

Trial of Robot Therapy in Elderly People using a Pet-type Robot

Toshimitsu
Hamada

Dept. of Urban
Economics
Nasu University
Kuroiso, Tochigi,
Japan
hamada@nasu-
u.ac.jp

Tomomi
Hashimoto

Dept. of Engineering
Saitama Institute of
Technology
Saitama, Japan
tomomi@sit.ac.jp

Toshiko Akazawa

College of
Liberal Arts and
Sciences
Kitasato University
Sagamihara,
Kanagawa, Japan
akazawa@kitasato-
u.ac.jp

Yoshio Matsumoto

School of
Information
Technology and
Electronics
Tokai University
Hiratsuka, Japan
ymatsumoto@keyaki
.cc-u.tokai.ac.jp

Yoshihito Kagawa

Dept. of Mechanical
System and
Engineering
Takushoku
University
Tokyo, Japan
ykagawa@ms.takush
oku-u.ac.jp

Abstract— We conducted a trial applying pet-type robot therapy to the welfare and care of the elderly people. Through performing RAA (Robot Assisted Activities) to evaluate the effectiveness of robot therapy quantitatively, we analyzed the impression and the effect of RAA from viewpoints such as the situation of the evaluation person and the physical, mental and living environment of the subject. Although there was a difference between the evaluation of institution member and intervention persons, the evaluation of RAA was high.

Keywords— robot therapy; pet-type robot; welfare; care ; elderly people

I. INTRODUCTION

Attempts are being made to design robots to assist human beings in their life activities. Personal robots are expected to enhance people's feelings of satisfaction in their daily lives. In Japan's aging society, personal robots are considered a useful means of enhancing and supporting elderly peoples' living and social activities. We investigated the application of pet-type robots to elderly people's welfare and care. A pet type robot (dog-type, cat-type robots) judges the external situation using sensors such as a tactile sense, vision, and hearing, and expresses feelings such as joy, sadness, anger, and surprise, by sound (cry), light (color of eyes), etc. and action. Such robots also have instinctive desires such as love, avarice and curiosity. The expression of feeling is modified by whether these desires are satisfied. A pet-type robot has learning capability to correct subsequent operations etc., by being praised or being scolded, which constitutes communication with people [2] [3]. Robot therapy has advantages over animal therapy. Unlike animals, robots suffer no stress and there is no risk of the subjects becoming infected from an animal disease. Despite these problems, animal therapy is reported to be effective in the welfare and care of elderly people [5] [6]. However, evaluation of the effect of animal therapy is difficult to

quantitatively verify, and there is no established evaluation method

Our investigation into expectations of robot therapy in an institute for elderly people revealed that expectations were high [1]. In order to evaluate a robot's validity quantitatively, the impression and effect of RAA were evaluated considering the physical, mental and living environment elderly people. This paper summarizes the evaluation results.

II. EVALUATION EXPERIMENT IN RAA (ROBOT ASSISTED ACTIVITIES)

In order to quantitatively evaluate a robot's validity in the welfare and care of elderly people, the impression and effect, elderly people's living environment, history, and physical/mental condition were recorded, while carrying out RAA. The impression and the effect of RAA were analyzed from viewpoints, such as the evaluator's position, elderly people's living environment, history, and physical/mental situation. RAA was conducted in two



Figure 1 Example of RAA scene in nursing home



Figure 2 Pet-type robots

locations: periodically in a nursing home for the aged and irregularly in a care house for the aged. In the nursing home, 15 elderly people, each with their own pet-type robot and a volunteer, participate in the same activity for about 1 hour. In the care house for elderly people, 1 robot and 1 volunteer participate in activity with several elderly people. The elderly people who participated in the activity ranged from 68 years old to 98 years old, averaging over 85 years old. Female participants comprised 80% or more of subjects. Figure 1 shows an example an RAA scene in nursing home, and Fig. 2 shows the pet-type robots that participated in RAA.

A. Evaluation Criteria

1) Evaluation of RAA

Measurement of the state of a subject's brain, or physiological measurement of a subject's blood, urine, etc. can be used to evaluate the validity of RAA using a pet-type robot. However, since the RAA activity was short term (about 1 hour per time), evaluation with emphasis on the social effect was carried out in this research. In RAA, the intervention person between a robot and a subject observed the subject's action, and recorded the grade and time of reaction and operation of the subject to the robot: touching the robot, looking at the robot, embracing the robot, speaking to the robot, imitating the robot, etc. The impression of activities was recorded in five grades based on subject's action and reaction (1: not good 2: a little good 3: good 4: fine 5: excellent). This enables the intervention person to record the reaction to the subject's external environment and evaluate the social effect of RAA. The intervention person is usually a volunteer and does not know the background to the subject's life. An institution representative also recorded the effect and the impression of RAA, and evaluated the effect of RAA. The evaluation performed by the institution member is considered a synthetic evaluation not only based on the evaluation of the short-time social effect but the general life of the subject.

2) Background

A pet type robot is comparable to an animal in many cases. The subject's sense of the type of animal that was represented by the robot was classified under five categories a) nothing, b) cat, c) dog d) cat and dog, and e) others.

3) Activities of Daily Living (ADL)

The subject's ADL was recorded according to the Barthel Index and FIM (Functional Independence Measure), which are used in rehabilitation, and the level of dementia was recorded with a revised Hasegawa dementia scale (HDS-R) [7].

These records were performed by filling in a data sheet. And the obtained data was inputted into a Microsoft Access in order to realize data accumulation and various analyses. The database was structured so that data that was not collected in the trial, such as quality of life (QOL) and solitary feeling, could also be inputted.

B. Results of Evaluation

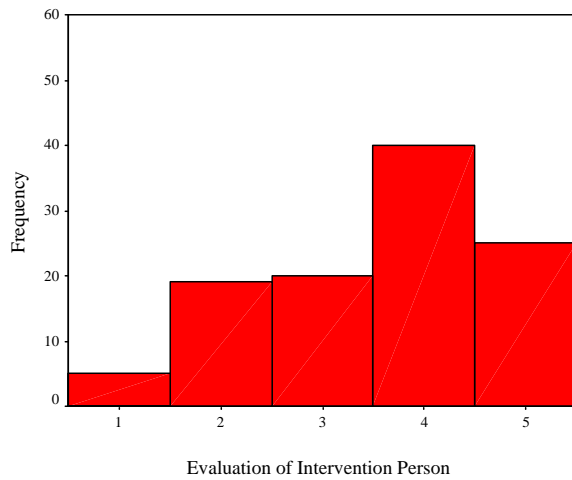
Required data were picked out from the database by query, and analyzed by the statistics processing program SPSS.

1) Evaluation of an intervention person and an institution member

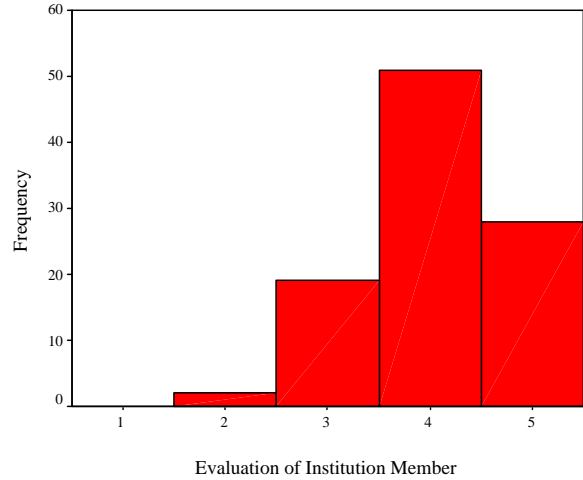
In the effect and impression of RAA, the evaluation of the intervention person who intercedes between a subject and robots was compared with the evaluation of the institution member. Fig. 3 shows a histogram of an evaluation value. Both the intervention person and the institution member gave a relatively high evaluation value about the effect and impression of RAA. The average evaluation value of an intervention person was 3.6 whereas the average evaluation value of an institution member was 4.1. A paired sample *t*-test of two evaluations of an institution member with an intervention person revealed a significant difference of 5%. This difference is likely due to the following reasons.

2) Level of dementia

Based on HDS-R, the level of dementia was classified into three stages (1: healthy (normality), 2: some dementia, 3: dementia), and the evaluation result was compared. Figure 4 shows the result by error bar chart (average value and 95% confidence interval) in an intervention person and an institution member. In the result of analysis of variance, both evaluations of an intervention person and an institution member showed that there was no statistically significant difference corresponding to the difference in the level of dementia. However, Fig. 4 shows that the distributions of the evaluation to the level of dementia differ in an intervention person and an institution member. Although an intervention person gives a healthy person a high evaluation, the institution member has given the subject of dementia a high evaluation. Since an

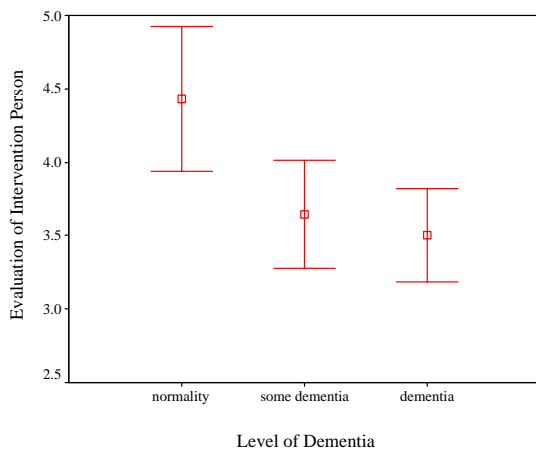


(a) Intervention Person

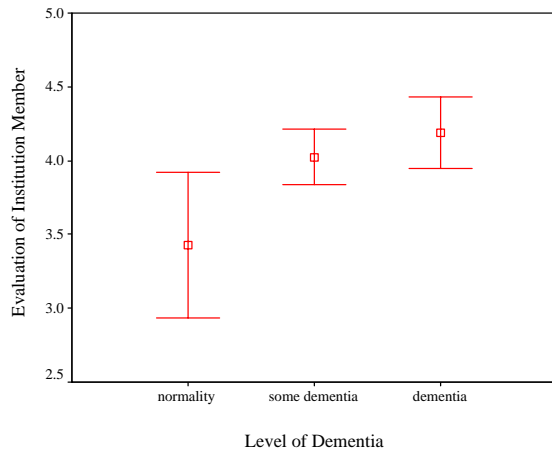


(b) Institution Member

Figure 3 Histogram of Evaluation



(a) Intervention Person



(b) Institution Member

Figure 4 Evaluation in Dementia

intervention person associates with a subject only at the place of activity, he/she makes the evaluation based on the short term. Therefore, it is difficult for intervention person to judge effect on a subject with dementia, and a high evaluation was given to a subject without dementia. On the other hand, although the subject with dementia seldom shows a reaction not much usually, the institution member detected a slight change of the expression which the subject with dementia showed in RAA, and has given high evaluation to the subject with dementia.

3) Animal breeding history

The difference in the evaluation as to which animal the robot resembled was compared with the evaluation of the

intervention person, and that of the institution member. An error bar chart shows the results in Fig. 5. In the case of the intervention person, there was a statistical significant difference is between the subject with animal breeding history and the subject without it. On the other hand, in the case of the institution member, there was no significant difference. Since the intervention person talks about the animal frequently in their communication with the subject, he/she gives the subject with an animal breeding history high evaluation. It seems that the pet type robot which is a thing similar to the animal has brought social interchange between the subject and the intervention person.

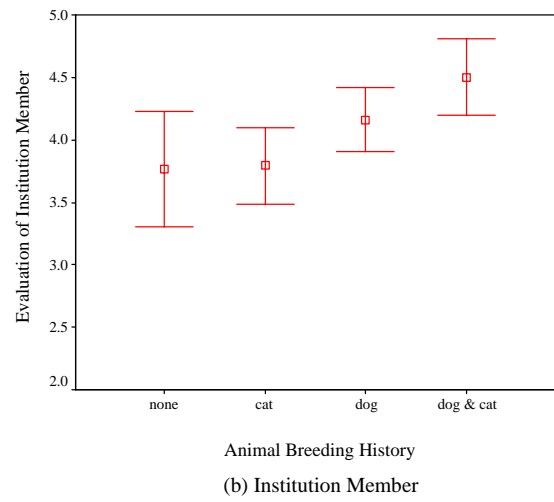
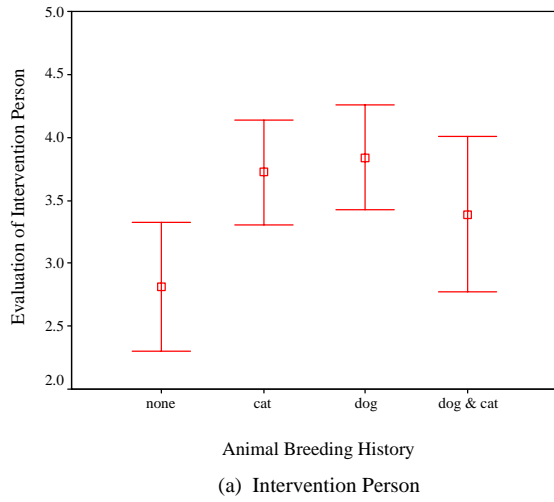


Figure 5 Evaluation in Animal Breeding History

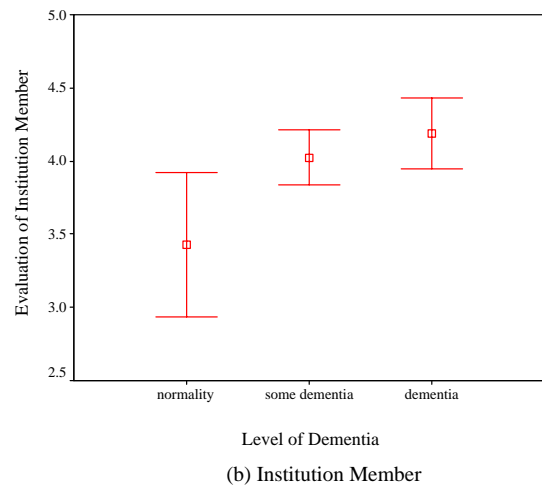
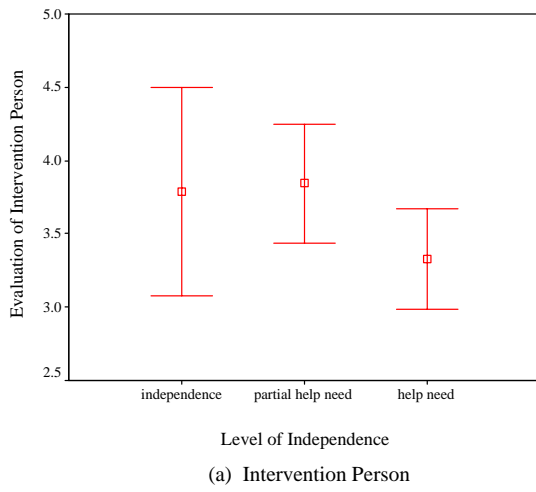


Figure 6 Evaluation in Independence

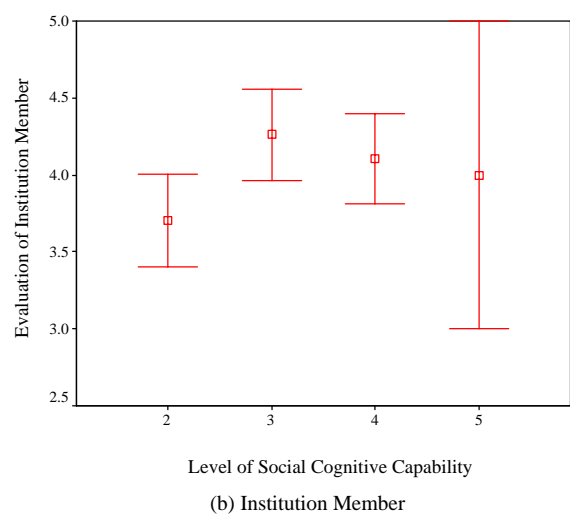
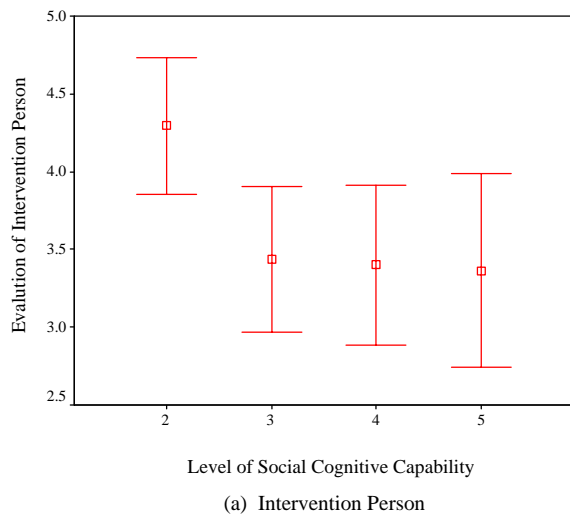


Figure 7 Evaluation in Social Cognitive Capability

4) *Activities of Daily Living (ADL)*

The effect and impression of RAA were analyzed based on the difference in a subject's level of independence in movement, eating, clothing, bathing, and excretion (Fig. 6). In addition, using FIM, a subject's social cognitive capability was evaluated and the effect and impression of RAA were analyzed based on the difference of social cognitive capability (Fig. 7). Consequently, in the evaluation of an intervention person and an institution member, there was no statistical significant difference in the difference of the level of independence and the difference of social cognitive capability. RAA is apparently accepted regardless of ADL.

III. CONSIDERATION OF EVALUATION EXPERIMENT

The above evaluation summarizes the results of RAA carried out over eight months once per month, and RAA carried out at a different location irregularly. When the levels of a subject's dementia differ, there is a difference in evaluation between the intervention person and the institution member. Communication of a certain kind arose in RAA between the subject with slight dementia and the intervention person, and since the intervention person thinks that it is the social effect of RAA, he/she has given high evaluation to RAA.

High evaluation was given to a subject with dementia by an institution member who knows the background life of the subject. Two episodes that express these findings are described below. An elderly person with dementia who cannot even distinguish a family member's face began to speak using the name of a dog kept a long time ago, and the family was surprised. Another elderly person who is all care of excretion wanted to use the toilet and requested to go by himself during RAA, which surprised the institution members. However, the intervention person thought that the elderly person considered the activity to be boring, and the intervention person judged that there was no effect in RAA.

Moreover, the intervention person's evaluation result in an animal breeding history and the above-mentioned episode showed that a pet type robot reminds elderly people of an animal and generates communication between an intervention person and elderly people. Since a subject tends to take communication with the external world in robot therapy like this, it is thought that a social effect is in it.

However, since evaluation differed between the intervention person and the institution member, it is difficult to evaluate robot therapy. In addition, it became clear that evaluation in many fields is indispensable. Although evaluation is based on an evaluator's subjectivity in this report, we will add the evaluation technique using

an objective technique in future. Except for these points, evaluation of RAA was high.

IV. CONCLUSION

In order to explore the possibility of robot therapy, RAA was conducted in an institution for elderly people. It became clear that a robot is effective. An intervention person between the robot and the subject is important in the reaction of a subject's external world. However, more research is required to determine why a robot is effective, what function of robot is effective, and how an intervention person can participate effectively. In robot therapy, the operation of a robot or conversation with the intervention person stimulates human sensitivity, and induces a feeling of peacefulness, happiness or pleasure to subjects. By being in the shared place with a robot, people recollect the past animal breeding and communicate about common subjects with surrounding people. The capability of a pet-type robot to stimulate such sensitivity remains insufficient, and the intervention person is still important. If a robot's function increases, other elderly people will also be able to act as the intervention person who constitutes the place, the variation of place will increase, and it will be thought that robot therapy also develops.

ACKNOWLEDGMENT

We would like to thank the staff of the institution for elderly people for their cooperation in this research. In addition, we thank Mr. K. Suzuki (Hitachi Information Systems, Ltd. at present) and Mr. S. Shoji (Price System, Ltd. at present) of Tokai University for their cooperation, and members of the animal assisted activities club of Teikyo University of Science and Technology and students of Nasu University for volunteer activities in RAA. Furthermore we thank Dr. A. Yokoyama of the National Defense Medical College, Prof. M. Nagamuma and associate Prof. T. Kimura of Teikyo University of Science and Technology for advice and discussion in this research.

REFERENCES

- [1] T. Hamada, T. Hashimoto, T. Akazawa, M. Mizukawa, "Study on Pet-type Robot Application in Welfare and Care", Proc. of the 19th Annual Conf. of RSJ, pp.149-150 (2001.9)
- [2] M. Fujita, "Representation of Kansei in Pet-type Robot", Journal of RSJ, Vol.17 No.7 pp.33-37 (1999.10)
- [3] T. Shibata, "Mental Commit Robot Curing Mind of Human Being", Journal of RSJ, Vol.17 No.7 pp.29-32 (1999.10)
- [4] T. Hamada, A. Yokoyama, T. Shibata, "Evolution of Robot Therapy", Journal of SICE, Vol.42 No.9 pp.756-762 (2003.9)
- [5] Y. Hayashi, "Animal Therapy Investigation (in Japanese)", Kodansha Press (1999.5)
- [6] A. Yokoyama, "What is Animal therapy? (in Japanese)" NHK Books (1996.12)
- [7] T.Ueda et.al., "Standard Rehabilitation Medicine (in Japanese)" Igakushoin (2001.3)