Are People Ready for Unexpected Encounters With Social Robots?

Sofia Thunberg and Tom Ziemke
Department of Computer & Information Science
Linköping University, Sweden
[sofia.thunberg,tom.ziemke]@liu.se

ABSTRACT

Recent developments in robotics are potentially changing the nature of service, and research in human-robot interaction has previously shown that humanoid robots could possibly work in public spaces. We conducted a mixed-method study with the humanoid robot Pepper at a central train station. The results indicate that people are not yet accustomed to talking to robots, and people seem to expect that the robot does not talk, that it is a queue ticket machine, or that one should interact with it by using the tablet on the robot's chest.

KEYWORDS

public spaces, humanoid, human-robot interaction.

1 INTRODUCTION

Recent developments in robotics are potentially changing the nature of service [4], and research in human-robot interaction has previously shown that humanoid robots could possibly work in public spaces, for example, airports [12]. The quickly growing passenger volume in train traffic poses a serious challenge for all train carriers and station operators. With the increasing number of passengers arriving and departing at a train station, the probability of delays and missed connections grows accordingly. At the same time, much of the day-to-day customer service has moved out on the internet. Therefore, the customers that enter the support shop at Stockholm Central Station are usually not the web-page and app users, and instead they want to talk to someone in person.

With this background, an ethnographic study was conducted with the humanoid robot Pepper[1]. The research question was: *What expectations do people have regarding Peppers interactive abilities?*

2 METHOD

In this section we describe the study procedure, the robot system and the mixed-method used with participatory observation and questionnaire. We also report the participants and the analysis of the data.

2.1 Procedure

The study took place in a Swedish railway company's (SJ) customer support shop at the central station in Stockholm. As can be seen in Figure 1, the robot was dressed up with an SJ logo on its display and an SJ employee scarf around its neck. Beside the robot, a roll-up about the study was placed (in English: "SJ in cooperation with Linköping University is conducting a study on social robotics. You are welcome to try the robot!"). The study was conducted during five occasions, six hours each, with a total of 30 hours during October 2018.

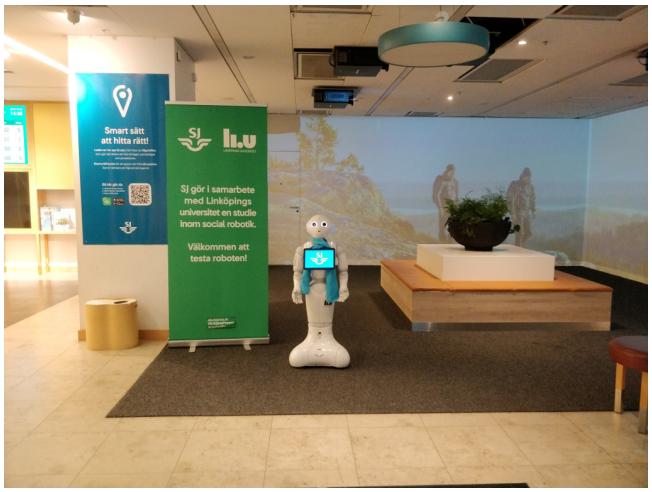

Figure 1: The study setup with Pepper at Stockholm central station.

2.2 System

SJ has a chatbot application for the Google Assistant, where customers can ask questions about trains, platforms and also get to know fun facts about SJ. This application is developed in Google DialogFlow and was here also used for the Peppper robot. But some of the standard questions in the web application would be confusing if the robot answered, for example, if a person asked "Who are you?" and the robot answered "I am SJ". To correct this, another natural language process was developed, also in DialogFlow, that overrides some of the questions with a more suitable answer. For example, "I am the robot Pepper" for the above question. In the second chatbot, some behaviours were added, for example, that the robot could perform a small dance and laugh at jokes.

In the general system the robot moved its arms in a random order while talking in order to simulate natural talking behaviour imitating human gestures, and it followed faces. The robot was listening at all times (except when it spoke) and dialogue was initiated if a person said something that matched what the chatbot knew. The robot did not initiate interactions by itself. When a person talked to the robot it took a few seconds for the system to analyse what was said and how to answer. Because of the parallel chat-bots, this process took about twice as much time as it should. During this time the robot showed different modes in the lower part of its eyes.

[1]Extended version of late-breaking report at HRI'20.

When the robot was listening, they turned blue and when the robot analysed what had been said the eyes were pink. This was implemented to indicate to the user that the robot is doing something (instead of, for example, a progress bar). When nothing happened or when the robot spoke, the eyes were neutral. The system was programmed in Python and C++, and the software stack was based on the Robot Operating System [8].

2.3 Observation

The study used participatory observation, which means that the observer is not trying to be invisible but could be a part of the event that is being observed [1]. During the study sessions, the observer (the first author) sat on the side of the robot against the wall (outside the picture in Figure 1). She also interacted with the participants at times and carried out interviews with open-ended questions about the robot and the interaction. The interview questions could, for example, be "What do you think about the robot?" and "What do you want the robot to be able to do?".

2.4 Questionnaire

A Swedish version [11] of the GODSPEED questionnaire [2] was used, which is a semantic differential questionnaire. GODSPEED has five sections that address anthropomorphism (degree of humanlikeness), animacy (something that seems sentient or alive), likeability, perceived intelligence and perceived safety. The first four sections are filled in based on the participants' impression of the robot and the last section is filled in based on the participants emotional state when they met the robot. Descriptive data such as age, gender and if the participant had met the robot before was also collected.

2.5 Participants

During the observation, hundreds of people were moving inside the support shop and interacting with the robot. All these are included as the participants in the observational data, but there are no exact amount to be reported.

For the questionnaire, a total of 44 people (M=49 years old, SD=15,48, 52%=female) participated. Participants for the questionnaire were recruited at the central station in Stockholm after they had interacted with the Pepper robot in the setting illustrated in Figure 1. 14 participants had met the robot prior to that day, and 30 had not. 23 participants were women and 21 were men. To measure age difference the participants were divided into two groups. The mean age was 49 years, and participants 44 years and younger were in the younger group (n=20, M=32) whereas 54 and older were in the older group (n=14, M=63).

2.6 Analysis

The notes from the observation were *open coded*, which means that one writes keywords in the margin to mark what is important. In the next step the keywords were put together to identify themes. After creating these themes, the authors did a *focused coding*, by going through the material again using more general codes and only those that belongs to one of the themes.

The data collection from the questionnaire was analysed in IBM SPSS 24 through Mann-Whitney U-tests, with the mean of the Likert-scale data as dependent variable. The Mann-Whitney U-test were chosen over an Independent t-test, because it handles non-parametric data and is suitable for ordinal numeric data, like Likert-scales [7].

3 RESULTS AND DISCUSSION

The result from the observation, and the GODSPEED questionnaire, will be presented below.

3.1 Observation

The results from the observation were divided into four main themes, *Unaccustomed*, *Concern and fear*, *Emotional connection* and *Entertainment*, and these will be explained and exemplified below. All quotes from the observation are freely translated from Swedish to English.

3.1.1 Unaccustomed. The most common thing that happened during the study was that a person came in to the store, approached the robot, pointed on the tablet on the robot's chest and went away. On the tablet there was an SJ logo and nothing happened when it was pressed. We would like to call this *the pointer finger syndrome*, which seemed like the main affordance of the robot. For example, a woman had just interacted with the robot and had a conversation with the observer. While they were talking she tried once again to touch the tablet and nothing happened – "it's twitching a little [in the finger]" she said and explained that she had a hard time not pressing it.

There were also a lot of people who thought that the robot was a queue ticket machine (which are common is Sweden) and that the tablet should be used to get a ticket, or that one should twist the arm a little to get a ticket. Most people did actually not get that it was a robot, just a broken machine. Even if they looked at the roll-up on the side the message was not understood, and they did not seem to reflect on why the queue ticket machine had head and arms. Even when the robot was dancing and music was coming from it people went up to it and tried to get a ticket from it. This behaviour increased during stressful times, when the train was late or during commute hours. One explanation could be the physical form of the Pepper robot and that the placement of the tablet on the chest affords pressing it. Also, to some degree, it could be explained by the fact that people do not really reflect on their surroundings and are focused on getting what they want out of the situation they are in. But it can also occur because of the element of surprise, perhaps few people expect to see a robot in the customer support shop.

Moreover, in Swedish society, there so far are very few voice assistants. These are not common in the home environment or at work places. During the study (October 2018), Google released the first voice assistant in Swedish and apart from that, the only one that is somewhat used is Siri on Apple products. This had an effect on the interaction since people had a hard time understanding what to do with the robot. Many people would just go up to the robot, stare at it and say "it doesn't do anything". Then the observer, or someone from SJ, would say "you can try talking to it", and this fact made people very perplexed. Then, if they tried saying something and got proof that the robot could hear them and reply, they quickly adapted and kept up the conversation. There were also problems

with how people acted around and toward a robot. Some people were addressing it as a "machine" and thought "that you cannot talk to a machine". When they were talking to the robot, some had a hard time understanding how such a system works, such as that you have to say something comprehensive and then wait for a reaction before you can say something more. When people talked about non-related things, or asked questions with incomplete sentences, the robot had a hard time answering satisfactorily. For example, when a traveller said "I need to go to town to take the train to Eskilstuna" (which is not actually a question) and the robot answers "I did not understand you now, can I help you with a question about the train?", the person got agitated and told the robot "bye, you don't understand anything". The person had not asked a question about the train, but still got upset about the "malfunction" of the robot. This could be a sign of digital exclusion [10]. The Swedish Local Fibre Alliance defines digital exclusion as a lack of internet, equipment, knowledge, motivation and ability, coupled with digital tools. From recent numbers, 1.1 million people in Sweden live in digital exclusion [5]. But we want to broaden this definition. A digital exclusion is not only a total lack of connection to digital tools, it is also a lack of knowledge how digital tools work and how to interact with them. It is a kind of gap between cause and effect. Further, one older man noted the colours in the eyes of the robot and said to his younger friend "one can see that the robot is blushing while it is thinking, there is probably much of these kinds of things that we don't know yet but we will learn". This also indicates that people are not used to talk to machines, but that they believe they will adapt later on when robots are more common.

3.1.2 Concern and Fear. People were a bit hesitant to approach the robot and expressed a concern about how the robot is made and how it works, and especially "who is controlling it?". For example, a young woman stood in the door to the customer support shop and asked the observer what the robot can do, and she was told that she could try to ask the robot a question about the train. She then looked scared and said "No, ew, I don't dare to do that. Is somebody controlling it? Promise me that you are not controlling it!" she said and the observer explained a bit how programming works. She then continued saying "No shit, I do not dare go up to it, but it is great to have robots here. Then you can ask it questions." and she left. So, she saw an area of use for the robot, but she was scared how the robot worked, if somebody was controlling it, and maybe worried her personal data would be stored. One reason for this could be that people are getting more aware of internet security problems, connected with integrity. For example, people expressed that the robot could be hacked and that it would not be an option to have a robot at home because it would be able to record you. People also had a fear that the robot could get physical with you. For example, follow you out of the store: "What if the robot starts following us now" and "Don't talk to it, it might start following us".

3.1.3 Emotional Connection. Some people expressed an emotional connection to the robot. For example, saying "This poor thing looks like a vacuum cleaner", "We are standing here and harassing this poor thing", "This poor thing has to stand here and work all day" and "Look, the poor thing really wants to answer the questions (but is failing)". It is already well established that people tend to anthropomorphise robots and treat them as social entities [3, 6, 9]. This means that people attribute them with both social rights and responsibilities. The reason for people addressing the robot as a "poor thing" could be multiple. One interpretation is that the robot is rather short (120 centimetres) and has a child-like voice. Some people mentioned that the robot looked and sounded like a child, i.e. the association to children and child labour may be close at hand.

3.1.4 Entertainment. Some people thought that the robot's main use was for entertainment purposes. There were many people coming in, thinking it was a funny thing, and enjoying when it danced or told a joke. It also seemed like a successful family attraction where many parents and their children tried the robot, danced with the robot and it seemed like the children could be fully occupied having fun with the robot for hours.

3.2 Questionnaire

Mann-Whitney U-tests were conducted on participants' self-assessed social acceptance toward robots (see Table 1).

Table 1: The result from the Mann-Whitney U-tests for the GODSPEED questionnaire in the public space, regarding if the participant had met the robot before, gender and different age groups.
Statistical significance is marked with a *.

Sub-scale	Met before	Gender	Age group
Anthropomorphism	.829	.841	.012*
Animacy	.397	.532	.239
Likeability	.949	.100	.426
Perceived Intelligence	.228	.039*	.361
Perceived Safety	.828	.886	.123

3.2.1 Met Before. The result was not statistically significantly different between the participants' that had met and had not met the robot before, U=183, z=-.681, p=.496. These results suggest that the interaction and perception of this robot might not be affected by meeting the robot several times.

3.2.2 Gender. On the sub-scale perceived intelligence, the result was statistically significant, U=154, z=-2.069, p=.039, where women found the robot to be more intelligent than the men did.

3.2.3 Age Group. On the sub-scale anthropomorphism, the result were statistically significantly, U=68.5, z=-2.520, p=.012, where the younger group found the robot to be more anthropomorphic than the older group. This result indicates that younger people find the robot to be more natural, humanlike, lifelike, that it acted more conscious and that it moved more elegantly, then older people does.

4 CONCLUSION

This ethnographic study has evaluated the human-robot interaction between travellers and the Pepper robot in a customer support shop at the central station in Stockholm. The results show that people are not yet accustomed to talking to robots. A reason for this might be

that voice assistant tools are not common yet. People seem to expect that the robot does not talk, that it gives out queue numbers, and that one should interact with it by using the tablet on the robot's chest. The - somewhat unsurprising - conclusion is that the results of our study indicate that neither people nor robots are fully ready for open-ended interaction in public spaces at this point. But robots, like Pepper, have a potential high value for marketing purposes and entertainment, so while other applications are developed and evaluated, robots might at least be useful for entertaining people in public areas.

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