. Next, Pepper encouraged the participants to sing the songs of their favorite entertainers, and both patients A and B enjoyed singing the songs they knew during the conversation. After the patients sang, Pepper praised them and said, "Good . . . good." After singing, Patient A asked Pepper to sing, but Pepper said it could not sing.

Pepper's gaze

Eye gaze is defined as the pointer from the viewers' eyes to an object (He et al., 2015). In this study, Pepper's gaze refers to the direction point from Pepper's eyes to participants. During the conversation, two patients maintained their gaze at the Pepper until the end of the conversation. However, Pepper's gaze did not always meet patients' gaze. Pepper appeared to be pointing in a nearly intermediate direction between the two participants.

Response time

It was observed that there was an inappropriate timing response from Pepper during the conversation. Once, Pepper asked a question to Patient A. When Patient A was still answering Pepper's question, Pepper said other things.

Patients' impression toward Pepper

After the conversation, both patients were interviewed regarding their impressions during the conversation with Pepper, and both patients replied that they enjoyed talking with Pepper. During the experiment, there was a scene where Pepper froze in the middle of a conversation and got stuck. At that time, Patient A said, "Because it is a robot, it must have a good brain. I thought Pepper was thinking about something." "There was no problem with the conversation," Patient A said. Patient B was delighted that she could talk to Pepper, and she said, "Pepper turned to me. The distance to Pepper was also good. I want to talk to Pepper again if I have the opportunity."

Below is the figure depicting the conversation situation between Pepper and two patients with schizophrenia (**Figure 3**).

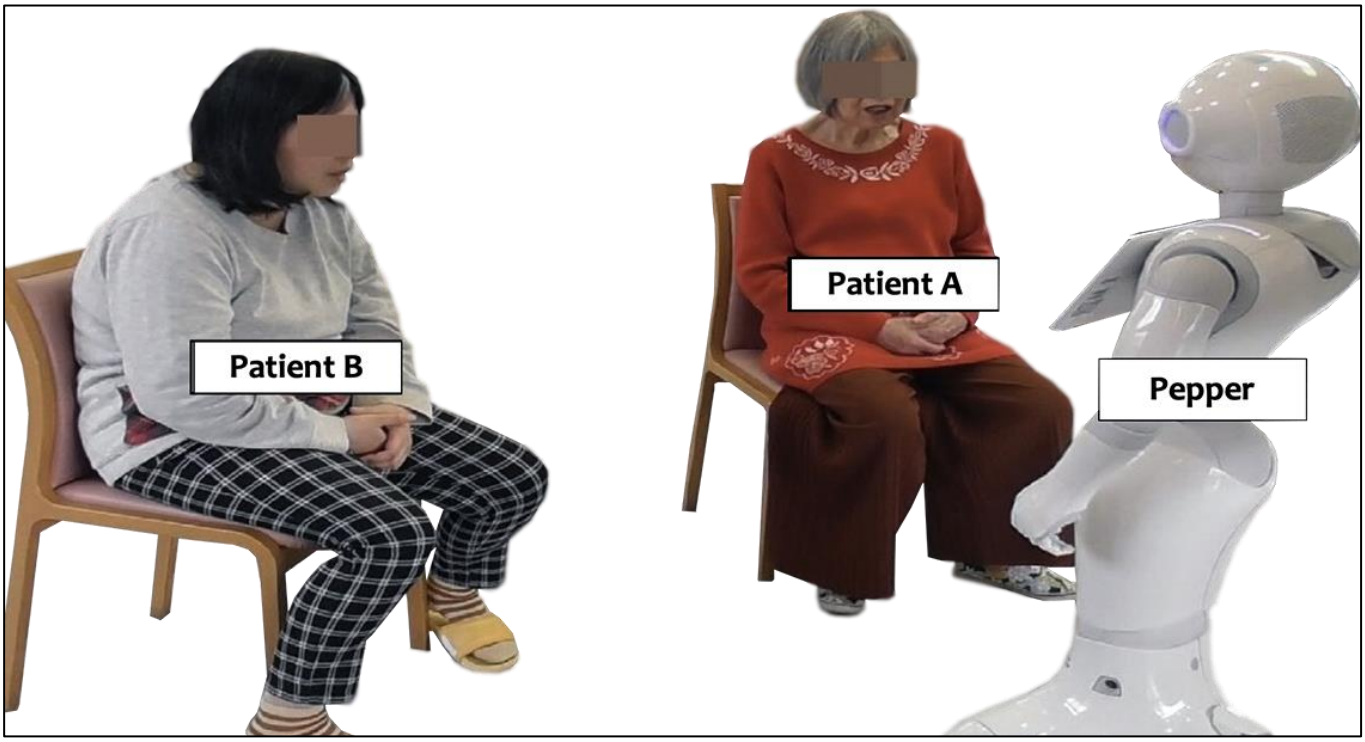

Figure 3 Patients with schizophrenia conversing with Pepper

Note: Due to ethical reasons, we removed the background of the hospital ward and retained only the patients with Pepper

Healthy Participants

The following are the results of the conversational situation between Pepper and two healthy participants.

Conversation

At the beginning of the conversation, Pepper greeted the two participants, "I am Pepper. Thank you for coming today." The conversation continued about family, food, work, daily life, and entertainers. Next, Pepper gave questions to both participants. After Participant C answered, Pepper then asked Participant D. When asking a question to Participant D, the operator could not manipulate Pepper's face to turn to her.

The conversation functioned as a two-way conversation. After Pepper asked, both participants also asked some questions to Pepper, such as, "Pepper, do you have a friend?" "Pepper, how old are you?" Additionally, Participant C asked Pepper to sing twice. However, Pepper could not sing.

When both participants talked, Pepper nodded and said, "Oh yes…," as if Pepper intelligibly followed the conversation. This gesture was noticed by both participants as they said, "It's good that Pepper nodded when I talked." Pepper also moved its hand while talking.

The conversation lasted around 30 minutes.

Response time

On some occasions, it was observed that Pepper delayed in responding to participants' questions, making them seem to be confused about whether to wait for Pepper to respond or to go ahead and say something else. The other time, Pepper talked while the participant was still talking.

Pepper's gaze

Pepper turned to Participant C and spoke during the conversation. Pepper sometimes uttered Participant D's name but did not turn to her. There were also scenes when Pepper did not turn to Participant C nor Participant D but faced the middle of these two participants when it spoke to one of them. This averted gaze was noticed by both participants.

At the start of the talking between Pepper and Participant C, Pepper faced Participant C. Afterward, our operation switch just turned Pepper's face to the front. However, Pepper could not meet the gaze of Participant D because Pepper only turned its face to Participant C and the middle of both participants.

Participants' impression toward Pepper

After the conversation, both participants were interviewed regarding their impressions during conversing with Pepper. Both participants expressed amazement at how Pepper could engage in the conversation. Participant C said, "I could have a conversation without any discomfort. It was easy to talk. It felt like a natural conversation, Pepper's eyes moved, and its eye color changed during talking." She also added, "Pepper is good. It always saw me when it talked to me."

However, Participant D seemed less satisfied and said, "I talked with Pepper, but Pepper did not look at me. It called my name, but it did not turn to me." (See **Figure 4**). Participant D also said that Pepper asked a question and then another question without giving enough time for her to answer each question.

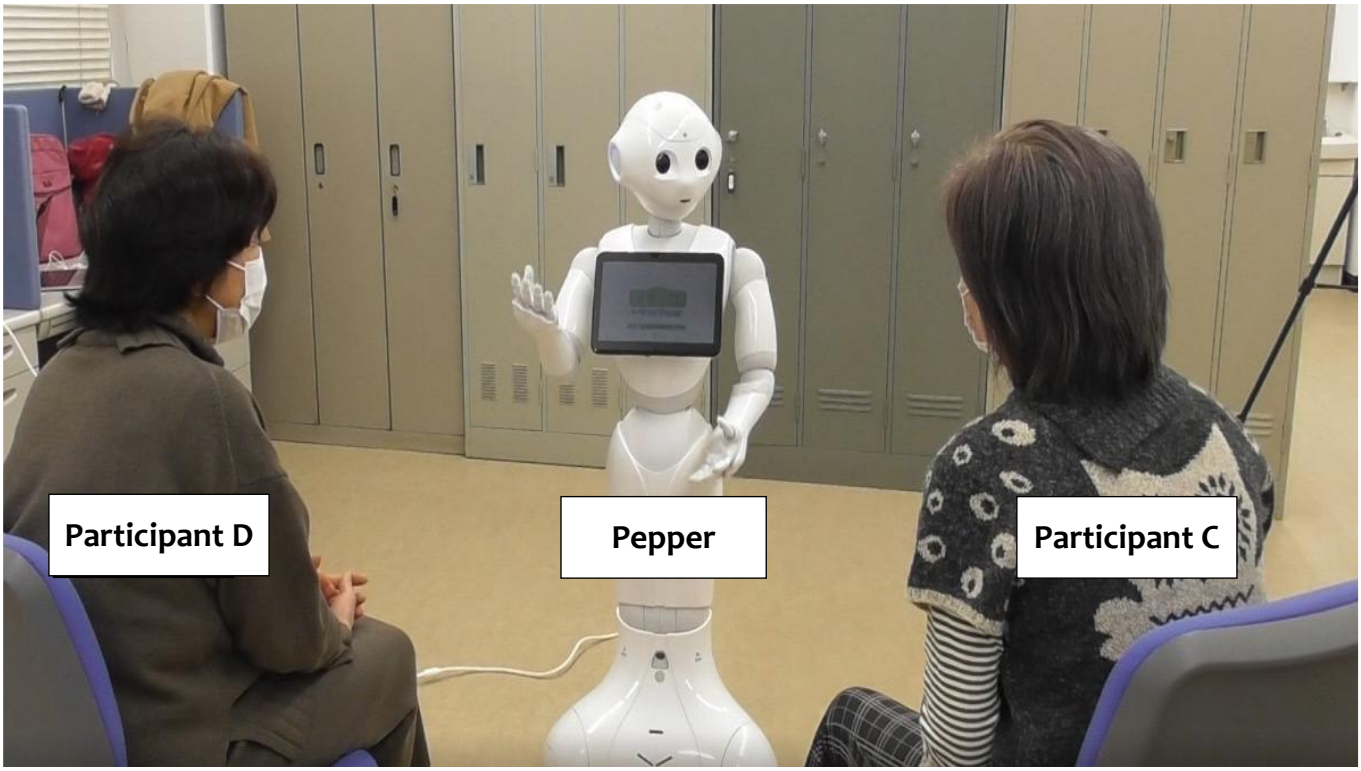

Figure 4 Healthy persons conversing with Pepper while Pepper only turned to Participant C

Discussion

This case study addressed the characteristics of communication between Pepper and patients with schizophrenia and with healthy persons, with results expressed as similarities and differences in communication.

Similarities were found in the enjoyment of users, both patients with schizophrenia and healthy persons, in their interaction with Pepper. In both cases, it was observed that both participants and Pepper had two-way conversations. After Pepper asked, the participants replied and asked Pepper some questions, which were answered by Pepper. In both cases, participants asked Pepper to sing. However, Pepper could not sing. This situation highlighted that those users of robots, either patients or healthy persons, expected Pepper to entertain during communication. While the current application could not control Pepper's function to sing songs, this finding encouraged improvement for a future design that will allow the application to switch converse and sing songs.

During the conversation, both patients could answer Pepper's questions appropriately, and although not as much, patients could ask and maintain the conversation with Pepper. Similar to the previous study (Ujike et al., 2019), communication between Pepper and patients with schizophrenia is regarded as intentional communication, in which communication was intended and initiated by the patients.

Differences in interaction are found in the impression of participants toward Pepper. In this study, Pepper was operated remotely by an operator and an assistant. While healthy persons were amazed and wondered how Pepper could maintain the conversation, patients with schizophrenia thought Pepper initiated the conversation of his own will. Therefore, when there was a silent moment when Pepper did not speak, patients thought that Pepper was thinking. This finding conforms to a previous study, which found that patients with schizophrenia had a distorted main perception in which they tended to perceive a humanoid robot to have mental capacities to plan and act on his will (Raffard et al., 2018).

Furthermore, it was observed that Pepper could maintain eye contact with one person while talking in both cases and faced the middle of participants. When the next speaker spoke, the operator's assistant moved Pepper's face to the front. That is, Pepper's face could only be turned to the front but not facing the second speaker. Pepper tended to face the first speaker because this application did not allow Pepper to gaze at the second speaker. Although it did not affect patients with schizophrenia, it made sense of uncomfortable feeling for healthy persons. In the case of patients with schizophrenia, Pepper appeared to be looking in a nearly intermediate direction between both participants. Therefore, the patient evaluated that she could talk to Pepper even when their eyes were not aligned.

For patients with schizophrenia, their symptoms were characterized by not meeting their gaze or avoiding gaze (de la Asuncion et al., 2015), and abnormalities in the eye gaze perception in which patients misinterpret averted gaze or as being directed toward them and watching them (Hooker & Park, 2005; Seymour et al., 2016). Whether this abnormality is caused by social cognitive deficits or perceptual impairment is unknown; however, this gaze misinterpretation is implied as to the manifestation of the later conscious stage of gaze processing (Seymour et al., 2016).

In the experiment of two healthy persons, Pepper was observed mostly to face one direction (Participant C) and not

the other. This was noticed by Participant D. Participant D seemed less satisfied, especially when she said, “Pepper called my name, but it did not turn his face to look at me.” For healthy people, the value of the gaze contains the message being sent. If a person averts the gaze, it will send the signal of not being willing to interact with another person (Cañigueral & Hamilton, 2019). Therefore, when Pepper did not direct the gaze to Participant D, Participant D perceived that Pepper was not interested in interacting with her.

In a group conversation, sometimes only a particular pair of participants talk to each other, and the other particular side participants lose the opportunities to join in the conversation (Kobayashi, 2016). This condition highlighted the need for improvement in the design of a robot that is expected to be able to gaze at another person when necessary and join in group conversations. Tanioka, Yokotani, et al. (2021) reported that inefficient gaze activity is one of the development issues in the current healthcare robot.

To participate in collaborations with people, robots must not only see and talk with people but also use the conventions of conversation to connect with their human counterparts (Sirithunge et al., 2021). A group conversation is a form of conversation in which three or more participants talk to each other about a topic on an equal footing. In a group conversation, the robot system should understand the conversational situation such as who is speaking, to whom he is speaking, also to whom the other participants pay attention (Matsusaka et al., 2003). A sensor network system embedded within the environment was proposed for these responsive behaviors to build a human-like interaction (Chikaraishi et al., 2008). With the sensor network system, an android was enabled to display human-like behavior, such as turning its head to a person when that person walks (Chikaraishi et al., 2008).

Examples of an experiment on the interaction between an older person and a robot using a telenoid have been reported (Ogawa et al., 2011). As a result, telenoid induced a positive attitude in the older person. Older people moved independently and actively talked, which also affected the behavior of the telenoid operator. Telenoid can nod and make simple gestures and can be held by the older person. Therefore, communication in contact with the robot is possible. When the older person holds a telenoid, the older person can adjust the gaze to the telenoid.

In the case of Pepper, users cannot hold it, so the robot needs to be able to move and direct the gaze to its users. If the gaze and movement of the robot do not match the dialogue partner and dialogue content, it was considered that the person would feel uncomfortable. In this respect, it is necessary to improve the control aspect to perform more complicated movements that change the line of sight without discomfort by synchronizing with the dialogue content and another person.

Alternatively, Pepper is capable of shaking hands and has a more human-like form than telenoids so that Pepper can communicate more closely with humans. With this, it will be possible to encourage the patients to take positive actions (speaks) by using various gestures (such as beckoning and pointing) that Pepper can realize in dialogue. Even if operators are prompted to sing a song, Pepper can supplement it with actions, such as clapping, nodding, etc. It has an advantage over non-human robots like telenoid. In the future, it will be necessary to consider whether the content of the conversation suits the situation and whether the atmosphere and impression during the dialogue are positive or negative. However, since there is little knowledge about the interaction between patients with schizophrenia and robots, it is necessary to accumulate cases in the future.

Furthermore, Pepper was set to interact with two participants in each case in this study. With this situation, researchers can confirm the case of the effectiveness of Pepper interacting with more than one participant, including whether Pepper could meet the gaze. Thus, these two cases could confirm communication characteristics between Pepper and humans, both patients and healthy persons.

The summary of characteristics of communication in this study is presented in **Table 1**.

Table 1 Characteristic of interactive communication between Pepper robot and patients with schizophrenia, and with healthy persons

Characteristic of interactive communication between Pepper robot and patients with schizophrenia, and with healthy persons	
Similarities	
Enjoyed talking with Pepper	
Expected Pepper to entertain, such as singing	
Two ways conversations (Pepper asked questions, and subjects in both cases asked Pepper too)	
Differences	
Patients	**Healthy persons**
Not noticing Pepper’s inaccurate response time	Appreciating Pepper’s gestures correctly, e.g., appreciating Pepper’s nods when talking, and noticing Pepper’s averted gaze
Perceived Pepper as a full automaton that thinks and speaks on his own will	Noticing Pepper’s inaccurate response time Amazed and wondered how Pepper could maintain the conversation

Implications for Nursing Practice and Nursing Research

With the increasing use of healthcare robots for patient care in the hospital and other healthcare institutions, the responsibility to operate healthcare robots during engagements with patients might require nursing expertise. As such, this situation becomes important for nurses to have competency with robotics and understand of communication patterns occurring between healthcare robots and patients, particularly those with mental illness and those not suffering from mental health conditions, as was represented by the healthy persons in this study. Furthermore, nurses are encouraged to see healthcare robots as significant partners in facilitating patient care activities; therefore, nurses need to be educated in quality practice through the integration of these technologies

(Betriana et al., 2020). In addition, nurses are encouraged to be cognizant of multidisplicinary research, in which teams, especially engineers and robotics experts, are well informed about nursing practice so that the future designs of healthcare robots can be more in synchrony with the demands of patient care in specific nursing situations.

Limitations

This study presents two cases of interactive communication between Pepper and patients with schizophrenia and Pepper with healthy persons. Generalizing the findings of the study may not be appropriate because of the limited number of interactive engagements derived from the four participants. However, in this human-robot interaction as a case study, findings showed basic information, which can be useful for improving Pepper's ability for effective use in situations involving different users in the future.

Conclusion

This study described two cases describing the characteristics of communication between patients with schizophrenia and healthy persons in interactive communication with Pepper. Findings showed that the similarity of both cases is participants were found to enjoy conversing with Pepper. However, differences are found in terms of participants' impressions of Pepper. Patients with schizophrenia perceived Pepper as a full automaton that plans and acts based on its own will. Nevertheless, healthy persons were amazed by Pepper's ability to engage in the conversation but noticed that Pepper's responses to questions were often time constraints, and Pepper displayed inaccurate gazes. Findings clarified that Pepper was effective for communication treatment that provides enjoyment for users, including patients with mental health conditions and healthy persons. For the better use of robots in the future, gaze, appropriate response time during the conversation, and entertaining functions are suggested to be improved.

Declaration of Conflicting Interest

All authors have declared no actual or potential conflict of interest.

Funding

This research study was supported by JSPS KAKENHI Grant Number JP17H01609.

Acknowledgment

None.

Authors' Contributions

TT, RL, and SS developed the initial idea. FB, TT, and RL together drafted the initial manuscript. FB, RT, TY, MY, TT collected the data. FB, RL, TT conducted data analysis. TT, FB, RT, TY, KM, YZ, KO, MM, YK, SS, and RL reviewed, revised, and contributed additional information toward the manuscript. All authors critically reviewed and approved the final version.

Authors' Biographies

Feni Betriana, S. Kep, Ns, MNS, PhD is a post graduate student at the Graduate School of Health Sciences, Tokushima University, Japan.
Ryuichi Tanioka, RPT, MA, PhD is a post graduate student at the Graduate School of Health Sciences, Tokushima University, Japan.
Tomoya Yokotani, RN, MSN, PhD is a post graduate student at the Graduate School of Health Sciences, Tokushima University, Japan.
Kazuyuki Matsumoto, PhD is an Associate Professor at the Graduate School of Technology, Industrial and Social Sciences, Tokushima University, Tokushima, Japan.
Yueren Zhao, MD, PhD is an Associate Professor at the Department of Psychiatry, School of Medicine, Fujita Health University, Aichi, Japan.
Kyoko Osaka, RN, PhD is a Professor of Psychiatric Nursing, Department of Clinical Nursing, Kochi Medical School, Kochi University, Kochi, Japan.
Misao Miyagawa, RN, PhD is a Professor at the Department of Nursing, Faculty of Health and Welfare, Tokushima Bunri University, Tokushima, Japan.
Yoshihiro Kai, Dr. Eng., is a Professor at the Department of Mechanical Engineering, Tokai University, Kanagawa, Japan.
Savina Schoenhofer, RN, PhD is a Professor of Nursing (ret), and Board member, Anne Boykin Institute, Florida Atlantic University, Boca Raton, FL 33431–0991, USA.
Rozzano C. Locsin, RN, PhD, FAAN is a Professor Emeritus in Tokushima University, Japan, and Professor Emeritus in Florida Atlantic University, Boca Raton, FL 33431, USA.
Tetsuya Tanioka, RN, PhD, FAAN is a Professor at the Department of Nursing Outcome Management, Institute of Biomedical Sciences, Tokushima University, Tokushima, Japan.

Data Availability

The datasets generated during and/or analyzed during the current study are not publicly available due to ethical considerations but are available from the corresponding author on reasonable request.

References

Aungsuroch, Y., & Gunawan, J. (2019). Viewpoint: Nurses preparation in the era of the Fourth Industrial Revolution. *Belitung Nursing Journal*, *5*(1), 1-2. https://doi.org/10.33546/bnj.744

Bazin, N., Sarfati, Y., Lefrère, F., Passerieux, C., & Hardy-Baylé, M.-C. (2005). Scale for the evaluation of communication disorders in patients with schizophrenia: A validation study. *Schizophrenia Research*, *77*(1), 75-84. https://doi.org/10.1016/j.schres.2005.01.020

Betriana, F., Tanioka, T., Locsin, R., Malini, H., & Lenggogeni, D. P. (2020). Are Indonesian nurses ready for healthcare robots during the covid-19 pandemic? *Belitung Nursing Journal*, *6*(3), 63-66. https://doi.org/10.33546/bnj.1114

Cañigueral, R., & Hamilton, A. F. d. C. (2019). The role of eye gaze during natural social interactions in typical and autistic people. *Frontiers in Psychology*, *10*, 560. https://doi.org/10.3389/fpsyg.2019.00560

Chikaraishi, T., Minato, T., & Ishiguro, H. (2008, 2008). Development of an android system integrated with sensor networks. IEEE/RSJ International Conference on Intelligent Robots and Systems, Nice, France.

de la Asuncion, J., Docx, L., Sabbe, B., Morrens, M., & De Bruijn, E. R. A. (2015). Converging evidence of social avoidant behavior in schizophrenia from two approach-avoidance tasks. *Journal of Psychiatric Research*, *69*, 135-141. https://doi.org/10.1016/j.jpsychires.2015.08.008

He, Q., Hong, X., Chai, X., Holappa, J., Zhao, G., Chen, X., & Pietikäinen, M. (2015). OMEG: Oulu Multi-Pose Eye Gaze Dataset. In R. R. Paulsen & K. S. Pedersen (Eds.), *Image Analysis. SCIA 2015. Lecture Notes in Computer Science* (Vol. 9127, pp. 418-427). Springer International Publishing. https://doi.org/https://doi.org/10.1007/978-3-319-19665-7_35

Hooker, C., & Park, S. (2005). You must be looking at me: The nature of gaze perception in schizophrenia patients. *Cognitive Neuropsychiatry*, *10*(5), 327-345. https://doi.org/10.1080/13546800444000083

Kahn, R. S., Sommer, I. E., Murray, R. M., Meyer-Lindenberg, A., Weinberger, D. R., Cannon, T. D., O'Donovan, M., Correll, C. U., Kane, J. M., van Os, J., & Insel, T. R. (2015). Schizophrenia. *Nature Reviews Disease Primers*, *1*(1), 15067. https://doi.org/10.1038/nrdp.2015.67

Kobayashi, T. (2016). A robot-based enjoyable conversation system. *The Journal of the Acoustical Society of America*, *140*(4), 3005-3005. https://doi.org/10.1121/1.4969316

Kuperberg, G. R. (2010). Language in schizophrenia part 1: An introduction. *Language and Linguistics Compass*, *4*(8), 576-589. https://doi.org/10.1111/j.1749-818X.2010.00216.x

Locsin, R. C. (2005). *Technological competency as caring in nursing: A model for practice*. Indianapolis, IN: Sigma Theta Tau International

Matsusaka, Y., Tojo, T., & Kobayashi, T. (2003). Conversation robot participating in group conversation. *IEICE Transactions on Information and Systems*, *86*(1), 26-36.

Ogawa, K., Nishio, S., Koda, K., Balistreri, G., Watanabe, T., & Ishiguro, H. (2011). Exploring the natural reaction of young and aged person with telenoid in a real world. *Journal of Advanced Computational Intelligence and Intelligent Informatics*, *15*(5), 592-597. https://doi.org/10.20965/jaciii.2011.p0592

Ozeki, T., Mouri, T., Sugiura, H., Yano, Y., & Miyosawa, K. (2020). Use of communication robots to converse with people suffering from schizophrenia. *ROBOMECH Journal*, *7*(1), 1-14. https://doi.org/10.1186/s40648-020-00161-6

Raffard, S., Bortolon, C., Cohen, L., Khoramshahi, M., Salesse, R. N., Billard, A., & Capdevielle, D. (2018). Does this robot have a mind? Schizophrenia patients' mind perception toward humanoid robots. *Schizophrenia Research*, *197*, 585-586. https://doi.org/10.1016/j.schres.2017.11.034

Sabanovic, S., Bennett, C. C., Chang, W.-L., & Huber, L. (2013, 2013). PARO robot affects diverse interaction modalities in group sensory therapy for older adults with dementia. 13th international conference on rehabilitation robotics (ICORR), Seattle, WA, USA.

Seymour, K., Rhodes, G., Stein, T., & Langdon, R. (2016). Intact unconscious processing of eye contact in schizophrenia. *Schizophrenia Research: Cognition*, *3*, 15-19. https://doi.org/10.1016/j.scog.2015.11.001

Sirithunge, C., Jayasekara, A. G., & Chandima, D. P. (2021). An evaluation of human conversational preferences in social human-robot interaction. *Applied Bionics and Biomechanics*, 3648479. https://doi.org/10.1155/2021/3648479

Tanioka, T., Betriana, F., Yokotani, T., Osaka, K., Locsin, R. C., King, B., & Schoenhofer, S. (2021). The experience of older persons with mental health conditions who interact with healthcare robots and nurse intermediaries: The qualitative case studies. *Belitung Nursing Journal*, *7*(4), 346-353. https://doi.org/10.33546/bnj.1541

Tanioka, T., Locsin, R. C., Betriana, F., Kai, Y., Osaka, K., Baua, E., & Schoenhofer, S. (2021). Intentional Observational Clinical Research Design: Innovative design for complex clinical research using advanced technology. *International Journal of Environmental Research and Public Health*, *18*(21), 11184. https://doi.org/10.3390/ijerph182111184

Tanioka, T., Yokotani, T., Tanioka, R., Betriana, F., Matsumoto, K., Locsin, R., Zhao, Y., Osaka, K., Miyagawa, M., & Schoenhofer, S. (2021). Development issues of healthcare robots: Compassionate communication for older adults with dementia. *International Journal of Environmental Research and Public Health*, *18*(9), 4538. https://doi.org/10.3390/ijerph18094538

Ujike, S., Yasuhara, Y., Osaka, K., Sato, M., Catangui, E., Edo, S., Takigawa, E., Mifune, Y., Tanioka, T., & Mifune, K. (2019). Encounter of Pepper-CPGE for the elderly and patients with schizophrenia: an innovative strategy to improve patient's recreation, rehabilitation, and communication. *The Journal of Medical Investigation*, *66*(1.2), 50-53. https://doi.org/10.2152/jmi.66.50

Van Wynsberghe, A. (2013). Designing robots for care: Care centered value-sensitive design. *Science and Engineering Ethics*, *19*(2), 407-433. https://doi.org/10.1007/s11948-011-9343-6

Walther, S., Stegmayer, K., Sulzbacher, J., Vanbellingen, T., Müri, R., Strik, W., & Bohlhalter, S. (2015). Nonverbal social communication and gesture control in schizophrenia. *Schizophrenia Bulletin*, *41*(2), 338-345. https://doi.org/10.1093/schbul/sbu222

World Health Organization. (2019). *Schizophrenia*. https://www.who.int/news-room/fact-sheets/detail/schizophrenia

Cite this article as: Betriana, F., Tanioka, R., Yokotani, T., Matsumoto, K., Zhao, Y., Osaka, K., Miyagawa, M., Kai, Y., Schoenhofer, S., Locsin, R. C., & Tanioka, T. (2022). Characteristics of interactive communication between Pepper robot, patients with schizophrenia, and healthy persons. *Belitung Nursing Journal, 8*(2), 176-184. https://doi.org/10.33546/ bnj.1998