Case Study

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The experience of older persons with mental health conditions who interact with healthcare robots and nurse intermediaries: The qualitative case studies

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Abstract

Background: Caring expressions between humans and nonhuman intelligent machines are futuristic prototypes with healthcare robots as major advocates.

Objective: To examine the experience of older persons with mental health conditions, particularly patients with schizophrenia and with dementia in the interaction with healthcare robots and intermediaries in a transactive relational engagement.

Methods: Two qualitative case studies were conducted using sophisticated audio-video technologies to record the conversation and activities that were carefully documented. Following the procedure for qualitative descriptive analysis, a framework based on the Transactive Relationship Theory of Nursing was employed to analyze and interpret the data.

Results: Three themes were revealed, including feelings for the other, inspiring meaningful responses, and demonstrating expressions of joy. The description of the experience of older persons involved in the conversation with humanoid robots *was feeling for the other while inspiring meaningful responses in demonstrating expressions of joy*.

Conclusion: This study provided initial evidence that the transactive engagements of robots with older persons with schizophrenia and dementia and nurse intermediaries in psychiatric and mental health settings can result in occasions of 'joy' for the patients. These findings suggest that transactive engagements with robots facilitate expressions of joy among older persons with schizophrenia and dementia. However, these findings are not intended to prescribe nursing care actions but to describe the experience of older persons who are in transactive engagements with intelligent machines, indicating the importance and value of healthcare robots in nursing older persons with schizophrenia and with dementia.

Keywords

dementia; mental health; robotics; schizophrenia; technology; nursing; Japan

The rate of aging in Japan is rapidly reaching 27.7%, making Japan a country with the highest aging rate in the world (Cabinet Office, 2018). This situation, together with a declining birth rate, is enhancing shortages of workers,

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including in healthcare services. In order to respond to this shortage, the Japanese government has funded robotics programs, advancing the development of healthcare robots in healthcare settings, particularly for rehabilitative activities (Tanioka, Smith, et al., 2019). In psychiatric and mental health settings, schizophrenia and dementia are common mental health conditions in Japan. Social robots, such as PARO, have been used as companions to provide emotional and social support for older persons with dementia (Hung et al., 2021). It is noteworthy to consider that as persons age, interacting with healthcare robots might be an interesting life experience, especially for those with mental health conditions.

Van Wynsberghe (2016) explained that responses to healthcare robots depend on their many capabilities, such as attributes and characteristics commonly shared by all types of robots. With healthcare robots, Tanioka et al. (2017) found that the older adult population reacts to it very well. For example, Pepper, a humanoid robot manufactured by SoftBank Robotics, with applications made by Xing Company, Japan (Tanioka et al., 2018), can identify humans and react attentively to conversations. In Japan, Pepper has been used for interactive communication purposes, such as to dictate menus in several retail shops, including sushi restaurants, and as an interactive directory in healthcare institutions. In their study using the Pepper robot in geriatric health facilities in Japan, Sato et al. (2020) found that it was necessary to determine the preliminary effects of its use, focusing on considerations to appreciate the use of humanoid robot technologies in healthcare.

Another communication robot is Unazuki Kabochan© or known as Nodding Kabochan. Kabochan has features that enable it to sing, talk, and nod while its owner speaks. Kabochan is also programmed to enable it to call its owner by saying “Grandpa” or “Grandma”. To enable a two-way conversation, the feature of Kabochan can be added with Pechan©, a speaker that can remotely control Kabochan to sing and talk through the dedicated app (Osaka et al., 2017).

Developing healthcare robots for the care of older persons with schizophrenia and/or dementia is relatively new. Some of these developments focus on broadening the context of robotic design to function in situations of dementia in order to provide an important role for family members as informal caregivers (Moharana et al., 2019). Additionally, the robot design included providing new schematic strategies that consider robots in family caregivers’ context, suggesting innovative actions and functions of robots. Still, another form of development design addresses links between the features of robots with the relationship to the phase of dementia, which is often an integral criterion in caregiving activities (Moharana et al., 2019).

Based on the theory of nursing and caring from a Japanese perspective, innovative ideas intended for an aging community can be better understood (Tanioka et al., 2017). A proposed model for future healthcare involves human caring articulated through human-to-human relationships and between humans and nonhumans, particularly healthcare robots with their supportive roles (Tanioka, Yasuhara, et al., 2019). With robots in healthcare settings, new interactions roles of healthcare providers emerge. A new role for nurses and other healthcare workers is that of intermediaries, whose role is to establish communicative relationships between older persons and intelligent machines (Osaka et al., 2017; Osaka, 2020).

The Transactive Relationship Theory of Nursing (TRETON), by Tanioka (2017), explains the practice process relating to transactive engagements between persons (patients) and intelligent humanoid robots. Within the nursing encounters involving healthcare robots, patients and nurses are in transactive engagements. Transactions between persons and healthcare robots are seen as mechanisms to support interventions for ensuring excellent healthcare for older persons in situations of scarce human resources (Tanioka, 2017).

This paper aims to examine the experience of older persons with schizophrenia and with dementia in the interaction with healthcare robots and intermediaries in a transactive relational engagement.

Case Presentation

In this case study, the central feature of the healthcare robots is an intelligent machine capable of performing sophisticated technological skills of care. For example, healthcare robots can perform nursing tasks such as having a directed communication with older persons with schizophrenia and dementia. Previous relationships between patients and nurses were only two-way relationships. However, with healthcare robots, it developed into a three-party interactive transactive relationship (Tanioka, 2017).

Description of the Patients

There were two patients in the study from different institutional settings.

Patient A was a 52-year-old woman diagnosed with schizophrenia and mild early-onset dementia. She was admitted to the psychiatric hospital in 2018. She had problems with being unable to tolerate her hallucinations and troubles with her family because of her behavior. When walking, her body tilted to the right side and was bent over, and she often fell. Other patients often reported that she frequently made loud voices and laughed loudly, especially when she heard voices (auditory hallucination). Pepper was selected for her as she could have a conversation cooperatively and stand in front of Pepper, touch Pepper, and interact with Pepper.

Patient B was a 72-year-old woman diagnosed with severe Alzheimer's disease. She had lived in the institution since September 2019. She needed assistance and close monitoring in performing daily activities, for example changing clothes, and communication. Kabochan was

selected for her as she could do only limited interaction while sitting.

Settings

For one of the cases, data were collected at an institution for older persons and another from a psychiatric hospital in a prefecture in western Japan. The institution for older persons provided daily and long-term nursing care services, particularly ensuring personal hygiene maintenance such as bathing, exercise, meals, and activities of daily living. The healthcare staff provided daily healthcare activities that started in the morning and continued until evening. The other institution is a private hospital for patients with mental health problems such as dementia and schizophrenia. In these settings, both the Pepper and Kabochan were regularly used for physical exercises and recreational activities.

Patient A and Patient B were patients in one of these settings and were familiar with the healthcare robots. They were able and willing to participate and familiar with the two robots, Pepper and Kabochan.

Procedure for Data Generation

Data were collected in November 2019. Digital video recordings were made during similar interactions in two separate transactive care situations. Research assistants were trained to observe and note the interactions among the older persons, Pepper and Kabochan, and the intermediary. During the data collection period, the researchers recorded field notes regarding significant situational events between the older person, Pepper, Kabochan, and the nurse intermediary. The field notes also included researcher reflections during the interactions. Observation notes and recorded dialogues were transcribed and translated into English. Those data supported with recorded scenes (pictures) were analyzed and interpreted carefully by reading and rereading the transcriptions and carefully watching and listening to audiovisual recordings. The significant data were highlighted and grouped into the same identified thematic categories. (Please see Figure 3 for the examples of data used for analysis).

Clinical Examination

The first situation was between Patient A and Pepper. Pepper is a humanoid robot manufactured by SoftBank Robotics, with applications made by Xing Company, Japan (Tanioka et al., 2018). This clinical examination utilized the "Kenko Okoku" Talk application for Pepper to enhance human-robot interaction through improved communication between older people and humanoid robots (Miyagawa et al., 2019). This Pepper has been used for communication purposes and could identify humans and respond to conversations.

The second situation was among Patient B, Kabochan with Pechat, and the nurse as an intermediary. The intermediary facilitated the conversation between Patient B and Kabochan by repeating and supporting the question and answer for Patient B when she indicated that she did not hear the words uttered by Kabochan.

Data Analysis

Data were generated from two nursing care activities involving conversations and observations recorded through sophisticated audio-video technologies. These observations recorded interactions among older persons with mental health conditions, healthcare robots (Pepper and Kabochan), and a nurse as an intermediary. Osaka (2020) has described the role of an intermediary as a nurse or healthcare provider who is "the critical component of a responsive management program" (p. 267).

A qualitative thematic analysis following Lambert and Lambert (2012) was used to analyze and interpret the data. Lambert and Lambert (2012) described a process of thematic analysis as an approach in qualitative descriptive study, in which interviews, written descriptions, or observational recordings are used as data. In the qualitative descriptive analysis, a window to the experiential occasion is not moderated by adhering to established criteria such as saturation point and the number of patients, but by the philosophical underpinnings appreciated as the guiding principles for robust analysis and interpretation of data. In essence, a descriptive statement ultimately answers the research question describing the phenomenon being studied (Sandelowski, 2000).

The framework for the analysis and interpretation was grounded from TRETON (Tanioka, 2017). TRETON clarifies the shared engagement that occurs in nursing situations involving healthcare robots as partners. Generated data using observational and conversational dialogue during a transactive relational engagement between healthcare robots, older persons with mental health conditions, and the nurse as intermediary were analyzed and interpreted. Interpretation of the data emphasized the dialogical engagement context, as described and explained by Vaismoradi et al. (2013). The presentation of the findings was done through a straightforward descriptive statement in which the organization of the results greatly depended on the researchers' understanding of the descriptions and how the data were extracted (Lambert & Lambert, 2012).

Trustworthiness

Trustworthiness and rigor were established through triangulation and detailed transcription (Gunawan, 2015). Triangulation was conducted by generating data from multiple sources, including digital-video recordings, photographs, conversational dialogue, observation, and reflections field notes, which were also transcribed. Detailed descriptions of the patients, the settings, and the data collection process were presented. Audit trails were done by the researchers supporting the derived themes. Additionally, findings, discussions, and conclusions were confirmed to fit the data gathered. The research team consisted of five experienced scholars and researchers with two doctoral students as co-researchers. No conflicting

relationships between the research team members and with patients were found to influence the findings.

Ethical Considerations

The study was approved by the Ethics Committee of the Tokushima University Hospital (# 3046) and the Mifune Hospital Clinical Research Ethics Review Committee (#201180502). Patients and their responsible family members approved their participation, including being audiotaped and having excerpts from transcripts and altered photos from the audio-video recordings used in the research reports. Photographs taken during the data generation were blurred to protect identities.

Results

The themes revealed from this study were derived from all collected data, including dialogue between patients and healthcare robots, observation and field notes, and recorded videos. Results were presented from both situations of Patient A with Pepper, and Patient B with Kabochan, and the nurse as an intermediary.

Initially, when Patient A was introduced to Pepper, she was freely welcomed by Pepper. She stood in front of Pepper and touched its arm while they were interacting. Subsequently, her conversation with Pepper seemed to exhibit familiarity, as if they have known each other for a long-time. In the interaction with Patient B, in the beginning, Patient B showed a lack of interest in Pepper, but after some time, she became more interested and seemed to have enjoyed interacting with Pepper until the end of the session, which could be seen from her facial expressions and laughter.

Findings from both cases revealed observations and reflections that thematically reflected behaviors exhibited as expressions of joy. This was uncovered from the three thematic categories described as *feeling for the other*, *inspiring meaningful responses,* and *demonstrating expressions of joy.*

Feeling for the other

The conversation between Patient A or B and the healthcare robots, whether Pepper or Kabochan with Pechat, revealed the theme of “feeling for the other.” The behavioral displays of patients, such as when Patient A empathetically responded to Pepper complaining about their knees and waist, reflect this theme:

Pepper: “Uh-uh. I’m a robot, but sometimes my knees and waist get tired…, By the way, I am a robot, and I sometimes can’t work.”
Patient A: “I’m sorry to hear that.”

Figure 1 shows Patient A interacting with Pepper robot. When talking with Pepper robot, she stood up in front of Pepper, maintained eye contact, and touched Pepper`s hands as though communicating a sense of comfort, familiarity, and friendship with Pepper.

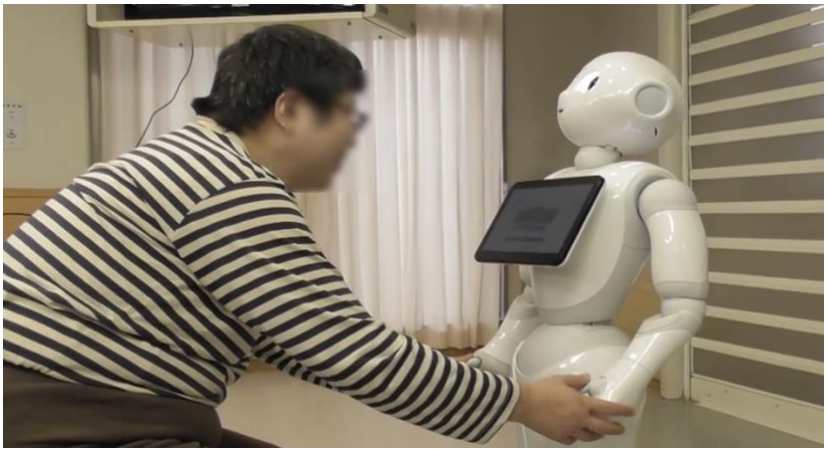

Figure 1 Patient A with Pepper robot

Inspiring meaningful responses

Despite the mental health conditions of Patient A, *meaningful responses* were expressed during the conversation with Pepper, such as:

Pepper: What kind of food do you like?
Patient A: Cheese
Pepper: I see, and I like a fried egg.
Patient A: That is delicious, isn't it?
Pepper: Talking about food is making me hungry.
Patient A: Do you want something to eat?

While Pepper is an interactive robot with artificial intelligence, when its programming includes words and phrases that convey some form of emotion or affection, it might meaningfully respond to patients. In this situation, Patient A's response was appropriate to the statement raised by Pepper. Patient A was shown to be a caring person.

Patient B could also express a meaningful response when Kabochan with Pechat, with the intermediary, did join in the singing to end the session:

Kabochan: Can I sing?
Intermediary: Let's end the session with singing together.
Patient B: Can I sing?

Demonstrating expressions of joy

Patients A and B displayed expressions of happiness, such as tenderly touching Pepper, smiling while raising Kabochan, and stroking Kabochan`s arm. At the beginning of the conversation using Kabochan, Patient B closed her eyes and did not show any interest in the surroundings (Figure 2, No. 1). However, when the nurse, as the intermediary, handed Kabochan to her and encouraged her to talk to Kabochan, she opened her eyes, smiled slowly, and started talking to Kabochan (Figure 2, No. 2). Once Patient B was holding Kabochan, she engaged without hesitation in the conversational dialogue with Kabochan as managed by the researcher using the Pechat application on a smartphone. These situations are captured in the pictures displayed in Figure 2.

Figure 2 Patient B with Kabochan

As Kabochan said, "Lift me up!" Patient B smiled and obligingly raised Kabochan (Figure 2, No. 3). Then, she gently stroked Kabochan`s arm, and Kabochan called her name, "Ma'am. B" (Patient B`s name), and Patient B answered, "Yes" while smiling (Figure 2, No. 4). (Observation note)

In these interactions with Kabochan, Patient B's behavior, as seen through her facial expressions, changed from being withdrawn and eyes closed to eyes open and active engagement. This change shows improvement in her interest in the surroundings and engagement with others. (Observation note)

The evidence of data for analysis derived from representative excerpts of interactions between patients and robots, observation notes, and recorded scenes (pictures) is presented in Figure 3.

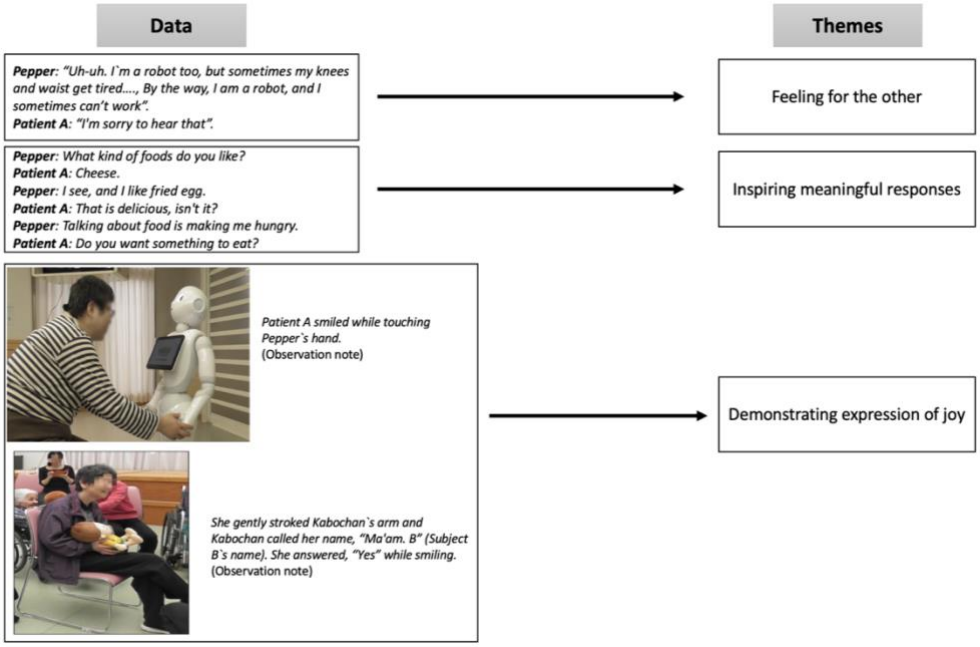

Figure 3 Evidence of interactive conversation between the patient, healthcare robots, and intermediary

Discussion

From the analysis and interpretation of generated data, a constitutive pattern was revealed. The three thematic categories from the two cases were *feeling for the other, inspiring meaningful responses,* and *demonstrating expressions of joy.* These themes revealed the experience of the older persons with schizophrenia and with dementia as an *experience of joy.* It is a relational engagement of 'joy' experienced by older persons with schizophrenia and dementia, the healthcare robot, and the intermediary.

Feeling for the other

Feeling for the other was seen from the interaction between Patient A with Pepper. There was a welcoming feeling freely expressed at the beginning of their conversation. Despite her mental health condition, she could empathize with Pepper and appropriately responded to the spoken statements. The communicative interaction provided the opportunity for Patient A to share her physical complaints and express her concern for Pepper`s complaints.

A study by Miyagawa et al. (2019) showed that interactions between older people and humanoid robots could be mediated. The findings of that study suggested that developing dialogue patterns that enable humanoid robots to sympathize or show empathic understanding with older persons are critically important.

Inspiring meaningful responses

The second theme, *inspiring meaningful responses,* was derived from the conversation in which Patient A seemed to feel safe and comfortable in the environment with a robot in her surroundings. In one observation, Pepper said, "*you must have been popular with boys when you were young*", Patient A said, "*It's wrong*" (meaning that admitting being popular with the boys at a young age may not fit well in the Japanese culture of shame). From this conversation, her expression of humility can be understood. The confidence to reply appropriately to Pepper showed that Patient A expressed her honesty and humility (Mayeroff, 1971).

Demonstrating expressions of joy

The third theme was identified in the changes in physical expressions. Patient B, at the beginning of the interaction with the healthcare robots, did not show interest in her surroundings, even with Kabochan. However, when the nurse in an intermediary role initiated and facilitated interaction by starting to interact with Kabochan, eventually Patient B showed expressions of happiness. Her interest in her surroundings began to increase. Here, the nurse as an intermediary played a significant role in stimulating transactive relational interactions. The nurse was tuned in to Patient B's facial expression and helped to facilitate her expression of joy. The intermediary intentionally observed the situation and managed the conversation (from the smartphone) to respond to a particular condition, such as calling Patient B's name. Controlling the robot`s conversation with human beings during the interaction was previously used in other studies. Similar to this finding, Moharana et al. (2019) found in their research that interaction with robots brought joy and entertainment for older people with dementia.

General Impression

When using social robots for people with inadequate facial processing, for example, people with schizophrenia, clinical symptoms are important considerations. The use and acceptance of humanoid robots may negatively impact persons with symptoms associated with schizophrenia (Raffard et al., 2016). Patient A actively accepted the sympathetic dialogue with Pepper, and she could respond with compassionate words. Patient A lived with symptoms of schizophrenia, yet she could express a compassionate attitude toward Pepper. This may have been related to Pepper's long-term presence in the facility. Patient A's communication with Pepper provided evidence of herself as a caring person and reinforced the presence of her being as a whole person whose potential for healthy engagements is sometimes realized, even in the presence of schizophrenic symptoms. Such empathetic natural language functions of the robot may advance patient rehabilitation in mental health settings (Marti et al., 2006).

This approach used the WoZ environment, from the story of the "Wizard-of-Oz," in which the empathic reactions of human beings to robots were explored, with the robot's verbal and non-verbal expressions being manipulated by unseen humans. These studies showed that the patients displayed some emotional attachments toward the robots (Lakatos et al., 2014; Vallverdú et al., 2018).

These two patient findings illuminate the healthcare robots' value of possibilities in mental health care and the role of the nurse as a facilitator of transactional engagements. Tanioka, Yasuhara, et al. (2019) and Osaka (2020) assert that the healthcare worker as an intermediary person plays an essential role in facilitating communication between healthcare robots and patients. However, the quality of applications for existing healthcare robots is inadequate (Tanioka et al., 2021). The dialogues between healthcare robots and patients often end with errors. Also, the verbal expressions and response timing of healthcare robots are delayed and different from those of nurses (Miyagawa et al., 2019). Despite, as the role of intermediary competency is increased, empathic conversations will create caring environments within the transactive relationships among older persons, healthcare robots, and intermediaries.

The findings of this study can contribute to the development of appropriate nursing care processes involving healthcare robots in situations of mental health conditions such as schizophrenia and/or dementia among older persons (Lee et al., 2018). Healthcare robots need to be imbued with communication functions that are based on caring in nursing. To reconstruct a similar human-like interaction, it is crucial for a social robot to understand humans' needs and modify their behaviors accordingly (Tanevska et al., 2020). Importantly, without guarantees of

safety, and the starter of healthcare robots in health facilities will not continue. Due to the different regulations in each country, it is essential to examine the national policies and related regulations for healthcare robots' use. As the initial stage, developing guidelines for the use of healthcare robots are encouraged (Yasuhara et al., 2020).

These qualitative case studies were conducted with two patients involving two nursing situations. Thus, the findings of this study cannot be representative of all situational involvements with healthcare robots; however, the results can inform healthcare providers as well as robotic engineers on ways healthcare robots can be used in healthcare practice, particularly in settings with older persons who have mental health conditions. In addition, further studies are needed in relation to the use and benefits of transactive engagements with healthcare robots.

Conclusion

This study provided initial evidence that the transactive engagements of robots and nurse intermediaries in psychiatric and mental health settings with older persons can result in occasions of 'joy' for the patient. Understanding the experiences of older persons can inform healthcare providers about prioritizing health concerns of older persons and provide new insights regarding the development of nursing care for persons with mental health conditions. Findings suggest that transactive engagements with robots in the aforementioned settings facilitate the experience of joy among older persons in psychiatric-mental health settings. However, these findings are not expected to be prescriptive but rather indicate the importance of this study as an early step in testing the value of healthcare robots in nursing situations.

Declaration of Conflicting Interest

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

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Authors' Contributions

TT: Conceptualization, data collection, analysis, writing and revising the manuscript. FB: Data collection, analysis, writing and revising the manuscript. TY: Data collection, analysis, reviewing and revising the manuscript. KO: Conceptualization, data collection, reviewing and revising the manuscript. RL: Conceptualization, analysis, writing and revising the manuscript. BK: Data analysis, reviewing and revising the manuscript. SS: Data analysis and interpretation, reviewing and revising the manuscript. All authors agreed and approved the manuscript for publication.

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Data Availability Statement

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

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