EU-JAPAN VIRTUAL COACH FOR SMART AGEING

Grant Agreement: 101016453

D6.6 – Design Case Studies to Support End-User Appropriation - Updated Version

Deliverable D6.6		
Authors and institution	USI & WASEDA	
Date	M24	
Dissemination level		
PU	Public, fully open, e.g. web	
CO	Confidential, restricted under conditions set out in Model Grant Agreement	CO
CI	Classified, information as referred to in Commission Decision 2001/844/EC	

Document change history			
Date	Version	Authors	Description
2022/11/25	V1.0	Ruben Albers (USI)	First Content Draft
2022/12/01	V1.1	Ruben Albers (USI)	German Case Study Android
2022/12/06	V1.2	Ruben Albers (USI)	Japanese Case Study Android
2022/12/13	V1.3	Cecilia Palmier (APHP)	French Results Gatebox Study
2022/12/13	V1.4	Yegang Du (WASEDA)	Japanese Results Gatebox Study
2022/12/14	V1.5	Ruben Albers (USI)	German Results Gatebox Study
2022/12/14	V1.6	Ruben Albers (USI)	Introduction, Conclusion, Executive Summary
2022/12/20	V1.7	Dana Roelen (IXP)	External Review
2022/12/22	V1.8	Ruben Albers (USI)	Revision
2022/12/23	V1.9	Yegang Du (WASEDA)	Added JP Participant Information
2023/01/09	V2.0	Rainer Wieching (USI)	Finalization of Deliverable

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

Disclaimer

[Full project title] E-VITA – **European-Japanese Virtual Coach for Smart Ageing**

[Short project title] E-VITA (**EU PROJECT NUMBER 101016453**)

[Number and title of work-package] WP6 – Practice-based Design in International Living Labs

[Document title] **Design Case Studies to Support End-User Appropriation - Updated Version**

[Editor: Ruben Albers (USI), Cecilia Palmier (APHP), Yegang Du (WASEDA)]

[Work-package leader: Ruben Albers, USI; Gabriele Trovato, SHIBAURA]

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

Executive Summary

These deliverable reports design case studies about the Gatebox device and the Android. In e-VITA both devices are considered as potential coaching devices for older adults. They both allow interactions with a quasi-social counterpart. The Gatebox can contain virtual avatars whereas the android offers a more humanlike social experience.

In a cross-cultural focus group study, we explore which virtual avatars might be fit for older adults. We find that some avatars reproduce misconceptions and stereotypes. Other avatars are preferred because of positive connotations that participants had with them. In summary, it seems advisable to add a character that embodies the technological nature and abilities of a virtual being while avoiding human stereotypes. A potential choice for this could be a genderless robot.

For the android robot we explored the effect of increased human likeness. In a German study, we look at the potential of mimicking human emotions. In a Japanese study, we compare differences in the perceived aliveness and human likeness by varying the richness of facial expression. Both, the German and Japanese study suggest that robots which mimic human interaction are easier to interact with.

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

Table of contents

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

Lists of Figures and Tables

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

Acronyms and Abbreviations

Acronym/Abbreviation	Explanation
D	Deliverable
WP	Work Package
M	Month
3D	3-dimensional
FR	France
JP	Japan
GER	Germany
GDS	Geriatric Depression Scale
MMSE	Mini Mental State Examination
AU	Action Unit
DOFs	Degrees of Freedom

Introduction

This deliverable follows up on an earlier report of design case studies in D6.5 (M12). In this deliverable we report three design case studies: one about the Gatebox and two more about the Android Robot. Design case studies are the method of choice for the design in cross-cultural living labs because they allow end-users to co-created the developed technologies. The goal of the design case studies in this deliverable is to involve older adults in the design of virtual coaches and retrieve feedback about their experience.

1.1 Objectives of the deliverable

This deliverable aims to inform the re-design of existing coaching devices and interactions with them. Specifically, we investigate potential additions to the avatar selection for Gatebox and reactions to more lifelike interactions with an android robot.

- Gatebox Avatar: For the re-design of the e-VITA platform we are looking for avatars that older adults like to display in their Gatebox. Specifically, we want to know how the appearance of the avatar affects the ascribed role, willingness to accept advice, appropriateness for homes of older adults. To this end, we conduct three focus groups in Germany, France, and Japan.
- Android Robot: As a humanoid robot the android can have facial expressions and display emotions. This could help to better mimic the interaction of humans. In two design case studies we explore how older adults in Germany and Japan perceive the enhanced mimicry.

1.2 Overview of Contents

We describe the respective design case studies in the following chapters:

Chapter 2 describes the focus group study in Germany, Japan, and France to assess the appropriateness of Gatebox avatars.

Chapter 3 describes a comparative study in Japan that juxtaposes android interactions with non-verbal communication (mimic, gestures) and without.

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

Chapter 4 describes an explorative study in Germany to find out whether machines that mimic emotions are perceived as trustworthy or deceptive.

Chapter 5 summarizes the findings and implications for e-VITA.

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

2 Design Case Study Gatebox Avatars (JP, GER, FR)

The pilot study (wave 1) showed that some older adults did not like the avatars inside Gatebox. For the re-design phase we considered the possibility to add additional avatars. We conducted the following case study to find out which avatars could be a good addition.

2.1 Methods

We conduct a focus group study to open a discussion with and among older adults.

To prepare the discussion we made a pre-selection of avatars that embody different characteristics. We retrieved available resources (i.e., images and 3D models) from the internet to visualize potential avatars inside the Gatebox. We then invite older adults at the different living lab sites to see the avatars inside the Gatebox and discuss about their appropriateness (see Annex 1 Gatebox Study Protocol)

We created a questionnaire that should serve as a conversation starter and assessment tool during the focus group discussion (see Annex 2 Gatebox Study Questionaire). Specifically, the questions address roles that older adults ascribe to the avatars, whether they would take advice from the avatar, and whether they would display it in their home. For the roles, we provide a choice of four distinct roles that have been identified for technological others: confidant, teammate, task performer, expert (Ringfort-Felner et al., 2022). This ascription of roles facilitates a better understanding how appropriate a visual representation is for a dedicated task. For example, an avatar that is perceived as a task performer affords the delegation of tasks (e.g., set a reminder)

- The confidant has a social, non-task-oriented relationship with the human being in daily life. It interacts with the human being partly at eye level and pursues a social goal such as relatedness or emotional support.
- The teammate has a task- and goal-oriented relationship with the human being. It actively works together with the human being to achieve a common goal
- The task performer has a formal professional task-oriented relationship with the human being. It is subordinate to the human being and carries out tasks assigned to it.
- The expert has a professional relationship with the human being. It has above-average in-depth knowledge and specialized skills in a particular field, which makes it superior to the human being and supports them with its knowledge.

2.1.1 Participants

We invited three participants from the Siegen living lab to the university where we showed them the characters on the Gatebox. All participants had been involved in prior studies and were familiar with the e-VITA project. Two of them had already used e-VITA coaches, such as the NAO robot, at home.

Table 1 Participant Overview Gatebox Study Germany

Pseudonym	Age	Gender	Living Situation	Former Occupation
P1	67	Male	Cohabiting with life partner	Director of a Care Home
P2	80	Female	Cohabiting with life partner	Judge
P3	79	Male	Cohabiting with life partner	Judge

2.1.2 Results

The German participants preferred the robot and the young boy.

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

Roles. Affordances help to design technological tools that are intuitive to use because they offer a perceiveable instruction for use. When technologies are not perceived as tools, but as counterparts, they become quasi-social. In social relation we use roles to describe a set of potential interactions. For example, it seems obvious to consult a dentist about tooth pain, but less obvious to ask a dentist for financial advice. Thus, the usability of a virtual coach could benefit from a representation that people associate with the capabilities and expertise that the device has to offer.

Therefore, we chose a set of distinct roles to facilitate a discussion among participants about the associated interaction possibilities of virtual characters. In some cases, they ascribed multiple roles to an avatar, whereas in other cases they did not find a fitting role. The participants were particularly reluctant to ascribe the role of confidant. The only avatars they saw fit for this role were older humans or animals. Generally, they attributed a broader range of roles humanoid avatars. Non-human avatars were often seen as more dedicated to specific tasks.

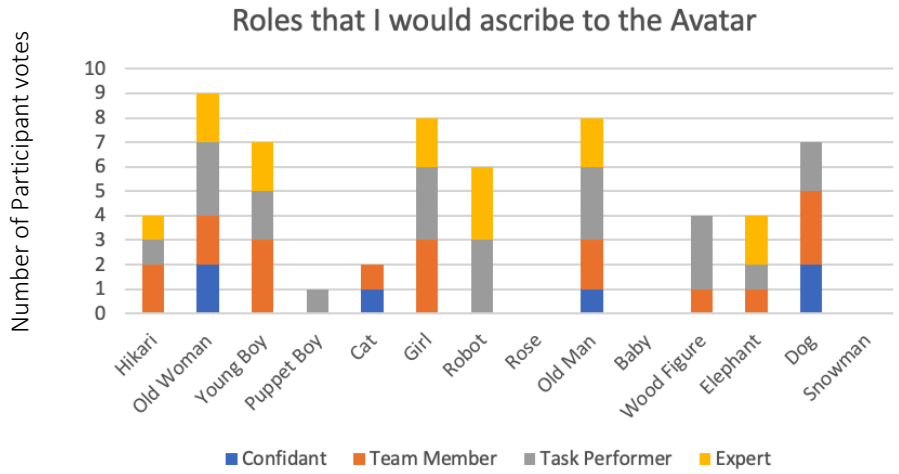


Figure 1 Gatebox Avatar Roles Germany

Advice. The participants discussed whether they would accept advice from each of the virtual characters. For human characters with a younger appearance the older adults ascribed specific areas of expertise. P2: "*It depends in which area she is going to give me advice. When she wants to give me advice around smartphones or computers I would strongly agree*." They were more inclined to accept lifestyle advice from characters that appear to be older because they assumed life experience. Consequently, the age of the avatar did affect the decisions of the participants. P1 explained: "*There is this idea about older people. They live in a different world. I rarely meet older people who think future-oriented. The things they say are based on the experiential world of the fourties, fifties, and sixties. Some of it is right, other things not.*" The robot was more associated with technological abilities, such as retrieving information from online databases.

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

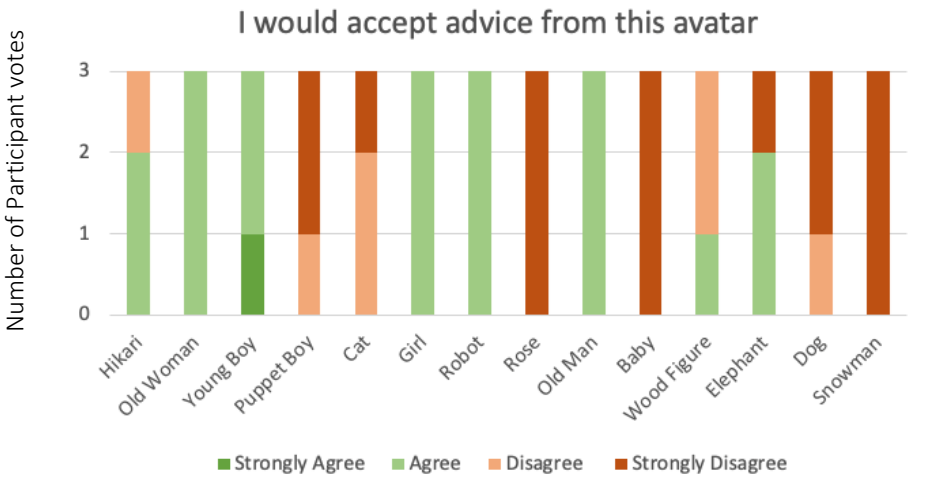


Figure 2 Gatebox Avatar Advice Germany

Home. The participants discussed whether they would display the different avatars in their own home. Their judgement was based on whether they found the avatar pleasant to look at, enticing, or decorative. As a virtual coach they preferred the young boy or robot avatar.

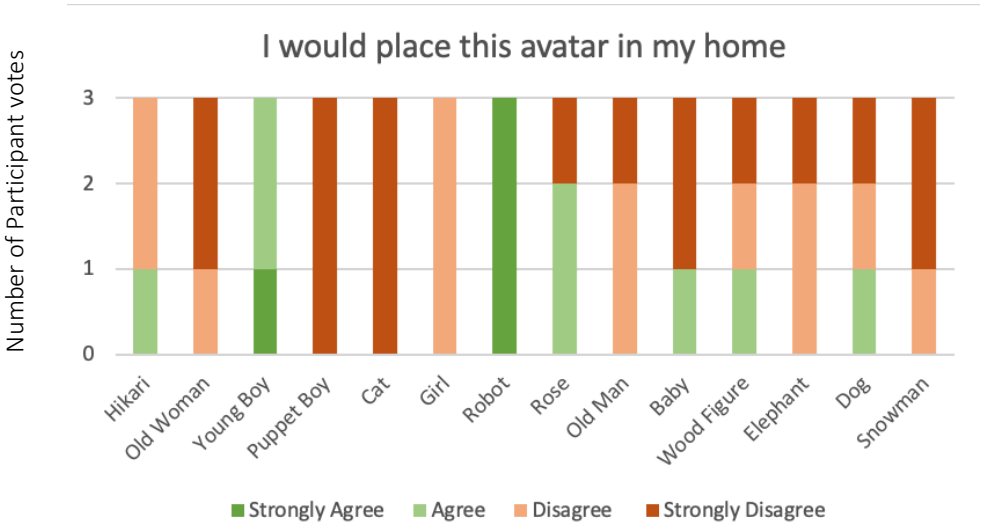


Figure 3 Gatebox Avatar Home Germany

2.1.3 Discussions within the Group

Hikari. Participant's choice to display an avatar in their home was often influenced by consideration for other cohabitants. When deciding whether to display Hikari at home P1 said "*If I think about my wife. No! (laughs)*". P2 and P3 found the Hikari character to be inappropriate to be displayed at home. P2: "*I think that is a questionable avatar. If I think about all the sexual misconduct that is happening. […] If she was dressed differently maybe. It is not her youth. That would be appealing to me. But it is something that might awaken bad fantasies.*"

Old Woman. The participants were divided on the question of gender. While two older adults assumed that the avatar is a man dressed in womens' clothes the third saw it as a woman. Similarly, their perceptions of the avatar differed. P3: "He looks like a respectable person. You would assume that he has knowledge and experience." P2 on the other hand could not take the avatar seriously. P2: "I

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

disagree. For me he seems like a joke. […] It is just ridiculous. The skirt and the socks." P1 then pointed out that he saw the avatar as a woman and P2, P3 agreed that it could also be a woman. However, they claimed that this changes nothing about their opinion.

Younger Boy. Based on the boy's looks the participants thought of him as a smart and reflected person. P1: "*For me it is a nerd. Glasses. Whether in movies or wherever, those short people are often in roles where they give advice. For me he is an expert*". P2: "*He looks smart. […] He seems likeable. His aura is like that. That is why he is a good team member. He calms the team down*."

Puppet Boy. The appearance of a wooden puppet evoked different ideas about the avatar. P3: "*It is not a human. It is a fictional character*." All participants agreed that they would not talk about personal subjects with this character. P1: "*It is like the robots in movies. You give it a task and that's it.*" The facial expression of the puppet did also influence the perception: P1: "*The wide open eyes don't make him look very knowledgable. He seems sceptical, puzzled, as if I would need to help him.*"

Cat. The decision of the participants dependent on their general preferences and experiences regarding domestic animals. P2 "*I do not like cats. And that looks like a cat. However, I could imagine a dog as a confidant*." She further explained: "*We had a dog for 17 years. A crossbreed. That was an awesome animal*."P1: "*We do not have animals at home, neither dog, nor cat. I have many acquaintances, for example, my son. They have two cats. When I did a call with them they were always in the background. They were familiar to me.*" When imagining advice from a cat the participants imagined an anthropomorphic cat like in a tale from Western folklore called "Puss in Boots". P2: "Puss in boots could talk. He also gave advice. He continuously gave advice."

Girl. The younger girl was perceived rather neutral. P1: "*She seems like a typical German. I would see her as a team member. Would also fit to the younger boy and you could also give her tasks. So that she takes care of some things*." However, her age affects how the older adults perceive her and limits the conversation topics. P2: "*For a confidant she is too young. Although, I have nothing against young people. But, the problems that I have would be a burden for her. […] Everything that I have experienced in my life. I would not tell her that.*" Participants could also not imagine to display her at home. P1: "*She is a bit boring. I want something more enticing. If I have guests and show her to them they will say: 'Nice avatar', but nothing more […] that would be different with the first avatar [Hikari]*"

Robot. The particpants associated a machine-like avatar with technological abilities, such as machine learning and retrieval of knowledge. P1: "*As an expert he might have more detailed knowledge. For me robots are linked with computers and everything underneath like artificial intelligence. It becomes better. If it looks for advice it will look up wheather it is right or wrong and subsequently it learns more*." P2 who had already interacted with NAO at home was more sceptical about the expertise: "*If I think about the nonsense that it told us now and then I would have to disagree. But I assume that it is in development and will get better with time. Then I would rather agree*".

Rose. Participants did not find a fitting role for a virtual flower. They saw it more like a decorative object and had difficulty to imagine interactions with it. P1 highlights that typically humans care for flowers and not vice versa. *P1: "The flower needs to be cared for. You become the task performer for the flower."* He further elaborates*: "They can give you something back. When I spend time in nature it gives me a lot. But it is a silent togetherness*. *Not active*." P2 would use it for a decorative purpose. *P2: "Beauty. That is what I associate with flowers. […] It looks quite nice if it is glowing like this."*

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

Old Man. The participants found the old man likeable due to his appearance. P1: "*He is likeable. The way he is holding his hands. Open. Come here. Can I help you. For me he could even be a confidant.*" However, they were divided on the question of taking advice from him. P3: "*The white shirt and the bow tie. And the suspenders. […] He reminds me of an old primary school teacher.*" P1: "*More an expert in questions of life, not necessarily an expert for computers or other technologies. He appears like a teacher, that is right. But could also be a German teacher.*" While they speculated about his area of expertise they all agreed that he could draw on life experience.

Baby. The older adults could derive some joy from it, but did not see a role that it could play in their life. P1: "*I have to care for it. I can get a lot of joy from it. Big eyes. The face. The smile. It appeals to every father*." P2: "*Too young. It is radiant with joy, but in need of help. Then I would have to help.*" The participants saw it as an infant and not suitable as a coach due to the young age. P2: "*What kind of advice should this give to me?*"

Wood Figure. The participants were uncertain whether the avatar was facing them or not. Generally, it was perceived as more suitable for dedicated tasks, specifally tasks that involve human anatomy and movement. P2: "*Sit down. Stand up. Lift your right arm. If I imagine that it would be a yoga trainer, it could be a task performer*." They also saw this as a limitation for the advice the character could give. P2: "*Advice for movement. Faster. Slower. Go. Go*." The missing face lead participants to assume limited ability to make conversation. P1: "*The gestures. The mimic. That is missing.*"

Elephant. The older adults associated cultural narratives with the elephant. P3 "*It is the Hindu God.*" This also involved the ascription of characteristics. P1 "*Elephants are wise animals. They have a good memory. They forget nothing and they hear everything with their big ears*." P3 pointed out that it is an anthropomorphic representation of an elephant. P3: "*It is not a real elephant. Just the head of an elephant on a human body.*" P1. "*Still it represents the character traits of an elephant, wheather it is a god or something else*." P3 replies to this: "*If you think of it as smart and hardworking then it could take on many roles: team member, task performer, expert, not so much a confidant*."

Dog. The older adults ascribed roles that they experienced with a real dog. P2. "*I could imagine it as a confidant. As a teammember, because it finds its place in the family and recognizes me as the lead animal. Task performer also by watching out.*" Consequently, they could not imagine to receive advice from a dog.

Snowman. The participant could not imagine to display a virtual snowman in their home. P1 explains: "*I have no use for that. […] I also do not like winter so much.*" P2: "*It melts to fast. […] Of course you sometimes put those small figurine in your home, but not this*."

2.2 Evaluation in Japan

2.2.1 Participants

In the morning of December 1, 4 women and 1 man attended this survey in the Oberlin University to discuss the Gatebox avatars. All participants are alone and live in serviced housing, and they are all independent in life. They have no previous contact with robots.

First, the participants read the information letter and filled out the permissions (consent forms and right to audio recording of the session).

With the Gatebox turned on and showing different avatars, they were reminded of the context of the study and the purpose of the session. Following this, the different avatar representations were shown

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

with the help of a PowerPoint. After each presentation of an avatar, the participants exchanged among themselves and completed the questionnaire.

2.2.2 Results

European female and male avatars

For the female avatar, they want to see her face more clearly "P1: The face is too small compared to the whole body." They do not like the color of her dress "P2: The color is a little bit…..", and also the design of the dress "P3: The clothes are too rustic". One just does not like the look "P4: Not a good look". And one prefers a more virtual avatar "P5: It's too real".

For the male avatar, they care about the voice "P1: Cannot hear the voice of him. The range of motion is a bit small. Only the upper part of the body can also be fine, but it needs to become a little larger". About the dress, they also mention the color "P2: It looks interesting, and not bad. It would be nice if the clothes were a little more vibrant. I do not like the black background color". They do mind the gender "P4: If I can talk with him it will help. As we all leave alone, we feel lonely sometimes. If I can talk with him, the loneliness will be relieved. Also, I don't want a male character for us women". At last, they give some opinion about the Gatebox "P5: Can we take him out of this box? If we can take him out of this box, it will be better. And I want to hear his voice".

Roles. The participants discussed the roles they would ascribe to each of the virtual characters.

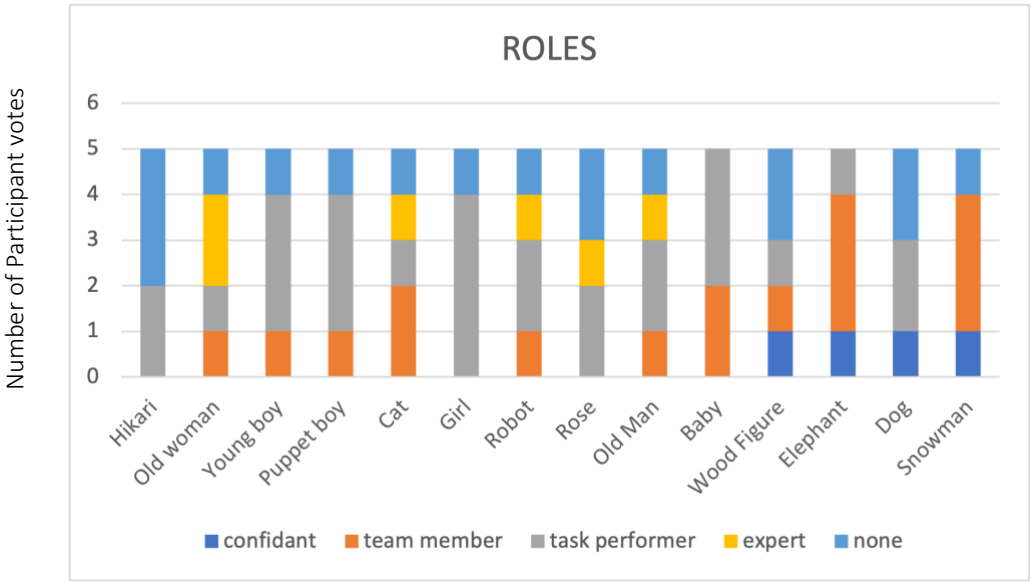


Figure 4 Gatebox Avatar Roles Japan

Advice. The participants discussed whether they would accept advice from each of the virtual characters.

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

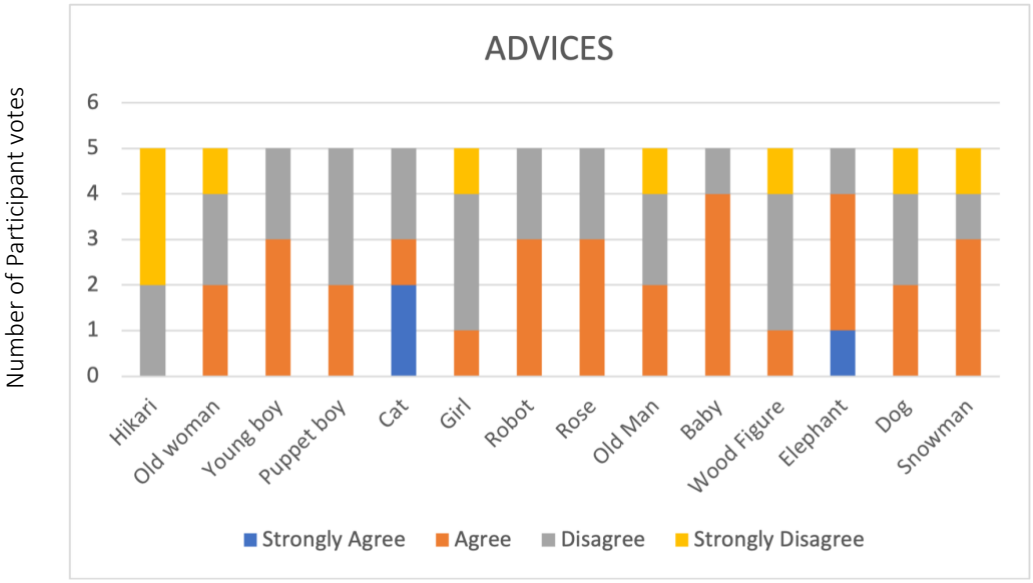


Figure 5 Gatebox Avatar Advice Japan

Home. The participants discussed whether they would accept advice from each of the virtual characters.

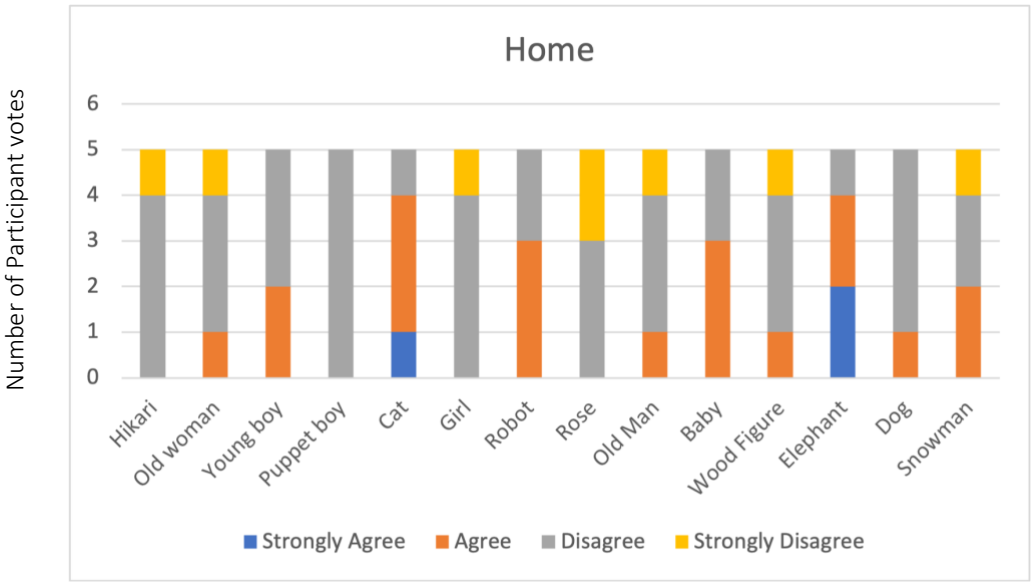


Figure 6 Gatebox Avatar Home Japan

Explanation of their choices

Hikari :

P1: It makes me feel lonely.

P2: For us older people, it will make us feel more lonely.

Old Woman :

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

P1: Not bad.

Young boy :

P1: Love this hat. The red is very conspicuous.

P2: Can it be a little bigger?

P3: It would be good if there were more expressions, and it would be good if the face and body would move.

P4: The glasses are also very good.

P5: Is it made so small to save money? Not a big fan

Puppet boy :

P1: The other clown there

P2: No, this one is really ugly

P3: It looks like it's made of wood and therefore totally inanimate. We don't see why we would talk to him because we would wonder if he could even speak.

P4: That's for kids

Cat :

P1: Can cat talk like human?

Young girl :

P1: He looks younger. And he is better.

P2: He is cute.

Robot :

P1: As a robot, every part of its body can move right?

P2: But it is not a real robot. It is just a virtual robot.

P3: Will he have facial expressions?

P4: If the background is not black, it will be better, and more interesting. It's good to have one thing like that for who live alone.

Rose :

P1: A little more intimacy is better. There is no intimacy.

P2: Can flowers talk?

P3: It's better to have real flowers compared to this.

Baby :

P1: He is very cute. Isn't it good?

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

P2: Simply feel very cute.

P3: My mother is more than 90. If a doll can say welcome back to her or something like that when she comes back from outside, she will look forward to it very much.

P4: It's nice to have that sense of closeness, something that makes people look forward to (going home).

P5: If it can move its eyes and have a cheerful expression, I will like it more.

Wood figure :

P1: Is this person facing backwards? Frontal?

P2: A little weird.

P3: Feet and knees are facing forward, it is forward, right?

Elephant :

P1: Fresh, white, very good.

P2: By far the largest in size.

P3: It's good if it can move its ears and hands, and nose.

P4: I like the ears most, even if it is a doll also makes people feel very close to it. The atmosphere of being together.

P5: Please have a banana.

Dog:

P1: Don't like it, some may like it while others don't.

P2: Makes me feel lonely.

P3: I want to touch, but I can't.

P4: He's not a real dog, I can't touch him, and that makes me feel lonely. Don’t like it.

Snowman:

P1: There are seasonal restrictions.

P2: Snow does not make people feel warm.

Table 2 Selection of Preferred Characters in France

Pictures	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Vote		1		1			**1**			3		2		

The participants indicated the avatars they preferred in order of preference.

Conclusion

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

- People are very concerned about the size of the characters. The vast majority of characters are considered too small. It was suggested that a bust would be better if possible. Because that would make the figure a little bigger and make it possible to see the facial expressions.
- People were more concerned about the movement of the characters and always thought it would be better if there were more physical movements.
- If the characters are real in the real world, such as dogs, flowers, etc, then people don't like virtual characters. People prefer to have real characters.
- Gender role behavior: Women generally agree that they prefer female characters. At the same time, men did not express a clear preference.
- People are very concerned about the facial expressions of the characters. And thought that it could make them feel better if they could see the expressions clearly.
- People also mentioned voices and said that if they could hear them speak, then they could make better judgments.

According to the final vote of the avatars, people like the baby and the elephant avatar. On the other hand, they do not like the rose and puppet boy at all.

2.3 Evaluation in France

2.3.1 Participants

On the afternoon of November 22, 4 women and 1 man met in the Broca Living Lab to discuss the Gatebox avatar. The invited participants were already aware of the e-VITA project.

First, the participants read the information letter and filled out the permissions (consent forms and right to audio recording of the session).

With the Gatebox turned on and showing different avatars, they were reminded of the context of the study and the purpose of the session. At the request of a participant who had not had the opportunity to see the European characters, they were displayed on the Gatebox, which led to a short exchange. Following this, the different avatar representations were shown with the help of a PowerPoint. After each presentation of an avatar, the participants exchanged among themselves and completed the questionnaire.

2.3.2 Results

European female and male avatars

For the European avatars it is necessary to review their gestures, they do not move enough when they speak *"P3: I think during the sentence she says, they should move the body, the arms move, the legs move. She needs to go with the sentences that she's saying*". Moreover, their position appears to be stuck, with their hands at the level of their sex *"P2: It's like a sex cover"*, which does not make us want to interact with them *"P4: It doesn't make you want to question him because you think he's stuck, so no*". The greeting gesture of "Hi" seems very strange and not adapted to the situation. Finally, they are relatively young compared to the participants, which can make the users irritate *"P4: Why would kids give us advice?".*

Roles. The participants discussed the roles they would ascribe to each of the virtual characters.

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

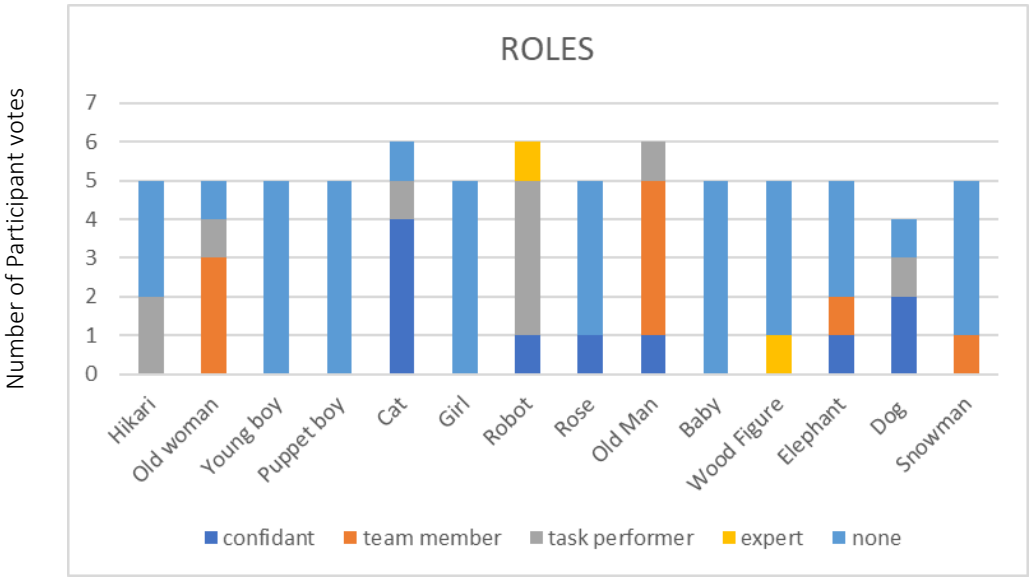


Figure 7 Gatebox Avatar Roles France

Advice. The participants discussed whether they would accept advice from each of the virtual characters.

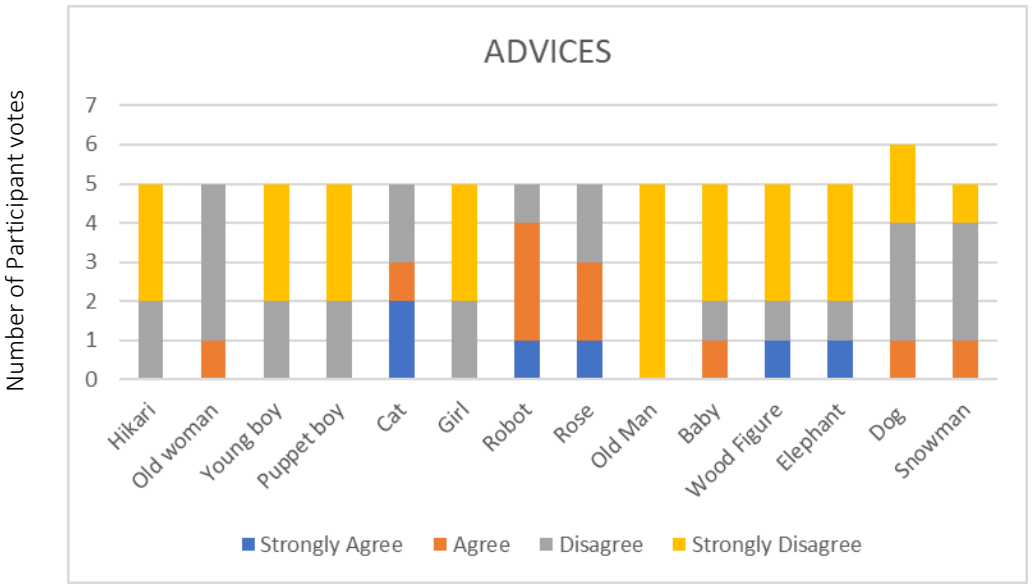


Figure 8 Gatebox Avatar Advice France

Home. The participants discussed whether they would accept advice from each of the virtual characters.

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

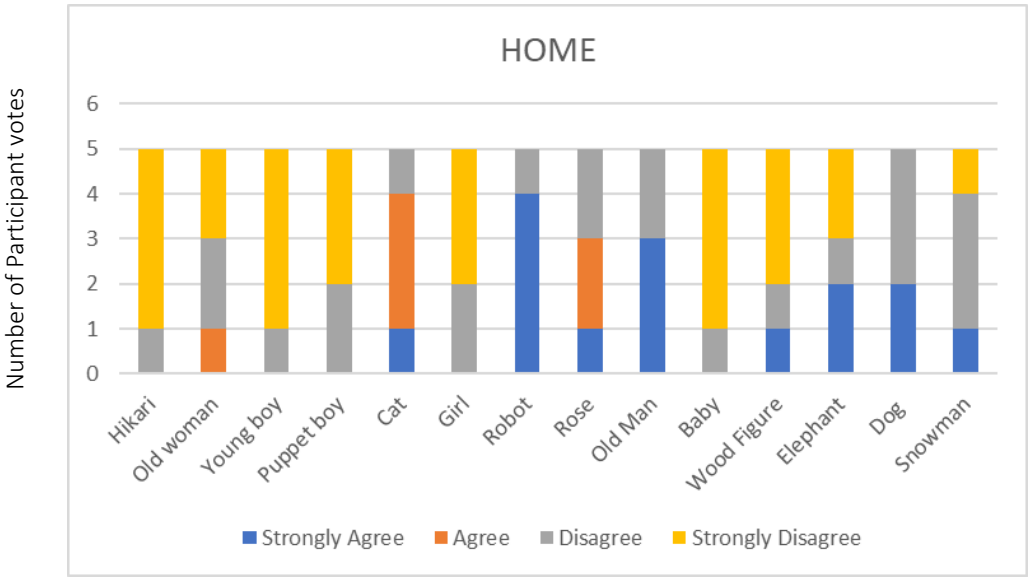


Figure 9 Gatebox Avatar Home France

Explanation of their choices

Hikari : For this avatar, the participant think it's to different from French culture *"P3: It's typical Japanese culture, so it's not French culture"* and the representation of the woman is not adapted *"P1: it's terribly mysoginous […] It doesn't pass at all. A barbie doll"*.

Old Woman : It's also not adapted to French culture *"P4:* It's not really our culture, we agree" *and the participant had difficulties to identified the gender of this avartar* "P1: No that's right the socks yes. No he's transgender, I don't mind but I'm not looking for that either". And they don't think it's a pretty avatar *"P2: But he doesn't have a nice face frankly".*

Young boy : The participants think it's for young people *"P3: It's for the younger generation, all the young people, the children. This would be an avatar for a kid, I could see it in hospitals for sick children for example"*, they don't think it's attractive *"P1: But they're not attractive, that's strange, who's the one who did that?".*

Puppet boy : It's unacttractive *"P4: No, this one is really ugly"*, for children "*P2: That's for kids*" and inanimate "*P3: It looks like it's made of wood and therefore totally inanimate. We don't see why we would talk to him because we would wonder if he could even speak."*

Cat : This avatar brings positive feelings to the participants *"P4: It's warmer", "P1: An animal is always irresistible to me""P2: It's relaxing, reassuring".* A participant said it's positive because it doesn't remplace the Human *"P5: Everything that is far from this idea of replacing a man by an object is niet niet. While there we say well it is an animal*". But this avatar can be improved *"P2: It would be sitting down, it might be nicer, well"* and it's important that he moves.

Young girl : Participants said that this avatar is not attractive *"P5: she is a hermaphrodite", "P2: She's not very feminine eh", "P1: And then more aesthetically. because why represent ugly individuals? It's very strange"*, their wonder who create such avatar *"P3: Yes, but the problem is that if you have been looking for these avatars on the internet, originally they were created for what? They were not created for the functions you want them to do. So that's why it doesn't work"*.

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

Robot : Participants found this idea to be quite interesting. Because there are no age or gender issues *"P3: You want to bring a computer system, which is entirely electronic, into the homes of elderly people, I think it could work totally. Plus there's no male/female thing"*. Improvements can be made like a mouth or removing the helmet "P4: But he can't talk, he has no mouth", *"P1: Yes, this helmet, it's a bit ridiculous"*. But you have to be careful that it is not too humanoid either and be adult *"P3: Nao looks like a child when you see him, but I think that's what's attractive about him, you want to play. I suppose he will have tasks like calendar, taking medicine etc. So it has to be a little bit like a child. So it has to be a little bit more adult. I think that's already well underway*."

Rose : Participants had mixed feelings. For some this rose has no interest *"P2: I don't see what she's doing here alone, what she can bring us."*, others like it but would not know how to assign it a role *"P4; I like it enough. I don't know what role I would give her but I like it enough"*.

Baby : Participants think that it is not suitable for older people *"P3: This one is for the nursery school, the maternity ward"*.

Wood figure : This is strange for the participants, inhuman "*P1: it's totally inhuman*", it has no head, it can not speak *"P3: It's very neutral. In the dialogue, I imagine the dialogue that he would have etc., pff it does not attract. It's not convincing, he can't speak because he doesn't have a face, he looks like a human, but a robot is better. I say better a robot than this"*

Elephant : Most participants thought it was for children "*P3: So this is for the kids*", except one who associated it with Hinduism "*P1 : In Hinduism, Ganesh, since it has an elephant head. It's really the representation of the god to whom we call upon as soon as we have to pass a contest, an exam, any undertaking etc. We need him. That's how I see it*".

Dog: The participants like it but find it much less realistic than the cat *"P4: it is not whole, it does not give an impression of softness like the cat."* "*P1: I don't mind an animal, but I find that it is badly represented"*.

Snowman: This avatar does not seem to be suitable "*P1: Oh no for me it's not cold either but it's not suitable*", unless you are very fancy "*P3: Since you want to put something behind it that will talk, but that will do serious things in terms of taking medication, that you have an appointment with the doctor, do you want me to call a friend and so on? The problem is that you also have to figure out what you want it to work with. Unless you're really fancy, why not"*

Selection of desired characters in the house

Hikari	Old woman	Young boy	Puppet boy	Cat	Girl	Robot	Rose	Old Man	Baby	Wood Figure	Elephant	Dog	Snowman
	4			2		1						3	
				3		2		1					
				4		3		2			1		
		4		2		1		3					
				2						1	3		4

The participants indicated the avatars they preferred in order of preference.

We notice that the cat is mentioned by all the participants, although it is not in the first place.

The robot comes in second place with 4 participants who mention it, including 2, who position it first. Avatars Hikari, Puppet Bot, Girl and Baby, are rejected by all the participants.

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

Finally the Old man, which corresponds to the elderly avatar is also mentioned by 3 participants, 1 of which puts it in first place.

Conclusion

This focus group was very enriching. Some avatars were rejected by all the participants, for other avatars the opinions were rather mixed. Only one avatar, that of the cat, was unanimously approved.

The main elements to remember are:

- An avatar that is neither too young nor too old and that corresponds to the age range of the participants. Indeed, an avatar that is too young does not seem to be adapted to people, they would not appreciate receiving advice/orders from "someone" younger than them. On the other hand, an older avatar could be guilt-inducing by showing that he is healthier than the participant.
- Creating an avatar that resembles humans can be complicated because of the female and male representation. Also judged will be the avatars' outfits which may be perceived as unattractive or too vulgar. For some participants, this also refers to the idea of replacing humans by technology.
- An animal avatar seems to be more easily accepted, because of the positive connotations that it can bring and the fact that an animal does not replace a human being. On the other hand, it may be more intriguing to talk with such a representation.
- A robotic avatar could also be proposed, since there are no connotations of gender, age, or replacement of the human being. However, this representation must be harmonious and adult enough. The representation of a face can be considered as long as it does not look too much like a human. The participants often take as a reference the Nao robot, although it may appear childish.
- It is also essential to pay attention to the types of avatars proposed, which should not be too childish.

In terms of interaction, it seems important for the participants that the avatars move and accompany their words with gestures, thus making the interaction more lively.

In sums, propose several different avatars: An elderly human avatar, an animal, a robot, an object could be interesting and allow the user to choose the one that suits him best.

2.4 Discussion and Implications

The older adults differentiated little between virtual representation and existence in the real world. Consequently, they ascribe the same roles and behaviors that they know from real world equivalents. This tends to limit their acceptance of novel encounters that a virtual avatar could enable. At the same time, it creates an explanation of how something works which is not applicable to technology. For example, an older avatar inside the Gatebox has neither more nor less life experience as a baby inside the Gatebox. Familiar deviations from realism were used to imagine the interactions with non-human characters, such as anthropomorphic animals from tales and cultural narratives.

An interesting cultural difference is that Japanese older adults were open to the idea to receive advice from a baby and anthropomorphic elephant. In France and Germany the participants could not imagine to talk with an elephant and the older adults found it fit for children. The general preference for the characters was different at all living lab sites:

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

Table 3 Gatebox Avatar Preference in different focus groups (FR, GER, JP)

France	Germany	Japan
1. Cat 2. Robot 3. Old Man	1. Robot 2. Young Boy	1. Baby 2. Elephant

Attention should also be paid to avatars that reproduce stereotypes. Especially human characters were often judged by their clothing style, looks, and gender roles. A genderless avatar could be a good addition to the avatar selection in e-VITA.

Further, the perception of characters influenced the anticipated interactions. For example, some older adults would not disclose personal issues to a younger conversation partner because they do not want to burden him or her. Needless to say, this considerateness is not applicable to conversations with technology.

All in all, it seems advisable to add an avatar that embodies its technological nature and abilities. The older adults in the European living labs associated a robot with this embodiment. Ideally, it should also not reproduce stereotypes. Consequently, a genderless robot could be a suitable choice.

Obviously, judgments about the avatars are based on the bias of appearance. Certainly, the perception would change after living with a human or non-human avatar. The participants also emphasized that the actual valuation depends more on the interaction than looks: P3: "*It depends on the quality of the advice given. You would reflect is this helpful or not*"

3 Japanese Case Study Android Robot

3.1 Introduction

Older adults want to maintain independence and therefore rely on cognitive function. Conversation with others is important to prevent social isolation and the depression associated with isolation. Conversations involve cognitive tasks that enable direct companionship and social interaction and are involved in maintaining cognitive function. In contrast to 'language', which is a human communication tool, 'conversation' is an action of communicating using all kinds of movements (non-verbal communication; gestures, body movements, facial expressions, drawing pictures, etc.), which play an important role in inter-understanding between persons (Marangolo & Pisano, 2019). In recent years, smartphone apps, small robots and robots equipped with a watchful eye function have become more accessible for older people to have conversations with. However, while previous research on interactive robots has shown that they can help to reduce loneliness in the elderly (Gasteiger et al., 2021), the non-verbal communication functions necessary for conversation, such as facial expressions and body movements, have not always been considered important.

Figure 10 Android Robot

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

Humanoid robots (e.g., Android Robots) imitate the appearance of humans with artificial materials and mechanical parts. Researchers expect human-likeness to facilitate 'natural' conversations as they possess non-verbal communication functions such as human-like facial expressions, smiles and nodding. However, the effects of this non-verbal communication function on cognitive function, have not been investigated in detail. This study investigates how the non-verbal communication function of a humanoid robot (Android Robot) affects the conversational and cognitive functions of a person, using older persons as participants.

3.2 Methods of the Study

Our experiment aimed to examine the influence of non-verbal communication factors present on a humanoid-robot. This was achieved through a short conversation between participants and an android robot. We conduct a comparative study where one group of participants talks to an Android Robot without non-verbal cues, while a second group talks to an Android Robot that mimicks non-verbal cues, such as facial expression.

Further, we wanted to examine the influence of the presence of non-verbal communication on cognitive functions, investigating this through the android conducting a series of cognitive tests with the participant, by itself (remotely controlled by researchers).

Participants were recruited from local newspapers (Kahoku Weekly), with those who met the eligibility and exclusion criteria hearing an explanation of the experiment, before signing a consent form before the start of the experiment.

Participants were randomly assigned to two groups: the first group would interact with the android without non-verbal movements; the second group would interact with the android with non-verbal movements. Following a 2-week “wash-out” period, the participants again interacted with the android, with the android having the verbal/non-verbal condition that the participants had not yet been exposed to. In this way, participants were exposed to both conditions, balanced for the order of interaction.

Pre-screening tests conducted were:

- Geriatric Depression Scale (GDS) (Yesavage et al., 1982)
- Mini Mental State Examination (MMSE) (Folstein et al., 1983)

On the first day, participants watched a sample video of a person interacting and talking with the android. In the video, the android was moving and making facial expressions. The shown video length is 6 minutes, and the purpose of watching the video was to learn the conversational turn-taking and timing required for interacting with the android. The participants were then introduced to the android, where they were able to practice talking with the android using a reference manual, to ask questions to the Android.

Following the practice session, the first intervention session began. Participants initially had a period of free-talking with the android, with both the android and the participant asking and answering each other questions. This period lasted around 5-10 minutes.

Immediately after the conversation period, the android began a series of cognitive tests. The tests administered were:

- Wechsler Adult Intelligence Scale (WAIS-IV) (Drozdick et al., 2018)
- Wechsler Memory Scale-Revised (WMS-R) (Elwood, 1993)
- Frontal Assessment Battery (FAB) (Iavarone et al., 2004)

After the completion of the cognitive tests, an initial interview was conducted. The participants were then invited again to the Institution two weeks later, where they followed the same procedure, having an initial conversation with the android, and then conducting the same cognitive assessments.

3.2.1 Participants

6 persons were recruited for the current experiment. Participant information is as per the below table.

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

Table 4 Participant information.

ID	Age	Sex	Working Status	Social participation	Highest Education Level	Living Situation	Physical activity
A001	71	F	Working	Yes	University	Alone	In the past
A002	73	F	Not working	Yes	High-school	Alone	Yes (current)
A003	75	M	Not working	No	High-school	Spouse only	Yes (current)
A004	76	F	Not working	No	High-school	Other	Yes (current)
A005	76	F	Not working	No	University	Spouse only	No
A006	74	M	Not working	No	University	Other	Yes (current)

3.3 Results

The major answers from the participants are described below. Five out of the six participants had never interacted with either a conversational robot, or a humanoid robot before. One participant had been previously introduced to the small robot Nao in a separate activity.

3.3.1 Interview following Session 1

Q: Do you have any comments about the movements of the android?

[Android had non-verbal communication gestures]:

A002: It doesn't move its hands … but the words are clearly coming out.

A004: The fact that it can move like that, I was really surprised. I feel like it's looking at me.

[Android did not move, using voice only]:

A001: Its voice is difficult to hear; the words are difficult to hear - what exactly it is saying. If there were visible characters somewhere, it would be very clear.

A005: I didn't think it was moving, it felt a little strange. It was difficult to accept.

A006: It would be even better if her hands also moved, she would be closer to humans then.

Q: How were the directions from the android during the cognitive tests?

[Android had non-verbal communication gestures]:

A002: It was easy for me to understand.

A003: my eyes are getting a little worse, and difficult to see, so it would be nice to pick up information from the android through speech, getting information through the voice. and if it could teach me things, like what I should do with my garden. I'd like to use it instead of my smartphone.

[Android did not move, using voice only]:

A001: There were times it was difficult to understand.

A006: I have been asked these kinds of questions before by a human, so I think I was also able to accept the android doing so. It might be a nice idea if the android could also confirm, oh you don't understand?

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

Q: How was it to talk to with the android during the free conversation period?

[Android had non-verbal communication gestures]:

A002: It was difficult with the timing… I thought it's better to answer straight to the point, so I left out a lot of other information when talking.

A003: There were some times I couldn't understand … the intonation of the words; and because there's no feeling in the words. But maybe, I can get used to it over several times. Although it felt like something is different than a usual conversation.

A004: I was able to talk with the Android.

[Android did not move, using voice only]:

A001: It was not easy. when there are periods of silence, I am not sure if it's waiting for me to speak, or thinking by itself, so I don't know if I should speak, or wait, so I feel a bit perplexed, it's difficult.

A006: There were some words I couldn't understand, but over 90% I could understand okay.

Q: How was talking with the android different than talking to a human?

[Android had non-verbal communication gestures]:

A002: I didn't think it's different to talking with a human, because I know the android is being operated by humans behind the scenes; I know the android isn't making the decisions to reply by itself.

A003: It's very close to a human… I would like a bit more feeling inside it. Like, if it talked in the way a woman talks, it might be easier to talk with it. But it's a great device.

A004: Talking with a person, expressions can change in an instant. That's difficult with the android, although I'm still amazed by how its eyes move, and its face moves a little.

[Android did not move, using voice only]:

A001: The android didn't have warmth in its words; I couldn't see the human aspect in it, what kind of person it is. As it's my first time, I'm also not used to it, it was a bit business-like; ordinary conversation is difficult.

A005: When humans talk to each other, we look at each other's eyes and mouth, so for example, even if you couldn't quite understand what someone is saying, you can look at their mouth, and use their intonation and expression to make it easier to understand. With the android, it's only sound, so it just becomes if I could hear or not hear. I'm wearing this hearing support, and I can hear everything you are saying now, but with the android it was difficult to pick up the words… the pronunciation is not like humans - that was difficult.

A006: When I am not able to answer, or when I am a little bit confused about the question that she has asked. Well, would it be good if the android could ask a more in-depth question or give some advice or something like that, as humans can do; as in everyday conversation.

Q: What kind of robot would make people want to talk with it? What's important in making you want to talk with a robot?

[Android had non-verbal communication gestures]:

A002: If the conversation could be a bit deeper, if it could ask the deeper reasons behind the things I say

A003: I want it to smile! Although I guess if I could get used to it, I can talk with it.

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

A004: As for anything I would want to add, maybe expressions? Although the fact it's eyes move is already wonderful. If it gets any better, humans won't be necessary!

[Android did not move, using voice only]:

A001: When humans want to talk, there are also gestures, as there weren't any gestures with this android, I couldn't understand what kind of feeling the android is having, so I was a bit uncertain. I would like more reaction

A006: If we can have everyday conversations, even about things like the weather, food, and things about daily life, that would make we want to talk with it.

3.3.2 Interview following Session 2

Q: Did you notice anything different this time with the Android? How did it feel to talk with the Android this time as compared to last time?

[Android this time used voice only, previous time had non-verbal communication gestures]:

A002: I am not sure… Oh that's right, she is not moving today. I didn't notice any difference in the ease of talking. It felt like there is someone there talking to me, although her expression didn't change.

A003: I feel like I was able to talk more smoothly this time compared to last time, otherwise, I didn't notice any major changes. It seems like her eyes are looking down the whole time today. Last time I felt like she was looking around more. Actually last time I felt it was scary, that she was looking directly at me. It gave me a little pressure.

A004: Today she wasn't blinking, right? Her mouth also didn't move. I was wondering what happened to her! I still thought she is amazing. I think of her as a robot, so if she doesn't move, it seems natural to me. Because she was blinking last time, I was really surprised.

[Android this time had non-verbal communication gestures not move, previous time used voice only]:

A001: I feel like this time, its eyes are blinking. It's line of sight seems to move, was it like that last time too…? It was easier to talk with it this time. I felt like it was caring about me a bit more than the first time. I think her clothes are the same as the first time. Her lips move… did they also move last time, no right? So it feels that she is a bit more expressive.

A005: Her eyes are moving, and her face too. Last time she wasn't moving at all. Having movements is a little better than her not moving at all. Her mouth movements are still not the same as a human's in forming the shape of the sounds, but I understand that's difficult for a robot. I didn't find it had much bearing on making it easier to talk with her.

A006: I'm totally used to talking with the Android now. It didn't move last time, right? Last time there were no expressions, and this time its eyes are moving, so I thought it's totally different. The fact that it has these movements and expressions, it made me feel like it has some emotion. It was easier to talk with it because I'm used to it.

Q: After interacting with the Android twice, are there any areas you still feel are lacking?

[Android this time used voice only, previous time had non-verbal communication gestures]:

A003: Her eyes can move right? This time her eyes didn't move. I tend to feel nervous talking to females anyway. Can she also show an expression of anger? Although, I think she is fine as she is, without more expressions. Maybe her cheeks could get flushed, that might be interesting. I would like her neck to move again and nod. Also, it's a little strange if she only blinks without other parts of her expression changing.

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

A004: I'm still so impressed by the android. Can it smile? That's right, it smiled a little last time. If there were a bit more expressions, it might be nice, more natural.

[Android this time had non-verbal communication gestures not move, previous time used voice only]:

A001: I still have times when I can't understand the words Ms Ando is saying… it may also be the words in the test themselves, I would need to see the characters to understand. It may not be the fault of Ms Ando.

A005: I saw a TV program about a company making 3D robots, and they included motors to make the movements as smooth as possible. It looked just like, the very cute doll is moving by itself - dancing. So smooth movements could be nice.

A006: I really think if, in addition to the face, if its hands could move. If its hands moved, it would be much closer to humans.

Summary of short questionnaire conducted following the second session

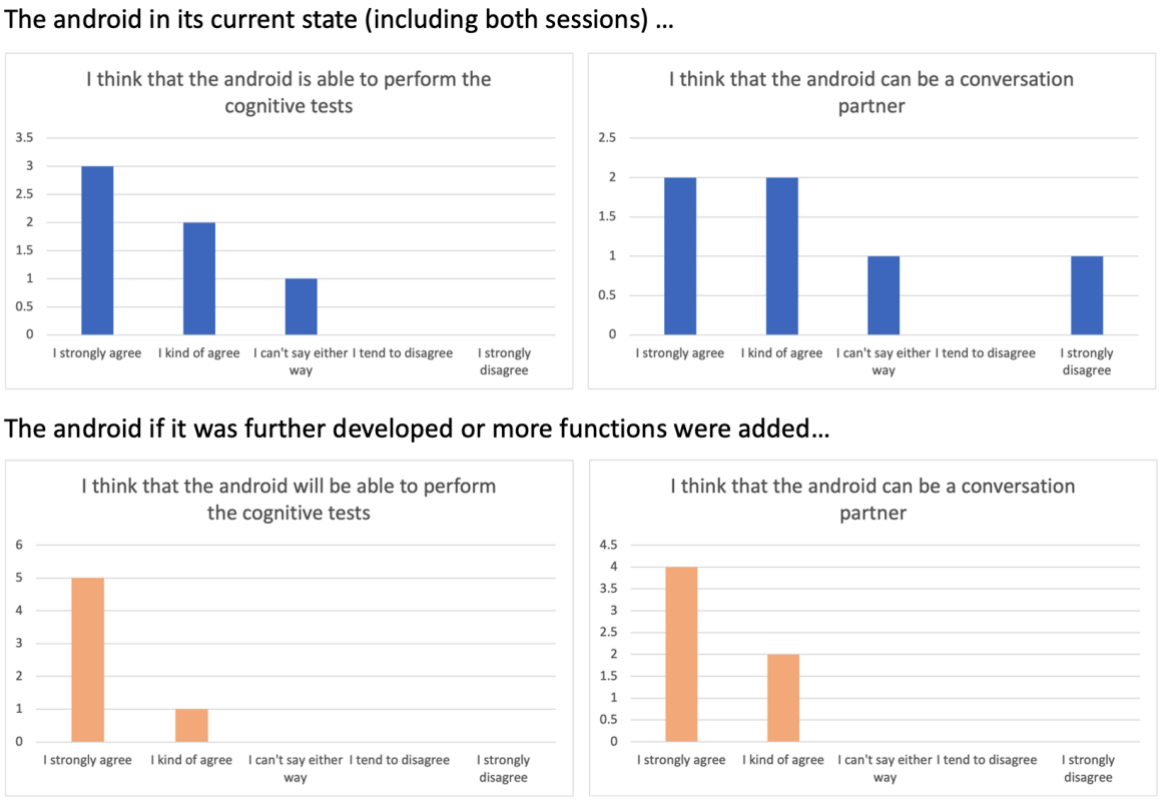


Figure 11 Responses to a short questionnaire.

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

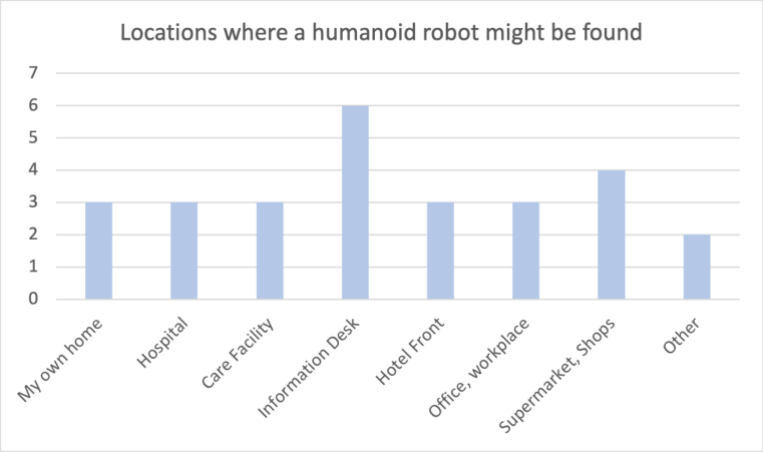


Figure 12 Responses to the question, where do you imagine androids such as the one interacted with today, being placed in society? "Other" responses included: a library, the park.

Summary of Cognitive Test Scores

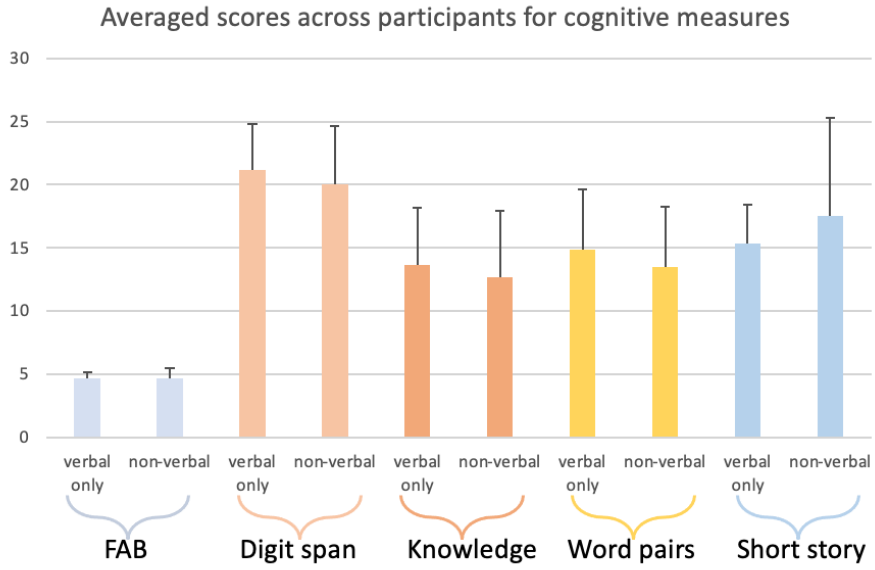


Figure 13 Cognitive test score means and standard deviations. There were no statistical differences between the two groups (two-tail t-test) for each cognitive measure.

3.4 Conclusion and Implications

Participants were generally positive towards the android, and appreciated its realism and construction. They found the android's speech to be an obstacle in understanding what the android was saying, due to the intonation of phrases and some words. This is a particular problem in standardized testing, as the contents are established words, so there is no opportunity to re-phrase the word or expression in another manner. Standardized tests conducted by robots may need to be more flexible than those conducted by humans.

In the case of interaction when the android was entirely still, participants recognized this lack of movement, and appeared to find it difficult to communicate with the android, in terms of not understanding if the android was waiting, thinking or had not heard them. They especially noticed this lack of expression when considering how talking with an android is different to a human. On the other hand, the interaction in the case with non-verbal

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

movements, participants exposed initially did not tend to explicitly mention these factors as contributing to the success of the conversation. Indeed, they commented that they would like to see more movements, and expressions such as smiling. In particular, movement of the hands was a feature strongly requested by participants.

After the wash-out period, participants picked up on the presence of, or lack of, movements such as blinking and mouth moving. Participants who interacted with the android their second time with non-verbal communication features seemed to find it easier to talk with the android, and generally preferred movement to no movement at all. However, participant A003 in the reverse case (voice only the second time) said he found it easier to talk the second time, and A006 also explicitly mentioned it was easier because he had got used to the android, so this could be a factor in the responses, rather than the presence of expressions. Further, A003 said that her eyes looking at him (in the non-verbal communication case) gave him a feeling of pressure, and A005 had the expectation that a robot would not be able to express emotions.

There were no statistical differences between the two groups across the conducted cognitive measures. This may be for two reasons. Firstly, the sample size is small. The experiment could be continued with more participants to increase statistical power. Secondly, there are several limitations associated with the current status of the technology of the android. The breadth and depth of non-verbal expressions of the current android is quite limited. The expressions and movements made by the robot are slight, and so difficult to recognise unless one is looking directly at the android. When the robot smiles, this interrupts the lip movement for speech, leading to the android smiling while the speaker is concurrently playing words. The smile is a slight movement. Other than a smile, expressions such as a frown and a surprised face are possible. The surprised expression is noticeable, but was found to be difficult to deploy in the conversations with older adults as an appropriate natural response to their statements. Similarly, the frown, being a negative reaction, was almost never used. Hence, the smile was the major expression deployed in the study. Further, as has been described by participants and above, the hands of the android do not move at all. Gestures and emotional expression using hands is a major component of non-verbal expression, and so this lack of hand involvement is a major limitation in the comparison. The differences between the two cases could be further differentiated through technological improvements.

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

4 German Case Study Android Robot

In our time there is a surge of technical improvements, making it appear like every aspect of the human condition may soon be replicable by a robot. Still, emotions are seen as one of the aspects that separate humans from machines. They are often seen as the opposite of reason, as a contradiction to objectiveness and pragmatism. What happens if these two diametrical forces are combined? Can there be robots that are emotional? May emotions even be the prerequisite to achieving a sense of connection between humans and machines? And how do people react to machines that mimic feelings? Are they read as trustworthy or fake? In this report, we summarize the current state of the art in regard to emotions and social robots. A study in which humans interacted with an android that could display emotion was performed and we want to investigate how people react to such robots and which emotions they see as desirable. Lastly, it is discussed how they would rate a future in which robots display emotions, especially in regard to the use of such robots within care homes.

Emotions are integral to developing empathy. Sadness, joy, and fear are used by humans to determine that the creatures they interact with are deserving of respect and care (Torre et al., 2020). Still, we also developed fine-tuned abilities to notice signs of disingenuousness (Reed et al., 2018). Next to tone and gestures we mainly use facial expressions to detect and infer the emotions of our human counterparts (Crivelli & Fridlund, 2018). In order to shed light on how humans in different age groups react to the display of emotion by a human-like robot, we let people interact with a very realistic android in a Wizard-of-Oz study. Through interviews and surveys, we captured the impression these basic emotions caused in elderly people as well as other stakeholders and investigated their opinion on using emotional androids in care homes.

4.1 Background

In human-to-human interaction, the expression of emotions plays a very important role as they allow people to build empathy and understanding (Torre et al., 2020). A phenomenon called emotional contagion describes the fact that emotions can even be transmitted to another person (Hatfield et al., 2014). This often includes facial mimicry, the copying of a facial expression that was displayed by a counterpart (Rymarczyk et al., 2019).

Emotions can be classified into two distinct groups. Primary emotions are more rudimental and often describe a spontaneous and intuitive reaction toward an event. Primary emotions are joy, sadness, anger, fear, disgust, and surprise. They also have very prominent facial expressions associated with them that are understood across cultures. Secondary emotions are less universal and therefore more likely to be learned through society. Examples of secondary, more nuanced emotions are guilt, regret, pride, and jealousy (Ekman, 1992).

Across cultures joy and happiness are associated with smiling, sadness with frowning and tears, anger with furrowed brows and lifted upper lips, and fear with widened eyes and a gasping mouth (Du et al., 2014). The facial expressions that signal anger and fear are very similar to those that signal disgust and surprise respectively and studies in developmental psychology could show that young children are more likely to recognize anger and fear in expressions that are ambivalent between the two. That is why some sources combine the six primary emotions further to form only four archetypes: joy, sadness, anger & disgust, and fear & surprise (Jack et al., 2014).

There are conflicting views on what the purpose of emotions - or rather their display - is. Basic emotion theory (BET) sees facial expressions as direct consequences of internal states, like the primary

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

emotions. A smile would therefore always be caused by the feeling of happiness. In contrast to this, the behavioral ecology view (BECV) sees emotions as social tools that are used consciously to influence social situations (Crivelli & Fridlund, 2018).

Smiles for example do not solely communicate an internal state of happiness, but can also be seen as a tool to influence an interactant to engage with us (Crivelli & Fridlund, 2018).

Of course, smiles can be an expression of joy or happiness, i.e. feeling pleasure, but people also often smile when feeling embarrassed. Generally, the most common reason for a smile is the intention to communicate affiliate intent, meaning that we smile to show our engagement and positive attitude towards the recipient (Fang et al., 2020). They can serve as social rewards to the one who sees them, triggering a reaction of the brain's reward system and often prompt us to mirror the expression, causing the reaction so fast that it can even be considered involuntary. Here emotional contagion elicits the rise of happiness in the other person as well (Beamish et al., 2019). As we interpret them as someone having good intentions in regard to us seeing smiles can even increase how much humans trust a statement (Reed et al., 2018).

As emotions play such an integral part in how humans act and understand the world around them, there have been multiple attempts to incorporate them into robots as well. Parisi & Petrosino simulated robots with different needs, like shelter, food, or mating, and could show that robots that had emotional circuits embedded into their neural networks took more effective actions to reach their goals. This showed that it might be beneficial to equip robots with an internal approximation of emotion to help guide their decisions (Parisi & Petrosino, 2010).

Coeckelbergh contemplated the effect feelings can have on morality. The capacity to experience emotions and detect as well as mirror the emotions of others is often understood in close relation to the capacity to act morally. Coeckelbergh argues that robots will most likely never be able to have real emotions or consciousness and can therefore not develop morality in a sense that is adjacent to the way humans develop morality. Despite this, he does go on to argue that the appearance of emotions alone may be sufficient to successfully integrate robots into society and meaningfully include them, as morality can also be rule-based (Coeckelbergh, 2010).

The display of emotion can be used by robots to communicate their internal state in a way that is familiar and therefore easily understandable by humans (Löffler et al., 2018). Successful human- robot-interaction has to be based on an understanding between the counterparts. It is necessary for the robot to understand and infer the emotions of its human counterpart as well as it is important for the human to be provided with a familiar social setting (Azeem et al., 2012).

There is already a lot of very insightful research shedding light on the beneficial effect of displayed emotions in robot-human interaction within the service industry. It could be shown that the display of joy and surprise by service robots positively influenced potential customers (Chuah & Yu, 2021).Correia et al. showed that especially in group settings the display of group-based emotion had a very positive effect on likeability and also increased trust and identification with the team that consisted of robots and humans (Correia et al., 2018).

As it is rather complicated to artificially create realistic facial expressions, many researchers explored different channels to convey emotions (Häring et al., 2011). Haring et al. tried communicating emotions through sounds, body movements, and even eye color using a Nao robot but concluded that the latter

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

was ineffective, as it was too far removed from the way emotions are naturally displayed (Häring et al., 2011).

Torre et al. found that not only visual expressions of happiness like smiles increased trust, but also conversational agents that spoke with a tone implying a smile were met with a higher level of trust (Torre et al., 2020). Likewise, Beck et al. could show that even a Nao robot that lacks the ability to alter its face could communicate emotions using its body language (Beck et al., 2010). Another way to create realistic emotions is through using animated avatars (Noël et al., 2009). These avatars can be portrayed on a display or projected into a three-dimensional space. There are also robots that try to very closely mimic natural human faces. These so-called androids can mimic facial expressions very closely as they have controllable joints in their faces (Ishiguro, 2007). Nishio et al. even built a robot that exactly resembled one of the researchers to directly compare the effect this robot would have on people to the one the real person has (Nishio et al., 2007).

One area in which robots are often seen as a potential addition is the care of elderly people. Here they would have to work very closely with humans and therefore adhere to very strict criteria and be developed with additional care. Robots can potentially be integrated into physical work like lifting or bathing elderly people (Satoh et al., 2009), but there are also aspirations to integrate them as more personal help, emulating human social interactions. There have been projects in which robots helped people with dementia (van Wynsberghe, 2013). It has been shown that elderly people in care homes can be positively engaged by robots (Carros et al., 2020) as well as that the interaction with robots can reduce stress (Aminuddin et al., 2016).

The aim of this project is to explore how people react to robots that can display emotion, paying special attention to elderly people and a potential use in care homes.

4.2 Methods

In the study 16 participants interacted with an android robot, that looked like a young woman with light skin, brown hair and eyes and realistic proportions. The model of the android was an A-Lab Android Standard Model AL-G109ST-F. It has 18 DoFs (degrees of freedom) of which more than half are positioned within the face of the android. These allow it to blink, move and widen its eyes, raise the lower part of its eyes, open its mouth, smile and shift its eyebrows inward or upward. It can also tilt and move its head.

Through combinations of these abilities, four primary emotions could be represented. An expression of joy or happiness was achieved by lifting the corners of the mouth upward and raising the skin right below the eyes. This emulates a human contracting the orbicularis oculi muscle, the muscle that is positioned around the eyeballs, which is a sign of a so-called Duchenne or genuine smile (Beamish et al., 2019). Surprise was emulated by widening eyes and mouth and lifting the eyebrows. Sadness was achieved by assuming a neutral, closed mouth position, and lowering the eyes as well as tilting the chin downward. For anger, the eyebrows were shifted together and the eyes were narrowed but while the other emotions were easily possible to distinguish, anger did not translate perfectly and was therefore not utilized during the study.

In terms of gestures, the android was capable of moving its head forward and sideways, shifting its upper body and even leaning forward. The last ability was hardly ever utilized during the interactions. The entire lower body was fixed in a seated position and the hands were stiff and placed on the legs of the android under the table in front of it, only occasionally moving due to movements of the whole body.

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

A living lab situation was created in which participants had the opportunity to interact with the android for about thirty minutes. The first interaction was designed as a Wizard-of-Oz interaction, meaning that the android's phrases were controlled and written by the researchers (Dahlbäck et al., 1993). The facial expression was a mix of the Wizard-of-Oz simulating emotions and an automatic mode making micro movements such as simulating breathing or looking around the room. During the interaction, the android was seated across from the participant, while two researchers sat behind them out of view and through a series of loosely defined questions and statements a conversation was started. The topics started with casual small talk like "What is your favorite season?" to more personal questions like "What are you looking forward to today?" to very deep questions like "What is your greatest fear?".

Afterward, the android was connected to the e-VITA chatbot that could access a health databank to give answers to certain, predefined health-related questions such as symptoms or definitions of maladies. This allowed the participants to compare two interactions. In one the android acted very robotically, answering with set answers to specific questions. In the other the android acted more like a human, being able to specifically address what the participant had said and also using the display of emotion that was specifically tailored to the topic discussed.

4.2.1 Participants

In addition to the eight regular elderly participants who were all above the age of 60 and can be seen in Table 5, four stakeholders, whose ages ranged from 48 to 67, were invited to offer a professional opinion on the effect a robot displaying emotion could have on elderly people. They were also interviewed about their personal assessment of the facial expressions and are listed in Table 6. In the following, these stakeholder participants will be denoted with SH in order to signal that they are stakeholders.

Table 5 Participants Android Study Germany

	Gender	Age
P1	Female	63
P2	Male	71
P3	Male	72
P4	Female	79
P5	Male	78
P6	Female	74
P7	Female	64
P8	Female	81

Table 6 Stakeholders Android Study Germany

	Gender	Age	Position
SH1	female	58	Head of Hospice
SH2	male	67	fmr. Mgmt. Care Home
SH3	female	49	Speaker for Social Policy
SH4	male	48	Mgmt. Hospital
SH5	female	43	Head of Social Services

While majority of the study was performed within a living lab at the university, the android was also brought to a care home and 11 residents there were able to interact with it and were later interviewed.

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

Table 7 Android Study Germany Care Home Residents

	Gender	Age
P10	Female	82
P11	Female	85
P12	Female	85
P13	Female	83
P14	Female	88
P15	Male	88
P16	Female	93
P17	Female	98
P18	Male	88
P19	Female	93
P20	Male	89
P21	Female	85

Additionally, everyone who was in contact with the android at the university had the opportunity to describe their impressions through an online questionnaire. This was used by four participants, whose demographic data can be seen in Table 4.

Table 8 Android Study Germany Online Participants

	Gender	Age
P22	Female	72
P23	Male	24
P24	Female	38
P25	Female	21

4.2.2 Data collection and analysis

The interactions with the android were filmed from the side and the faces of the participants were also recorded from the front, using two different cameras. Directly after the interactions that lasted about 30 minutes, semi-structured interviews were done to acquire qualitative data on how the interaction was perceived and how the participants would evaluate potential future uses, especially in regards to care homes. During the interviews, which lasted between 30 and 60 minutes, audio recordings were made and later transcribed. These transcripts as well as the survey results were analyzed with a deductively created code system in the program MAXQDA 2022. Using a reflexive thematic analysis (Braun & Clarke, 2021) initial categories were formulated and inductively expanded while reviewing the interviews. The codes were also discussed among researchers. As main categories it was looked at the way the participants rated the speech, gestures, and facial expressions of the android. Making a distinction of whether an aspect was seen as positive or negative in each one. It was also coded how often the participants mentioned an emotion. Further main categories were potential problems, visions for the future, and the usage of the android within a care home – each of which was further divided into subcategories.

The recording of the participant's faces was used to perform a technological emotion analysis that computed whether an expression was most likely to convey that the participant was neutral, calm, happy, surprised, fearful, angry, disgusted or sad. Using image processing values for 45 different facial action units (AUs) were determined for each frame and these were computed into one of these eight emotions.

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

4.3 Results

4.3.1 Initial Reactions

Despite the fact that the android was capable of displaying the emotions happiness, surprise and sadness, most participants only recalled that the robot showed joy. All the participants who interacted with the android in the university mentioned its smile and so did two of the stakeholders. SH1 stated that the android's smile encouraged her to keep talking. P8 described the smile as "pretty cute, only just alluded but visible." (german original "ganz niedlich, so ganz eben angedeutet, aber sichtbar"). P4 called the smile nice and P3 explained that she thought the smile was astute and that it brought her joy. P7 was more tentative and described that the android had tried to smile, implying he would not consider it a success.

In contrast to that the emotion of sadness was only referred to by three participants. P1 and P3 described the display of emotion as compassion and as looking very serious, while P7 said: "I noticed, she sometimes tried to look sad or to also look abashed once." (german original: "mir ist aufgefallen, sie hat versucht, mal traurig zu gucken oder auch mal versucht beschämt zu gucken"). P22 said that he recognized sadness because of a long pause before an answer. Surprise was recalled the least with only P1 mentioning having recognized it. This disparity can definitely be explained by the fact that the facial expressions were only used when they were appropriate in the context of the conversation, which was true more often for happiness than it was for either sadness or surprise.

In general, the fact that the android was capable of displaying facial expressions was seen as very positive. P2 said he was impressed by how technologically advanced the expressions were. P3 and P8 also stated that they were positively surprised by them. P6 said that the expressions made the robot likable and human-like. P8 mentioned that she considered the nodding of the android to have a reassuring effect on her and stressed that this aspect in particular made the android appear very human-like. She praised how low-key the expressions were while still being recognizable and called them the main reason she would judge the entire android as well-done. She also called it feminine and compassionate. P7 on the other hand stated: "because it's a robot, it doesn't need to show emotions for me." (german original: „Weil es ein Roboter ist, braucht er für mich keine Emotionen zu zeigen.")

SH4 saw the facial expressions were seen as providing an additional path of communication. SH2 stressed that the important part about the facial expression was not that they were present, but rather that they were displayed in the right moment within the context of the conversation. SH1 emphasized the fact that the android smiling at her made her realize that she understood what the topic was about. She also mentioned that this encouraged her to talk more. One of the most important key words in regards to emotion was reaction. Whenever they spoke positively about the display of emotions the participants stressed how the android, which they often even called by its human name, reacted with a smile or mirrored their own emotion (P1, P2).

When rating the verbal utterances of the android it was stressed that the answers of the android corresponded to the context as well and that itself was even seen as additional proof that the android showed emotion (P1). P1 mentioned specifically that she appreciated the robot saying "I am sorry that happened to you." (german original: "Es tut mir leid, dass Ihnen das mal passiert ist").

4.3.2 Wishes and Improvement

When asked what parts of the facial expressions could be improved P4 criticized that they were too repetitive. It was also mentioned that the transitions between the expressions were too abrupt (P25),

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

the expression themselves not smooth enough (P2), did not incorporate enough facial muscles, and should be more human like in general (P1). P2 also said that she found that they lack feedback, stressing that one of the most important parts about facial expressions is that they make sense in the context of the conversation. SH3 described that she would appreciate a wider range of emotions and also mentioned that she found it hard to differentiate what emotion was supposed to be transmitted through some individual gestures, saying that lifting an eyebrow could have multiple meanings. In contrast to that P8 did say though that she liked how subtle the facial expressions of the robot were and that she would not want them to be overdone.

A large deficit of the android was that the tone and speed of the verbal speech was constant and did therefore not match the emotion that was displayed by the facial expression. SH3 praised that the speech was clear and easily understandable and called it "optimal for listening to" (german original: "zum Zuhören ist es optimal") and P4 also appreciated the levelness of the voice because it was neutral and non-manipulative.

P2 called it too inhuman and robotic. P3 likened it to the voice of a news anchor and suggested that it could be improved by incorporating "uhm"s or "hmm"s into the speech. P4 wanted the voice to vary in its tone. P25 suggested that the movement of the lips should be matched more precisely to the words and P23 criticized that the speaker box where the sound came from should be placed closer to the head of the robot, instead of below the table where it was positioned in order to hide it from view.

Regarding the movement the participants wished for hand gestures (P1, P3, P7, SH4). P3 specifically suggested gestures that humans typically do subconsciously like trailing a hand through its hair, or scratching its eye, but also wished that it would have the ability to communicate through gestures, like shaking the head or express dissent by moving a hand (german original: "abwinken, wenn ihr irgendwas nicht gefällt"). SH4 explained that "every human uses their hands to communicate" (german original: "jeder Mensch redet mit den Händen") and therefore the android should too. P1 and P7 also found that the android was sitting to stiffly and should move her entire upper body more to appear more familiar. SH1 criticized that the robot could not provide any physical support in a care setting.

When asked how the emotions of the robot could be expanded, the participants mentioned that they could imagine a robot displaying embarrassment (P3), compassion (P4), laughing out loud (P3, SH2), or crying (SH1).

P6 stressed that it was important that the robot never showed aggression though and always stayed gentle. P8 and SH2 also stressed that the robot's main objective should be to be calm and not upset anyone interacting with it. They also wished the android would show more intrinsic curiosity (P4) through asking questions and inquiring on them.

In contrast to this, P1, P2 and P8 all wished for the robot to have its own opinion and be able to discuss controversial topics and even stressed that they would want the robot to disagree, set boundaries and actively urge the counterpart to discuss with them. P8 even elaborated that she would consider it problematic for humans to constantly interact with a counterpart that always agreed with them and never opposed them.

SH2 imagined a specific future scenario in which the robot could help elderly people overcome traumatic losses in their lives. She said that during such conversation it would be very integral that the robot assured the counterparts that it was okay to cry.

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

P8 on the other hand stressed that she could not imagine certain emotional tasks to ever be done by robots. Her examples were hugging a person in need or helping a patient with dementia to return to the real world by reacting with empathy and understanding.

SH2 also brought up the interesting consideration that the still lower body of the robot could potentially be explained by having her sit in a wheelchair. This would imply that the robot was in need of support or help and could trigger interesting reaction from her human counterparts. A similar idea would be to make the robot look like a child (P1, P2). P1 elaborated that a childlike look might help especially elderly people to set realistic expectations for the android, because the android would be in the process of learning about the world, just like children are.

4.3.3 Fears and Concerns

A very prominent concern is that emotional display will eventually blur the lines between humans and robots to a point where it is no longer easily possible to tell them apart (P3, P6, P8, SH1, SH2, SH3). P8 even described that she briefly thought of the android as human. She explained: “I honestly have to say this happened to me just now. I always looked in her eyes. Those eyes appear very natural due to the blinking. Yes, it’s an illusion that you start to go along with in parts.“ (german original: “Ich muss ehrlich sagen, das ist mir vorhin passiert. Ich habe ihr immer in die Augen geguckt. Diese Augen wirken durch das Klimpern auch sehr natürlich. Ja, das ist dann schon eine Illusion, auf die man sich auch einlässt ein Stück weit.”)

SH3 explained that people in elderly homes were at an especially great risk to make that mistake as they were likely to suffer from illnesses and disabilities like impaired sight or dementia. P3 stressed that it was important to ensure that robots and humans could always be told apart.

P8 and SH3 also mentioned that they would think it was very likely for an elderly person to fall in love with a robot. P6 stated “when you are with a robot there will somehow always be relationships that develop. And whether they can bring fullfillment or lead to disappointment we cannot tell.” (german original: “Wenn ich jetzt mit so einem Roboter zusammen bin, dann entstehen schon auch irgendwie Beziehungen. Und ob die dann was erfüllen können oder später Enttäuschungen hervorrufen, das weiß man nicht.“). SH1 also said: „A robot will not be able to react right, when the other person starts to cry or show emotions.“ (german original: „das wird ein Roboter nicht so auffangen können, wenn der andere dann auch anfängt zu weinen oder Emotionen zu zeigen.“)

SH2 did not see any risks in humans mistaking robots for others humans.

Although concerns were also raised by SH1 she did draw the conclusion that it would ultimately be the “lesser evil” (german original: “kleinere Übel”) to have some elderly people mistake a robot for a human, if they could at least be connected through an actual human by the robot. The stakeholder described a scenario where the robot could animate and enable the elderly person in a care home to use a phone or a tablet to call their loved ones. She was imagining this scenario specifically as a use case that would have been beneficial during the covid-19 lockdowns and stressed that in her opinion the treatment of elderly people during this time was so worrisome that almost all interaction would have been an improvement. P8 agreed that it was important to weigh the benefits and disadvantages.

SH1 stressed that it would be very crucial to ensure that a robot was seen as an addition but not a replacement for human care workers. Her idea was to implement control systems that would observe whether the patients were still regularly visited by human staff as well.

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

She also said that she suspected many care workers would be worried that their jobs could be in jeopardy when a robot was added to their work place and stressed that there was a lot of negative energy directed at robots in that field. She also mentioned though that many human care workers were often overworked, had too many patients to take care of at once and could therefore be annoyed easily, while a robot would have infinite patience.

On the other hand she stated that she was sure many people would accuse a robot that could display realistic gestures, facial expressions and emotions of lying to the users and deceiving them. SH3 also initially stated that she would consider it wrong to deceive people as they had the right to agency. Then she reflected on the fact that many people in care homes were not able to live their life with agency anyways and finally decided that she would consider it the best strategy to clearly state that android was in fact a robot in the beginning but not repeat it over and over, as she saw potential for a very close and fruitful relationship as well. She also stressed though that there was a need to intercede as soon as there was any indication that the interaction with the robot had a negative influence on anybody. In conclusion it seemed like honesty was the most important value for her in this regard. P6 and P8 both agreed that they would not see any threat of manipulation in the current state of the robot. P8 also elaborated that she considered it non-problematic to create the illusion of emotion as long as the users had a positive experience. P7 added that many books and movies also created illusions and that those were not seen as ethically questionable.

When the same robot was later placed in a care home, none of the 11 interviewed participants there got the impression that they were talking to a human. Many also confirmed that they did not believe the android had feelings and asserted that they would deem this impossible. When asked about it P13 answered: “No, I do not think so. He did not feel anything. I do not believe it. He cannot feel after all. It is impossible.“ (german original: “Nein, das glaube ich nicht. Der hat nichts gefühlt. Das glaube ich nicht. Er kann ja nicht fühlen. Das geht ja gar nicht.“)

4.3.4 Emotional State of the Participants

In general, it can be stated that the participants were very much at ease during the interactions. When asked about their emotional state in the subsequent interview many even seemed to feel the need to adamantly assure the interviewers that they were not upset or tense in the slightest. P3 explained that the fact that he was crossing his arms was not an expression of discomfort or unease, but a natural position for him. He did so even without being asked about this gesture. P4 stated: “It wasn’t an extreme situation for me and it was not stressful in any way.“ (german original: „Es war keine Extremsituation für mich und es war auch in keiner Weise stressing.“) P8 responded to the question if there was any unease during the interaction: “No, definitely not. I did not [feel tense]. I knew what I was getting into after all. But even if you mean something in the direction of: This creature that sits across from me is a little creepy or something like this. No, not at all. For me it was pretty pleasant.” (german original: “Nein, ganz klar. Das habe ich nicht. Ich wusste ja, wo ich mich darauf einlasse. Aber auch wenn Sie jetzt in die Richtung meinen, dieses Geschöpf, was mir da gegenübersitzt es ist ein bisschen gruselig oder so was. Nein, überhaupt nicht. Also, es war für mich ganz angenehm.“)

The emotion analysis aims to provide an objective insight into the participants’ emotional state during the interactions with the android. It was only conducted for P1 through P6, as P7 and P8 wore masks which cloud the results during the conversation. The results were way more negative than what the participants self-disclosed.

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

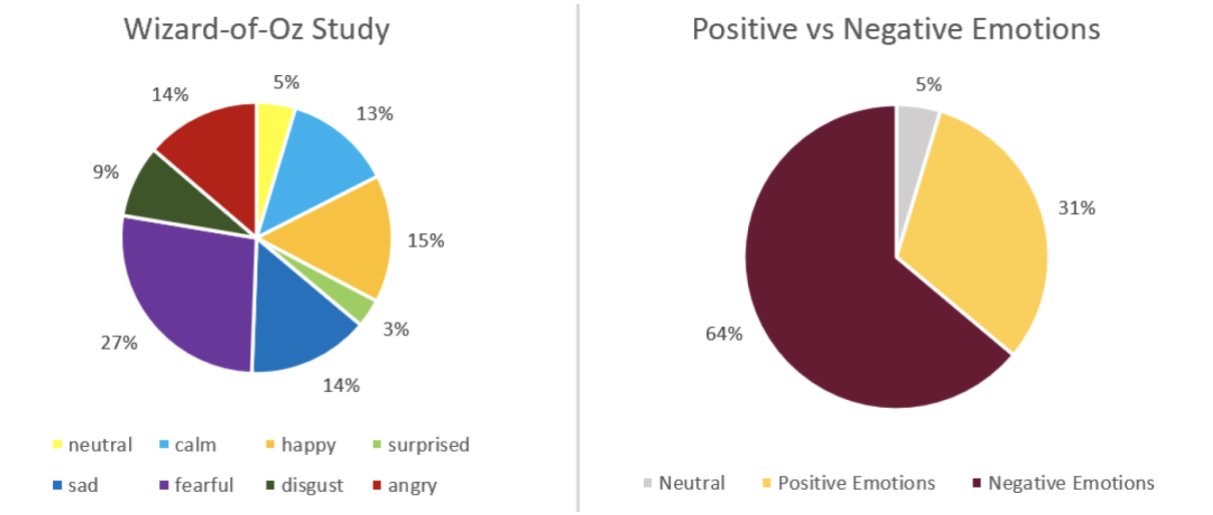


Figure 14 Emotions across P1 through P6 in the Wizard-of-Oz study

Figure 14 shows that the participants' faces mainly displayed fear, followed by happiness, sadness and anger. When fear, sadness, anger and disgust are grouped as negative emotions and happiness, calmness and surprise as positive emotions, negative emotions were displayed more than twice as often as positive ones. These results form a stark contrast to the self-reported state of the participants.

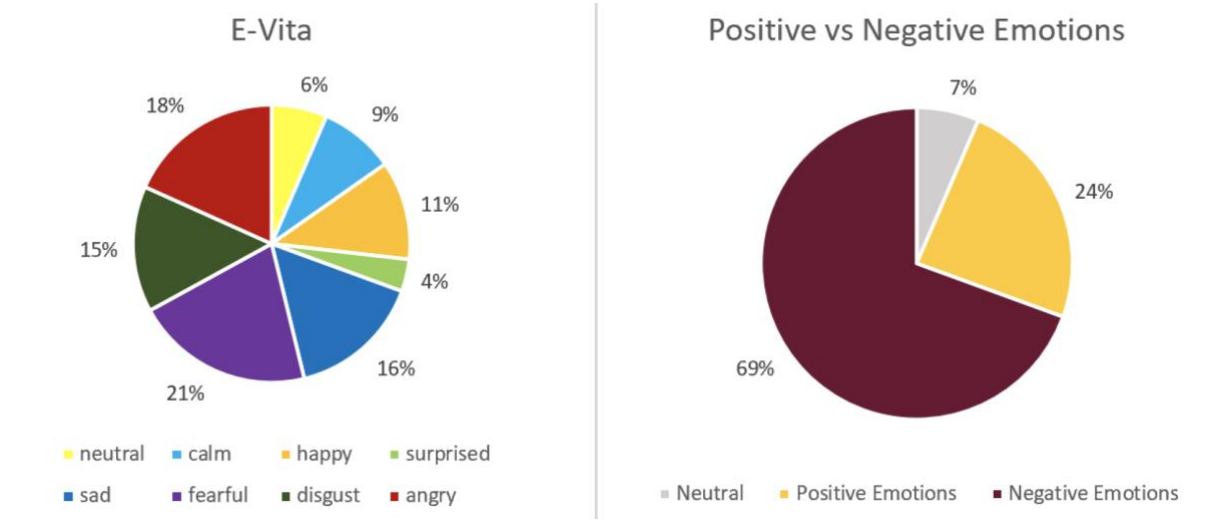


Figure 15 Emotions across P1 through P6 in the e-VITA study

When compared with the E-Vita interaction (Figure 15) during which facial expressions were generated automatically and therefore did not match the context of the conversation, the emotions during the Wizard-of-Oz study were slightly more positive.

4.4 Discussion

If emotions are expressions of internal states and robots do not have consciousness, is it not ingenuine to make them display emotions?

It could be argued that even humans use facial expressions as tools and as communicational shortcuts (Crivelli & Fridlund, 2018) so letting robots utilize them as well will only positively affect the ability to interact with them. Furthermore, it was stated by many researchers that human-robot interaction can

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

be facilitated by letting robots show emotion (Azeem et al., 2012; Löffler et al., 2018) and the feedback of the participants suggests the same.

In the context of using androids with emotions in care homes, it is necessary to keep in mind that especially people that have disabilities due to their age could be at risk of mistaking an android for a human. This can lead to expectations that are ultimately not met and lead to situations like unrequited love that will raise negative emotions.

SH1 and SH3 raised an important point with their assertion that even if the use of robots as emotional support surely is not ethically unquestionable we have to ensure that we need to weigh the potential threats against the benefits and compare a world where elderly people will have robots as social contacts with one where they are completely alone.

It can be argued that robots might actually be more capable of providing emotional support to humans as they are equipped with certain “superpowers” like unlimited patience and time that humans do not possess . Still, it is necessary that new laws and guidelines accompany the potential use of robots in care homes that ensure that enough staff supervises the interactions and that the artificiality of the robot is openly communicated to everyone who interacts with it.

The study also reveals a problem with very human-like robots. Their naturalistic parts lead to certain expectations that are then often disappointed (Löffler et al., 2020). The participants were impressed by the android’s facial expressions but also immediately disappointed the voice did not match the emotions and that it was not underlined by gestures. Potential solutions to this problem could lie in altering the looks of the robot to resemble a child or a handicapped person.

The smile of the robot was generally seen as beneficial. It leads the participants to rate the android as more human and likable. This is most likely not due to the fact that the participants thought the robot was actually happy, but caused by the fact that smiling at someone signals understanding. This type of encouragement can powerfully extend the motivation to engage in conversation, which is why participants also said that it was increasing their willingness to speak to the android. This is consistent with the theory that smiles are not predominantly used to convey happiness but more often simply signify affiliate intent (Fang et al., 2020).

When it comes to other and potentially more negative emotions there are a lot of risks and benefits to be weighed. On the one hand, there is a desire for humans to interact with a real counterpart that is capable of discussion and offering dissenting views, one that would have reason to display emotions like anger and disgust, on the other hand, there is the valid assertion that robots should only display emotions that will evoke a positive reaction in the interactant. Likewise, the display of sadness or pity could serve as valuable resources in helping people overcome hardship but simultaneously comes with the threat of leading to expectations for the relationship that will ultimately be disappointed or create a situation that is so emotionally charged that the robot cannot help the human to overcome them.

When it comes to the discrepancy between the self-disclosed emotional state of the participants and the results of the emotion analysis it is noticeable that the participants were very eager to assure that they were calm. These overaccentuated reactions could be due to two reasons: The researchers did expect the reaction to the android to be more negative and tense and therefore might have influenced the participants to assure them they were not. Furthermore, people generally do not easily disclose negative emotions in social situations. The expression of fear or unease can be interpreted as weakness

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

and therefore the participants might have been cautious to express them. The emotion analysis could potentially provide more objective data on how people felt during the interactions with the android.

Nevertheless, the results should be interpreted with caution as a comparison with a human-to-human conversation is missing. Still, it is safe to conclude that the reactions towards the android were complex and shaped by occasional irritation due to long waiting times or unintuitive reactions. There is evidence that the use of the display of emotion leads to more positive feelings in the Wizard-of-Oz interaction compared with the e-VITA interaction. Still, due to the low amount of data and lack of control groups, these results should not be overrated.

4.5 Limitations

Despite a relatively large amount of qualitative interviews, the number of participants is still not sufficient to draw definite conclusions on the effect of the display of emotions and whether it can provide more benefits or risks. The displayed emotions were not the central focus of the conversations and were also used spontaneously whenever they matched the context leading to a varying experience for each of the participants.

The interactions were confined to a short period of time and therefore no long-term implications can be derived.

The emotion analysis also shows a great need for additional research, including comparisons to the emotions displayed in a conversation with a human.

4.6 Conclusion

The study could prove an amazing potential for using the display of emotion to deepen the connection between humans and robots. Nevertheless, it cannot be disregarded that humanizing robots also carries a great risk. When the lines between humans and robots blur it may soon be impossible for certain people to tell the two apart. The risks and benefits need to be carefully evaluated and it might also be reasonable to establish internationally binding guidelines on how to visually differentiate robots and humans.

For now, it has to be clearly stated though that there was no difficulty experienced by any of the participants to tell that they were not in fact interacting with a human. Many participants reported a positive reaction to being smiled at. The display of other, potentially more negative emotions, like sadness, fear or anger has to be evaluated in further study. Future research could solidify our result with quantitative data, directly comparing the interaction with robots who do and do not show emotions.

It can also be concluded that context awareness and the feeling of being understood by the robot were reported as a greater benefit than the idea of the robot feeling or communicating joy. It encouraged the participants to talk more and it could be further investigated whether this effect could be achieved through other visual or auditory cues that are not directly related to a human-typical expression of happiness.

Great potential to improve the experience of interacting with an emotional android, in general, can be found in adjusting the voice of the android to carry emotion as well and therefore provide a better match between facial expression and tone.

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

Another interesting approach to explain the not yet perfected social abilities of the robot would be to give the robot the appearance of a child and observe how participants would react to it then. The study could show that the display of emotion by an android was generally seen as positive and beneficial but also shed light on the fact that there are many aspects that could be improved to achieve an even more natural interaction as well as many ethical questions that need to be investigated.

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

5 Main Outcomes and further Implications for e-VITA

The design case studies in this deliverable provide insights for the further development of coaching devices, specifically Gatebox and Androids. The results can be taken up in the re-design phase.

5.1 Summary of implemented end-user studies

Gatebox Avatar. The discussions with older adults suggests that humanoid avatars tend to reproduce misconceptions and stereotypes. At the same time, they raise higher expectations for the potential roles that the avatar could fulfill. The participating older adults often did not differentiate between the capabilities of a virtual representation and their real world existence.

Android Robot. Both, the German and Japanese study suggest that robots which mimick human interaction are easier to interact with. The design case study in Germany affirms the assumption that the robotic imitation of human emotion can deepen the connection between humans and robots. The comparative study in Japan

5.2 Main Implications for the e-VITA project

Gatebox Avatar. The three focus groups in Germany, Japan, and France helped to narrow down the options of potential avatars. There are some differences between the living lab sites in terms of reasoning and choices. In summary, it seems advisable to add a character that embodies the technological nature and abilities of a virtual being while avoiding human stereotypes. A potential choice for this could be a genderless robot.

Android Robot. The two design case studies in Germany and Japan show that older adults appreciate robots that mimic the interaction between humans. It often seems easier for them to interact with humanlike robots due to its familiarity. Some people seem to be concerned about the blurred lines between human and robots, however the current technological mimicry is not convincing enough for this conflict to surface. For example, the synchronization between facial movement and speech sometimes does not match so that the android keeps talking while a smile interrupts lip movement. To create a convincing mimicry would requires a lot of work.

5.3 Relation to other Deliverables and WPs

This deliverable follows up on an earlier report of design case studies in D6.5 (M12). The devices that we explore in this deliverable also have been studied in other WP6 deliverables. Android robots were a topic in D6.5 and D6.8. The Gatebox was addressed in D6.5 and D6.2. We also present more technical information about the coaching devices in the WP4 Deliverables D4.7 and D4.8.

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

6 References

Aminuddin, R., Sharkey, A., & Levita, L. (2016). Interaction with the Paro robot may reduce psychophysiological stress responses. *2016 11th ACM/IEEE International Conference on Human-Robot Interaction (HRI)*, 593–594. https://doi.org/10.1109/HRI.2016.7451872

Azeem, M. M., Iqbal, J., Toivanen, P., & Samad, A. (2012). Emotions in Robots. In B. S. Chowdhry, F. K. Shaikh, D. M. A. Hussain, & M. A. Uqaili (Eds.), *Emerging Trends and Applications in Information Communication Technologies* (pp. 144–153). Springer Berlin Heidelberg.

Beamish, A. J., Foster, J. J., Edwards, H., & Olbers, T. (2019). What's in a smile? A review of the benefits of the clinician's smile. *Postgraduate Medical Journal*, *95*(1120), 91–95. https://doi.org/10.1136/postgradmedj-2018-136286

Beck, A., Cañamero, L., & Bard, K. A. (2010). Towards an Affect Space for robots to display emotional body language. *19th International Symposium in Robot and Human Interactive Communication*, 464–469. https://doi.org/10.1109/ROMAN.2010.5598649

Braun, V., & Clarke, V. (2021). Can I use TA? Should I use TA? Should I not use TA? Comparing reflexive thematic analysis and other pattern-based qualitative analytic approaches. *Counselling and Psychotherapy Research*, *21*(1), 37–47. https://doi.org/https://doi.org/10.1002/capr.12360

Carros, F., Meurer, J., Löffler, D., Unbehaun, D., Matthies, S., Koch, I., Wieching, R., Randall, D., Hassenzahl, M., & Wulf, V. (2020). Exploring Human-Robot Interaction with the Elderly: Results from a Ten-Week Case Study in a Care Home. *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*, 1–12. https://doi.org/10.1145/3313831.3376402

Chuah, S. H.-W., & Yu, J. (2021). The future of service: The power of emotion in human-robot interaction. *Journal of Retailing and Consumer Services*, *61*, 102551. https://doi.org/https://doi.org/10.1016/j.jretconser.2021.102551

Coeckelbergh, M. (2010). Robot rights? Towards a social-relational justification of moral consideration. *Ethics and Information Technology*, *12*(3), 209–221. https://doi.org/10.1007/s10676-010-9235-5

Correia, F., Mascarenhas, S., Prada, R., Melo, F. S., & Paiva, A. (2018). Group-Based Emotions in Teams of Humans and Robots. *Proceedings of the 2018 ACM/IEEE International Conference on Human-Robot Interaction*, 261–269. https://doi.org/10.1145/3171221.3171252

Crivelli, C., & Fridlund, A. J. (2018). Facial Displays Are Tools for Social Influence. *Trends in Cognitive Sciences*, *22*(5), 388–399. https://doi.org/10.1016/j.tics.2018.02.006

Dahlbäck, N., Jönsson, A., & Ahrenberg, L. (1993). Wizard of Oz studies: why and how. *International Conference on Intelligent User Interfaces*.

Drozdick, L. W., Raiford, S. E., Wahlstrom, D., & Weiss, L. G. (2018). The Wechsler Adult Intelligence Scale—Fourth Edition and the Wechsler Memory Scale—Fourth Edition. In *Contemporary intellectual assessment: Theories, tests, and issues, 4th ed.* (pp. 486–511). The Guilford Press.

Du, S., Tao, Y., & Martinez, A. M. (2014). Compound facial expressions of emotion. *Proceedings of the National Academy of Sciences*, *111*(15), E1454–E1462. https://doi.org/10.1073/pnas.1322355111

Ekman, P. (1992). An argument for basic emotions. *Cognition and Emotion*, *6*(3–4), 169–200. https://doi.org/10.1080/02699939208411068

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

Elwood, R. W. (1993). Delayed recall on the Wechsler Memory Scale—Revised: The factor structure revisited. In *Journal of Clinical Psychology* (Vol. 49, pp. 854–859). John Wiley & Sons. https://doi.org/10.1002/1097-4679(199311)49:6<854::AID-JCLP2270490613>3.0.CO;2-F

Fang, X., Sauter, D. A., & van Kleef, G. A. (2020). Unmasking smiles: the influence of culture and intensity on interpretations of smiling expressions. *Journal of Cultural Cognitive Science*, *4*(3), 293–308. https://doi.org/10.1007/s41809-019-00053-1

Folstein, M. F., Robins, L. N., & Helzer, J. E. (1983). The Mini-Mental State Examination. *Archives of General Psychiatry*, *40*(7), 812. https://doi.org/10.1001/archpsyc.1983.01790060110016

Gasteiger, N., Loveys, K., Law, M., & Broadbent, E. (2021). Friends from the Future: A Scoping Review of Research into Robots and Computer Agents to Combat Loneliness in Older People. *Clinical Interventions in Aging*, *16*, 941–971. https://doi.org/10.2147/CIA.S282709

Häring, M., Bee, N., & André, E. (2011). Creation and Evaluation of emotion expression with body movement, sound and eye color for humanoid robots. *2011 RO-MAN*, 204–209. https://doi.org/10.1109/ROMAN.2011.6005263

Hatfield, E., Bensman, L., Thornton, P. D., & Rapson, R. L. (2014). New Perspectives on Emotional Contagion: A Review of Classic and Recent Research on Facial Mimicry and Contagion. *Interpersona: An International Journal on Personal Relationships*, *8*(2), 159–179. https://doi.org/10.5964/ijpr.v8i2.162

Iavarone, A., Ronga, B., Pellegrino, L., Loré, E., Vitaliano, S., Galeone, F., & Carlomagno, S. (2004). The Frontal Assessment Battery (FAB): normative data from an Italian sample and performances of patients with Alzheimer's disease and frontotemporal dementia. *Functional Neurology*, *19*(3), 191–195.

Ishiguro, H. (2007). Android Science. In S. Thrun, R. Brooks, & H. Durrant-Whyte (Eds.), *Robotics Research* (pp. 118–127). Springer Berlin Heidelberg.

Jack, R. E., Garrod, O. G. B., & Schyns, P. G. (2014). Dynamic Facial Expressions of Emotion Transmit an Evolving Hierarchy of Signals over Time. *Current Biology*, *24*(2), 187–192. https://doi.org/https://doi.org/10.1016/j.cub.2013.11.064

Löffler, D., Dörrenbächer, J., & Hassenzahl, M. (2020). The Uncanny Valley Effect in Zoomorphic Robots: The U-Shaped Relation Between Animal Likeness and Likeability. *Proceedings of the 2020 ACM/IEEE International Conference on Human-Robot Interaction*, 261–270. https://doi.org/10.1145/3319502.3374788

Löffler, D., Schmidt, N., & Tscharn, R. (2018). Multimodal Expression of Artificial Emotion in Social Robots Using Color, Motion and Sound. *Proceedings of the 2018 ACM/IEEE International Conference on Human-Robot Interaction*, 334–343. https://doi.org/10.1145/3171221.3171261

Marangolo, P., & Pisano, F. (2019). Conversational Therapy in Aphasia: From Behavioral Intervention to Neuromodulation. *Seminars in Speech and Language*, *41*(01), 61–70. https://doi.org/10.1055/s-0039-3399500

Nishio, S., Ishiguro, H., & Hagita, N. (2007). Geminoid: Teleoperated Android of an Existing Person. In *Humanoid Robots: New Developments*. https://doi.org/10.5772/4876

Noël, S., Dumoulin, S., & Lindgaard, G. (2009). Interpreting Human and Avatar Facial Expressions. In T. Gross, J. Gulliksen, P. Kotzé, L. Oestreicher, P. Palanque, R. O. Prates, & M. Winckler (Eds.), *Human-Computer Interaction -- INTERACT 2009* (pp. 98–110). Springer Berlin Heidelberg.

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

Parisi, D., & Petrosino, G. (2010). Robots that have emotions. *Adaptive Behavior*, *18*(6), 453–469. https://doi.org/10.1177/1059712310388528

Reed, L. I., Stratton, R., & Rambeas, J. D. (2018). Face Value and Cheap Talk: How Smiles Can Increase or Decrease the Credibility of Our Words. *Evolutionary Psychology*, *16*(4), 1474704918814400. https://doi.org/10.1177/1474704918814400

Ringfort-Felner, R., Laschke, M., Neuhaus, R., Theofanou-Fülbier, D., & Hassenzahl, M. (2022). It Can Be More Than Just a Subservient Assistant. Distinct Roles for the Design of Intelligent Personal Assistants. *Nordic Human-Computer Interaction Conference*. https://doi.org/10.1145/3546155.3546699

Rymarczyk, K., Żurawski, Ł., Jankowiak-Siuda, K., & Szatkowska, I. (2019). Empathy in Facial Mimicry of Fear and Disgust: Simultaneous EMG-fMRI Recordings During Observation of Static and Dynamic Facial Expressions. *Frontiers in Psychology*, *10*. https://doi.org/10.3389/fpsyg.2019.00701

Satoh, H., Kawabata, T., & Sankai, Y. (2009). Bathing care assistance with robot suit HAL. *2009 IEEE International Conference on Robotics and Biomimetics (ROBIO)*, 498–503. https://doi.org/10.1109/ROBIO.2009.5420697

Torre, I., Goslin, J., & White, L. (2020). If your device could smile: People trust happy-sounding artificial agents more. *Computers in Human Behavior*, *105*, 106215. https://doi.org/https://doi.org/10.1016/j.chb.2019.106215

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

Yesavage, J. A., Brink, T. L., Rose, T. L., Lum, O., Huang, V., Adey, M., & Leirer, V. O. (1982). Development and validation of a geriatric depression screening scale: a preliminary report. *Journal of Psychiatric Research*, *17*(1), 37–49. https://doi.org/10.1016/0022-3956(82)90033-4

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

7 Annexes

7.1 Annex 1 Gatebox Study Protocol

Protocol for the focus group session with seniors in Europe and Japan.

Group size: about 5 people - duration: about 1h30.
Materials:
1 Gatebox + avatars provided by the USI team downloaded into the Gatebox
5 Information letters
5 consent forms
5 questionnaires
5 Authorisation to record the session
1 video projector + powerpoint support.
1 dictaphone

Objective of the session: to discuss how the avatar should look in the Gatebox

Step 1: Avatars

a) Offer coffee/water/snacks to participants
b) Give the information letter and have the consent form and permission to record signed
c) Start record the session
d) Recall the context of the study
e) Show the European and 2 other avatars (files provided by USI)
f) Discuss each avatar (go around the table):
    - What do you think of them?
    - What do you like?
    - What do you dislike?
    - Do you like the way it moves?

Step 2: Questionnaire

a) Give each participant a questionnaire
b) Ask them to answer the first question
c) Display the first avatar of the questionnaire on the power point and discuss this avatar with the participants:
    - What do you think of it?
    - What do you like about it?
    - What do you dislike?
d) Ask participants to fill in question number 2
e) Show the second avatar of the questionnaire on the power point and discuss this avatar with the participants:
    - What do you think of it?
    - What do you like about it?
    - What do you dislike?
f) Repeat steps d and e for each question in the booklet
g) End the session by asking them to select the characters they would like to have in their homes (the last two pages of the questionnaire).
h) Thank the participants for coming

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

7.2 Annex 2 Gatebox Study Questionaire

E-VITA: choose your favorite avatars

Preamble:

The e-VITA project is part of a collaboration bringing together two distinct consortia composed of academic and industrial actors within the European Union (France, Italy, Belgium, Germany) and Japan. The goal of e-VITA is to improve the well-being of older adults, to promote active and healthy aging and to maintain independence. This will be possible thanks to an innovative virtual coaching system based on ICT (Information and Communication Technologies) to detect subtle changes in the physical, cognitive, psychological and social domains of the daily life of the older adults. The e-VITA virtual coach will thus provide personalized recommendations and interventions for sustainable well-being in a smart home living environment. An innovative virtual coaching system offered is the Gatebox. In this Gatebox appears a hologram representing an character. It is with the character that the user will interact to obtain information on the weather, news, ask questions, etc.

Gatebox with an avatar

Background:

However, following the Pilot study that we conducted between April and June 2021 with seniors in good health, it appeared that the avatars offered in the Gatebox were not satisfactory in terms of appearance.

That's why we suggest you fill out this short questionnaire to help us identify the avatar that would be best suited for a senior using the Gatebox. We offer you several avatars with a different design.

Please indicate which roles you would assign each character (you can tick multiple), whether you would accept advice from this character and if you would use this character in your home.

Ministry of Internal Affairs and Communications, JAPAN

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

Which roles would you assign to this character?

☐ Confidant
☐ Teammate
☐ Task Performer
☐ Expert

I would accept advice from this character!

☐ Strongly Agree
☐ Agree
☐ Disagree
☐ Strongly Disagree

I would display this character in my home!

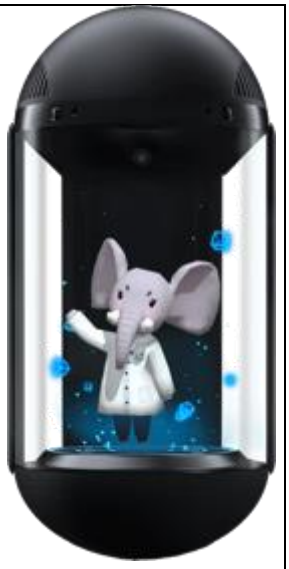
☐ Strongly Agree
☐ Agree
☐ Disagree
☐ Strongly Disagree

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

Select characters that you would like to have in your home.

 ☐	 ☐	 ☐	 ☐
 ☐	 ☐	 ☐	 ☐

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).

 ☐	 ☐	 ☐	 ☐
 ☐	 ☐		

The project has received funding from the European Union H2020 Programme under grant agreement n° 101016453. The Japanese consortium received funding by the Japanese Ministry of Internal Affairs and Communication (MIC).