

# Study on Transition of the Elderly People's Reaction in Robot Therapy

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## Abstract

Most elderly people staying in nursing homes have dementia, and various kinds of recreational programs are provided in order to prevent or ameliorate this problem. Robot therapy is a recreational program that has recently been introduced in some nursing homes. However, the effects of robot therapy are difficult to evaluate. In this study, we identified events occurring during therapy that are important in the proliferation and evolution of robot therapy. We also found that the presence of an intervener encourages elderly people to be more active.

**Key words:** robot therapy, aging society, dementia, recreation, nursing care, work sampling

## 1. Introduction

Most elderly people staying in nursing homes have dementia, and various kinds of recreational program are provided in order to prevent or ameliorate this problem. Robot therapy is a recreational program that has recently started in some nursing homes in which robots replace real animals used in animal therapy. There are thought to be 3 beneficial effects of animal therapy:

- 1) Physiological effects (e.g., improvement of vital functions)
- 2) Psychological effects (e.g., relaxation, motivation)
- 3) Social effects (e.g., promotion of communication among inpatients and care-givers)

However, animal therapy is executed in few hospitals and nursing homes in Japan because there are risks such as allergies, infections, bites, and scratches even though there are these positive effects [1] -[3]. Robot therapy may be more useful than animal therapy because robots do not carry such risks and robot actions are easily programmable for specific purposes.

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Studies on robot therapy started when a seal-type robot named Paro and an entertainment robot named AIBO were launched on the market [4]. Shibata et al. developed Paro and used it at pediatric wards and facilities for elderly people [5]-[9]. Kanamori et al. examined the usefulness of the pet-type robot AIBO among elderly patients and those with disabilities in nursing homes or at home using biochemical markers, self-assessment, or health-related QOL questionnaires [10]. Yokoyama, a researcher on animal therapy and a psychiatrist, used AIBO in a pediatrics ward and observed the interaction between AIBO and the children [11]. He said the introduction of robots into hospitals was much easier than expected compared to the introduction of animals. Ohkubo et al. discussed the effective use of a wireless LAN-controlled robot, and developed a simple operating console for wireless LAN [12]. The robot can be controlled by a therapist through a wireless LAN.

We discussed the possibility of robot therapy when AIBO appeared, and concluded that robot therapy is promising based on the results of a questionnaire survey [13][14]. Moreover, we discussed effective methods of robot therapy from the viewpoint of intervention and robot behavior. We showed what type of intervention induces spontaneous actions of elderly people and what is the optimal intervention time based on experimental therapy for elderly subjects with dementia. The results of the experiment also indicated that some robot behaviors frequently induce elderly people to react to the robot spontaneously [15][16].

However, it is difficult to evaluate the effects of robot therapy. Most evaluation results are dependent on questionnaires or observations. Physiological tests, for example, testing urine and sputum, have been applied to investigate the mental stress of subjects in some researches [17] [18]. Evaluation by analyzing EEG signals has also been reported [19]. However, these evaluation methods may not be ideal because most therapy executors have no skill in physiological testing or using EEG. We developed a recreational program in which we conducted games using a pet-type robot and induced elderly people to perform specific actions. The effects of recreation were evaluated by measuring the degree of occurrence of an elderly person's action [23]. In this method, it is difficult to design useful games. An evaluation method that is easy and acceptable to most therapy executors has not been developed yet.

Many studies have reported that robot therapy is useful for activating elderly people and promising for improvement of dementia. However, there is no quantitative evidence that robot therapy is effective for the activation of elderly people and why robot therapy is useful for the improvement of dementia. In this study, we investigated events occurring during therapy and sought to identify and understand events that are important in the proliferation and evolution of robot therapy. Our investigation was based on a work sampling method and the reactions of elderly people and the presence of interveners were recorded. In addition, we analyzed the reactions of the elderly people by comparison with evaluation values that were recorded for each subject through discussions with robot therapy administrators and nursing home staff members.

## 2. Robot Therapy in Groups and Evaluation of Elderly People's Reactions

### 2.1. Form of Robot Therapy

There are two types of robot therapy. One is therapy where the therapist communicates with the subject using a robot. The other is group therapy. In this research, we investigated group therapy. **Figure 1** shows a photograph of robot group therapy where elderly people sit around a table on which several robots perform their functions. There is one intervener for a few elderly people. They facilitated the elderly people's interactions with the robots by explaining the functions and movements of the robots or selecting suitable robots for the elderly people etc. Therapists, staff of the nursing home, or student assistants acted as the interveners. About 10 to 20 elderly persons joined the activities of robot therapy, and the activities continued for about one hour.

### 2.2. Evaluation of Elderly People's Reactions in Robot Therapy

In this research, we recorded evaluation values for each subject through discussions with robot therapy administrators and nursing home staff members. The evaluation values consisted of five grades: "5" is the best and "1" is the worst. **Figure 2** shows the distribution of the evaluation



Figure 1 Appearance of Robot Therapy

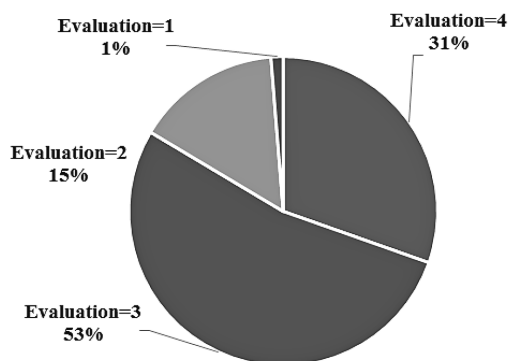


Figure 2 Distribution of Evaluation

values, which were obtained from 75 elderly persons in 11 robot therapy activities. These activities were executed for 14 months. As most of the results were grade “3” or higher, it was concluded that robot therapy is effective for the activation of elderly people. The number of recorded elderly people’s reaction is 643, and the number of reaction which occurred in the activities with the intervener is 310.

### 3. Investigation of Elderly People’s Reactions by Work Sampling Method

Robot therapy activities are evaluated based on events during activities. However, most analysis of events is not quantitative. In this research, in order to investigate and analyze events macroscopically, the observers recorded the subject’s reactions, the intervener’s presence and the kind of robot every five minutes by the work sampling method.

**Table 1** shows the work sampling sheet used to record the events. We recorded events as shown in **Table 1**. We categorized the elderly people’s reactions into 9 kinds: 1 : accompanying the robot, 2 : laughing or pleasing, 3 : touching or patting, 4: looking or listening, 5: talking with intervener, 6: disliking, 7: no reaction, 8: sleeping, 9: others. Subject’s reactions such as

Table 1 Work Sampling Sheet

Subject: Name:			Date :	
Time (min)	Subject	Robot	Intervener	Comment
0				
5				
10				
15				
20				
25				
30				
35				
40				
45				
50				
55				
60				

**Subject**

1. accompanying the robot
2. laughing, pleasing
3. touching, patting
4. looking, listening
5. talking with the intervener
6. disliking
7. no reaction
8. sleeping

**Intervener**

0 : No-presence  
1 : Presence

**Kind of Robot**

accompanying the robot, laughing, pleasing, touching, patting, looking listening, or talking with the intervener were considered positive, and subject's reactions such as disliking, no reaction, sleeping or others were considered negative. And accompanying the robot, laughing, pleasing, touching, or patting were considered active reactions, and looking listening, or talking with the intervener were considered passive reactions.

#### 4. Elderly People's Reactions and Evaluation of Therapy

The reactions of 75 elderly persons in 11 robot therapy activities are shown in **Figure 3**. On the whole the percentage of positive reactions was 75%, and this was considered to correspond to the results of therapy evaluation. The differences in elderly people's reactions to evaluation values of therapy are shown in **Figure 3**. **Table 2** presents a summary of the results. The figure and the

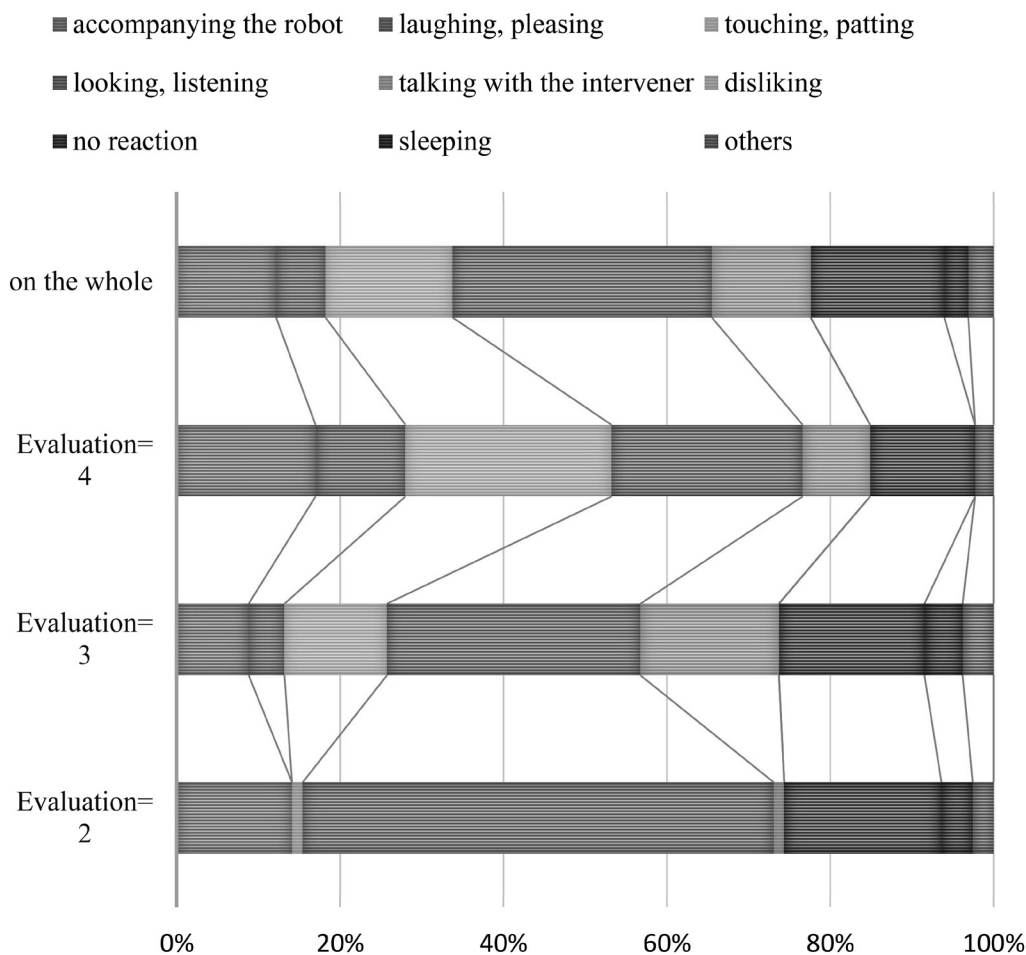


Figure 3 Elderly People's Reactions and Evaluation Values in Robot Therapy

Table 2 Reactions of Elderly People

Evaluation Value	Reaction		
	Positive		Negative
	Active	Passive	
4	53	34	13
3	28	50	22
2	13	57	30
Total	36	39	25

(unit : %)

table show that negative reactions increase as evaluation values decrease. As evaluation values decreased at 4, 3, and 2 or less, the percentages of negative reactions increased at 13%, 22%, and 30%. Moreover, they show that the percentages of active reactions indicate a major influence on therapy evaluation. The percentage of active reactions in the case of evaluation value "4" was 53%, and about double that of evaluation value "3." Robot therapy administrators and nursing home staff members appreciate elderly people's active reactions highly. These results indicate that one of the advantages of robot therapy is that it induces the elderly people to have many active reactions.

## 5. Presence of the Intervener in Robot Therapy

As mentioned above, the intervener plays various important roles in the therapy. In this research, we investigated the influence of the intervener's presence on the evaluation of therapy. **Figure 4** shows the reactions of elderly people without and with interveners. A comparison of these figures reveals that the presence of interveners makes the reactions of the elderly people less negative. Negative reactions decreased from 30% to 10%.

Moreover, we considered the relation between therapy evaluation and the presence of interveners. **Figure 4** shows the reactions of elderly people without and with the interveners with an evaluation value of "4." In this case, the presence of interveners decreased the negative reaction slightly. The percentage of talking with the intervener increased, and the percentage of active reaction decreased slightly. However we did not consider this to be a problem, and elderly people who achieved evaluation value "4" showed positive and active reactions in spite of the presence of interveners.

**Figure 4** also shows the reactions of elderly people without and with interveners with an evaluation value of "3." In this case, the presence of interveners decreased the negative reaction and increased the positive and passive reaction a lot. The presence of interveners is important for increasing positive reactions.

**Figure 4** also shows the reactions of elderly people without and with interveners with an evaluation value of "2." In this case, the presence of interveners decreased the negative reaction more and increased the positive reaction more too. The presence of interveners is more important

for increasing positive reactions and decreasing negative reactions. This result shows that interveners may be able to develop a means of inducing the elderly people who do not act positively to have more positive and active reactions.

**Table 3** shows a summary of these results. The table and 8 graphs of figure show that the presence of interveners has a major influence upon changes in elderly people's reactions.

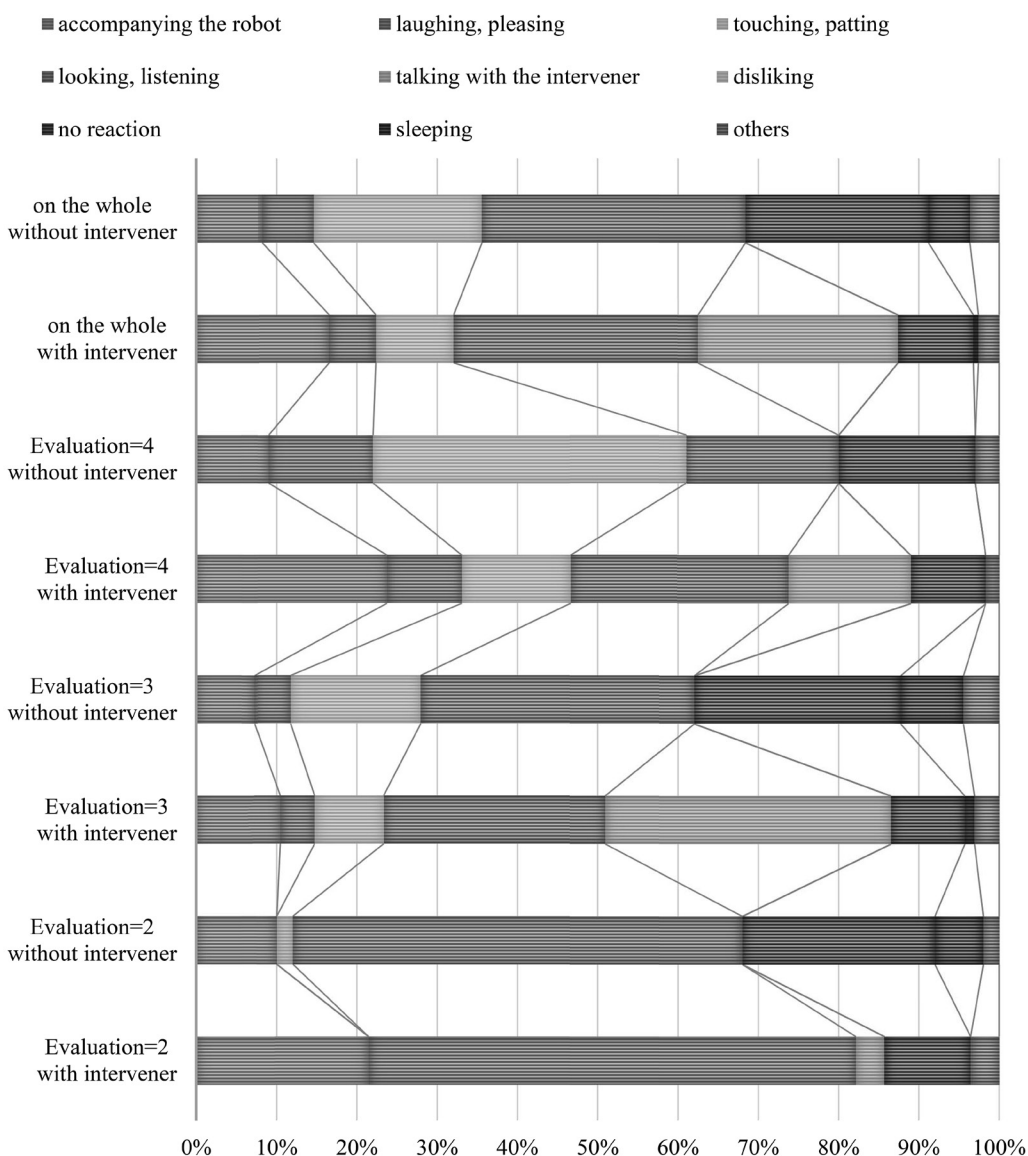


Figure 4 Elderly People's Reactions and Evaluation Values with and without Intervener

## 6. Transition of Elderly People’s Reactions and Presence of the Intervener in Robot Therapy

As mentioned above, the presence of interveners brings good influence to the elderly people’s reactions. Then we discuss the transition of the elderly people’s reactions caused by the presence of interveners. In the discussion we classify the elderly people’s reactions into four categories; active reactions, passive reactions, negative reactions, and others. **Table 4** shows the transition states of the elderly people’s reactions on the whole. There are no changes of reaction category in about 70% of transition at each case of active, passive and negative reactions. This indicates that the elderly people almost continue the same reaction category. Then we compare the differences between the elderly people’s reaction transition in activities with and without interveners. **Table 5** and **Table 6** indicate transition of the elderly people’s reactions in activities with and without interveners respectively. These tables show that the presence of interveners causes good transition: from negative reactions to active or passive reactions and from passive reactions to active reactions. On the other hand the presence of interveners doesn’t exactly bring good transition in active reactions. It is considered as its cause that the transition from active reaction to talking with the intervener increases. However this transition is not necessarily bad, but the elderly people were only talking

**Table 3** Reactions of Elderly People with and without Interveners

Evaluation Value	Intervener	Reaction		
		Positive		Negative
		Active	Passive	
4	N	60	23	17
	P	46	33	11
3	N	27	42	31
	P	30	60	10
2	N	7	49	44
	P	19	68	13
Total	N	33	37	30
	P	35	55	10

N : without interveners (unit : %)  
 P : with interveners

**Table 4** Transition of Elderly People’s Reactions (on the whole)

Reaction before transition	Reaction after transition			
	active	passive	negative	others
active	66.0%	27.4%	5.6%	1.0%
passive	16.7%	72.4%	7.7%	3.3%
negative	11.4%	15.8%	68.4%	4.4%
others	17.6%	35.3%	17.6%	29.4%



with the intervener among active reactions. We think that good communication among the elderly people, the intervener and robot was achieved.

We discuss details of the transition of elderly people's reactions with the intervener. Table 7, Table 8 and Table 9 show the transition from negative reaction state, passive reaction state and active reaction state respectively. As shown in Table 7 when the intervener was present, the elderly people who made negative reactions tried to do the reaction related to robot such as accompanying the robot, laughing for the robot, pleasing with the robot, touching the robot, patting the robot, looking at the robot, or listening to the robot. **Table 8** shows that the elderly people who made passive reactions tried to do the reaction related to robot moreover. We may conclude that the presence of the intervener activate the communication among the elderly people, the intervener and robot

## 7. Conclusion

We investigated elderly people's reactions in robot therapy. Our investigation was based on a work sampling method and the reactions of the elderly people and the presence of interveners were

**Table 5 Transition of Elderly People's Reactions (with Interveners)**

Reaction before transition	Reaction after transition			
	active	passive	negative	others
active	57.0%	38.4%	2.3%	2.3%
passive	19.0%	76.2%	3.4%	1.4%
negative	17.0%	27.7%	51.1%	4.3%
others	22.2%	55.6%	0.0%	22.2%

**Table 6 Transition of Elderly People's Reactions (without Interveners)**

Reaction before transition	Reaction after transition			
	active	passive	negative	others
active	73.0%	18.9%	8.1%	0.0%
passive	13.1%	66.7%	14.1%	6.1%
negative	7.5%	7.5%	80.6%	4.5%
others	12.5%	12.5%	37.5%	37.5%

**Table 7 Transition from Elderly People's Negative Reactions (with Interveners)**

Reaction before transition	Reaction after transition							
	accompanying the robot	laughing, pleasing	touching, patting	looking, listening	talking with the intervener	disliking	no reaction	sleeping
negative	6 %	2 %	9 %	17 %	11 %	0 %	51 %	0 %

**Table 8 Transition from Elderly People's Passive Reactions (with Interveners)**

Reaction before transition	Reaction after transition							
	accompanying the robot	laughing, pleasing	touching, patting	looking, listening	talking with the intervener	disliking	no reaction	sleeping
passive	12%	1 %	7 %	41%	36%	0 %	3 %	1 %

**Table 9 Transition from Elderly People's Active Reactions (with Interveners)**

Reaction before transition	Reaction after transition							
	accompanying the robot	laughing, pleasing	touching, patting	looking, listening	talking with the intervener	disliking	no reaction	sleeping
passive	12%	1 %	7 %	41%	36%	0 %	3 %	1 %

recorded. Through analysis of the reactions of the elderly people by comparison with the evaluation values, we concluded that most reactions are positive and active reactions are appreciated highly. The quantities of active reactions determined the evaluation values of the subjects in therapy. It is important for more effective robot therapy to develop many more ideas to induce elderly people to have more active reactions.

We also investigated the effects of interveners. The presence of interveners induced the elderly people to have more positive reactions. Even if the subject showed negative reactions without the intervener, he/she often showed positive reactions with the intervener. The interveners hold the important roles and create active communication in robot therapy. According to this result, it is important for more effective robot therapy to take on more of the role and actions of the intervener. As above-mentioned we have demonstrated two items to develop in the next study. We would like to report necessary and desired roles and actions of the interveners in the near future.

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