Not that uncanny after all? An Ethnographic Study on Android Robots Perception of Older Adults in Germany and Japan *

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Abstract. Intercultural studies are scarce but yet insightful to better understand reactions of older adults to human-like Android robot behavior. They help to see which reactions of participants are universal and which are country specific. Research with android robots and older adults has many results that are based on online research with pictures or on research that has been carried out in labs in one country. Within a Japanese-European research project, we had the rare occasion to work with an android robot in both countries and compare the results. We collected data from 19 participants that were invited in a Living Lab at two universities in Japan and Germany. The data contains interviews, videos and questionnaires and was analyzed with a mixed method approach. Results indicate that the android robots of this study are not in the valley of the uncanny valley theory. We could observe that the older adults and stakeholders from both countries were open to talk to the robot, some even about private topics, while others preferred to use the robot to retrieve information. German participants wished for more gestures, while Japanese participants were keen on the relatively little number of gestures. With this work we contribute to a broader understanding on how older adults perceive android robots and could show that an android robot with its human-like appearance is not seen as uncanny.

Keywords: Social Robot · Ethnography · Living Lab · Appropriation · Self-disclosure · HRI · Android Robot · Uncanny Valley · Older Adults · Assisted Living · NLP · Wizard-of-Oz.

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1 Introduction

The ongoing demographic change will result in an increase of older adults living independently at home, both in Japan and in Europe. Younger family members have often moved to other cities or are occupied with challenging careers. These factors may result in a situation that often leaves community-dwelling older adults with little company, resulting in a growing loneliness and a general lack of external assistance for daily life challenges and personal questions. One possible assistance to counteract these challenges in the future can come from social robots; they are not the same as human interaction partners and have often a different approach on interaction, but are able to provide information, imitate basic conversations and help in contacting other people in the community. Specifically, information on health and assistance in daily life are promising application fields for social robots like android robots.

These robots aim to look like humans in order to create a smooth interaction between the human and the robotic system [21]. But the human-like shape of a robot is only one dimension of an interaction partner. Gestures, movement and conversations are also important to create a good interaction. For this, conversational abilities, gestures and the movement of the robot has to be matched. What a robot says needs not only to be synchronised with the gesture and mimic of the robot but also both should be adapted to the context of the situation [29].

In the study reported here, the contribution aims at a better understanding of potentially needed changes of the concept of the uncanny valley [26], based on a cross-cultural qualitative field study with community-dwelling older adults from Germany and Japan.

2 Related Work

2.1 Older Adults and Robots in Assistive Living and Healthcare

Numerous concepts, projects, prototypes, and established solutions already exist in the field of robotics for older adults. However they are, for the most part, yet to be fully established in the communities where elderly persons live. The spectrum of applications is diverse and ranges from commercial robots for logistical support to robots talking and playing with humans. Robots can not only assist in functional tasks such as bathing (e.g. [30]) or dementia care (e.g. [18]) but also become social interaction partners (e.g. [2, 11, 31, 20]) and improve engagement [28] or they can help to facilitate communication with family and friends [7, 15] or perform exercises for rehabilitation [17]. A factor of success seems to be the participatory design of the software of the robot [12, 11, 14, 33] as well as a long-term approach of development, to constantly redevelop the robotic system. A successfully used framework for the development and redevelopment of socio-technical artifacts such as social robots is the so-called "design case study" mentioned by Wulf et al. [40, 39], which has been used in several R&D projects to explore the effects of social robots on human-robot interaction [13].

2.2 Androids and Uncanny Valley

An android robot refers to a kind of humanoid robots whose appearance highly resembles humans. The skin of the android is made of soft silicon rubber and the face often is copy of a real human face. It can show various facial expressions and the movements are inspired by humans for achieving natural human-robot interaction [21]. Due to the technical limitations and safety issues there is no android robot developed so far that can walk around. Therefore robotics research using android robot focuses on communication and social issues in seated or standing positions [21, 27].

As a literature review [3] reported, there are quite a few studies on social robots applied in the care of older persons in the last decade. They can be categorized in four purposes: (1) Supporting everyday life, (2) Providing interaction, (3) Facilitating cognitive training, and (4) Facilitating physical training. However there is no android robots used in these studies. In order to improve the impressions, acceptance and trust of the robot used for such purposes in the care, it is important to investigate the effects of the human-likeness such as the appearance and the movement. As Mori hypothesized as the "uncanny valley" [26], human-likeness of the robot could induce both positive and negative impressions. The uncanny valley is intensively investigated with a mixed methods approach, however as Wang et al. [37] points out, results on the theory are still inconsistent and further exploratory research is needed.

It is also important to conduct the cultural comparison on uncanny valley, since it is known that people in different cultures could show different attitudes towards robots [6]. Previous research featuring cross-cultural studies on humanoid robots do exist. For example, Haring et al.[19] showed cultural differences on the attitude towards an android robot in Japan and Australia. Trovato et al. showed cultural adaptation regarding greeting choices for more mechanical-looking humanoids [35] in Japan and Germany. However they are neither focused on the interaction with older persons, nor on care/healthcare domains in daily life activities. In this paper, we present our exploratory experimental results specifically on the acceptance of the android robots by older adults in Germany and Japan, which are being developed to assist in daily life activities or inform about health related topics.

3 Methods and Study Set-Up

3.1 Android Robot

The android utilized in this research was A-Lab Android Standard Model AL-G109ST-F for German study and Kokoro Actroid-F for Japanese study. The former has 18 DoFs (degrees of freedom) and the latter has 12 DoFs in the upper bodies, which are all driven by a linear or cylindrical pneumatic actuator. More than half of these DoFs are located in the face to control various facial expressions like blinking, smiling, lifting eyebrows or looking sad, surprised or angry. In addition, the neck can move, that enables the robot to nod, shake her

head or do inclining motions. Furthermore, it has actuators for bending in the waist, and for breathing at the shoulder. The limbs (i.e. arms and legs) are not movable. All of the DoFs are position-controlled with air servoing. The use of air actuators allows silent and robust motions without heating problems and besides only needs annual maintenance. The compressed air is supplied by an external air compressor. The air valves are all installed inside the body. The system runs with a 100-220V power supply. Both robots had a female appearance. The appearance can be changed to male but is stayed as female to have some comparability between both study settings.

Fig. 1: Living Lab at University of Siegen and Tohoku University. (1) Living Lab Siegen with participant. (2) Frontal picture of android robot in Siegen. (3) Frontal picture of Android in Tohoku. (4) Living Lab Tohoku with participant.

3.2 Living Lab & Wizard of Oz

Both studies were exploratory and results are presented in descriptive way. The German study part took place within the University of Siegen. A specific room was created that resembles a cultural typical living room in the social context of the participants. The robot was seated at a table in the middle of the room. Each participant was seated in front of the robot. Two researchers were sitting approximately two meters behind them and controlled the robot from there. The experiment with the participants consisted of two parts. For one it was a conversation that was done with a Wizard-of-Oz [16, 23, 13], the second part was a conversation with the dialog management system that has been developed

by the e-vita project[22]. The conversation with the robot took on average 17 minutes. Topics went from smalltalk to more personal and profound topics. Later on, the topics jokes and politics were added. The duration thereby depended on how detailed the participants were willing to answer and whether queries were made.

The Wizard-of-Oz was an interface on the notebook, that was controlled by the researchers behind the participants and was designed to trigger different topics of conversation. It therefore had several buttons that included predefined questions and answers of the robot. Additionally a text-to-speech field was available that allowed the researchers to include short speech sequences. The interface also allowed to control parts of the body movement of the robot, it enabled us to make the robot express emotions like happiness or sadness or to nod its head or to bow its upper body towards the participants.

In Japan, the Living Lab at Tohoku University was used. The Living Lab parallels the room in Germany, resembling a normal living room space found in a modern Japanese home. Participants sat in front of the robot at a square table, apart from one person who preferred to sit at a 45° angle to the Android. Researchers were situated in the room behind a tall screen that blocked them from the view of the participants.

3.3 Participants

The study was done with 19 participants (15 older adults and 4 stakeholders). The majority of them has been participants in previous research activities and therefore already worked with other robotic systems. The other participants were recruited by the previous participants. The criteria to participate was to be over 60 years old and that they do not have cognitive impairments. Due to the small sample size the results are not representative. We see previous experience with robots as advantage as effects of novelty are less strong and participants are able to make comparisons.

No.	Participant Code	Age	Gender	Position	Country
1	1TN-G	63	f	Participant	Germany
2	2TN-G	71	m	Participant	Germany
3	3TN-G	72	m	Participant	Germany
4	4TN-G	79	f	Participant	Germany
5	5TN-G	78	m	Participant	Germany
6	6TN-G	74	f	Participant	Germany
7	7TN-G	64	f	Participant	Germany
8	8TN-G	81	f	Participant	Germany
9	9TN-G	62	f	Participant	Germany
10	1SH-G	58	f	Head of Hospice	Germany
11	2SH-G	67	m	fmr. Mgmt. Care Home	Germany
12	3SH-G	49	f	Speaker for Social Policy	Germany

13	4SH-G	48	m	Mgmt. Hospital	Germany
14	10TN-J	66	f	Participant	Japan
15	11TN-J	66	m	Participant	Japan
16	12TN-J	72	m	Participant	Japan
17	13TN-J	70	f	Participant	Japan
18	14TN-J	68	m	Participant	Japan
19	15TN-J	68	f	Participant	Japan

Table 1: List of Participants

The participant code will be used in the results to make the statements traceable.

3.4 Data Analysis & Ethical Application

The data of the presented study relies on different sources of data. We used a mixed methods approach [34, 1] to compile it and present here quantitative data from Germany, we further show qualitative results from Germany and Japan and draw comparisons but also similarities between both countries. Quantitative data were not collected in Japan in this session.

For the qualitative part semi structured interviews were done with all participants and later analysed with the reflexive thematic analysis [10, 8, 9], themes of the analysis were for example the role of the robot, conversation topics and emotions towards the interaction. In particular, participants were asked how they felt and if they had negative feelings like fear or uncanniness. Themes of the transcripts were created threefold: 1. deductively based on the interview guidelines; 2. inductively, if certain topics were reoccurring or seemed important; 3. by discussing themes with the authors of this paper. In addition observation protocols and videos of the interaction were analysed, in regard of the reaction of the participants towards the robotic system.

The quantitative data, that was collected in Germany, contained all the Godspeed scales [38, 5], which are often used in studies where the impression from a robot has to be assessed. Reliability and validity of each scale (anthropomorphism, animacy, likeability, perceived intelligence, and perceived safety) were described in [5]. Further data were acquired by using 5-steps semantic scales with adjectives inspired by a previous study [41], with the purpose of assessing the possible feeling of "uncanny" more in detail. Collected samples were taken from 11 participants (M: 4; F: 7, age mean: 69.91; age SD: 7.67) among older adults and stakeholders.

The study received ethical approval from the University of Siegen, with the Android study being a part of multiple studies in the e-Vita project. In Japan, ethical approval was received from the Tohoku University Graduate School of Medicine Institutional Review Board. All participants signed an informed consent form. The data that was retrieved is safely stored at the universities and kept under GDPR and APPI regulations.

4 Results

4.1 Attitudes towards the Android Robot

Reactions towards the Android, after the conversation with it, were overall more positive than negative. None of the participants stated in the interviews that they saw the robot as creepy. Still the views toward the robot were not consistent. While some saw the robot as a machine that exists only to serve, other participants thought of it as a conversation partner.

Likewise in Japan, first impressions were generally positive. Some participants felt that precisely because it was close to a human, they could talk to the android naturally (13TN-J) and didn't feel uncomfortable if they looked at the android generally (10TN-J). On closer inspection during their interactions, participants picked out some aspects, especially with regard to the expression of the eyes (11TN-J, 13TN-J, 14TN-J) as being different from that of a real person, so much that the expressionless face could feel a little scary (12TN-J), or cold like a wax figure (10TN-J).

The appearance of the android was a topic of discussion, in the German setting some mentioned that the robot looks beautiful, one even stating that he would kiss the robot (3TN-G). But not everyone thought so, some mentioned that the behavior and emotions were repetitive and not variable enough. One participant (1TN-G) said that it should learn new gestures to be more human like, for example moving its body and changing sitting positions while talking (1TN-G).

Japanese participants also found the robot beautiful (15TN-J), and were impressed with the quality of the construction (12TN-J). One aspect mentioned by several participants (10TN-J, 13TN-J, 14TN-J) was the physical size of the android. They felt a little overwhelmed or intimidated by its physical presence. The size difference led to the android's eye level being above some of the participants', leading them to feel as if the android was looking down on them.

Regarding quantitative results in Germany, they appear in line with the qualitative results. All Godspeed scales proved to be relatively consistent (Cronbach's alphas were: Anthropomorphism: 0.71; Animacy: 0.88; Likeability: 0.87; Perceived Intelligence: 0.92; Perceived Safety: 0.77). Consistency of Anthropomorphism raises to 0.87 by dropping the [Unconscious — Conscious] item. This should suggest how being machine-like or natural may have little to do with the concept of consciousness, at least for a German subject. Future comparisons with Japanese subjects will shed more light on this matter.

These five scales do not have a reference data to be compared yet, however in terms of absolute values, it should be noted that Likeability was 4.16 (SD: 0.71) and Perceived Safety was 4.00 (SD: 1.15), which are quite positive results. Together with the measurement of feeling uncanny, scary and uncomfortable (all three of them 1.09 out of 5 (SD: 0.30), these results seem to indicate that the response was good in absolute terms of means and standard deviations, and that the perceptions of anthropomorphism, animacy and intelligence do not necessarily have to be high, even for an android.

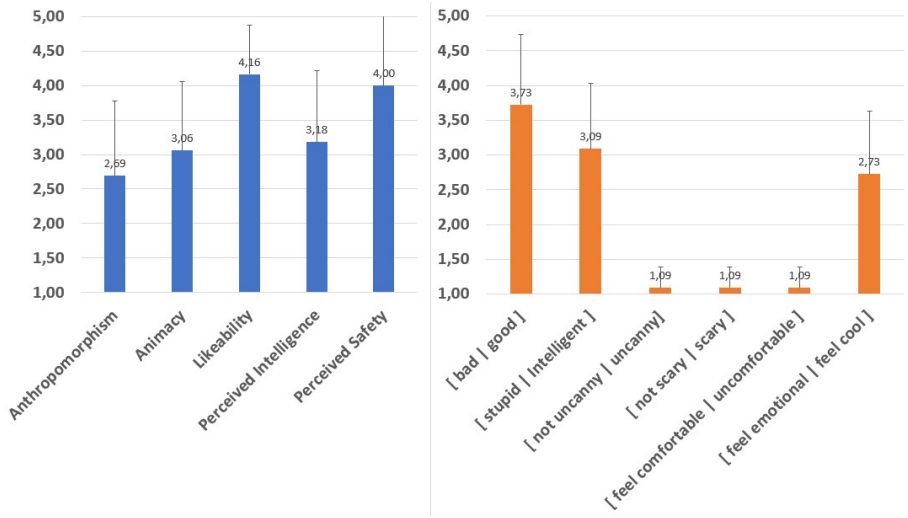

Fig. 2: Quantitative data from the experiment in Germany. On the left, Godspeed scales; on the right, additional questions.

4.2 Expected Role of the Android Robot

One participant stated that he could imagine to have the robot at home on his couch and to talk about topics, he knew he could not talk with his wife, as it would create tensions. Topics like talking about other family members, where he and his wife have different opinions (3TN-G). Other participants declined talking about too personal topics (4TN-G & 5TN-G) The participant (3TN-G) wanted to do this in order to share the burden of knowledge, to have someone to share his feelings and believes about certain family members or situations. 2TN-G and TN1-G stated that they could imagine to discuss with the robot about certain topics they have different opinions about. In this relation 2TN-G exposed that the robot could become part of the family. In this context it was noticed that TN2s conversation duration was, with more than 26 minutes, a lot longer than the average caused through his detailed answers and questions he asked the android. Another suggestion was to use the robot as a foreign language trainer (1TN-G).

But opinions about talking to the android were polarised as the following two statements show:

Several participants in Germany mentioned that they could imagine to get information from the robot (e.g. 1TN-G, 2TN-G). One expressed that the android could help for memorizing or reminding (2TN-G). During the interaction 2TN-G told us that he would like the robot to remind him to drink enough. But also biography work (talking about the past) was a possible task for the robot (6TN-G).

Keen	**Averse**
"So when it comes to family disagreements [...] I could imagine [...] that I simply talk about what is burdening me [...] I could deflate when I am a bit charged." (3TN-G)	*"Then I could rather imagine to talk to myself in the woods."* (4TN-G)

Table 2: Contrary opinions about talking to the android robot

One participant told us that she could imagine the android alleviating loneliness in people living alone by the embodiment of the android and filling the silence with talking (8TN-G). Other participants thought that the robot could narrate fairy-tales or reads out books (4TN-G, 6TN-G).

In the dialog between the android and the participants several topics were used, such as family, incidents in their life, opinions about specific things, wishes, fears. Some participants were not so comfortable talking about very private topics. Especially one participant did not wanted to talk to the robot at all (7TN-G). In the interview 7TN-G stated that she had no interest to have a conversation with the robot as the robots only purpose is to give information or help in daily life, such as giving advice then cooking by looking up recipes. This small interest could also be seen in the conversation duration of only 12 1/2 minutes

In Japan, conversation with the android was over several domains: introduction and greetings, receiving health/exercise advice, talking about family, playing a simple Japanese word game together, and then free talking using the Wizard of Oz feature. Participants tended to respond to the android as a real conversation partner, and not simply a robot. In a free-talk session, they tended to be proactive, and asked all kinds of questions one might typically expect to ask a person, such as asking the android about her favourite foods, or recommendations for local places to see. One male participant (11TN-J) said that he talked to the female android as if she was a real, young woman, and consequently found it a little uncomfortable to chat with her, and stated he may have found it easier to bond with a male android.

Another participant (13TN-J) told us that she would want to talk about problems and her true feelings to the android, and additionally, participant (15TN-J) stated that she doesn't need to care about what she says so much because the android is not human, and would want to talk about her problems with it. Like the participants in Germany, participants in Japan could see the android as being a source of qualified information. Something they could confide in.

5 Discussion and Conclusion

The presented results seem to be in contrast to the theory of the uncanny valley by Mori [26]. The Android that looks strongly humanlike was not perceived as uncanny by the participants that met the android, this contrast to Mori [26]

could be because the data was retrieved in Living Lab settings, while Mori [26] presented a theory. Not in the uncanny valley in the sense that we have expected to have an android robot in the valley, based on its appearance, as some people might forget that it is a robot. After the experiments, we come to the conclusion that the participants always saw the android as a robot and did not at any point saw something else in it. This results are in line with the results of Shimada et al. that could show with the 'Repliee Q2' android robot that it is not seen as uncanny [32]. Further, none of the participants reported the robot as eerie, this might be because it was constantly moving and talking and therefore different than the results of Minato et al. who found out that the robot is seen as eerie if it does not move its body [25].

We assume that some of the results are to be explained because the participants were from the beginning told that they would speak to a robotic system and therefore there was no mismatch to them. It was announced as a robot and they met a robot. Still that did not mean that they did not want to talk to it. Some reported to have joy in the conversation others preferred to use it to retrieve information and others preferred to talk to oneself then to the robot (see 4.2). We believe that this means that the android robot with the used software is to be located on the uncanny valley before the valley [26, 37], something that was also confirmed by one stakeholder (4SH). But as Apple et al. points out, the term uncanny is not clearly defined and might have several meanings [4].

In the intercultural comparison we see many similarities, as participants from both settings reported that they did not feel 'fear' or 'creepiness'. Another similarity was that participants from both countries were sharing private information with the robot about their family and feelings. One distinction can be seen in the role of the robot. The Japanese participants saw the robot as an equal partner and had high expectations towards the system (e.g. quick responses). The German participants (not all) were more sceptical and mostly thought that the robot should serve them. Another distinction is the perceptions of the robot gestures. While the Japanese participants enjoyed that the robot is not displaying a lot of emotions and gestures, the German participants thought that the robot should do more of it and have a higher variety of gestures.

It is worth noting that both androids used in this study were made in Japan, with a behavior and appearance that is grounded in Japanese culture (participants were informed about its origin). Perception of in-group and out-group can typically influence the responses, as an in-group robot may be seen more advanced in terms of mind attribution. This is however not always true, as it was seen in a study with pictures of Geminoids and Japanese high school students [36].

Limitations of this paper are the relatively small size of the sample of participants and that the participants have not been chosen in a representative manner. Further the results are missing the quantitative questionnaire results from Japan and we could only do a comparison of qualitative results. It is also possible that some of the results have been influenced by the Hawthorne effect, as the participants were closely monitored [24].

In conclusion we can say that the android system was accepted as an interaction partner in both settings in Germany and Japan; so from this perspective we could not detect cross-cultural differences. Some participants in both countries/cultures had particular interests on dialog topics like cooking or talking about family secrets, others had specific roles for it and saw it either as an information agent or as a conversation partner. But none of the participants reported after the confrontation with the system that it was creepy. These results that were obtained in the living lab are promising and show us that androids can have real world use-cases. We therefore see potential to intensify research with older adults and dedicated android robots that have been designed in a participatory design process. As a future outlook, institutional care homes could be an interesting use-case and research topic for the future, where android robots could have dialogues with residents in order to counteract loneliness, assist in daily tasks or support a healthier lifestyle.

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