Paper: jc*-**-**-****

Exploring the Natural Reaction of Young and Aged Person with Telenoid in a Real World

Kohei Ogawa*, Shuichi Nishio*, Kensuke Koda*,,
Giuseppe Balistreri*, Tetsuta Watanabe*,**, and Hiroshi Ishiguro*,****

*ATR Intelligent Robotics and Communication Laboratory, 2-2-2 Hikaridai seikacho sourakugun Kyoto, Japan
E-mail: ogawa@atr.jp
**Graduate School of Engineering Science, Osaka University, 1-3 Machikaneyama Toyonaka Osaka, japan
[Received ; accepted]

This paper describes two field tests conducted with visitors to shopping mall and with aged persons. For both of the field tests, we used an android we developed which is called "Telenoid R1" or 'Telenoid" for short. For both field tests we interviewed visitors regarding their impressions of the Telenoid. The results of the shopping mall showed that almost half of the interviewed visitors reported having negative feelings toward the Telenoid. But once they gave the Telenoid a hug, they changed their opinions from negative to positive. Meanwhile, the results of the other test showed that the majority of aged persons reported having a positive opinion. As a remarkable point, all aged persons who interacted with the Telenoid gave it a hug without any specific instruction from us. These results show that the Telenoid must be an acceptable medium for the elderly. However, the Telenoid might also be acceptable for younger persons because the visitors we interviewed developed positive feelings toward the robot after giving it a hug. These results inform our future research working with and developing androids.

Keywords: Telenoid, Geminoid, HRI

1. Introduction

Within the last decade, the development of very human-like anthropomorphic robots, which are at first glance indistinguishable from real humans and are often referred to as "androids", has become feasible. Such androids have been expected to aid in the understanding of areas of human cognition which could not have been tested or clarified until now.

Very human-like androids in the past, such as the Geminoid HI-1 and Geminoid F androids developed by our research group, resembled real persons, and were intended to convey the feeling that those specific individuals were present at the robot ' s location. For example, a person facing such an android feels the presence of the actual operator, and, when using the tele-operation system we developed, reacts to the android as if the operator were really there [**?**].

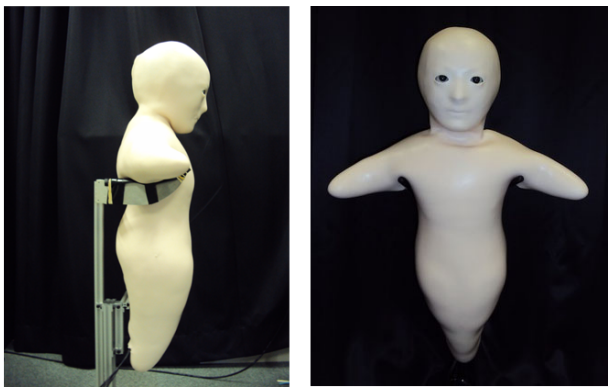

Fig. 1. Telenoid R1.

Telenoid R1 was designed to appear and behave like a minimalistic human; at first glance, one can easily recognize that the Telenoid resembles a human, but it can be interpreted as being either male or female, old or young. Due to this minimal design, the Telenoid allows people to feel as if a far-away acquaintance were close to them. In this paper, we want to investigate ordinary people's natural reactions and impressions outside of the laboratory in order to check that the concept for the Telenoid works.

Laboratory interactions are rather artificial in nature, because the situational context influences the participants' expectations and attitudes [**?**]. Experimental laboratories are perfectly controlled environments. Therefore, results obtained within such an environment can be very useful from a scientific perspective. But data regarding people ' s natural impressions or reaction toward androids cannot be obtained easily in such an environment. We think that the field environment - although uncontrolled - must also be an important source for obtaining knowledge toward the further development of androids.

In this paper, we describe two field tests using the Telenoid. These two field tests were conducted in order to acquire insight into two questions, as follows: (1) whether minimal humans such as the Telenoid will be a next telecommunication media and (2) whether the Telenoid R1 accepted by ordinary people.

2. Related Work

Geminoid HI-1 was developed so as to closely resemble the outer appearance of its creator, Prof. Hiroshi Ishiguro. In contrast to typical humanoid robots [?], which are designed with a human-like shape or features in order to allow people to associate the robots with humans, the outer appearances of androids such as Repliee R1 [?], Repliee Q2 [?], or Geminoid HI-1 [?] even feature artificial skin and hair, and they are modeled to the finest detail in the aim to make them indistinguishable from real humans at first sight. With these androids it is possible to pursue research in the field of Android Schience [?], in which these special robots are seen as "a key testing ground for social, cognitive, and neuroscientific theories." [?]

The effects of an android ' s anthropomorphic appearance and body movements have so far mainly been investigated in a number of empirical studies conducted within laboratory environments. Minato et al. used the android Repliee R1, for example, to investigate the hypothesis that the uncanny feeling diminishes together with increased complexity of the android ' s behavior. This hypothesis was supported by a number of subsequent laboratory studies, e.g. [?], but investigating this question is still a prime motivation underlying android science research.

3. Telenoid R1

In this section, we describe the Telenoid's hardware and tele-operating system to clarify the concept for the Telenoid.

3.1. Specification and Teleoperation System

The Telenoid has nine degrees of freedom, or DOFs. (By contrast, HI-1 has fifty DOFs, and F has twelve DOFs.) Specifically, the provided DOFs allow horizontal and vertical motion for the left and right eyes, opening and closing of the mouth, yaw, pitch and roll rotations for the neck, as well as motion for the right hand and left hand. The Telenoid ' s length is eighty centimeters, and its weight is about six kilograms. The covering skin is fashioned from silicon, and it feels pleasant and similar to human skin when touched.

The operator's face directions, mouth movements and facial expressions are captured by a face recognition system. These face tracking results are used to create commands which are sent to a server via TCP/IP. The video stream for the face recognition system is obtained using a web camera attached to a laptop. Some specific behaviors, such as "bye-bye", "happy" or "hug", can be controlled by GUI buttons on the display. Some spontaneous behaviors, such as breathing and eye blinking, are generated automatically to create the sense that the android is alive. Basically, the tele-operation system requires only a single laptop. Therefore, if an internet connection is available, the Telenoid can be operated from anywhere in the world.

Fig. 2. Left: Aged person with Telenoid, Right: Demonstration at DesignTouch

3.2. Design Concept

The design concept for Geminoid HI-1 is almost opposite in nature to that for the Telenoid. If the Geminoid HI-1 and F are called a "maximum human", Telenoid should be called a "minimal human". The aim for the Telenoid was to create a minimalistic human's appearance, as such an appearance might allow any kind of person to transfer their own presence to distant locations. In order to achieve this purpose, the design of Telenoid is quite different from that for Geminoid HI-1 and Geminoid F. Both the Geminoids have very specific characteristics. For Geminoid HI-1 or F, such specific features are very important to convey the feeling of the intended actual human's presence. But if a Geminoid were operated by an unsuitable operator, these specific features might negatively affect an interaction. An advantage of the Telenoid compared with the Geminoids is that any kind of human can transfer their own presence. This means that the Telenoid can not only be used to convey a specific presence like the Geminoids, but can also additionally be used by all types of people.

The person interacting with the Telenoid must be able to see any kind of person in the Telenoid. In order to achieve this purpose, we removed human features we felt weren' t crucial for communication from the android. Unnecessary features were found from the results of previous empirical studies. For example, Geminoid HI-1 can move its whole body: i.e., its arms, legs, fingers and so on. On the other hand, Geminoid F can move only its upper body. But these two Geminoids are almost equally capable of conveying a specific human's presence. This study indicates that bodily movements except for facial movements might not so important for tele-communication with Geminoids.

Telenoid, as a minimalistic human, was created following a strategy to remove as many unnecessary features as possible. Essential features that remained after this pruning process might be helpful to create efficient telecommunication media which can be used by all types of people.

4. Demonstration at Shopping Mall

The first field test targeted ordinary people visiting the shopping mall. This field test was held as a part of an art event at shopping mall We displayed the Telenoid for two

days during this event and conducted visitor interviews (fig: **??**, right side).

4.1. Settings

First, we provided basic information about the Telenoid. After the explanation, some applicants were asked to sit on a sofa where the Telenoid was located, then started talking with the Telenoid. The operator was the only person who was accustomed to operating the Telenoid. The first field test targeted ordinary people interested in media art visiting the event. These visitors to the event were highly interested in art and new technology. We interviewed 75 visitors who interacted with Telenoid R1. They were mostly in their 20 ' s (10's: 7, 20's: 42, 30's: 14, 50's: 3, unknown: 2).

4.2. Interviews

We asked the visitors the following three questions.

Q.1 How did you feel toward the Telenoid?

Q.2 Was the Telenoid better than a telephone for talking with a distant person?

Q.3 Was it better to talk to a distant person using the Telenoid than to talk face to face?

4.3. Interviews

We asked the visitors the following three question. Because interviews were conducted using natural conversation, visitors ' opinions were hard to clearly divide into particular categories. Therefore we show typical opinions for each question and describe brief tendencies for the opinions.

4.3.1. Q.1 How did you feel toward the Telenoid?

Typical opinions for Q.1 are as follows; (1)"At first glance, I felt strange but once I talked with it, I began to feel it was cute.", (2) "Anyway I was just really scared.", (3) "I felt attachment while I was talking with it.".

The tendency of opinions for Q.1 show that about half of the interviewed visitors felt positively toward the Telenoid. The typical negative opinion shows that the Telenoid's appearance is a bit difficult to accept at first glance for ordinary people. Meanwhile, as a remarkable point, some visitors mentioned that after giving the Telenoid a hug, they felt positively toward the Telenoid.

4.3.2. Q.2 Was the Telenoid better than a telephone for talking with a distant person?

Typical opinions for Q.2 are as follows; (1)"I felt like I was in a shared space with the person operating the Telenoid.", (2) "It might be easier to picture others using the Telenoid than when using a telephone.", (3) "When conversing with someone using the Telenoid, I can imagine the other person's emotion.".

The tendency of opinions for Q.2 show that about seventy percent of interviewed visitors thought that the Telenoid was better than the telephone as a telecommunication media.

4.3.3. Q.3 Was it better to talk to a distant person using the Telenoid than to talk face to face?

Typical opinions for Q.3 are as follows; (1)"Direct communication is absolutely much better for me.", (2),"I think I can speak my wife honestly by using the Telenoid.", (3)"I can accept the Telenoid as a toy.".

The tendency of opinions for Q.3 show that about seventy percent of interviewed visitors thought that face-to-face conversation is better than Telenoid.

4.4. Discussion

Concerning Q.1, about half of the interviewed visitors accepted the appearance of the Telenoid at first glance. At the same time, the other half of the visitors, who had a negative impression of the Telenoid, changed their opinions after giving the Telenoid a hug. The Telenoid, as a minimalistic android, is a new concept. Nobody has had experience with the Telenoid. People tend to have negative impressions for new things. Therefore, it is not unexpected that almost half of the visitors felt strange using the Telenoid. However, hugging decreased their negative impressions.

Next, the majority of interviewed visitors answered that the Telenoid is better than a telephone for talking with someone. On the other hand, a majority of interviewed visitors chose face-to-face conversation compared with the Telenoid. These results show that the Telenoid is currently not a replacement for face-to-face communication. Meanwhile the Telenoid has possibilities as a new tele-communication media. As I mentioned above, people tend to avoid new unknown things. If the Telenoid becomes popular in the future, we hope some people in some situations might feel an advantage to using the Telenoid over face-to-face communication.

5. Telenoid with Aged Persons

The second field test involved elderly persons using the Telenoid (fig: **??**, left side). This second experiment provided us with further material for discussion.

5.1. Settings

This test was held as a part of a tour introducing our laboratory. The aged persons went to several locations, including one where the Telenoid demonstration was held. This exposure might have allowed some to become accustomed to the environment.The visitors were in their 70's, 80 ' s and 90's (average age was 84.9 years old). The visitors receive service from a "Day Care Center" at their own home. They were not diagnosed with dementia.

First, we provided basic information regarding the Telenoid. After the explanation, some applicants were asked to sit on a sofa placed by the Telenoid, then started talking using the Telenoid. The operator was a female employee from the Day Care Center. The staff and aged persons were acquainted.

5.2. Interviews

We asked the following 4 questions to the aged persons. Interviews were conducted while engaging in natural conversation. Therefore, the opinions obtained are hard to clearly divide into particular categories. Additionally answers from the visitors were sometimes not consistent. Therefore we employ the same approach as for the previous test, by showing typical opinions for each question and describing in brief the tendencies for opinions. Q.1 could only be answered as "staff" or other. Thus the description regarding typical opinions for Q.1 is skipped.

5.2.1. Q.1 Whom were you talking with?

The aged persons and the staff were known to each other. However the result for Q.1 showed that about 47 % of the elderly did not realize whom they were talking with through the Telenoid even though the experimenter had described the Telenoid before the interaction.

5.2.2. Q.2 How did you feel toward the Telenoid?

Typical opinions for Q.1 are as follows; (1)"Very cute. It looks like my grandchild.", (2)"It is very soft and nice to touch.", (3)"It is very far from actual humans and the tactile sensation is like rubber.".

The tendency of opinions for Q.2 shows that majority of aged persons felt positively toward the Telenoid. As a remarkable point, all aged persons gave the Telenoid a hug without any specific instructions (e.g. "This robot is a huggable media. Please try hugging it... ").

5.2.3. Q.3 Is the Telenoid good to talk with a distant person compared with the telephone?

Typical opinions for Q.1 are as follows; (1)"I think I can feel the actual person's presence with the Telenoid.", (2)"I am not used to using the Telenoid; the telephone is better for me.", (3)"The Telenoid is better because it is very cute.".

The tendency of opinions for Q.3 shows that about 60% of aged persons had a positive opinion of the Telenoid.

5.2.4. Q.4 Is the Telenoid good to talk with distant person compared with face to face conversation?

Typical opinions for Q.1 are as follows; (1)"Direct conversation is better. Because humans are alive.", (2)"Face to face is good for me. ", (3)"I like to talk with my grandchild face to face.".

The tendency of opinions for Q.4 shows that about 20% of aged persons had a positive opinion of the Telenoid.

5.3. Discussion

Concerning the result of Q.1, almost half of the aged persons did not realize who was operating the Telenoid. This suggests that maybe the concept of tele-operation was slightly difficult to understand for them. However, the aged persons had a very good impression of the Telenoid from the very start. This is one of the most different points when compared with the reactions shown by younger persons.

The results of Q.3 and Q.4 indicate a similar tendency to that seen in the last test. For aged persons as well, it is hard to imagine the Telenoid as being a replacement for humans (face to face communication). But as a telecommunication media, Telenoid is acceptable for them.

The most different point compared with younger people's reactions was the manner of conversation. For example, some aged persons did not pay very close attention to what the Telenoid said, and they instead talked about their own experiences. It might seem that Telenoid did not work efficiently for the elderly visitors. However they hugged the Telenoid and showed big smiles when talking with the Telenoid. Although the Telenoid is basically intended for tele-communication, some of the aged persons treated the Telenoid as just a huggable and communicative "AGENT". We think that this could also be a proper way to use the Telenoid. The most important goal for this Telenoid research is to discover not only unknown possibilities for the Telenoid but also for androids as a whole. The knowledge which we obtained from this field test with aged persons might be useful for android studies in the future.

Acknowledgements

I would like to thank the helpful suggestions of Dr.Nakanishi and Dr.Yoshikawa.This work was partially supported by Grant-in Aid for Scientific Research (S), KAKENHI (20220002) and JST, CREST.

References:

[1] S. Nishio, H. Ishiguro, and N. Hagita, "Geminoid: Teleoperated Android of an Existing Person," Humanoid Robots, New Developments, Vienna, I-Tech, Vol. 20, pp. 343-352, 2007

[2] Bartneck, C., Kanda, T., Ishiguro, H., & Hagita, N. (2007). Is The Uncanny Valley An Uncanny Cliff? IEEE Intl.Conf. on Robot & Human Interactive Communication (pp. 368-373). Jeju, Korea: IEEE.

[3] Kanda, T., Hirano, T., Eaton, D., & Ishiguro, H. (2004). Interactive Robots as Social Partners and Peer Tutors for Children: A Field Trial. Human Computer Interaction (Special issues on human-robot interaction) , 19, 61-84.

[4] Minato, T., Shimada, M., Ishiguro, H., & Itakura, S. (2004). Development of an Android Robot for Studying Human-Robot Interaction. Innovations in Applied Artificial Intelligence, (pp. 424-434).

[5] Shimada, M., Minato, T., Itakura, S., & Ishiguro, H. (2006). Evaluation of Android Using Unconscious Recognition. Humanoid Robots , 157-162.

[6] Ishiguro, H. (2005). Android Science: Toward a new cross-interdisciplinary framework. Proc. of the CogSci 2005 Workshop "Toward Social Mechanisms of Android Science", (pp. 1-6). Stresa, Italy.

[7] MacDorman, K. F.,& Ishiguro, H. (2006). The uncanny advantage of using androids in cognitive and social science research. Interaction Studies , 297-337.