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Paper:

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

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This paper describes two field tests conducted with shopping mall visitors and with aged persons defined as in their 70s to 90s. For both of the field tests, we used an android we developed called Telenoid R1 or just Telenoid. In the following field tests we interviewed participants about their impressions of the Telenoid. The results of the shopping mall showed that almost half of the interviewees felt negative toward Telenoid until they hugged it, after which opinions became positive. Results of the other test showed that the majority of aged persons reported a positive opinion and, interestingly, all aged persons who interacted with Telenoid gave it a hug without any suggestion to do so. This suggests that older persons find Telenoid to be acceptable medium for the elderly. Younger persons may also find Telenoid acceptable, seeing that visitors developed positive feelings toward the robot after giving it a hug. These results should prove valuable in our future work with androids.

Keywords: Telenoid, Geminoid, human robot interaction

1. Introduction

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

Very human-like androids, such as the Geminoid HI-1 and Geminoid F developed by our research group were intended to convey the feeling of specific individuals present at the robot's location. For example, a person facing the 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 [1].

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 (**Fig. 1**). It, however, can be interpreted as either male or female, old or young. Due to this minimal design, 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 to check whether our Telenoid concept actually operates.

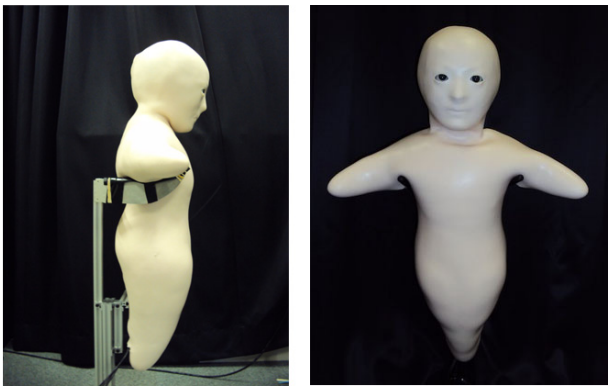

Fig. 1. Telenoid R1.

Laboratory interactions are rather artificial in nature, because the situational context influences the participants' expectations and attitudes [2]. 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, is important in acquiring knowledge toward the further development of androids.

This paper discusses two field tests for gaining insight into: whether (1) minimal human entities such as Telenoid can serve as telecommunication means and (2) ordinary people can accept Telenoid enough to interact usefully with it.

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2. Related Work

Geminoid HI-1 was developed to look like its creator, Prof. Hiroshi Ishiguro. In contrast to typical humanoid robots [3], 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 [4], Repliee Q2 [5], or Geminoid HI-1 [1] even feature artificial skin and hair, and they are modeled in detail to make them indistinguishable on first sight from real humans. In the android science [6], these special robots are viewed as "a key testing ground for social, cognitive, and neuroscientific theories" [7].

The effects of an android's anthropomorphic appearance and movements have mainly been investigated in of empirical laboratory studies. Minato et al. used android Repliee R1, for example, to determine whether the uncanny feeling people have about androids diminishes as android behavior. This hypothesis was supported in studies, e.g., [5], but investigating this question is still a prime motivation in android science research.

3. Telenoid R1

In the section, we discuss Telenoid hardware and teleoperating system to clarify the concept for the Telenoid.

3.1. Specification and Teleoperation System

Telenoid has nine degrees of freedom, or DOFs (by contrast HI-1 has 50 DOFs and F has 12 DOFs). Specifically, the provided DOFs allow independent horizontal motion for the left and the right eye, and synchronized vertical motion for both 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 80 centimeters, and its weight is about six kilograms. The covering skin is made from silicon and felt pleasantly similar to human skin.

The operator's face direction, mouth movement and facial expressions are captured by face recognition system. These face tracking results are used to create commands sent to a server via TCP/IP. The face recognition video stream is obtained using a Web camera on a laptop. GUI display buttons control specific behaviors such as "bye-bye," "happy" or "hug." Some "spontaneous" behaviors such as breathing and eye blinking are generated automatically to help give a sense that the android is "alive." Breathing is, for example, accompanied by slight, regular hand movement. Basically, tele-operation system requires only a single laptop, meaning that Internet connection enables Telenoid to be operated from anywhere in the world.

3.2. Design Concept

Telenoid's object is to create a minimal human, as such a design might allow any kind of person to transfer their own presence to distant location. This requires; (1) an omni-human likeness, (2) holdability, (3) mobility. Specifically, "omni-human likeness" enables users to feel any kind of person's presence. "Holdability" facilitates physical interaction with Telenoid. "Mobility" encourage persons to use Telenoid in a variety of situations.

The Geminoid HI-1 and F design concept is almost opposite to that for Telenoid. Geminoid HI-1 and F have specific characteristics. For Geminoid HI-1 or F such specific features are important to convey the feeling of the intended actual human's presence. An "unsuitable operator" controlling a Geminoid may cause these features affect interaction negatively. Geminoids are difficult to make mobile due to their weight and size.

Among robots having some commonality with Telenoid, the a teddy-bear-like IP RobotPHONE targets telepresent communication [8]. Its appearance may, however, affect interactive use. For the design of a minimal human, robot's appearance should thus avoid preconceived ideas about robots, if possible.

Telenoid, as a minimalistic human, was created to remove as many "unnecessary" features as possible by (1) choosing features for communicating with humans and eliminating unrelated ones, (2) reconsidering chosen features to fit design requirements eliminating unnecessary features, and (3) obtaining essential features.

Unnecessary features has been found from the researchers' experiences in previous Geminoid's studies, e.g., Geminoid HI-1 move its whole body: arms, legs, fingers etc., but Geminoid F moves only its torso. But the two Geminoids are almost equally capable of conveying a specific human's presence. This phenomenon indicates that movements other than facial may not be important in telecommunication with Geminoids. Post-pruning features may thus be helpful in creating an efficient telecommunication presence acceptable to different types of users.

Telenoid has three advantages over Geminoids – enabling physical communication, and enabling Telenoid to be moved easily anywhere. Telenoid thus conveys a specific human-like presence similar to Geminoids, but can be used by anyone due to its minimalistic design. A size of Telenoid enables physical communication and can be used anywhere.

The two field tests we conducted to determine user acceptability of the Telenoid concept are detailed in the sections bellow.

4. Demonstration at Shopping Mall

Field test 1 targeted shopping mall visitors as part of an art event at which we displayed Telenoid for two days and interviewed visitor (**Fig. 2**, right).

4.1. Setup

To begin a Telenoid demonstration, we provided basic information use, e.g., that Telenoid was huggable and communicative. Visitors were then invited to sit on a sofa and talk with Telenoid. Conversations typically lasted

Fig. 2. Left: aged person with Telenoid, Right: demonstration at DesignTouch.

about 5 minutes. Only the operator was to operating Telenoid. Ordinary visitors interested in media art and new technology took part in the event. We asked 75 people to take an interview but some of them refused due to lack of time, so we collected a total of 56 interviews. Interviewees were mostly in their 20's (10's: 6, 20's: 30, 30's: 12, 40's: 4, 50's: 2, unknown: 2). Interviews took about 5 minutes, during which the interviewer took notes on visitor opinions.

4.2. Interviews

Interviews involved three questions using natural conversation, which sometimes made opinions difficult to categorize, so results were reviewed by three judges and an opinion classified only if judges voted unanimously, otherwise, opinions were classified as "neutral," e.g., "strange and realistic" an answer to question 1.

Typical opinions on each question are shown together with trends.

4.2.1. Q.1: What Did You Feel About Dealing with Telenoid?

Typical responses to Q.1 were (1) "At first glance, it was felt strange, but once I talked with it, I began to find it cute," (2) "I was plain scared of it," and (3) "I felt some attachment to it once I started talking with it."

The tendency of opinions for Q.1 show that about half (48.2%) of the interviewed visitors felt positive and the other half felt negative (35.7%) or neutral (16.1%). The typical negative opinion showed that the "ordinary" persons found Telenoid's appearance difficult to accept at first glance.

Notably, 8 of 11 answering negatively mentioned feeling positively toward Telenoid after hugging it. This result shows that hugging changed visitor attitudes.

4.2.2. Q.2: Was Telenoid Better than a Telephone for Talking to a Person not Directly Present?

Typical responses were (1) "I felt like I was in a space shared with the person operating Telenoid," (2) "It might be easier to picture the other person when using Telenoid rather than when using a telephone," (3) "When talking with someone using Telenoid, I would imagine the other person was feeling."

The tendency of responses show that 72.9% of interviewed visitors thought that the Telenoid was better for communication than the telephone.

4.2.3. Q.3: Was it Better to Talk to a Person at a Distance Using Telenoid than Talking Face to Face?

Typical responses were (1) "Direct communication is definitely much better for me," (2) "I think I can speak to my wife more straight-forwardly using Telenoid," (3) "I can accept Telenoid as a toy."

The tendency of responses for Q.3 show that 74.4% of interviewed visitors thought that face-to-face conversation was better than via Telenoid.

4.3. Discussion

Based on Q.1 about half of the interviewed visitors accepted Telenoid appearance at first glance, and visitors with a negative impression of Telenoid, changed to a positive opinions after giving the Telenoid a hug. They found Telenoid a new concept as a minimal android. Interviewees tends to have negative impressions of new things, and it caught us by surprise when almost half of the interviewed felt strange using Telenoid but hugging it lessened their negative impression.

The majority of interviewed visitors found Telenoid better for talking with someone than a telephone but a majority of interviewed visitors chose face-to-face conversation over Telenoid. Clearly, Telenoid currently would not replace face-to-face communication, although it may have possibilities as a new tele-communication venue. One interviewee answered Q.3 by stating acceptance of Telenoid "as a toy." Although we classified this opinion as negative, we expect interviewee to provide interesting knowledge. Despite understanding the Telenoid concept, the visitor did not accept Telenoid as a telecommunication venue. Three other visitors had similar opinions, indicating that some accept Telenoid only as a conversational "agent."

Although field test results may be biased by visitor familiarity with new technology as part of an art event, some "ordinary" people were included in the common area of the shopping mall, possibly supporting some generality of the results.

Given a general tendency to avoid the unknown, we hope that those wanting to feel the "presence" of a person for away may take advantage of Telenoid use.

5. Telenoid and Aged Persons

Field test targeted older persons (**Fig. 2**, left) with the goal of providing further material for discussion.

5.1. Setup

This test was part of a tour introducing our laboratory, with visitors going to several locations, including the Telenoid demonstration. This exposure may have accustomed some to the Telenoid environment. We talked to

47 persons. They were in their 70's, 80's and 90's (70's: 6, 80's: 26, 90's: 9, unknown: 6). Conversations typically lasted 5 minutes, and were recorded on videos. Participants were part of home daycare center service and had not been diagnosed with dementia. Interviews involved basic information that Telenoid was a "communication medium." Visitors were asked to sit and talk with Telenoid, which was operated by a daycare center employee familiar to visitors.

5.2. Interviews

Interviews involved four questions answered using natural conversation, under the conditions in field test 1.

Answers from the visitors were sometimes not consistent because of their advanced age. Therefore some inconsistent answers, such as "I like moni-chan" (it's an answer to Q.2, we could not catch the meaning of it), were removed from the results because it's difficult to classify into categories.

Q.1, "Whom were you talking to?," could only be answered as "staff" or "other," so its description is omitted here.

5.2.1. Q.1: Whom Were you Talking to?

Typically, despite knowing the staff member operating Telenoid, 47% of the elderly did not apparently realize whom they were talking to, despite the earlier explanation.

5.2.2. Q.2: How Did You Feel Toward the Telenoid?

Typical respondents found Telenoid (1) "Very cute, like my grandchild," (2) "very soft and nice to touch," or (3) "very unhuman and feeling like rubber."

Some 88.8% of interviewees felt positive toward Telenoid, all hugging it without any suggestion. When Telenoid was handed to them, they hugged it immediately and they started patting it and talking to it, apparently happy to interact with it.

5.2.3. Q.3: Was it Better to Talk to Person at a Distance Using Telenoid or to Use a Telephone?

Typical respondents felt on (1) "actual person's presence with Telenoid," (2) "found the telephone better for me," or (3) "Telenoid is better because it is very cute."

Some 66.6% felt positive toward Telenoid, while answers (1) and (3) were classified as positive and the answer (2) was classified as negative.

5.2.4. Q.4: In Talking to a Person at a Distance, Which was Better, via Telenoid or Face-to-Face?

Typical respondents felt that (1) "direct conversation is better because humans are alive," (2) "Face to face was good for me, " and (3) "I like to talk with my grandchild face to face."

Some 26% felt positive opinion of the Telenoid. For example, three typical opinions above were classified as negative.

5.3. Discussion

Concerning the result of Q.1, almost half of the aged persons did not know who was operating Telenoid, suggesting that the teleoperation concept may have been somewhat difficult. They were, however, impressed positively by Telenoid from the very start. This means that some may not have used it for telecommunication, but found it acceptable for talking to at least.

Q.3 and Q.4 responses were similar to field test 1, i.e., Telenoid did not replace face-to-face communication, but may have been an acceptable tele-communication venue.

The most different point compared with younger people's reactions was the manner of conversation. For example, some aged persons paid little attention to what Telenoid said, and, instead, talked about themselves. 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 telecommunication, 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 Telenoid research goal remains to discover unknown possibilities for Telenoid as well as 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.

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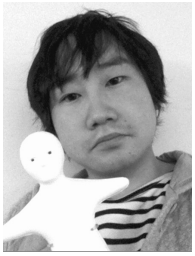

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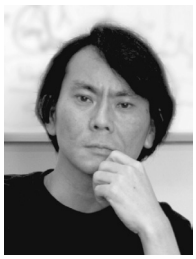

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