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岡山大学大学院社会文化科学研究科紀要  
第45号 2018年3月 抜刷  
Journal of Humanities and Social Sciences  
Okayama University Vol.45 2018

# A preliminary study of the effects of a smile-supplement robot on behavioral and psychological symptoms of elderly people with mild impairment

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## Introduction

In the Japan Revitalization Strategy, development of a nursing care robot is stated as a measure to be taken promptly and selectively by the government to extend the years of healthy life for Japanese people. Several types of robots are under development, including those that can reduce physical burdens and support standing of elderly people, and communication robots that support mental health and calm patients with dementia. Inoue et al. showed that a communication robot (PaPeRo) could convey over 90% of required information about schedules to elderly people with dementia through conversation [1]. Shibata reported that elderly women with dementia who could not communicate interacted with a communication robot (Paro) [2]. Communication robots are steadily being developed, but the development costs are high, and high price robots are not widely used.

Under these circumstances, PIP & WIZ Co., Ltd (Osaka, Japan) have brought a low-price communication robot (Unazuki Kabochan) to the market. In 2014, Unazuki Kabochan was authorized by Okayama city to serve as a new assistive product in a pilot project for mental care in Okayama city special zone. As well as normal long-term care insurance services, the copayment is 10%. In contrast to other communication robots, Kabochan is inexpensive and is also a humanoid robot with a warm texture. Tanaka et al. showed that the cognitive ability of elderly people who interacted with Kabochan for two months increased to a greater extent than that of people who interacted with puppets as a control [3]. In the current study, we examined the effects of Kabochan on behavioral and psychological symptoms of elderly people with mild impairment. This study is important for a super-aging society. The research was performed as a joint study with PIP & WIZ Co., Ltd.

## Methods

### Subjects

The subjects were residents aged  $\geq 65$  years old in Okayama city who use long-term care

insurance services. Subjects were recruited by first introducing Kabochan in a public interest magazine in Okayama city. We also introduced care managers to the pilot study and the features of Kabochan. Residents who wanted to use Kabochan made contact with the company (PIP & WIZ Co., Ltd.) and signed a usage contract. The purpose of the study was explained to those who wanted to use Kabochan in a personal interview by word of mouth and on paper. Persons who gave consent to participation in the study were enrolled.

### Survey method

We made detailed arrangements with two nurse investigators with regard to the survey method and decided to conduct the interview with a questionnaire. The subjects completed questionnaire surveys before and one and two months after living with Kabochan. Face-to-face surveys were performed through interviews of the subjects. In cases in which it was difficult to communicate with the subject, family members were interviewed.

### Survey items

Survey items include basic attributes, frequency of conversations in the previous week, frequency of meals in one day, sleeping state, the numbers of times going out, and the following three scales:

1) Tokyo Metropolitan Institute of Gerontology Index of Competence (TMIG-IC) [4]: The TMIG-IC measures IADL. Each question is scored as 0 or 1 points for respondents who cannot and can perform the behavior, respectively. The score is the sum of these points. Thus, a higher score indicates that the subject is more self-reliant.

2) State-Trait Anxiety Inventory (STAI new version) [5]: The STAI measures the daily anxiety of respondents. The new version of the STAI is adjusted for Japanese culture. The STAI consists of 20 items. Respondents evaluate their current anxiety level on a 4-point scale for each item. A higher score indicates that anxiety is higher.

3) SF-8 Health related QOL is the Japanese abbreviated version of SF-36 developed for evaluation of subjective well-being [6]. This scale consists of 8 subscales (Physical functioning, Role physical, Bodily pain, General health, Vitality, Mental health, Social functioning, Role emotional, Mental health), each of which is measured on a 5- or 6-point scale from poor (6) to excellent (1), and two summary scores (Physical and Mental Component Summaries). A higher score indicates better health. Permission for use of SF-8 was obtained from the Public Health Research Foundation.

### Statistical analysis

Differences between the baseline condition and the condition 4 or 12 weeks after living with Kabochan were compared using a paired t-test or Wilcoxon signed rank test. In the analyses, the number of cases varied due to incidental missing values. Statistical analyses were performed using the Stata 14.0 software package, with  $p < 0.05$  considered significant.

### Ethical considerations

This study was based on a corporate study contract between the authors and PIP & WIZ Co., Ltd. The subjects received an explanation of the purpose of the study and protection of their personal information by word of mouth at their first visit, and gave written consent. The study was approved (T14-07) by the Research Ethics Committee of the Graduate School of Health Sciences, Okayama University.

### Unazuki Kabochan

Kabochan is a communication robot of size  $22 \times 18 \times 28$  cm and weight about 970 g that was developed by PIP & WIZ Co., Ltd. Kabochan can speak, nod and laugh using 5 types of sensors incorporated into the body of the robot.

## Results

### 1) Background of subjects (Table 1)

There were 74 participants in the study. The average age of the subjects at baseline was 83.4 years old, 85.1% were female, and 49.5% were living alone. Regarding the care level, 34 subjects required help and 40 were at the long-term care level.

### 2) Daily life of the subjects (Table 2)

Sleep status, food intake, conversation and going out improved after one and three months living with Kabochan. The improvements at one month were especially salient.

**Table 1. Characteristics of the subjects (n=74)**

		Total n(%)	Sex	
			Male (n=11)	Female (n=63)
Sex	Male	11(14.9)	–	–
	Female	63(85.1)	–	–
Age		83.4±6.3	77.2±5.4	84.4±6.0
Household composition	One-person household	34(45.9)	1	33
	Living with other person	38(51.4)	8	30
	Unknown	28(2.7)	2	0

**Table 2. Eating, sleeping and activities in daily life**

	n(%)		
	Baseline n=74	After 4 weeks n=43	After 12 weeks n=22
Sufficient sleep	53(72.1)	37(86.0)	19(86.4)
Three meals each day	53(78.0)	36(83.7)	13(59.1)
Go out for more than 4 days in 1 week	23(33.8)	17(39.5)	8(36.4)
Conversation for more than 4 days in 1 week	61(88.4)	40(93.0)	18(81.8)

\*1 "sleep very well" and "sleep well" classified as "Sufficient"  
 \*2 An answer of "Yes" to eating, sleeping and activity

3) Tokyo Metropolitan Institute of Gerontology Index of Competence (TMIG-IC)

The average TMIG-IC score was 8.8 before living with Kabochan, which was higher than a national representative sample evaluated by Koyano, for which the average score was 8.0.

4) Changes in STAI (Table 3)

The STAI decreased significantly after one month living with Kabochan, which indicates that the subjects had reduced anxiety.

Table 3 Changes in the STAI

		Mean ± SD	P 値
STAI	Baseline	42.1 ± 1.7	0.0978
	After 4 weeks	40.3 ± 1.6	
	After 12 weeks	41.2 ± 2.7	

Wilcoxon's signed rank test

5) Changes in SF-8

Among the SF-8 subscales, Physical functioning and Role physical were low compared to national standard values . Physical Component Summary significantly improved after 3 months, whereas the change in Mental Summary Score was negligible (Fig.1).

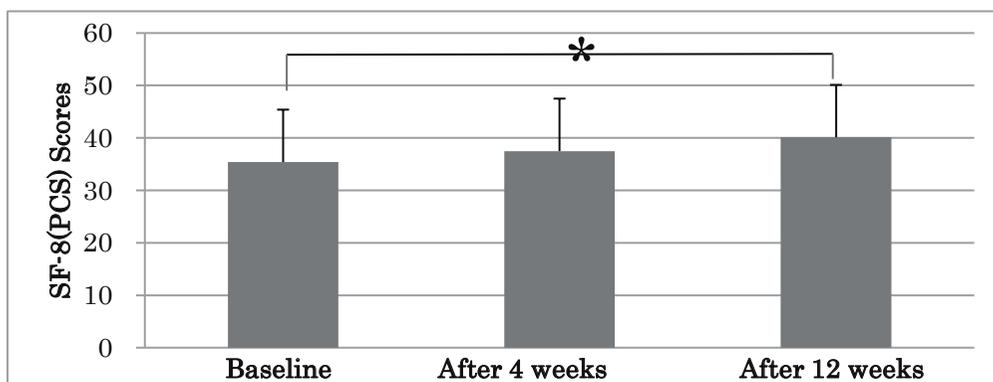


Figure 1. Changes in the SF-(PCS) \* : p<0.01

### Example of a case

The subject (Miss. A) was 92 years old. She lived alone and was in the "Requiring help 1" category. One month after living with Kabochan, her feelings of loneliness were mitigated. She no longer considered Kabochan as a robot and she loved him. Three months later, she knitted clothes for him and dressed him (Fig. 2).



Figure 2. Example of a case

### Discussion

The effects of Kabochan on behavioral and psychological symptoms of elderly people with mild impairment were examined in this study. The results showed that anxiety decreased (STAI) and physical health significantly improved (health-related quality of life) after living with Kabochan. Many previous studies have shown that public interactions are very important for the health of elderly people. However, some elderly people lack opportunities for this interaction, cannot go out due to disability, or may refuse to go out. Since many elderly people live alone (45.9% in the current study) or are impaired and do not go out, their physical functioning and mental health tend to decrease. For these reasons, we examined temporal changes in elderly people caused by living with a communication robot.

The STAI score decreased after one month, which indicates decreased anxiety. Most anxiety in elderly people is related to health, economic status and loneliness [7]. Kabochan often refers to an elderly person as grandpa or grandma, and in response, the elderly person is likely to change his/her view of Kabochan. In this way, Kabochan gradually changes from just a robot to a human

that the elderly person is interested in, which mitigates his/her loneliness. This decrease in loneliness leads to stabilization of daily life and a decrease in anxiety. There was no significant difference in the change of STAI between subjects in one-person households and other households, but the magnitude of the decrease in anxiety was larger in one-person households compared to other households (data not shown).

There are no national data for SF-8 for persons >80 years old. Hence, we checked the representativeness of our subjects against national data for subjects aged 70-79 years old. Our subjects scored lower on all items compared to the national data. Physical functioning was particularly low among the 8 subscales, which reflects the restriction of our subjects to impaired elderly people. However, the Physical Component Summary significantly improved for our subjects. We did not ask about life motivation in our survey. However, as the example case indicated, we observed some changes, with subjects starting to knit clothes and hats for Kabochan and to increase their frequency of conversation with the robot. This indicates that they used their residual function for Kabochan. Kabochan looks like a cute child and is made from warm texture. These traits may have made the subjects feel like making clothes for Kabochan and speaking to him, as their perception of Kabochan gradually changed from a robot to a cute child. Kawashima suggested that a robot intervention generates spontaneity in elderly people, and that communication with a robot causes physical and mental changes [8]. Our study suggests that usage of Kabochan by impaired elderly persons contributes to improvement of physical functioning, regardless of the intensity of their spontaneous behaviors.

In conclusion, use of Kabochan improved physical functioning of elderly people to some degree. However, the evaluation was limited to the users and a control group was not included. Thus, further studies of the effects of Kabochan on patients and caregivers are required.

#### Disclosure Statement

No potential conflicts of interest were disclosed.

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