

# Robots Visit Homes For Elderly People Who Have Difficulty Going Out and Practice Brain Training

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**Abstract— Introduction:** When it becomes difficult for the elderly to go out due to a decrease in walking ability, the decline in their mental and physical function accelerates. Currently, elderly people who have difficulty going out have no effective measures in place. Therefore, we wanted to prevent their functional decline by visiting homes and intervening. For the intervention, a robot developed for brain training for the elderly people was used. The goal was not only brain training, but also to obtain psychological activation through interaction with robots and supporters.

**Method:** The subjects were elderly people who had difficulty going out. Researchers, supporters, and robot visited their homes to conduct brain training by robots and recollection methods were performed with supporters. Cognitive tests (immediate and delayed reproduction of 10 words) and psychological surveys (interviews) were conducted before and after the intervention.

**Result:** There were 29 subjects, 8 males, and 21 females, with an average age of  $79.5 \pm 4.95$ . The maximum score for the cognitive test is 10. Immediate playback was improved from 5.5 points to 8.1 points ( $p < 0.01$ ), and delayed playback was improved from 4.7 points to 7.5 points ( $p < 0.01$ ). In the analysis of psychological verbatim record, as a result of the pre-interview, “Once I stop going out, it becomes troublesome to get dressed up and go out”, “There are days when I don't talk about anything all day”, “If someone doesn't come or make a phone call, there are no chance of a conversation”. In the interview after the start, there were most categories as “I came to think that vitality is important”, “I became more motivated”, and “I'm looking forward to talking”. As for robots, there were many reactions such as cuteness, healing, and fun compared to interpersonal communication.

**Conclusion:** Brain training during the visits showed that there is a significant improvement in cognitive score, and that it is effective as a countermeasure for the elderly who cannot go out. In addition, the robot has a high affinity for all subjects, the effect of softening the tension associated with receiving the visit was confirmed. Conversation with a robot that resolves the shortage of human resources is meaningful because in the situation where no one talks to anyone throughout the day the utilization of robot shows the improvement in energy and motivation due to increased conversation. By supplementing the interaction with regular supporters to this, it can be a more effective measure.

**Index Terms—** robots, home-visit, brain-training.

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## I. INTRODUCTION

When it becomes difficult for the elderly to go out due to a decrease in walking ability, the decline in their mental and physical function accelerates. Currently, elderly people who have difficulty going out have no effective measures in place. Therefore, we wanted to prevent their functional decline by visiting homes and intervening. For the intervention, a robot developed for brain training for the elderly people was used.

This robot is a humanoid robot that enhances communication functions and aims to increase psychological enjoyment through conversation and to improve thinking ability. This robot is equipped with brain training games and memory recall methods, and is expected to improve cognitive functions. One problem for elderly people who have difficulties going out is that they have significantly less opportunities for interpersonal communication and that various things become a bother for them. About 40% of elderly people who live alone in Japan have less than one conversation in two to three days [1].

This is a major issue, because conversation activates many areas of the brain. Regarding the activation of many areas of the brain by conversation, not only the language center, but also the frontal motor cortex works to move the mouth and tongue, and the auditory area of the temporal lobe works to listen to people [2]. Talking with someone as much as possible is recommended to prevent dementia, but elderly people who do not go out have very few opportunities for conversation, so that talking with a robot might be able to assist with solving this problem.

The brain training games and reminiscence method methods that can be done together with the robots are based on topics that evoke feelings of nostalgia and something with attachment in elderly people, which is said to make people feel relaxed and comfortable [3,4]. In addition, the brain training games include dual-tasks, such as performing different movements with the left and right side of the body, and delayed recall tasks, in which things that were memorized need to be reproduced later. Dual-tasks stimulate and activate the frontal lobe, which controls movement and thinking, by performing two actions simultaneously and thereby aim to improve cognitive function. Delayed recall tasks are used to discriminate between normal and mild cognitive impairment, and since it is among the first abilities to decrease, aim to improve cognitive function by providing training to strengthen this.

Previous studies about dual-tasks have confirmed that they activate the prefrontal cortex [5-7], and delayed recall

tasks have been reported to improve intelligence test scores and increase dopamine levels [8,9]. In this intervention, researchers therefore visit the homes of elderly people with the robot, the participants to perform dual-tasks, delayed recall tasks, and reminiscence method, and then measure the improvement of their cognitive function. Another goal is to activate psychologically through conversation with the robot.

## II. METHOD

### A. Subjects

Elderly people who had difficulty going out.

### B. Intervention Method

Researchers, supporters, and robot visited their homes to conduct brain training by robots and recollection methods were performed with supporters, as shown in Figure 1 and 2.

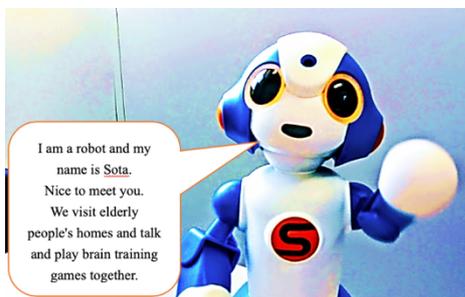


Fig. 1. The appearance of a communication robot



Fig. 2. Robot visits home and trains brain

### C. Evaluation Method

For the cognitive function test, a ten-word memory test measured immediate memory and recall delayed memory, each 10-point scale.

For psychological surveys, interviews were conducted with the subjects.

### D. Analysis Method

To compare the scores of immediate memory and recall delayed memory before and after the intervention, the corresponding t-test was carried out.

The results of the interviews were analyzed qualitatively.

### E. Ethical Considerations

The outline of the research, voluntary nature of participation, anonymity, and agreement regarding the publication of the document were explained to prospective participants both in writing and verbally, and their consent was subsequently obtained.

The study protocol was approved by the ethical review board of Nara Medical University.

### F. Clinical Trial Registration

This study has been registered in the clinical trial registration database: University Hospital Medical Information Network (UMIN); registration number: UMIN000037209.

## III. RESULTS

There were 29 subjects, 8 males, and 21 females, with an average age of  $79.5 \pm 4.95$ .

The results of cognitive tests: The maximum score for the cognitive test is 10. Immediate playback was improved from 5.5 points to 8.1 points ( $p = 0.000$ ), and delayed playback was improved from 4.7 points to 7.5 points ( $p = 0.000$ ).

Result of interview: In the analysis of psychological verbatim record, as a result of the pre-interview, "Once I stop going out, it becomes troublesome to get dressed up and go out", "There are days when I don't talk about anything all day", "If someone doesn't come or make a phone call, and there are no chance of a conversation". In the interview after the start, there were most categories as "I came to think that vitality is important", "I became more motivated", and "I'm looking forward to talking".

Impression of conversation with robot: Verbatims were categorized as cute, funny, happy, humorous, exhilarating, exciting, pleasant, heartwarming, blissful, relaxing, relieved, and so on.

## IV. DISCUSSION

Brain training during the visits showed that there is a significant improvement in cognitive score, and that it is effective as a countermeasure for the elderly who cannot go out. Training performed at home one-on-one is more effective than group training. In one-on-one training, there is more flexibility to respond to various individual conditions and quickly react to a changing situation. Previous studies have also reported that individual training is more suited for individual abilities, and that responding to specific needs and preferences can meet the specific developmental needs of an individual [10-12].

In personal training sessions, the instructor can also focus 100% of their attention on the individual, enabling them to react in a safer and more appropriate manner. Elderly people who have difficulty going out are relatively frail, so this one-on-one training seems to be the best approach and their cognitive scores have improved significantly. If elderly people who have difficulties going out are left in their current situation, their mental and physical abilities will decrease.

Interviews carried out for this research also revealed a vicious cycle in which the less a person goes out, the more it becomes a bother to go out, and then even change clothes and adjust the appearance becomes a bother, and the person goes out even less. This situation exacerbates the decrease of abilities that are not being used. The interview also showed that there were days when a person would not talk

with anyone all day, and the only opportunity for conversation was when someone came by or called them on the phone. Not talking to anyone all day is a big problem, and it has been confirmed that people who interact with others less than once per week have an about 1.4 times higher risk of getting dementia than people who interact with others every day [13].

People who have only limited social interactions are more likely to die early [14,15], and have a low sense of purpose in life [16], high levels of anxiety [17], and a high risk of developing dementia [18]. Efforts to address this issue are lagging, and the only current solution is to rely on the help of volunteers.

In response to this problem, a robot can reduce labor shortage and greatly increase the amount of communication of elderly people. Encouraging conversation and interaction improves health [19-21], affects the length of the remaining life span [22], and prevents depression [23]. In addition, "pleasant emotions" such as cuteness and fun that the robot brings with it are associated with long life [24-26], influence the level of physical abilities [27], and prevent coronary artery disease [28,29]. However, elderly people who have difficulties going out have very few opportunities to experience pleasant emotions and it is difficult for them to change their mood.

Pets and such have become popular as a possible solution to improve a person's mood, but an apparent problem is that people cannot take care of pets anymore when they get older. Thus, if a robot could achieve the same ability to improve a person's mood and encourage feelings of attachment like a pet does, it can be expected to improve mood stability, reduce loneliness, reduce anxiety and stress [30], and improve cognitive function [31], along with other effects.

In conclusion, it was suggested that the interventions performed during a visit with the robot improved cognitive abilities as well as the mental health of elderly people with difficulties going out.

## V. CONCLUSION

Brain training during the visits showed that there is a significant improvement in cognitive score, and that it is effective as a countermeasure for the elderly who cannot go out. In addition, the robot has a high affinity for all subjects, the effect of softening the tension associated with receiving the visit was confirmed.

Conversation with a robot that resolves the shortage of human resources is meaningful because in the situation where no one talks to anyone throughout the day the utilization of robot shows the improvement in energy and motivation due to increased conversation. By supplementing the interaction with regular supporters to this, it can be a more effective measure.

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## CONFLICT OF INTEREST

All authors declare that they have no conflict of interest.

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