

# On Positive Effect to Human Impression by a Forgetful Robot

Mitsuharu Matsumoto

**Abstract**—In recent years, many robots for interacting humans have actively been studied. How to attract users is a key topic in human-robot interaction and entertainment field. Although robot designers often aim to design the robot to be free of imperfections, we also know an old proverb; The sillier the child is, the cuter he or she is.

The aim of this study is to investigate the positive effect of sillier robots in human-robot interaction. To verify the positive effects, as an example, we design a forgetful robot, which sometimes forgets something as a relatively sillier robot, and investigate its effect on users' impression. For the experiments, two different types of robots were designed. One is a clever robot, which can remember users' name if users say their names once. The other is a forgetful robot, which sometimes forget user's name even if users say their names. Throughout the experiments, we obtained some positive effects to human impression by a forgetful robot although it could not remember users' name and asked them again.

**Index Terms**—Forgetful robots, Imperfect robot, Human-robot interaction, quality of life.

## I. INTRODUCTION

The sillier the child is, the cuter he or she is. This is an old proverb well-known in the world. Humans are often more attracted to the child that sometimes has difficulty remembering something and makes mistakes than the child that is free of imperfections. However, in robotic field, many researchers generally aim to design the robot to be free of imperfections to help our daily life such as houseworks and navigation [1]–[3].

Recently, some reports show that elderly people reduce their motivation and ability if humans and robots give them excess supports. For instance, some researchers reported that elderly people reduce their physical ability rapidly when there are nothing to do after retiring the company due to the retirement age [4],[5]. There are other studies about strong stress of cared people. According to the studies, they feel loss of independence even if well trained people care them as they feel that they live passively in their daily life [6].

Some researchers noted that it is important for elderly people to do some works or tasks in daily life. The tasks to be done give people some meanings for living their life [7].

Based on the above aspects, some researchers in robotic field pay attention to the importance of imperfections of robots, and reported some positive effect of the robots'

negative behavior to users.

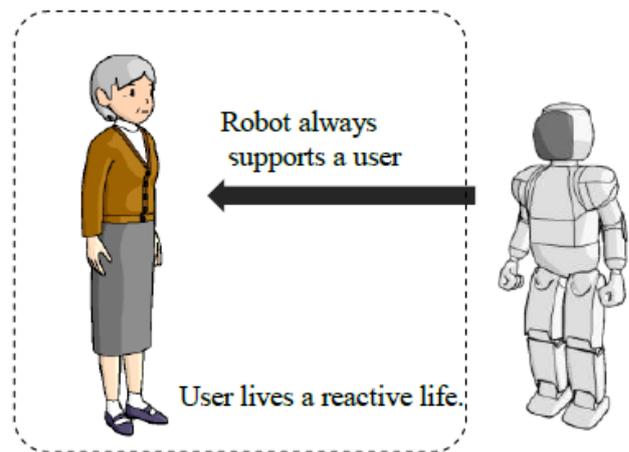


Fig. 1. Interaction between users and existing robots.

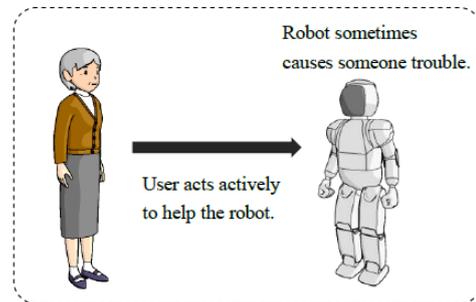


Fig. 2. Interaction between users and robots that cause someone trouble.

Matsuzoe *et. al.*, proposed a human-robot learning system not by one way teaching from a robot but by using bidirectional communication [8]. They set three types of robots, which has different cleverness.

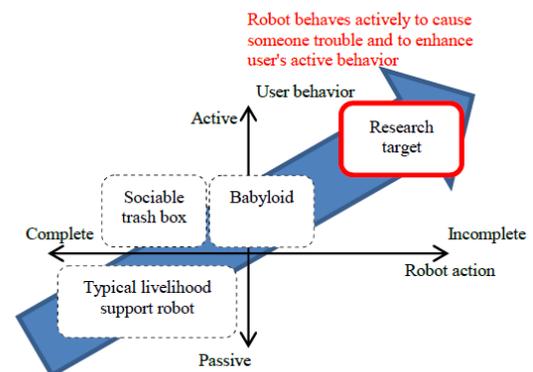


Fig. 3. Target of our research and other robots.

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They showed that the interaction increases when the robot sometimes makes mistakes rather than the robot does not

mistakes. In such cases, children taught the robot when it made a mistake, and as a result, they learned deeply compared to one way communication.

Miyake *et. al.*, proposed a trash-box robot to enhance children's assists when the robot dumps garbage. Although the robot is a kind of cleaning robot, it cannot do anything without users' help [9]. According to their reports, users came into contact with the trash-box robot, and helped the robot to dump garbage.

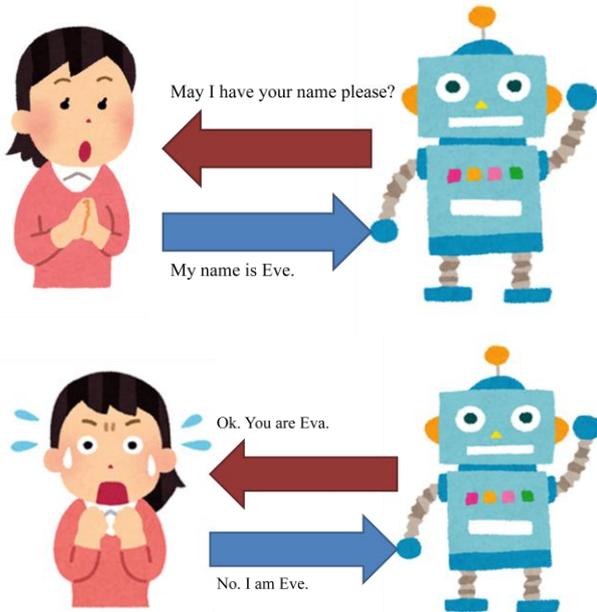


Fig. 4. Design concept of a forgetful robot: It sometimes forgets users' name, order and so on like human. We expect that users get compulsive to teach robots and are attracted to the robot.



Fig. 5. Prepared robots.

Terada *et. al.*, proposed a robot being able to deceive human. Their aim is to make users feel that the robot has a mind by setting the robot's unpredictable action [10]. In the

experiments, they set a game "red light, green light", and investigated what types of robot actions deceive users.

Based on the above prospects, we also investigated the positive effects of robots' negative behaviors to users' impression in the past [11], [12]. According to the past research, we found that some negative behaviors gave users positive impression.

This paper focuses on forgetfulness of the robots as robots' negative behaviors, and investigated the positive effects on users. To confirm the above concept, a forgetful robot is designed and its positive effect on users' impression is investigated throughout comparative experiments.

## II. GENERAL CONCEPT

This section describes a general concept of this research, and summarizes the target of our research.

Recently, we proposed the concept of imperfect robot.

Although many researchers aim to develop robots, which can help users as perfect as possible normally, incomplete robot is designed to be imperfect, that is, sometimes to cause users trouble [4], [5].

Fig. 1 and 2 show the interaction between typical human-robot interaction and proposed human-robot interaction to clarify our concept.

As shown in Fig. 1, the robot is typically designed to help users anytime, and is expected to support users perfectly.

Such robots are designed to avoid making mistakes. Of course, this approach is very meaningful and useful. However, users have nothing to do due to their helps and tend to lose their motivation to do it by themselves.

To solve the problem, we aim to design robots, which sometimes cause users trouble. Fig. 2 shows our concept. As shown in Fig. 2, we aim to give users something to do by designing the robots that sometimes cause users troubles. We expect that users behave not as passive cared persons but as active caretaker for the robot due to the troubles.

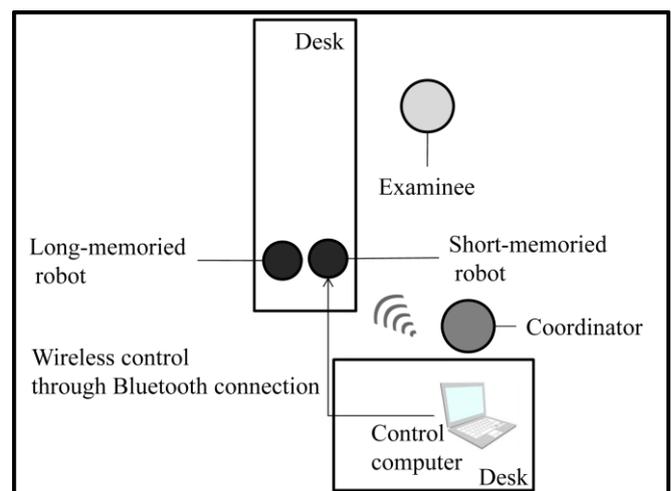


Fig. 6. Experimental environment.

This concept is from an observation of babies and infants.

As we know, babies and infants live not for parents or other people but for their own lives. They want to do many things by themselves, but they also made mistakes many times. Their

actions bring us many troubles, and we need to do many things for them due to the troubles.

However, their efforts and failure do not bring a feeling of dislike to us. They sometimes cause the attention and affection of us to them.

Based on the above aspects, we aim to design imperfect robots like babies and infants, and expect that users have more affection to the robots due to the troubles from the imperfect robots.

2nd trial (1 week or 2 weeks later)

Robot: says "Hello. Long time no see. Mr/Ms. xx. How are you ?" and rotates its body.

Robot: says "Long time no see. Sorry. I forgot your name. Please tell me your name again. " and moves forward.  
User: My name is xx.  
Robot: says "Oh. I remember you. Mr/Ms. xx. How are you ?"

To clarify the difference between our approach and other research, we also give Fig. 3. As shown in Fig.3, we aim to make robots trouble makers more than other researches, and to encourage active interaction from users due to the troubles.

### III. DESIGN CONCEPT OF FORGETFUL ROBOTS

Children do not always obey parents' orders. They sometimes refuse the orders and forget them.

Fig. 4 shows the design concept of a forgetful robot. It is a robot, which sometimes has difficulty remembering something. Normally, the system designers design the robot to be clever. They think that the robot should keep the memory eternally if it memorizes the users' name once. However, human sometimes has difficulty remembering something. Users may feel humanity due to their forgetting. Although it is considered that these types of negative reactions from robot should be avoided, we think that they inspire users' attachment to the robot. In other words, we aim to investigate whether the sillier the robot is, the cuter it is.

### IV. EXPERIMENTS

#### A. Experimental Setup

We prepared two types of robots as shown in Fig. 5.

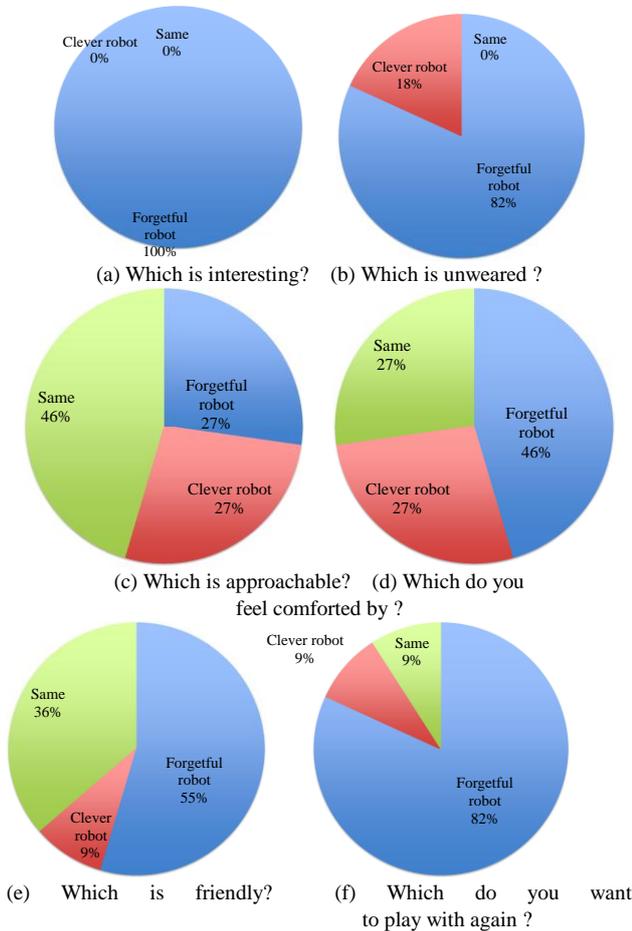
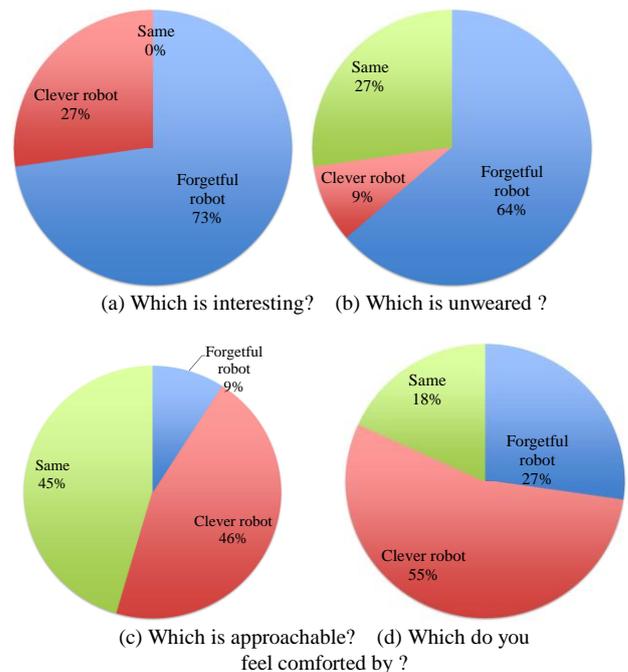


Fig. 7. Questionnaire results of the first experiments.

TABLE I: SCENARIO OF EXPERIMENTS

Trial number	Clever robot (Pink)	Forgetful robot (Yellow)
1st trial	Robot : says "How do you do ? " and moves forward.	Robot : says "How do you do ? " and moves forward.
	User: My name is xx.	User: My name is xx.
	Robot: says "I see. Your name is yy ?"	Robot: I see. Your name is yy ?
	User: No.	User: No.
	Robot: says "Please tell me your name again." and rotates its body.	Robot: says "Please tell me your name again." and rotates its body.
	User: I am xx.	User: I am xx.
Robot: Your name is xx, OK?	Robot: Your name is xx, OK?	
User: Yes.	User: Yes.	
Robot: says "Sorry for my mistake. Please come here again." and rotates its body.	Robot: says "Sorry for my mistake. Please come here again." and rotates its body.	



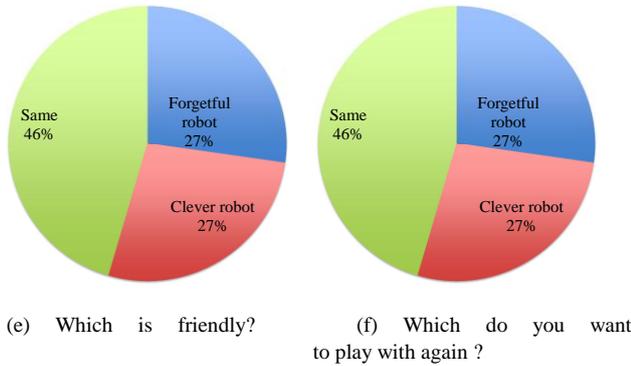


Fig. 8. Questionnaire results of the second experiments.

One is a forgetful robot, which sometimes has difficulty remembering users' name. The other is a clever robot, which can memorize users' name in a moment for comparison.

To clarify the difference of two robots, we set a different color doll on them as shown in Fig. 5. Figure 6 shows the experimental environment. In the experiment, we selected "greetings and remembering users' name" as a task.

The robots could be controlled from a remote computer with bluetooth connection.

The possible actions were "Move forward", "Move backward", "Turn clockwise" and "Turn counterclockwise".

The robot also could produce some sentences regarding greetings and asking users' name.

As shown in Fig.6, the examinees controlled the robot through wireless network. The experiments were conducted without letting examinees know that the coordinator controlled the robot.

This is because we aim to show the examinees as if the robot moved autonomously. The number of examinees is 11. The ages of them were from late teens to early twenties. We set two experiments with some intervals.

The scenario of the experiments is listed in Table.1.

In the first experiment, the robot tried to memorize users' name. The clever robot made the usual greetings and ask users' name. It remembers it quickly once the users told their names. In contrast, the forgetful robot forgets users' name after users told their names to it and asks the name again. In the questionnaire, we ask the users to select one from the following three check box regarding 6 items.

Forgetful robot is better than clever robot.

Clever robot is better than forgetful robot.

Both are the same.

After 1 week or 2 weeks of the experiment, we conducted another experiment. In the second experiment, the robot made the usual greetings and confirmed the users' name. The clever robot made the usual greetings with correct users' name. On the other hand, the forgetful robot forgot users' names and asked their names again. After confirmation, it made the usual greetings with correct users' name. We set the same questionnaire for the second experiment as that for the first experiment.

We set 8 items as follows:

Which is interesting ?

Which is unwearied?

Which is approachable ?

Which is attractive ?

Which do you feel comforted by ?

Which is friendly ?

Which is cute ?

Which do you want to play with again ?

We also set a free form to answer the impression for the experiment freely.

#### A. Experimental Results

In this section, we show some impressive results from questionnaire. Fig.7 shows the results of the first experiment. As shown in Fig.7, the forgetful robot gave users positive impression than a clever robot in most items. Although the robot appearance is far from a human, some users felt that the robot was child-like according to the comments in free form. Throughout the experiments, adequate forgetfulness gave users positive impression. Fig.8 shows the results of the second experiment. As shown in Fig.8, as the robot forgot users' name again, the impression of users to the forgetful robot becomes worse. However, the forgetful robot still gave users positive impression than a clever robot on some items especially regarding users' long-term interests. According to the users' comments, some users felt stronger positive impression to the robot after the second experiment than after the first experiment.

To evaluate the results, we also conducted square test.

In this test, we set "There are no difference on users preference on clever robot and forgetful robot." as null hypothesis.

In the experiment 1, the assumption is rejected regarding "interesting", "unwearied" and "play with again" when significant level was set to 1%. In the experiment 2, the assumption is rejected regarding "interesting" when significant level was set to 5%. In other words, the forgetful robot have more positive effects compared to the clever robot especially in experiment 1.

Some users give positive comments as follows:

The reaction from the robot was annoying compared to the general robot, but I felt it cute due to that reaction. The feelings are what we aim to design in forgetful robots. The most frequent negative comments from users is that they felt sad when the robot forgot their name again. Throughout the experiments, it could be confirmed that adequate forgetfulness has a strong potential to give users positive impression. However, the amount of forgetfulness should be designed carefully.

#### V. CONCLUSION

In this paper, the positive effects of relatively sillier robots in human-robot interaction were investigated.

As an example, I proposed a design concept of a forgetful robot and developed two types of robots, that is, a clever robot and a forgetful robot to investigate the positive effect of forgetful robot to users' impression.

Throughout the experiments, we found that users have positive impression on the forgetful robot rather than a clever robot although the forgetful robot causes users problems.

Although the experiments are first-stage and need more studies, relatively sillier robots have a potential to attract users. We think that these types of imperfections are important for human robot interaction.

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