Coimagination Method: Communication Support System with Collected Images and Its Evaluation via Memory Task

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Abstract. Prevention of dementia is a crucial issue in this aged society. We propose coimagination method for prevention of dementia through supporting interactive communication with images. Coimagination method aims to activate three cognitive functions: episode memory, division of attention, and planning function, which decline at mild cognitive impairment (MCI). Participants of the coimagination program bring images according to the theme and communicate with them. They share feeling rather than memory, which is a major difference between coimagination and reminiscence. They take memory task whether they remember the owner or theme of images after the series of sessions. We held coimagination program successfully at the welfare institution for elderly people in Kashiwa city, Japan. Each session was held one hour per week for five times. The result of the task indicates that the subjects showed empathy with each other. The effectiveness of the proposed method was validated through the experiment.

1 Introduction

The number of people suffering from dementia is expected to quadruple by the year 2050. Prevention and suppression of the progress of dementia are crucial issues in this century. More than eighty percent of patients with dementia are with Alzheimer's disease or cerebral vascular disease. Therefore, the major strategy for prevention of dementia is to reduce risk factors for these two diseases. There are two approaches for prevention of dementia. One is physiological approach and another is cognitive approach. Former approach includes dietary habits and physical activities. It is based on the fact that use of nonsteroidal anti-inflammatory drugs, wine consumption, coffee consumption, and regular physical activity were associated with a reduced risk of Alzheimer's disease[1].

Fig. 1. Subjects Surrounding the Image on the Screen during Coimagination Program

Latter approach includes intellectual activities and development of social network. There is an evidence that a long-term cognitive-motor intervention in cholinesterase inhibiter-treated early Alzheimer disease patients produced additional mood and cognitive benefits[2], and an extensive social network seems to protect against dementia[3]. The effectiveness and durability of the cognitive training interventions were validated in improving targeted cognitive abilities[4]. There is a hypothesis that activation of three cognitive functions which decline at mild cognitive impairment (MCI) is effective for prevention of dementia[5,6]. The cognitive functions include episode memory, division of attention, and planning function. Interactive communication activates above three functions. Reminiscence therapy is known as effective methods for the enhancement of psychological well-being in older adults[7]. However, its focus is not on activation of cognitive functions although it is based on communication. A replication of effectiveness studies of the well-defined protocols is warranted. This study proposes novel method with a measure, supporting interactive communication for activating three cognitive functions.

2   Coimagination Method

In this study, we propose coimagination method towards prevention of dementia through supporting interactive communication with images. The method is named after that we can share (co-) imagination through interactive communication with images. The basic concept of the method is listed below.

1. Communication is one of the typical intelectual activities. The method should support interactive communication so that three cognitive functions of subjects including episodic memory, division of attention, and planning function are activated as a whole.

2. Communication is a foundation for social network. The method should contribute to generate social network among the subjects through communication. Social network provides opportunity for sustainable communication among the subjects.
3. The method should have measures for effectiveness. It requires both long term and short term measures. Short term measure should evaluate whether the activities required three cognitive functions.

The first strategy comes from the fact that interactive communication requires division of attention to listening, understanding, estimating intentions, asking questions, making comments. If the allocated time is fixed, division of attention to keep time is also required. Planning function is required if the theme of the communication is determined beforehand. The subjects have to prepare topics of conversation according to the theme. We made rule to bring images according to the theme for communication so that both episodic memory and planning functions are activated. The subjects have to remember which images they have and to plan which images they bring.

In order to achieve second strategy, we extended theme of communication. Theme of communication of reminiscence has been past while theme of communication of coimagination is past, present, and future. The subjects bring feelings rather than memories, which is a major difference between the coimagination method and the reminiscence method, so that subjects who don't want to remember anything from the past can participate. For sustainable communication, forward-looking thinking towards future is better than backward-looking one towards past.

The third strategy is based on the fact that activation of cognitive functions leads to enhance the cognitive functions, although it takes time to alter cognitive functions. Activation of cognitive functions is measured by memory task. We make rule for subjects to take memory task in order to make clear whether communications themselves form episodic memory. Subjects guess the owner and the theme of the collected images after a series of communications. Division of attentions and episodic memories are assumed to be activated when the topics of surrounding subjects are remembered by each subject. In the same way, planning is successful when the topics of each subject are remembered by surrounding subjects.

To summarize, we define coimagination method and typical coimagination program as follows:

Definition 1. *Coimagination method supports interactive communication through bringing feelings with images according to the theme. Allocated time for each subject is predetermined. Subjects take turns so as to play both roles of speakers and listeners. The themes of communication are examined considering the effects for social networking. Cognitive activities which require episodic memory, division of attention, and planning are measured by memory task.*

Definition 2. *Typical coimagination program includes five series of sessions. Each session is held for an hour per week. Theme of each session is different.*

Average number of subjects is six. There are two rounds for each session. The first round is for brief speech, and the second round is for questions and answers. Average allocated time is five minutes for each subject and round during first four weeks. On the fifth week, the session for memory task is held. Images of the series of four sessions are displayed one after the other. Subjects guess the owner and the theme of the collected images.

3   Coimagination Support System

There are three requirements for coimagination support system.

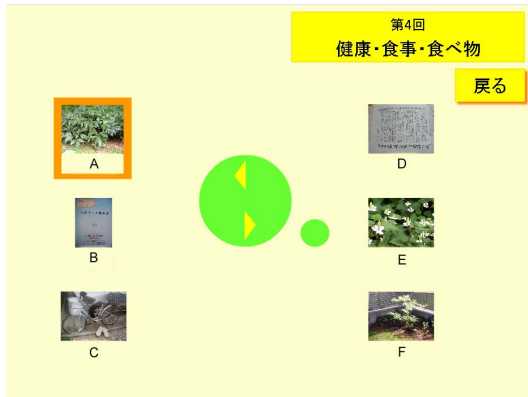1. The system dynamically displays the images corresponding to the stories of subjects.

Fig. 2. Displayed Images for the Group of Subjects

Fig. 3. Displayed Images for One Subject

Fig. 4. Enlarged Displayed Image of One Subject
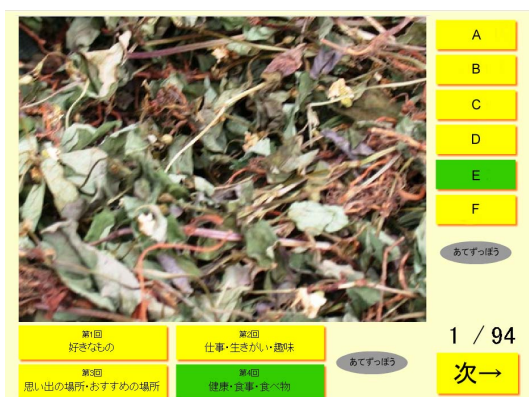

Fig. 5. Displayed Image for Memory Task

2. Users of the system easily register the images. The registered images are accumulated for each subject.
3. Operations of the system are logged so as to be analyzed afterwards. Questions for the memory task are generated from the registered data for display.

We developed coimagination support system which meets the above requirements. The system consists of a laptop computer for the chair of the session, a projector for displaying the images, and a screen.

Before starting the session, the chair of the session scans pictures into the computer and registers them for each subject. Once the session starts, the chair selects the images of the speaker. The initial window is shown in Fig. 2. Images for the group of subjects are arranged according to the seating order. The number of subjects is six. Allotted time for each speaker is five minutes. When one subject is a speaker, other five subjects are listner. The chair of the session selects images

considering the elapsed time. When subject E is a speaker, the chair clicks on the image of subject E of Fig. 2. The images brought by the subject E are displayed, which is shown in Fig. 3. The speaker selects the image to talk about, and ask the chair to click on the image to enlarge. The image is enlarged after the image in the center of Fig. 3 is clicked, which is shown in Fig. 4. The next speaker is subject F after five minutes has passed for subject E. Then, the chair operates the system so as to go back to the initial window, and clicks on the image of subject F of Fig. 2.

A number of images are collected after the series of four sessions in four weeks. On the fifth week, the fifth session for memory task is held. The window for memory task is shown in Fig. 5. It is operated by each subject rather than the chair of the session. The collected images are displayed one after the other. Subjects select the owner and the theme of the displayed image. The subject clicks on the "next" button after click on the buttons of the owner and the theme. Different images randomly appear until the all images are displayed. The scores of the memory task are recorded so as to be analyzed after the session.

4   Coimagination Programs at Welfare Institution

Coimagination programs for elderly people have been provided at welfare institution in Kashiwa city. In this section, we analyze two programs which were held for the first and the second time. Both programs include series of five sessions. Each session was held one hour per week. The last session provided memory task while other four were conversation sessions. The themes of each session are shown in Table 1. The theme of the first session was "favorite things", that of the second session was "work, purpose of life, and hobbies", that of the third session was "memorable or recommended places", and that of the fourth session was "health, dishes and foods". The last session was for memory task. Six normal subjects (3 men and 3 women; mean age= 74 years) for the first program and six normal subjects (3 men and 3 women; mean age= 70 years) participated in the second program. In total, twelve subjects participated in the two programs.

Table 1. Themes for Each Session

First Session	Favorite Things
Second Session	Work, Purpose of Life, and Hobbies
Third Session	Memorable or Recommended Places
Fourth Session	Health, Meals, and Foods
Fifth Session	Memory Task

## 5   Quantitative Evaluation of Coimagination Programs via Memory Task

Percentages of memorized images by self and others for each subject of the first and second coimagination programs are shown in Fig. 6 and 7. Numbers of

Table 2. Number of Images for the First Coimagination Program

Subjects	A	B	C	D	E	F	Total
First Session	1	2	4	5	1	6	18
Second Session	4	9	2	5	5	4	29
Third Session	3	4	6	3	2	5	23
Fourth Session	1	3	3	3	3	3	16
Total	9	18	15	16	11	17	86

Table 3. Number of Images for the Second Coimagination Program

Subjects	A	B	C	D	E	F	Total
First Session	4	3	3	3	6	4	23
Second Session	2	6	3	6	2	3	22
Third Session	5	5	7	4	7	1	29
Fourth Session	3	4	3	4	2	4	20
Total	14	18	16	17	17	12	94
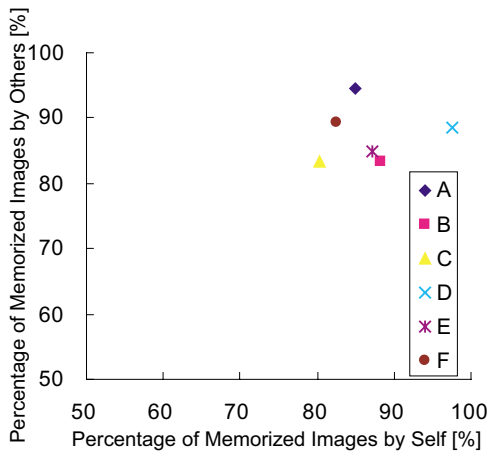
Fig. 6. Percentage of Memorized Images by Self and Others for Each Subjects of the First Coimagination Program

images in total were 86 for the first program and 94 for the second program. Numbers of images for each participants are shown in Table 2 and 3.

Horizontal axis shows the percentage of memorized images of other subjects by each subject. This indicates whether the subject listened carefully and remembered other subjects' stories with images. Episodic memory and division of attention functions are assumed to be activated if the percentage of memorized images of other subjects is high. Percentage of memorized images of other subjects was high for subject D of the first program in Fig. 6, and subject C of the second program in Fig. 7. They have good memories.
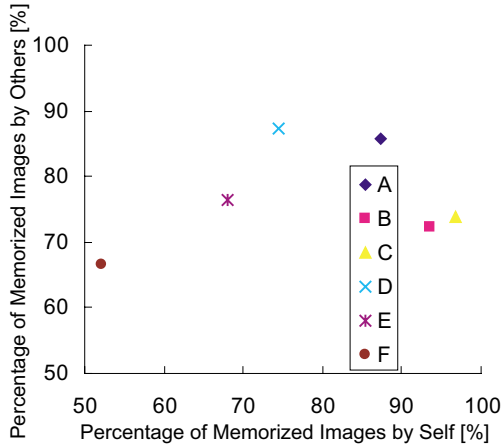
Fig. 7. Percentage of Memorized Images by Self and Others for Each Subjects of the Second Coimagination Program

Vertical axis shows the percentage of memorized images of each subject by other subjects. This indicates whether other subjects listened carefully and remembered the subject's stories. Planning of stories with images by each subject was successful when the percentage of memorized images by other subjects is high, although this depends on the efforts of other subjects. Percentage of memorized images by other subjects was high for subject A of the first program in Fig. 6, and subject D of the second program in Fig. 7. Their stories were memorable and attracted attentions of other subjects.

Overall, percentage of memorized images by both self and others were high. Interactive communications were achieved for both programs, so that cognitive functions including episodic memory, division of attentions and planning were supposed to be activated. The result indicates that the subjects showed empathy with each other. The effectiveness of the proposed method was validated through the experiment.

6 Conclusion

We have proposed coimagination method towards prevention of dementia through supporting interactive communication with images. Characteristics of the method are described as follows.

- Coimagination method supports interactive communication through bringing feelings with images according to the theme.
- Allocated time for each subject is predetermined. Subjects take turns so as to play both roles of speakers and listeners. The themes of communication are examined considering the effects for social networking.

 – Cognitive activities which require episodic memory, division of attention, and planning are measured by memory task.

The method was validated through providing programs for elderly people at welfare institution in Kashiwa city. Percentage of memorized images by both self and others were high. The result indicates that the subjects showed empathy with each other. We succeeded in achieving interactive communication during the programs, so that cognitive functions were supposed to be activated. Future work includes evaluation of the method through direct measurement of the cognitive functions, change in size of social network, and longer follow-up to observe effects on everyday function.

Acknowledgements

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