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Clinical Observations

A Progress Report of Long-Term Robot Assisted Activity at a Health Service Facility for the Aged

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Abstract: *We have proposed Robot-Assisted Therapy and Activity since 1996, and have been developing mental commit robots that provide psychological, physiological, and social effects to human beings through physical interaction[1)9)]. The appearances of these robots look like real animals such as cat and seal. The seal robot, Paro, was developed especially for therapy. We have applied seal robots to therapy of children at pediatric hospitals[4)] and to assisting activity of elderly people at a day service center[5)-7)]. Recently, several research groups have tried robot assisted therapy and activity. Dautenhahn has used mobile robots and robotic dolls for therapy of autistic children[10)]. Besides, robot-assisted activity that uses commercialized animal type robots (such as AIBO[11)], NeCoRo, etc.) has been tried[12)-14)]. For example, Yokoyama used AIBO in a pediatrics ward, and observed the interaction between children and pointed out that the initial stimulus received from AIBO was strong. However, the long term stability was quite weak, compared with living animals[12)]. In this presentation, we will explain the results of the robot-assisted activity for elderly people at a health service facility for the aged for more than one year.*

Method: In order to investigate the effects of seal robots to the elderly people, we evaluated moods of elderly people by face scales[15)] that express person's moods by illustration of person's faces, questionnaires of Geriatric Depression Scales (GDS)[16)]. Seal robots were provided into the health service facility on two days per a week from Aug. 2003.

Results: The results of face scale and GDS showed that feelings and depression of elderly people were improved by interaction with the seal robots, Paro. Regarding a case study, Hanako (pseudonym), aged 89, was sociable and comparatively independent. On the first day of the interaction with Paro, she looked a little nervous of the experiment. However, she soon came to like Paro. She treated Paro like her child or grandchild. Her face scale scores after interaction were always lower than before interaction after the first day. Unfortunately, she was hospitalized during Dec. 10 to 26, 2003. When she met Paro for the first time after leaving hospital, she said to Paro "I was lonely, Paro. I wanted to see you again." Her GDS score then improved. To the present, she has continued to join the activity and willingly interacted with Paro. Caregivers commented that interaction with Paro made the people laugh and become more active. For example, their facial expression changed, softened, and brightened. In addition, Paro encouraged the people to communicate, both with each other and caregivers, by becoming their common topic of conversation. Thus, the general atmosphere became brighter.

Conclusions: We have used seal robots, Paro in RAA for elderly people at a health service facility for the aged since August 2003. The results showed that interaction with Paro improved their moods and depression, and then the effects showed up through more than one year. Consequently, the seal robots, Paro were effective for therapy at health service facilities.

BACKGROUND

Interaction with animals has long been known to be emotionally beneficial to people. The effects of animals on humans have been applied to medical treatment. Especially in the United States, animal-assisted therapy and activities (AAT&AAA) are becoming widely used in hospitals and nursing homes.[1,2] AAT has clear goals set out in therapy programs designed by doctors, nurses or social workers, in cooperation with volunteers. In contrast, AAA refers to patients interacting with animals without particular therapeutic goals, and depends on volunteers. AAT and AAA are expected to have 3 effects:

- Psychological effect (e.g., relaxation, motivation)
- Physiological effect (e.g., improvement of vital signs)
- Social effect (e.g., stimulation of communication among inpatients and caregivers)

However, most hospitals and nursing homes, especially in Japan, do not accept animals, even though they admit the positive effects of AAT and AAA. They are afraid of negative effects of animals on human beings, such as allergy, infection, bites, and scratches.

We have proposed Robot-Assisted Therapy and Activity (RAT and RAA) since 1996, and have been developing mental commit robots that provide psychological, physiological, and social effects to human beings through physical interaction.[3-11] The appearances of these robots look like real animals such as cat and seal. The seal robot, Paro, was developed especially for therapy. We have applied seal robots to therapy of children at pediatric hospitals[6] and to assisting activity of elderly people at a day service center.[7-9] Recently, several research groups have tried robot assisted therapy and activity. Dautenhahn has used mobile robots and robotic dolls for therapy of autistic children.[12] Besides, robot-assisted activity that uses commercialized animal type robots (such as AIBO,[13] NeCoRo, etc.) has been tried.[14-16] For example, Yokoyama used AIBO in a pediatrics ward, and observed the interaction between children and pointed out that the initial stimulus received from AIBO was strong. However, the long term stability was quite weak, compared with living animals.[14]

In this paper, we discuss the application of the seal robots to assist elderly people at a health service facility for the aged, observing their psychological and social effects for more than *one year*. Chapter II describes a seal robot that was used for robot-assisted activity (RAA), and ways of experiments. Chapter III explains the effects of RAA on elderly people. Finally, chapter IV offers conclusions.

METHOD

The robot and its major functions are shown in Fig.1. Its appearance was designed using a baby harp seal as a model, and its surface was covered with pure white fur. A newly-developed plane tactile sensor[11] was inserted between the hard inner skeleton and the fur to create a soft, natural feel and to permit the measurement of human contact with the robot. The robot is equipped with the four primary senses; 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. The robot operates by using 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.

INSTRUCTIONS: The faces above range from very happy at the left to very sad at the right.

Figure 1. Seal Robot “Paro”

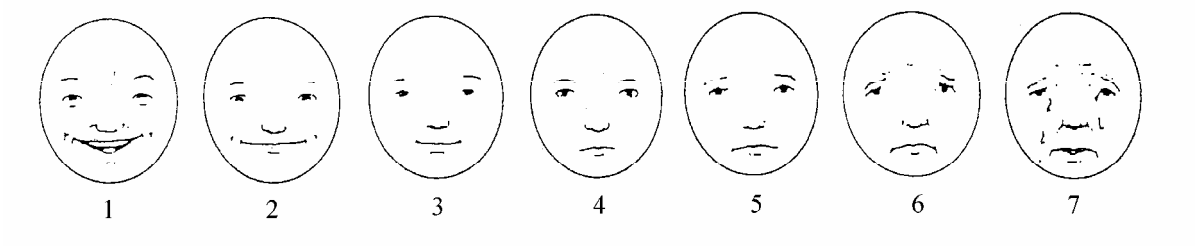

Figure 2. Face Scale

Check the face which best shows the way you have felt inside now.

In order to investigate the effects of seal robots to the elderly people, we evaluated moods of elderly people by face scales[17] that express person's moods by illustration of person's faces, questionnaires of Geriatric Depression Scales (GDS).[18] The original Face Scale contains 20 drawings of a single face, arranged in serial order by rows, with each face depicting a slightly different mood state. However, sometimes subjects are confused by original face scale because it has too many similar images. Then, we simplified it by using seven images #1, 4, 7, 10, 13, 16, and 19 in original ones (Fig.2).

Seal robots were provided into the health service facility on two days per a week from Aug. 2003.

Figure 3. An Elderly Person Kissing the Seal Robot

RESULTS

The elderly interacted with Paro willingly from the first day, speaking to it, stroking and hugging it. Sometimes, they kissed it with smile (Fig.3). Paro became common topics among the elderly people and caregivers (Fig.4). They talked about its appearance, kinds of animals, moods, and so on. For example, "its eyes so big," "it looks sleepy," etc. The elderly people came to love Paro very much and gave them new name "Maru" and "Maro," respectively. After 3 months of the introduction, we added one more Paro to the facility because many other elderly joined in the activity voluntarily. The new Paro was given new name "Hana-chan" by the elderly, soon. Moreover, Paro have been accepted by caregivers widely. They made a home of Paro in the facility.

We obtained the face scale data from 8 subjects (Fig.5). The average scores before interaction varied from 3.3 to 2.0 through 5 months. However, scores after interaction were almost always lower than those before interaction in

Figure 4. Interaction among Elderly People, a Caregiver and a Seal Robot

each week (except Nov. 29). Especially, a statistically significant difference* was shown in Nov. 15 (Wilcoxon's sign rank sum test: $p^* < 0.05$).

Regarding a case study, Hanako (pseudonym), aged 89, was sociable and comparatively independent. On the first day of the interaction with Paro, she looked a little nervous of the experiment. However, she soon came to like Paro. She treated Paro like her child or grandchild. Her face scale scores after interaction were always lower than before interaction after the first day (Fig.6). Unfortunately, she was hospitalized during Dec. 10 to 26, 2003. When she met Paro for the first time after leaving hospital, she said to Paro "I was lonely, Paro. I wanted to see you again." Her GDS score then improved (Fig.7). To the present, she has continued to join the activity and willingly interacted with Paro. Caregivers commented that interaction with Paro made the people laugh and become more active. For example, their facial expression changed, softened, and brightened. In addition, Paro encouraged the people to communicate, both with each other and caregivers, by becoming their common topic of conversation. Thus, the general atmosphere became brighter.

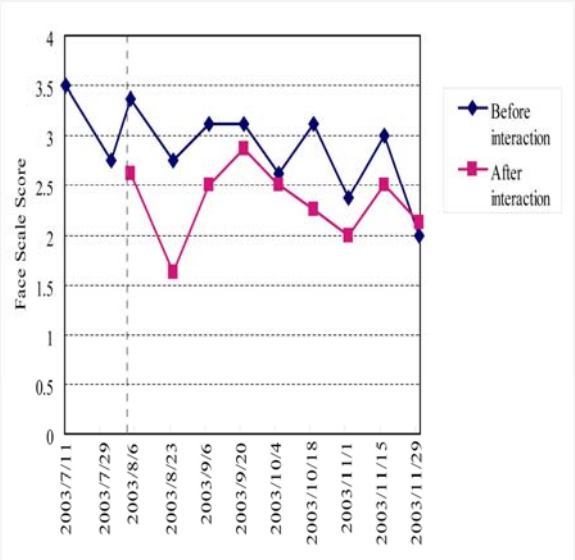

Figure 5. Change of Average Face Scale Scores of 8 Elderly People for 5 Months (Score: 1=best mood, 7=worst mood)

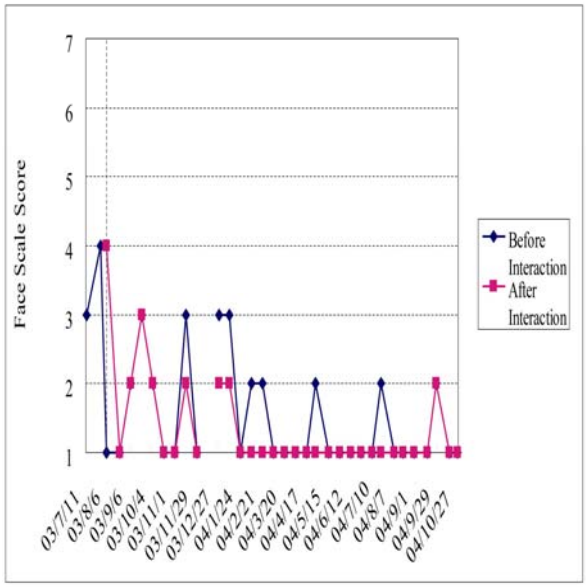

Figure 6. Change of Face Scale Scores of a Subject for 16 months
(Score: 1=best mood, 7=worst mood)

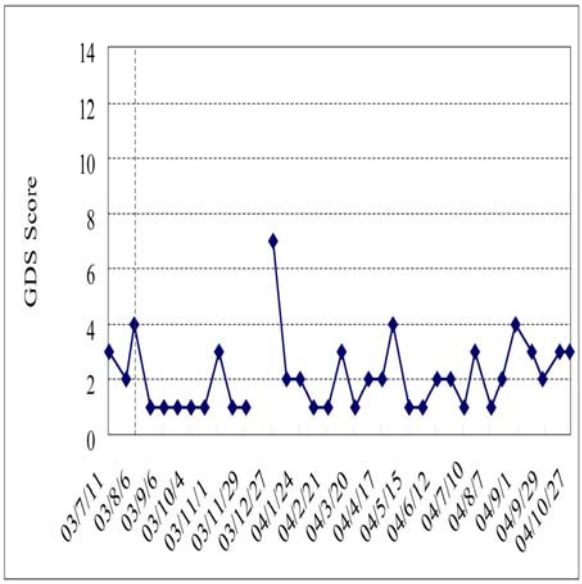

Figure 7. Change of GDS Scores of a Subject for 16 months
(Score: healthy condition <= 5 < probable depression)

CONCLUSIONS

We have used seal robots, Paro in RAA for elderly people at a health service facility for the aged since August 2003. The results showed that interaction with Paro improved their moods and depression, and then the effects showed up through more than one year. Consequently, the seal robots, Paro were effective for therapy at health service facilities.

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