

# Field Test of Manual for Robot Therapy using Seal Robot

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**Abstract**— Robot therapy is expected to have psychological, physiological and social effects as well as animal therapy. Especially, therapeutic seal robot, *Paro* is used in the various facilities for elderly and spreading in the world. However, the caregivers used *Paro* freely, and the way of using *Paro* was different among them. Therefore, the effects are influenced by their skills. The manual which shows effective ways to use *Paro* has been needed. So far, the manual was developed by extracting the caregiver's skills (presented at IEEE RO-MAN 2010). In this paper, the manual was introduced to 4 elderly facilities, and then, its effectiveness was investigated by 9 caregivers and 12 patients. As the results, caregivers' intervention was improved after reading the manual, and then, elderly people's smile was increased.

## I. INTRODUCTION

Robot therapy, mental health care through interaction with robots, has attracted many researchers [1-23]. Various robots have been tried to use in care of hospitalized/autistic children [4, 16, 17], elderly people in facilities [5-10, 18-22], and people with dementia [11-13, 23]. Especially, therapeutic seal robot named *Paro*, which was developed by AIST, is widely used in the world. So far, Clinical investigations were conducted in the various medical and welfare facilities; the results showed that interaction with *Paro* have psychological effects (e.g. increase motivation, improve moods) [5-8], physical effects (e.g. stress reduction) [9, 10], and social effects (e.g. encourage communication) on elderly people [10] and inpatients. Especially, there were some cases that *Paro* inhibited problematic behaviors of dementia patients, such as strong anxiety and wondering [11]. The neuropsychological effects of *Paro* on patients with dementia were assessed by analyzing their EEGs. The results showed that the activity of the patients' cortical neurons improved by interaction with *Paro*, especially in the case of those who liked *Paro* [12, 13]. However, the usage of *Paro* was not defined and the caregivers used *Paro* in their own ways, freely. Therefore, the way of using *Paro* was different among them, and then the effects were influenced by their skills. The manual which shows effective ways to use *Paro* has been required. Therefore, we have developed the manual for robot therapy using *Paro* [14]. In this paper, we evaluated efficacy of the manual in fields test. Section II describes seal robot, *Paro*. Section III explains robot therapy using *Paro* in elderly

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Figure 1 the Seal Robot, *Paro*

facilities and its problems. Section IV explains manual for robot therapy and section V fields test to investigate the effectiveness of the manual. Finally, offer conclusions and future works.

## II. THERAPEUTIC ROBOT, *PARO*

*Paro*, the seal robot, is shown in Fig.1. Its appearance is modeled after baby harp seal, and its surface is covered with pure white fur [1-3]. Ubiquitous surface tactile sensors are inserted between the hard inner skeleton and the fur to create a soft, natural feel and to permit the measurement of human contact with *Paro* [15]. *Paro* is equipped with four primary senses, i.e., sight (light sensor), audition (determination of sound source direction and speech recognition), balance, and the above-stated tactile sense. Its moving parts are as follows: vertical and horizontal neck movements, front and rear paddle movements, and independent movement of each eyelid, which is important for creating facial expressions. *Paro* weighs approximately 2.8 kg. Its operating time with the installed battery is approximately 1 hour. However, *Paro* can continue to operate by employing a charger, which resembles a pacifier.

*Paro* is operated by the 3 elements of its internal states, sensory information from its sensors and its own diurnal rhythm (morning, daytime, and night) to carry out various activities during its interaction with people. In addition, *Paro* has a function of reinforcement learning. It places positive values on preferred stimulation such as stroking. It also places negative values on undesired stimulation such as beating. *Paro* assigns values to the relationship between stimulation and behavior. The users are prevented from changing its behavior program manually; however, *Paro*'s behavior can be

gradually tuned to the preferred behavior of its owner. In addition, Paro can memorize a frequently articulated word as its new name. Therefore users can give Paro their preferred name during natural interaction.

### III. ROBOT THERAPY IN ELDERLY FACILITY

Clinical investigations of robot therapy using Paro were conducted in the various facilities, such as day service center, health service facility, and nursing home. There were varieties of usages of Paro in the activity, and elderly people have different kinds of symptoms in each facility. However, there were common features that at least one caregiver joined to manage the therapy activity, and it was conducted as a group activity during certain period of time. On the other hand, the ways of interaction with Paro were entrusted to the caregiver. Therefore, the ways of intervention were different among the caregivers, and then the effects were influenced by their skills.

For example, when Paro ran out its battery and stopped; caregivers might say to elderly people, "Paro fell asleep," or "its battery run out." However, the responses of the elderly people were different. The former case evokes animals; meanwhile, the latter case evokes machines and might destroy the mood of people enjoying Paro as a pet. These small differences of caregivers' actions influence on the elderly people's behaviors. However, the differences of the actions are very small and unconsciousness, therefore they hardly notice whether their actions are good. Moreover, actions depending on their symptoms and backgrounds are required. Therefore, manual which achieves effective robot therapy for everyone is necessary.

### IV. MANUAL FOR ROBOT THERAPY

As mentioned above, the caregivers hardly notice that their actions to elderly people are good or bad by themselves. Therefore, we collected the cases of their good/bad actions based on observation, and then, tried to extract skills for robot therapy by analyzing the collected cases. The caregivers used Paro freely. We observed and recorded their actions and responses of the elderly people. Then, the actions and phrases which led elderly people to positive responses (e.g. smile, laugh, acceptance behaviors, and etc.) were extracted as the skills. Observations were conducted for 64 days in total, in five facilities, and 332 intervention cases were collected. The cases were classified mainly into three scenes: "give Paro," "during interaction with Paro," and "receive Paro." The representative cases are follows.

#### 1) Give Paro

*To the person who interact with Paro at the first time*

A caregiver avoided giving Paro to the person suddenly in the first contact, and the caregiver tried to reduce her worry by showing Paro at her eye level until she became interested in Paro and asked "What is this?" The caregiver answered "This is a baby seal" then, gave it slowly. As a result, she accepted Paro and started interaction smoothly.

*Extracted Skill:* avoid giving Paro suddenly, and wait

until the person become interested in Paro.

*To the person who is familiar with Paro*

A person was sitting on sofa and do-nothing without expression. A caregiver closed to the person and sited next to her; then talked "Here is Paro, you have been waiting for" showing Paro's face to her. Her expression was softened and she started to stroke Paro.

*Extracted Skill:* most of them love Paro, and are waiting for it. Figuring out their minds and treating Paro as a pet are important.

*To group*

Four people were sitting around a table without talking and facial expression. A caregiver placed Paro in the middle of them. So that everyone can reach to it. As a result, all of them could join the interaction with Paro, and then, their conversations were encouraged.

*Extracted Skill:* place Paro in where all the people can see and touch.

#### 2) During Interaction with Paro

*The person who is holding Paro for long time*

A person held Paro unconsciously for long time because she was fascinated to play with Paro. A caregiver found her a little tired expression, and then talked "you can put Paro on the sofa." She put Paro next to her and started to stroke it with relieved expression.

*Extracted Skill:* mind the holding time, and talk that person could put Paro on the table/sofa.

*The person who hit or treat Paro roughly*

At the beginning, a person played with Paro gently. However, gradually, he hit and treated it roughly. A caregiver couldn't stand watching the behaviors, and then talked "Paro says, Ouch! Please treat it tender." He said "Oh, I see...are you OK, Paro?" and stopped hitting and started to stroke gently again.

*Extracted Skill:* tell the person that Paro can feel pain, and treat it gently.

*The person who stopped interaction with Paro*

A person was tired of interaction with Paro because she played alone for a long time. Therefore, she just sat and did nothing for a while. A caregiver found the situation, and then talked "Paro is cute, isn't it? Stroke it, please." She restarted interaction with Paro, and started conversation about Paro with the caregiver.

*Extracted Skill:* say something about Paro to encourage the interaction again.

*The surrounded people who are interested in Paro*

A person who watched interaction with Paro and other people was sitting around the other table of Paro. A caregiver noticed her situation, and talked "Would you join the play with Paro?" she smiled, and then joined the interaction.

*Extracted Skill:* don't notice only the participants, but also surrounded people.

#### 3) Receive Paro

*From the person who can pay assiduities*

Playing with Paro and the person became prolonged. A

caregiver decided to move Paro to the next person. The caregiver asked to her, “Can I borrow Paro? Because, next person is waiting for it.” As a result, she handed over it obediently.

*Extracted Skill:* tell the person that other people are also looking for Paro.

*From the person who dominate Paro*

The person who loved Paro very much refused to give it to the other people. A caregiver asked “Can we look after Paro?” as a result, she said “if you don’t give it to the others (elderly people),” and then gave it to the caregiver.

*Extracted Skill:* tell the person that staff looks after Paro.

*Pickup Paro because of the battery run out*

Paro stopped because of its battery ran out. However, the person was still talking to it, “Hey! What’s happen, Paro?” A caregiver who noticed the situation decided to pickup Paro to recharge it. The caregiver talked to her, “I’ll bring Paro to the bed, because it fell asleep.” As a result, she said “Oh, is she? Good night, Paro.” and gave it with smile.

*Extracted Skill:* treat Paro like a real animal.

And then, we developed manual for robot therapy based on the collected data and extracted skills. The manual consisted of 31 pages, 7 chapters. Chapter I explains basic functions and operation of Paro. Chapter II describes concrete examples of activity using Paro. Chapters III to VI describe the examples of phrases and important points during the activity. The points are explained by illustration. Chapter VII catalogs effective cases of robot therapy using Paro. Figure 2 shows the cover and some examples of illustrations.

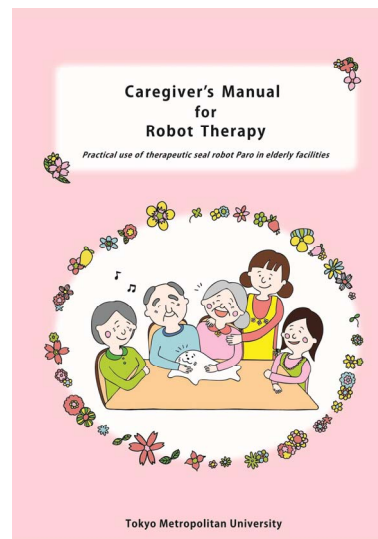
## V. FIELDS TEST OF THE MANUAL

### A. Method

In order to investigate effectiveness of the manual, we conducted fields test at elderly facilities. Before reading the manual, a caregiver was asked to conduct 30 minutes robot therapy freely. The therapy was conducted for three times in order to familiar with robot therapy. In the next fourth time, we observed the caregiver’s behaviors and participants’ reactions during the robot therapy. The behaviors and their reactions were measured one per minute using observation sheet (Fig.3 and Table I, described below). After that, we gave the manual to the caregiver and explained its contents briefly. The caregiver was asked to read the manual and conduct robot therapy for three times according to the manual. In the next robot therapy, the behaviors and participants’ reactions were observed in the same way. Fig.4 shows the experimental protocol.

### B. Observation sheet

We developed observation sheet to record caregiver’s behaviors and participants’ reactions (Fig.3). The sheet can record behaviors/reactions of 3 participants and a caregiver, one per minute. The observer describes the activity of the facility (e.g. lunch and recreation), state of the participant (e.g. sitting alone, group, and moving), directly. As for the



(a) Cover



(b) Give Paro at the first time



(c) Cleaning and grooming of Paro

Figure 2 Manual for robot therapy

min	activity of facility	Participant A					Participant B					Participant C					staff	Note
		state	expression	gaze	talk	Paro	state	expression	gaze	talk	Paro	state	expression	gaze	talk	Paro		
1																		
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		

Figure 3 Observation sheet

TABLE I CODE OF OBSERVATION SHEET

Class	Item	Code
Expression	Laugh	L
	Smile	S
	no expression	N
	Hate	H
Gaze	Paro	P
	Staff	S
	User (participant)	U
	Others	O
Talk	Paro	P
	Staff	S
	User (participant)	U
	Others	O
Paro (interaction with Paro)	Give	G
	Stroke	S
	Hold	H
	Others	O
Staff (caregiver)	talk to the user	T
	give Paro	G
	other intervention using Paro	P
	other work	W

participant’s expression, gaze, talk, interaction with Paro, and behaviors of the caregiver are described using codes (Table I). Most frequently appeared behavior is recorded as the representative behavior in the minute. Reliability of the sheet was tested among five observers against three participants and a caregiver, in 25 minute therapy. Concordance rate of each item was 69 to 100 %, therefore the sheet has enough reliability to use the experiment. In this experiment, four observers recorded the behaviors and reactions, and the results of each item were merged by majority voting.

### C. Results

The fields test was conducted in four elderly facilities. The subjects were 9 caregivers (Male: 4, Female: 5, avg. age: 28.1) and 12 elderly people (all Female, avg. age: 86.8, had symptoms of dementia). Occurrence rate of their each behavior was analyzed because elderly people’s time of participation in robot therapy was slightly different. Table II shows the results. Occurrence rate of the smile during the therapy was increased after the caregivers read the manual. Especially, the rate of caregivers’ intervention was significantly increased. In addition, we were able to observe

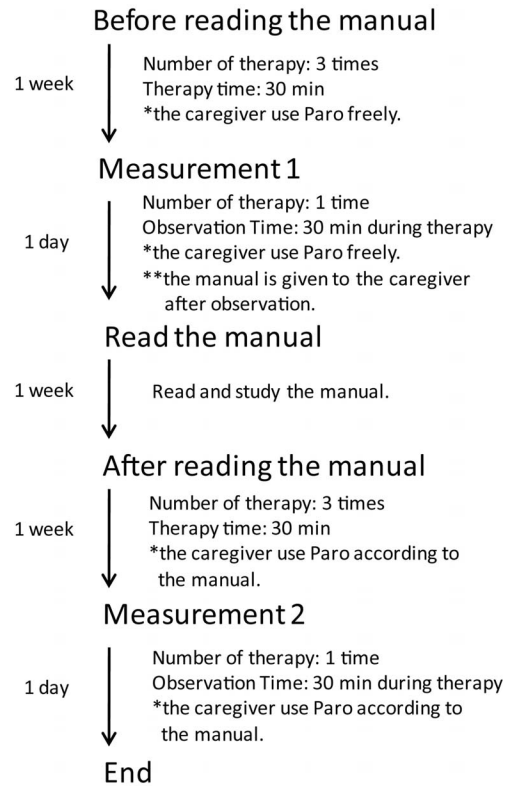


Figure 4 Experimental protocol

behaviors of 7 caregivers and 10 elderly people from 30 minutes before the therapy. Figure 5 shows the results. The rate of elderly people’s smile and talk during the therapy were significantly high than those before therapy, in the both condition (before/after reading the manual).

### D. Discussion

As shown in Fig.5, the elderly people’s smile and talk were significantly increased than those before the therapy. Therefore, the results showed the therapy encouraged their communication and improved their feelings. Moreover, elderly people’s smile was increased tendency and caregivers’ intervention was significantly increased after reading the manual (Table II). We considered that the caregivers became to use Paro appropriately according to the manual, and then it brought the elderly people’s smile. On the other hand, the increase of elderly people’s smile, and

TABLE II CHANGE OF THE OCCURRENCE RATE OF BEHAVIORS BETWEEN BEFORE AND AFTER READING THE MANUAL

Rate (counts/minutes)	Before reading the manual (mean ± SE)	Before reading the manual (mean ± SE)	<i>p</i> -value
Elderly people's smile	0.36 ± 0.06	0.42 ± 0.07	0.05
Elderly people's talk	0.42 ± 0.07	0.45 ± 0.07	0.36
Elderly people's interaction with Paro	0.26 ± 0.06	0.23 ± 0.05	0.3
Caregiver's intervention	0.27 ± 0.03	0.42 ± 0.08	0.04*

\**p* < 0.05, Wilcoxon's Rank Test  
 \*\* *p* < 0.01, Wilcoxon's Rank Test

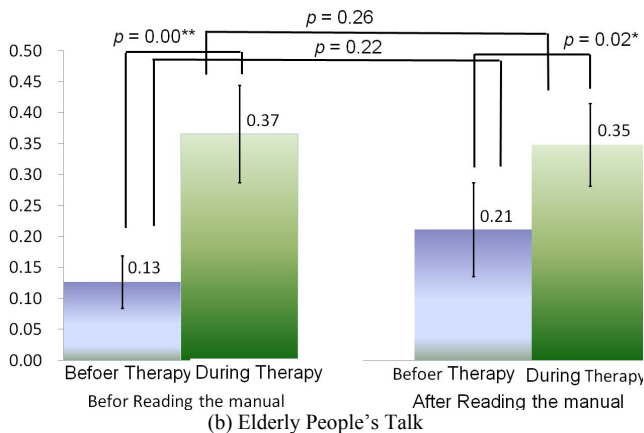
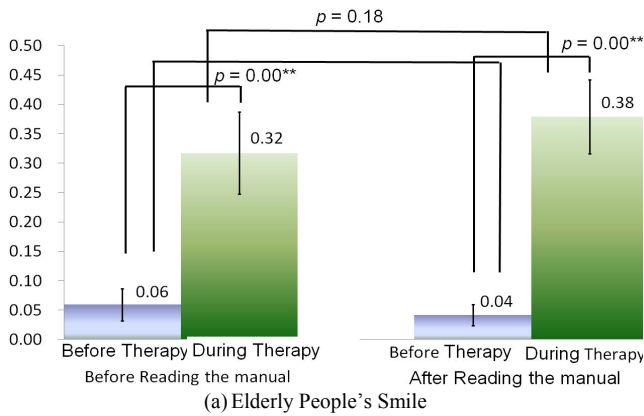


Figure 5 Change of occurrence rate of elderly people's smile and talk between before and after therapy

especially talk were not statistically significant. One of the reasons is the small number of subjects (12 elderly people and 9 caregivers). Therefore, we need further experiment to clarify the effect of the manual. In addition, the effective usage of Paro would be different among the people who have various symptoms. However, current version of the manual doesn't support specific methods depending on the individual symptoms. We need further improvement of the manual to enhance its effects.

## VI. CONCLUSION

Effects of robot therapy using Paro are emerged through triad interaction among participants, Paro and caregivers. Especially, the caregiver who manages the therapy plays an important role to achieve effective therapy. However, methodology of the therapy is not established. The effects are

influenced by their skills. Therefore, we developed the first manual for the robot therapy to reduce the difference among the caregiver's skills and achieve effective therapy. In this study, the effectiveness of the manual was investigated by 9 caregivers and 12 elderly people in 4 elderly facilities. The results showed the manual improved the caregiver's skills and could achieve better therapy. We will further improvement of the manual and conduct field test to evaluate its efficacy.

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