Topic-Setting Program to Advance Cutting-Edge

Humanities and Social Sciences Research

(Area Cultivation)

Progress Report

(Summary of Final Report)

[**Reflective Learning for the seniors through database creation**

and visualization of their life activities]

Core-Researcher: Chieko Mizoue

Institution: University of Tsukuba

Academic Unit: Faculty of Library, Information and Media Science

Position: Professor

Research Period: FY2014 – FY2017

1. Basic information of research project

Research Area	Research Area D : New advances in humanities and social sciences using analytical methods incorporating praxeology, cognitive science, and neural science
Project Title	Reflective Learning for the seniors through database creation and visualization of their life activities
Institution	University of Tsukuba
Core-Researcher (Name, Academic Unit & Position)	Chieko Mizoue. Faculty of Library, Information and Media Science. Professor
Project Period	FY2014 - FY2017
Appropriations Plan (¥)	FY2014　JPY　3,000,000
	FY2015　JPY　3,450,000
	FY2016　JPY　3,200,000
	FY2017　JPY　1,800,000

2. Purpose of research

In Japan, one in four people is currently an "older people" who is aged 65 years and over, and the speed of aging is the fastest in the world. The aging problem is not unique in Japan and has been a common issue for many countries. Therefore, it is required in the global community to scientifically clarify the characteristics of cognitive behavior of the older one and to solve problems based on their living environment. For example, "Lifelong learning in longevity societies" of the Central Council for Education in Japan (2012) said that we should make older peoples more proactive, and older people should "select their "*Ikigai*" by themselves and think themselves as a leading actor to create a better society.

While the population of people aged 65 or over has a common issue such as over 30 million people suffering from some degree of dementia, the older people cannot be put all together in to a single category. Instead, we must acknowledge that individuals have their lifestyles with inherent problems, such as reducing interpersonal exchanges and restricting activities. Therefore, it is time to discuss not only medical aspects of the older people but also humanities and social scientific aspects such as cognitive behavior characteristics based on data. Although data on daily life behavior of infants and children has already been collected and examined, almost no scientific analysis has been done on older one. Also, when they seek out "*Ikigai*", a useful support system is not available yet. As the baby-boomer generation reaches their retirement age, it is necessary to promptly analyze the cognitive and behavioral characteristics of older people objectively and to construct necessary support systems.

The purpose of this research was to (1) record the daily life behavior of older people by wearable/mobile devices, (2) visualize the analysis results of the obtained data and deepen "learning" with reflective learning method to promote "*Ikigai*." (3) We proposed and

implemented a support system that can facilitate older people to obtain information to find their "*Ikigai.*" In order to collect data of the daily life behavior of older people who are unfamiliar with the experimental environment, we designed a lifelog program that blended into the daily lives of older one. By providing the visualization of the analysis result to the elderly, we aimed to promote the transformation of their behavior, as the older one themselves looked back on the implicit daily life behavior. The concept of "*Ikigai*" means living wish and a concept that Japan has actively established in the lifelong learning field. We aimed at becoming a leading case and leading international contributions on aging society.

3. Outline of research (Including study member)

In this study, we recorded and accumulated the daily life behavior of the older people with wearable/mobile devices, visualized the analysis result of the obtained data, deepened "learning" with reflective learning method, and promoted the creation of "*Ikigai*". The research period was 3.5 years from October, 2014 to March, 2018.

Both the core-researcher and other researchers of this study belong to the same organization, and we conducted research by fusion of different fields on a daily basis. This research was carried out while mutual understanding had already been established. The overall research content is as follows. Figure 1 shows the flow of the research method.

(1) We collected literature on the daily life behavior and information related behavior of older people in Japan and overseas, and reviewed them with focus on the characteristics of the behavior of them which is a traditional method of humanities and social sciences system. The following (2) – (5) proceeded the research with a spiral model while collecting feedback including pilot experiments.
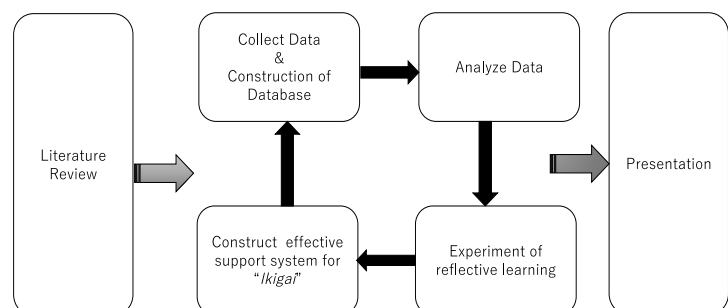

Fig.1 Flow of the study

(2) We collected data on daily life behavior of older people by wearable/mobile devices and constructed a database. Regarding the device, after examinations of multiple device options, we selected the smartphone, based on the affinity of its features such as camera, GPS, and acceleration sensor with the behavioral characteristics of them based on the results of the above (1).

(3) Data analysis of the daily life behavior constructed in the above (2) was conducted. We developed behavioral analysis method based on behavioral science and cognitive science such as behavior trajectory and analysis of speaking contents.

(4) We conducted an experiment of reflective learning for older people. We visualized the results

analyzed in the above (3) and asked participants to review the results. Behavioral changes of experiment participants were analyzed by observation and interview survey. In the field of education, it is pointed out that "reflective learning" is effective for adults, and we clarified this based on scientific data （D.A. Schon, *The reflective practitioner: how professionals think in action*, 1983).

(5) Based on the results of the behavior change obtained in the above (4), we proposed and developed an effective support system for "*Ikigai*" for older people.

(6) We presented our findings in Japan and overseas.

Below are the results of each group.

(1)　Literature Review Regarding Behavior of Older People

We collected literature on the daily life behavior and information behavior of older people in Japan and overseas, and reviewed them with focus on the characteristics of the behavior of them. Concerning whether attributes such as the living environment or physical condition of the older people could generate differences, this study team held discussions in order to extract research topics. Additionally, regarding information-gathering activity, because previous studies had been conducted with libraries as the field, we reviewed literature mostly in the library and information science field.

(2)　Methods for Collecting and Analyzing Data on the Daily Life Behavior of Older People by Wearable/mobile Devices

On the first year of the study, 2014, the life behavior data group considered the method for gathering and analyzing the data regarding the daily life behavior of the older people, using state of the art wearable/mobile devices. First, we examined the Autographer (BRULÉ Inc.), based on the affinity of its features such as camera, GPS, and acceleration sensor with the behavioral characteristics of the older people, and then collected data from 2 subjects as a pilot experiment. Based on the data gathered from the pilot experiment, we discussed among the daily life data collection/analysis group and the reflective learning design group, the challenges in data collection and analysis method.

However, we concluded, on analyzing the daily life behavior data gathered with Autographer, that protection of personal information and copyright were serious issues when it came to image data. Because of this, in 2015, we chose smartphones and activity meters as devices for the experiment, and considered new methods of analysis after having adjusted the data collection method to accommodate the new devices. As the result, we conducted a pilot experiment on 4 older people subjects that aimed to collect lifelog using smartphones, and confirmed the effectiveness of this method. The experiment showed that the lifelog data analysis could describe the diversity of the daily life behavior of older people. In addition, we also considered categories to be visualized for reflective learning, gathering daily life behavior data regarding emotions, and the usage of communication robots for reflective learning.

In 2016, we developed a program for gathering and analyzing lifelogs using smartphones as a wearable/mobile device, and studied the effectiveness of the program as a support system for reflective learning of the older people. The subjects were 10 older people (4 males, 6 females) living in Tsukuba city and its neighboring area, and the duration was 3 months. Over 68 thousand location-based data were

obtained by carrying the smartphones, and although there was difference between individuals, an average of 76 location-based data was obtained per day. We created a personal monthly report based on analysis of these lifelog data, and sent to support reflection by the survey subjects. Regarding the lifelog data, we attempted to support reflection from multiple perspectives by visualizing 10 categories. As the result, we were able to identify the diverse patterns of the older people's daily life behaviors, based on the behavioral patterns of each individual. Additionally, it became clear that the older people in general were highly interested in the accuracy of the data, and that they were especially impressed with visualization using maps. This is likely because although they are familiar with data regarding the number of steps measured by devices such as pedometer, they have little opportunity to witness data in the context of geographical information. Furthermore, based on the above findings, we started development of presentation method of lifelog analysis data using communication robots.

In 2017, we developed an interactive system using communication robots that verbally reported the visualized results of the lifelog data obtained through smartphones to the older subjects, and studied its effectiveness as a service supporting reflection by the older people. As for subjects and duration, in order to make the results comparable to the results from 2016, we studied 10 subjects from the same area for 3 months. Additionally, based on feedback from previous year's subjects, we used smartphones that allowed collection of a more accurate data. We can expect in the future when we make a thorough comparison between the results of 2017 with that of the previous year, we will gain insights on the presentation method (paper-based report/communication robot) of lifelog data aimed at supporting reflection by the older people.

(3)　Development and Experiments on Information Search Program

In the first year, 2014, the group designing the daily life support system created the pilot version of information search program. This program aimed to make the older people more interested in information search and improve their information literacy skills by letting them solve quiz style problems on tablet devices. Additionally, during this year, the group verified the program with 4 persons at the Akita Prefectural Library. Results showed that search activities by the older people tended to be limited both in terms of range and method. Furthermore, it was proven that information search method using devices such as tablets with game like properties was received favorably.

Fig.2 Experiments on information search program

In 2015, the group modified the information search program for older people, based on the results of the pilot experiment conducted the previous year. The group also verified the modified program by running an experiment on 12 subjects at the Hokkaido Sapporo Municipal Central Library. We added the results to that of the previous year, and based on insights regarding the older people's change in behavior, considered the necessary conditions for the support system for creating motivations in life, that is effective in older people.

In year 2016, in addition to the evaluation of the information search program tested on older people in 2014 and 15, we considered the information search method for older people. As a result, it became clear that behaviors of the older people related to information search could be categorized into patterns, based on experience using the library, and the attitude towards search methods. It was also suggested that reflection after information search changes information related behaviors in daily life. Furthermore, with hopes to develop measures for preventing older people from becoming the information illiterate in the highly informational society, the group considered building an effective support system that creates motivations in life for the older people, by suggesting an information search method that takes into account the characteristics of older people. In February, 2018, the group conducted additional experiments of the moderated program on 6 subjects and 6 youth subjects at the Ikoma-Eki-Mae Library in Ikoma city, Nara prefecture. They then added the results with those from previous years and compared the characteristics of information gathering behavior by the older people with those of the youths.

Fig. 3 Communication robots and
older people

In addition, experiment with older people as subjects aimed at exploring the possibility of communication robots as support tools for information search by the older people, showed that older people received the robots favorably as a communication tool, proving their effectiveness as a tool. Five media companies including NHK Mito and Tokyo Shinbun requested interviews regarding this experiment and then aired/published the results, showing the public's strong interest.

Furthermore, the behavior of the older people in selecting informative material was compared with those of college undergraduates, in order to further clarify the characteristic of the older people. Total 18 subjects consisted of 9 people over 65 who were members of senior volunteer program at the University of Tsukuba Library, and 9 undergraduates at University of Tsukuba. We asked the subjects to browse the 2nd floor of the University of Tsukuba Library on Library and Information Science, and to photograph the covers of materials they found interesting. Later, we conducted approximately 30 min. interviews regarding their choice of material. Results showed that while the average number of materials older people photographed while browsing was 23.8, it was 11 for the undergraduates. During the 30-minute browsing time, undergraduates were often spotted taking the material in hand, but then not selecting it. Contrarily, older people did not show such behavior. When asked in the interview after browsing about the reasons for choosing the material, while the undergraduates explained their reasons by making references to the contents of the materials, the older people hardly discussed the contents, but rather talked about their experience. This may be because the older people are reflecting back on their own experience by reading the materials. There is possibility that such behavior characteristic to older people could be applied in recollection methods for preventing dementia.
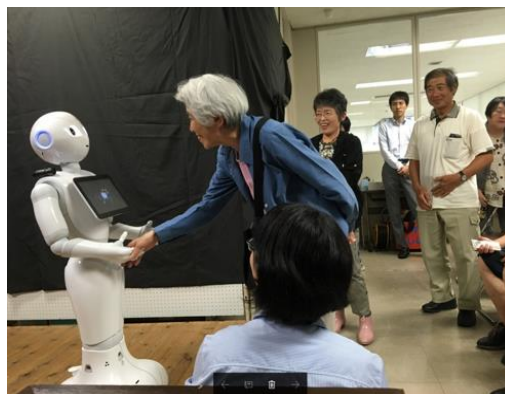
（4）　Development of Reflective Learning Method

This study designed two kinds of system with ways to visualize the analysis results of lifelog data, and considered ways to support the reflective behavior of older people. The first system（2014 to 2015）visualized multimedia information such as photograph or sounds together with the information on the time and location where the data was obtained.

Another system（2016 to 2017）focused on time and location information, and visualized their contents from different perspectives. For this system, the design included addition of explanation that helps understanding of the analysis results. Although both allows reflection on the past daily life behaviors, considering the amount of energy it requires from the older people, we decided to use the system specializing in visualization of information on time and location for the demonstration experiment. Below is part of the daily life behavior report and the time and location information gathered for reflection. The interview categories for reflection were designed based on metacognitive theory, so that the learners would direct their attention to their own daily life behaviors, and then the experiments were conducted.

Fig. 4 Lifelog Report for reflection（Left）

Visualization of daily ilfe behaviour from multiple perspectives（Right）

Fig. 5 Sample record of lifelog data（Coordinates were removed for privacy reason）

This study also developed another method of reflective learning that used "Remembering haiku." Remembering haiku is a haiku composition program that applies the concept of reminiscence, and aims to encourage active reflection by letting the older peoples compose haiku by reminiscing about past events. This method may be effective in preventing dementia and prolonging the health span, being an

activity that includes remembering the past in "reminiscence," the intellectual activity of composing haiku, "commuting" to the library where the event takes place, and interaction with other participants.

In 2016, the program was verified through experiment at the Miyamae Library in Kawasaki city, Kanagawa prefecture with 9 subjects. In this program, subjects were first asked to compose haiku that includes the "seasonal word" appropriate at the time. The haiku was then collected, and prepared so that the authors of each piece was disclosed. The verses were then redistributed among the subjects, and subjects were asked to evaluate the haiku, based on which haiku made them reminisce the most about the past. This was to consider the effectiveness of this method as a reflective learning

Fig. 6 Remembering Haiku

method. These demonstration experiments drew much social attention, and we shared our professional insight to companies such as KANEMATSU CORPORATION.

Table 1 Member list of this study

	Name	Academic Unit & Position	Charge
Core-Researcher	Chieko MIZOUE	Professor Faculty of Library Information & Media Science, University of Tsukuba	Research overview
Group leader	Masaki MATSUBARA	Assistant Professor, Faculty of Library Information & Media Science, University of Tsukuba	Reflective learning design group & Life behavior data group
Co-researcher	Toyoaki WATANUKI	Professor, Faculty of Library Information & Media Science, University of Tsukuba	Reflective learning design group
Group leader	Hideo JOHO	Associate Professor, Faculty of Library Information & Media Science, University of Tsukuba	Life behavior data group
Group leader	Saori DONKAI	Professor, Faculty of Library Information & Media Science, University of Tsukuba	Daily life support system data collection/analysis group
Co-researcher	Norihiko UDA	Associate Professor, Faculty of Library Information & Media Science, University of Tsukuba	Daily life data support system collection/analysis group

4. Research results and outcomes produced

This study found that smartphones were less burdensome for older people and that it was possible to gather data for a long period, and so we could show empirically the feasibility of collecting and

accumulating lifelog data for older people using smartphones. Moreover, by presenting the analysis result of lifelog data in accordance with the context of each older person, it was found that it could be utilized for support of reflective learning. This can be said that our study would be complementary research results with lifelog study which has been developed in computer science fields.

On the other hand, we would like to further advance the research on the function to explain the analysis result to older people in an easy-to-understand way. From the data group with little semantic information which is the common feature of lifelog data, this research suggests that information that serves as a source for older people to find daily motivation and messages that interpret the implications of data analysis results (e.g., action range wider than last week, walked more this month than last month) are essential for older people to take advantage of lifelog data. It was shown from this research that technological development to automatically generate such messages would be increasingly important in the future. This suggests that lifelog research becomes an important application in big data fields such as language generation from numerical data.

In this study, by hosting many workshops and panels, we were able to establish new cooperation with researchers in the field of cognitive science, computer science and information behavior field that conduct qualitative research. By doing this, it is expected that the elderly lifelog research will develop from now on to an interdisciplinary one.

As described in the above outline of research, the results of this study to clarify the information seeking behavior of older people have attracted a lot of attention in public libraries that already provide information searching places. The idea of age-friendly-cities is also advocated by the World Health Organization (WHO), and public libraries are the center of the most important places from the viewpoint of correcting information gaps for older people. The result of this study was able to contribute to providing a new development to the elderly service in public libraries where about 3,300 facilities were established nationwide.

This study also clarified the diversity of older people and we pointed out that the reasons and points where older people were stimulated were diverse. In other words, it was shown that it was indispensable to provide an individualized model for constructing information needs model aiming at building "*Ikigai*" for older people. From now on, we would like to categorize information needs by keyword "personalization".
By utilizing empirical data which is the result of this research, it is provided as evidence at the time of planning the aging measures faced by Japanese municipalities, or at the time of development of new services for older people by enterprises, etc. Kawasaki city of Kanagawa prefecture already practices the method of remembering haiku at the community center etc. and is trying to implement reflective learning of older people. In the TOSHOKAN RYUTSU CENTER, a library support company, one of the project member provided expert knowledge in providing new services utilizing the communication type robot.

In the future, in order to verify the effectiveness of the method proposed and developed by this study, it is necessary to compare not only to older people but also young generation data, to clarify the characteristics of older people. In addition, coexistence with people and their families with dementia becomes increasingly important for development of the age-friendly-cities. By grasping daily life behavior data of people with light dementia, we will clarify the information needs of them, deepen their collaboration with the gerontology field, and also contribute to measures for them.

5 Major Articles

- Visualizing Information Seeking Behaviors of Older Adults at Public Libraries: Reflective Learning and Information Literacy, Saori Donkai, Chieko Mizoue, Norihiko Uda, Hiroki Yamazaki & Ryoko Narita, 2015 A-LIEP Proceedings of the 6th International Conference on Asia-Pacific Library and Information Education and Practice, pp. 380–388. 2015. 11.28.

- Lifelogging by Senior Citizens in a Highly Ageing Society: A Pilot Study. Hideo Joho, Masaki Matsubara, Norihiko Uda, Saori Donkai, Chieko Mizoue. 1st Information Research and Learning with Lifelogging Devices, iConference 2016, pp. 9–12, 2016.3.20.

- Lessons learned from 8 months of lifelogging: Case of 2nd Year Undergraduate Students at the University of Tsukuba, Japan. Natsuki Nagaoka, Yuzuki Furuhashi, Naoko Minei, Hideo Joho. 1st Information Research and Learning with Lifeloggin Devices, iConference 2016, pp. 13–18, 2016.3.20.

- Overview of NTCIR-12 Lifelog Task. Cathal Gurrin, Hideo Joho, Frank Hopfgartner, Liting Zhou, Rami Albatal. NTCIR 2016. pp. 354–360, 2016.6.7.

- NTCIR Lifelog: The First Test Collection for Lifelog Research. Cathal Gurrin, Hideo Joho, Frank Hopfgartner, Liting Zhou, Rami Albatal. SIGIR 2016: pp.705–708, 2016.7.17.

- Humanoid robots and the new library services: Investigation of age differences on affinity toward humanoid robots. Saori Donkai, Chieko Mizoue & Hitomi Nakamura. 2016 A-LIEP Proceedings of the 7th International Conference on Asia-Pacific Library and Information Education and Practice, pp. 366–379, 2016.11.3.

- Development of a new information literacy education: A bibliographic search game. Norihiko Uda. 2016 A-LIEP Proceedings of the 7th International Conference on Asia-Pacific Library and Information Education and Practice, pp. 434–446, 2016.11.3.

- Information Seeking Behaviors of Older Adults in Public Libraries. Norihiko Uda, Chieko Mizoue, Saori Donkai & Saki Ishimura, 2017 A-LIEP Proceedings of the 8th International Conference on Asia-Pacific Library and Information Education and Practice, pp. 395–407. 2017. 11.13.

- Public Library Service for Older Chinese People: The Case of Hangzhou Public Library. Renji Lu, Saori Donkai. 2017 A-LIEP Proceedings of the 8th International Conference on Asia-Pacific Library and Information Education and Practice. pp. 409–419. 2017. 11.13.

- Enabling Research and Innovation Beyond Continental Borders: A Case for Satellite Events in Evaluation Campaigns. Frank Hopfgartner, Cathal Gurrin, Hideo Joho. ERCIM News 2017(108). pp.54–55. ERCIM. 2017. 60p.

- From sensors to sense-making: Opportunities and challenges for information science. Singh, V. K., Shah, C., Gwizdka, J., Joho, H. and Gurrin, C. In S. Erdelez & N.K. Agarwal (Eds.), Proceedings of the Association for Information Science and Technology, pp. 599–602. Hoboken, NJ: Wiley. 2017. 858p.