AN ANALYSIS OF THE ROOM USE OF ELDERLY CHINESE COUPLES LIVING IN URBAN APARTMENTS THROUGH ACTIVE RFID TECHNOLOGY
アクティブRFIDを用いた中国都市部の集合住宅における高齢者夫婦の部屋使用行動の研究

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屈 小羽, 松下 大輔, 吉田 哲

We aimed to clarify, by studying individual cases, the personal room use in the dwelling units of Chinese elderly couples in their daily lives. The room use was identified on the basis of the room in which they stayed the longest (base) and the route between the pair of rooms that they passed through most frequently (main link) by using sensing technology. The findings showed that the couples tended to stay most in the living room and master bedroom and moved between the dining room and kitchen most frequently. The dining and living rooms were used as hubs (rooms that had a main link with most rooms). The studied couples could be divided into two groups on the basis of whether or not they used the shared base (room used as the base by both husband and wife) as the hub. The grouping of room use did not correspond to the dwelling unit type.

Keywords: Elderly Couple, Room use, Duration of stay, Movement frequency, Dwelling unit, Active RFID

1. Introduction

This paper aims to quantitatively identify the personal room use of Chinese elderly couples living in urban apartments in their daily lives between rising in the morning and going to bed at night. We focus on showing the diversity and tendency of room use in several individual cases by continuously recording the duration of each subject’s stay in a particular room and his/her movement frequency between rooms using Active Radio Frequency Identification (Active RFID) technology.

1.1 Background and purpose

In the year 2008, the percentage of the aging among China’s total population was 12%. Unlike in Japan, the aging problem in China is concentrated in the urban areas. With the rapid growth in the aging population, the living status of the urban elderly has increasingly come into the limelight. A recently conducted survey suggests that 90% of the elderly in Beijing and Shanghaim choose to live in regular houses rather than nursing homes. Moreover, it has generally been observed that as compared to the working young, they spend more time at home. Thus, the quality of the houses in which the elderly reside is closely related to their quality of life. At the same time, an increasing percentage of China’s urban elderly population lives independently. In Beijing, such families numbered 504 thousand in 2005—33.3% of all families comprising elderly people. Additionally, a family unit comprising a couple and one child has been considered the standard type after 1979, which was when the one-child policy was enacted. The time frame of the child being old enough to start living independently coincides with the couple’s initiation into the elderly age group. Thus, left to their own devices, safe, comfortable, and convenient houses have become a bigger priority for the elderly. In cognizance of this burgeoning societal section, some new dwelling units have been designed to cater to the needs of the elderly. Major attention has been paid to the construction of barrier-free and safe facilities in functional rooms (such as the toilet), but there are few studies focusing on the layout of rooms based on measuring their actual room use.

Therefore, we precisely measured the room use of six ordinary elderly couples living in two typical dwelling unit types in the urban apartment complexes of North China. We chose two typical types of dwelling units because we were interested in ascertaining whether
any relationship existed between the room layout and room-use pattern observed in multiple cases. In order to study the factor of room use, we focused on the duration of the couples’ stay in certain rooms and their movement frequency between rooms for purposes other than performing specific daily routine activities. Every couple was studied individually. A resident’s room use is said to be concentrated in a certain room if he/she stays in the room for long durations, and from the same point of view, the fact that a resident moves frequently between two rooms shows the presence of a strong link between the rooms. Therefore, we attempted to clarify the characteristics of room use by identifying the following: (i) the room wherein the couples stayed for the longest duration (base), and (ii) the route between the pair of rooms that they passed through most frequently (main link) by continuously recording the elderly couples’ daily lives through Active RFID technology. Then, on the basis of the base and main link findings, we interviewed the subjects to identify their specific needs regarding room layout.

1.2 Previous studies

In previous studies on room use, the elderly were found to concentrate on using certain room(s) or spaces in a house. Kataoka et al. (1994)\(^9\) used questionnaires and interviews to verify whether elderly family members were aware of which rooms they used most, and it was found that the room use of the elderly living in rural areas was concentrated in the living room, while that of those living in urban areas was concentrated in the bedroom. Cao et al. (1996)\(^6\) interviewed 24 families comprising elderly members in Tianjin and found that they usually stayed in their own bedrooms. Lin et al. (2006)\(^5\) found that the Chinese elderly couples in Dalian and Harbin tended to use the same room during the day when they slept in the same room, and separate rooms when they slept separately. The spatial conditions of the room/space that the elderly usually use have also been clarified through several studies. Masunaga et al. (2002)\(^10\) found that single elderly people tended to use the room with the best physical conditions in terms of size, light, and storage space. Koga and Takahashi (1997)\(^7\) interviewed single elderly people living alone and found that they paid attention to the connection between external space and the living space they usually occupied. Sawada (2001)\(^8\) found that the elderly tended to eat and relax in a south-facing living room and slept separately in Japanese style rooms. Nakazono et al. (2006)\(^9\) found that in dwelling units with two rooms, the elderly tended to install tall furniture—such as wardrobes—in the smaller room, and used the larger room for main living activities—such as dining and relaxing. However, in the studies based on self-reported data, the variation in the room(s) that the elderly concentrate upon using and the duration of such use over a day has not been precisely measured. Additionally, their movements between rooms have not been measured, and therefore, the connection between the rooms being used has not been clarified.

We need an appropriate method for measurement. A common method for quantitatively measuring living space use is the time allocation survey of living activities, in which participants record their room-use schedules over one or two days. Such records comprise the factors of time, room, and activity. However, Sawachi and Matsuo (1989)\(^10\), who used this method, pointed out that it suffers from one limitation: the difficulty of proving the conformity between the obtained data and the actual situation. The development of sensing technology shows potential for the objective observation of living behaviors. There have been studies on outdoor trajectories in living quarters using GPS\(^11\), activity recognition in the house by state-change sensors\(^12\)\(^\text{–}\)\(^15\)\(^10\), walking track by slipper-type RFID\(^10\), and proving the availability of Active RFID\(^17\). However, we are unaware of research focusing on the tendency and diversity of multiple residents’ room use in home environments.

Unlike studies that aim to clarify the general room use of a certain group of people by surveying large samples, this study focuses on a deeper understanding of the specific room use of six individuals. Although this is a small sample, the stay and movement of each subject through all the rooms was recorded precisely and continuously on a per-minute basis for three to four days without overly burdening the subjects. Such an in-depth analysis is hardly possible through questionnaire surveys and interviews of large study samples. While a small sample is admittedly a limitation, the strength of this study lies in its precision. As the first Active RFID survey on Chinese dwelling units, although the findings in this study cannot be interpreted as the general room use of most Chinese elderly couples, they do reflect specific characteristics of room use that existed in some cases, thus making them concrete realities that we should not ignore\(^\text{*}\)\(^6\). Additionally, unlike studies attempting a qualitative analysis of the subjects’ living activities, we attempted to quantitatively measure the duration of the subjects’ stay in each room and their frequency of movement between rooms. The collective periods of remaining stationary in rooms as well as movement caused by daily living activities (relaxing, cooking, receiving guests, and so on) during the survey period were recorded through Active RFID technology, and this data was regarded as the total room use. The purposes behind the periods of staying still or movement were not taken into account during this stage: these were broadly ascertained during subsequent interviews with the subjects that were based on the findings of the conducted Active RFID tracking.

2. Method of data collection

2.1. The sensing device

Our Active RFID system comprised Active RFID tags (Tags), Active RFID readers (Readers), wireless ethernet converters
(Converters), and a PC (platform). The tag sent a signal with a unique ID on a per-second basis. Each reader was assigned a Static IP and installed in each room of the dwelling unit. The converter connected the PC and readers though a wireless LAN. The PC recorded the IP of the reader that had received signals from the tag, providing continuous data on when and in which room the subject was present. In order to fill in the missing values in the Active RFID data, we also used an acceleration sensor that helped us judge whether the subject had moved. Fig. 1 shows the configuration of the device.

### 2.2. The subjects and period of investigation

The investigation was conducted in Tangshan\(^{40}\) and Beijing, two large cities in North China. For our study, we chose dwelling units from the two dwelling unit types that are typically found in the apartment house complexes in North China: (i) the one with a small entrance hall (case A–C), and (ii) the one comprising a combined entrance hall and dining room (case D–F). The subjects of our study were six average, healthy elderly couples, all above 60 years and residing in the dwelling unit types described above (Fig. 2).

Each surveyed room was named on the basis of the subjects’ description of its main function. The subjects received visitors and watched TV in the living room. The dining room was where they had dinner daily, either by themselves or with guests. In the case of most of the couples living in two-bedroom apartments, the couple slept in the master bedroom at night, while the secondary bedroom was used as a guest room. Couple C, however, slept in separate bedrooms. We called the larger room—where the husband slept—the master bedroom, and the smaller one—where the wife slept—the secondary bedroom. The room having a bookshelf or PC, where the residents might read, nap, or carry out other activities, was designated as the studio. The toilet was the room comprising a close stool, washbasin, and shower nozzle. Some apartments were also equipped with a washer inside the toilet, thus turning it into a room for carrying out housework. The balcony was considered a part of the adjacent room through which it could be accessed\(^{40}\).

### 2.3. Investigation flow

Firstly, the aforementioned readers were installed in every room. The investigators wore the tags, moved among the rooms, and adjusted the parameters of the devices to ensure that the devices were correctly recording the movement and location of the tags. Then, the investigators instructed the residents on when and how to wear the tags and acceleration sensors. The investigation started after the investigators had left. The residents wore the tags and acceleration sensors between rising and going to bed when staying inside the house. They also recorded when and why they took the device off.
(going out, having a shower, and so on) on a paper sheet. The investigation lasted three to four days and ended with the investigators’ retrieval of the devices. Thereafter, we conducted a short interview with the subjects on the basis of the Active RFID data.

2.4. Time series data

After correcting the Active RFID data\(^\text{\textcircled{a}}\), we obtained a time series database. It showed the subject’s movements and the time, duration, and room in which each subject stayed during the investigation period (Table 1, Fig. 3 illustrates a sample of time series data). In this study, the “staying duration” in a certain room was measured by the total number of minutes from the resident’s entry into the room until his/her entry into another. “Movement” denotes a change of room. All the subjects took only a few seconds to move from one room to another, and so this duration was not counted\(^\text{\textcircled{b}}\).

Additionally, residents who had set a routine for their daily lives tended to arrange their living activities by time, which could have caused a variation in the room use recorded for each period of a day. In order to show this variation, each day was divided into morning (time of waking until 12:00), afternoon (from 12:00 till 19:00), and evening (from 19:00 till bed time).

### Table 1 Time series database

<table>
<thead>
<tr>
<th>Serial number (i)</th>
<th>Date &amp; Time to start staying (t(_i))</th>
<th>Period</th>
<th>Gender</th>
<th>Couple</th>
<th>Room to stay</th>
<th>Staying duration [min] (t(_{i-1}, t_i))</th>
<th>Rooms that the subject moved within (In no particular order)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>2009/7/22 7:46</td>
<td>Morning</td>
<td>man</td>
<td>F</td>
<td>Master bedroom</td>
<td>1</td>
<td>Toilet &amp; Master bedroom</td>
</tr>
<tr>
<td>13</td>
<td>2009/7/22 7:47</td>
<td>Morning</td>
<td>man</td>
<td>F</td>
<td>Living room</td>
<td>43</td>
<td>Master bedroom &amp; Living room</td>
</tr>
<tr>
<td>14</td>
<td>2009/7/22 8:30</td>
<td>Morning</td>
<td>man</td>
<td>F</td>
<td>Master bedroom</td>
<td>2</td>
<td>Master bedroom &amp; Living room</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

![Fig. 3 Time series graph, which shows when and in which room each of the subjects of couple F was staying on July 22nd.](image)

#### 3. Obtaining of base and main link for each subject in each period

The proportion of the total staying duration (\(P_T\)) in each room and movement frequency between every pair of rooms (\(P_M\)) for a given subject in a given period was calculated as below:

\[
P_T = \frac{T_i}{\sum T_i} \times 100 \qquad (1)
\]

\[
P_M = \frac{M_{ij}}{\sum M_{ij}} \times 100 \qquad (2)
\]

\(T_i\): Total staying duration of a given person in a given room (\(i\)) in a given period in the whole investigation period (3–4 days)

\(R\): Total number of rooms in a given dwelling unit

\(M_{ij}\): Total movement frequency between given pair of rooms (\(j\)) for a given subject in a given period in the whole investigation period (3–4 days)

Although we could have just appointed the room/link with the highest \(P_T/P_M\) as the base/main link in the period, there were also some cases where the second highest \(P_T/P_M\) was very close to the highest one. Thus, we set several intervals according to the relative ratio for a given number of factors, and appointed all the room/link(s) with \(P_T/P_M\) in the highest interval as the base/main link. For example, if a house had \(n\) rooms, when the proportion of the staying duration was 100/n in each room, it meant that the resident spent the same amount of time in each room. When the staying duration in one room was more than 100/n, it meant that the resident spent more time in this room than in at least one other room. In this way, the proportion (%) was divided into \(n\) intervals as below:

1. \(0, 100/n]\): Resident spent relatively little time in this room.
2. \((100/n, 100/n - 1]\): resident spent more time in this room than in at least one other room.
3. \(100/2, 100\]$: resident spent the most time in this room.

In the same way, we defined the link(s) with the highest level of \(P_M\) as the main link(s). For example, take a dwelling unit with seven rooms. As there are 21 possible links between every pair of rooms, if a \(P_M\) is in the interval of \((33.3, 50.0]\), it means that this link is stronger than at least 19 other links. Tables 2 and 3 show a
Given subject in a given period was calculated as below:

In this way, the proportion (%) was divided into \(n\) intervals. Staying duration was \(100/n\) in each room, it meant that the proportion of the example, if a house had \(n\) rooms, when the proportion of the duration, and room in which each subject stayed during the investigation period (Table 1, Fig. 3 illustrates a sample of time series from one room to another, and so this duration was not counted.

Additionally, residents who had set a routine for their daily lives tended to arrange their living activities by time, which could have retrieved of the devices. Thereafter, we conducted a short interview with the subjects on the basis of the Active RFID data. (going out, having a shower, and so on) on a paper sheet. The investigation lasted three to four days and ended with the investigators' retrieval of the devices. Thereafter, we conducted a short interview with the subjects on the basis of the Active RFID data.

Table 2

<table>
<thead>
<tr>
<th></th>
<th>Living room</th>
<th>Dining room</th>
<th>Master bedroom</th>
<th>Secondary bedroom</th>
<th>Studio</th>
<th>Kitchen</th>
<th>Toilet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Afternoon</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evening</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>Morning</td>
<td></td>
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<tr>
<td>Afternoon</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evening</td>
<td></td>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>

Fig. 4 Pattern of the bases and main links of each subject in each period

4. Discussion

4.1. Tendency of the base and main links for all the subjects

We overlapped the pattern formed by the base and main links of each subject in each period to identify the general tendency of room use of all the subjects in the entire day. (Fig. 5 shows an example of the overlapping process.) We counted the number of instances of one room being used as the base \(S_b\) and the number of main links between a given pair of rooms \(N_{ml}\) to show the room/route that subjects used the most. We also counted the total number of main links that one room had \(S_{ml}\) to show how frequently this room was linked with others and counted the number of rooms \(N_r\) that this room had a main link with (shortened as “linked with” henceforth) to show the range of rooms it was linked with. The room that was linked with the most rooms (highest \(N_r\)) was regarded as the hub.

In the morning, the subjects tended to use the living room and master bedroom as the base, and thereafter, moved frequently between the dining room and kitchen and between the dining room and master bedroom. The dining room was used as the hub (Fig. 6-1). In the afternoon, the dining room, master bedroom, living room, and studio were used as the base. The maximum number of main links was concentrated between the dining room and kitchen. The dining room was still the hub, but the living room tended to be linked with more rooms and linked with these rooms more frequently in the afternoon than in the morning. Either the master bedroom, kitchen, or studio was linked with both the dining and living rooms, and the kitchen was linked with these two rooms more frequently than the bedroom and studio (Fig. 6-2). In the evening, the subjects tended to use the living room as both the base and hub. They tended to move frequently between the living room and kitchen and between the living and dining rooms (Fig. 6-3).

In the whole day, both the husband and wife tended to use the living room and master bedroom as the base. The wife also used the kitchen as the base, but the husband did not. Both of them tended to move frequently between the dining room and kitchen and between the dining room and master bedroom: however, the dining room was also frequently linked with the living room for the husband, while for the wife, it was linked frequently with the toilet. The wife also tended to move more between the living room and kitchen. As compared with the husband, the kitchen was linked with more rooms and more frequently to these rooms in the wife’s room use (Fig. 6-4 and Fig. 6-5).
The use of the living room and master bedroom as the base during the day was found to be highest, followed by the dining room. Among the various rooms, the room used as the hub by the couple showed the characteristics of their movement. According to the general assumption, the shared base is characterized by a good orientation and an appropriate size, whereas the hub is located at the center of the house, from where the residents can conveniently access other rooms. A particular couple's use or non-use of the shared base as the hub (Fig. 6).

4.2 Grouping of the room-use patterns of the subjects

The room use of a studied couple comprises the room use of both the husband and wife. In order to show the characteristics of each couple's room use, we overlapped the pattern in this regard of the two persons making a couple during the survey period and obtained the room-use patterns for the room used as the base by both husband and wife (shared base), the room used as the base by either of the two (personal base), and the main links between the rooms. The shared base showed the characteristic pattern of the couple's stay in the various rooms, and the room used as the hub by the couple showed the characteristics of their movement. According to the general assumption, the shared base is characterized by a good orientation and an appropriate size, whereas the hub is located at the center of the house, from where the residents can conveniently access other rooms. A particular couple's use or non-use of the shared base as the hub could be taken to reflect different needs in connection with the room layout. In order to show this diversity in room use, we grouped the subjects on the basis of whether they used the shared base as the hub.

One group of subjects (Couples A, B, E, and F) used the shared base as the hub. Couple A used the dining and living rooms as the joint shared base and hub and tended to move most frequently between the two. Both rooms were linked with the studio and the kitchen and toilet, respectively. Couple E used the master bedroom as the hub and moved frequently between it and the kitchen, toilet, and dining room. Couple F used the living room as the hub, and moved frequently between it and the kitchen, toilet, and master bedroom.
bedroom. Couple B used both the dining and living rooms as the shared base, and the dining room as the hub. In this group, the shared base appeared to have a close relationship with the other rooms in the whole room-use pattern. The other group did not use the shared base as the hub. Both Couples C and D used the living room as the shared base but the kitchen as the hub. As for Couple C, their shared base was only linked with one other room. In this group, the link between the shared base and the other rooms was weak.

In addition, the couples living in the same dwelling unit type ( Couples A, B, and C, whose dwelling units were all of type (i)) sometimes displayed different patterns of room use. Conversely, the room-use patterns of subjects living in different dwelling unit types was at times found to be similar ( Couples A, B, E, and F, whose dwelling units were of types (i) and (ii), respectively). The grouping of room-use patterns did not correspond to the dwelling unit type (Fig. 7).

**4.3. Specific needs of the subjects with regard to room layout**

We interviewed the subjects to ascertain the reasons behind some typical room-use findings. As per our assumptions, the subjects should have always chosen a south-facing room as the base, but actually, some of them also happened to choose the dining room—a windowless room—as the base. In the interview, Couples A and B and the wife in Couple D, all of whom used the dining room as the base, said that they preferred to stay there, as this room remained cool even in the summer (they did not like to use an airconditioner), but they were not satisfied with the room, as it was a little dark during the day. This finding suggests that subjects who hardly use airconditioners in summer may need a base room that, though not necessarily facing south, should get a regular supply of natural light.

We also interviewed Couples A, B, C, D, and E about why they moved frequently between the dining room and kitchen, to which they replied that this was because their kitchen was too small to enable two persons to prepare dinner together, thus forcing one person to work in the dining room. This resulted in their having to shuffle frequently between the two rooms. This finding suggests that for couples who jointly prepared dinner, enlarging the size of their kitchen would prove convenient.

**5. Conclusion**

The findings of the study based on the room-use patterns of the studied elderly couples are as follows:

1) Throughout the day, all the subjects chose the living room as the base most frequently and one bedroom second most frequently. The dining and living rooms were frequently linked with each other and were both used as the hub. The kitchen was frequently linked with both hubs, especially to the dining room. The dining room was also frequently linked with the master bedroom. In the morning, the subjects tended to stay in the living room and master bedroom, and used the dining room as a hub. In the afternoon, the dining room was still the hub, but the living room was also linked with most of the rooms. In the evening, the subjects tended to stay in the living room and use it as a hub. As compared with the husband, the kitchen was linked with more rooms and more frequently to the master bedroom and living room in the case of the wife's room use.

2) The studied elderly couples could be divided into two groups by their room-use patterns, the first being the one that used the shared base as the hub and the other that did not. Couples living in the same dwelling unit type did not necessarily display the same pattern of room use. Conversely, the room-use pattern was at times found to be similar in subjects who lived in different dwelling unit types. The grouping of room-use patterns did not correspond to the dwelling unit type.

Through interviews based on findings related to room-use pattern, we also found that subjects who hardly used air conditioners in summer might need a base room that while not necessarily facing south, was ensured a good supply of natural light. The couples who prepared dinner together might need a larger kitchen. Through our precisely conducted survey on individual cases, we showed several specific characteristics of the room use of Chinese elderly couples during a specific period; thus, our findings with regard to the room layout needs of such couples also had a limitation. The accumulation of the room-use data of a sizeable number of subjects through a precise survey, such as the one featured in this study, is a significant step toward identifying the general room use of Chinese elderly couples through future studies.

**Acknowledgements**

We appreciate the cooperation of the six subject couples and the valuable help of Zhang Xinnan, Xu Weimin, and Zhang Ying. This work is supported by KAKENHI (19686036).

**Notes**

*1) Although accommodating guests forms a likely part of the life of the elderly who live by themselves, in this study, we chose to focus on the normal daily lives of the elderly between rising in the morning and going to bed at night without having guests over.

*2) The government of China defines citizens over 60 as the aged according to the Law of the People's Republic of China on Protection of the Rights and Interests of the Elderly: Article 2: The aged mentioned in this Law refer to citizens over 60.

*3) Homepage of China Population Information and Research Center: http://www.cpirc.org.cn
In our opinion, the study that focused on the specific room use of individual cases is also meaningful, because the general knowledge on room use is the accumulation of particular cases, and the detailed understanding of a particular case is a small but important part of this general knowledge.

Tangshan is an industrial city in Hebei province, located southeast of Beijing. The area is 13,472 km² and the population is 7.35 million (as of 2009.6).

The balcony was not regarded as an important space in which the subjects lingered for long, because it faced south and was enclosed by glass, thus making it hot in the summer and seldom used by the residents unless they were airing clothes or watering plants. Moreover, an Active RFID reader needs to connect to the power supply, but the studied balconies did not have any. Considering the feasibility of the survey, we had to give up installing Active RFID readers in the balconies. Therefore, in this study, the balcony is considered a part of the adjacent room from which it can be accessed.

Depending on the specific location of the resident, the reader in the adjacent room might receive signals sporadically, which we regarded as noise. For noise reduction, RFID data was filtered every minute. The number of signals received by each reader in a minute was counted, and the room in which the reader received the most signals in a minute was specified as the resident's "staying room" for that minute (Fig. 8). Then, we needed to fill in the missing values in the data. Though the tag sent a signal every second, the reader sometimes failed to receive the signal when the tag remained stable. Therefore, we needed to judge whether this was because the resident was simply in a stable position but wearing the tags, or had taken them off and forgotten to record his/her reason for doing so. Based on the acceleration data, when the sensor judged that "there is no movement" and "keep flat" successively, the subject was judged as having taken the device off and gone outside, and the missing values were completed by entering "Outside" in the relevant fields, and the other cases were completed in the context of the staying room (Fig. 9).

Since the balcony was considered a part of the adjacent room, the movement from a certain room to the balcony was taken as a movement between rooms, and the duration was not counted.

### References

7. Koga Toshie and Takahashi Takashi: A Discussion on “Jouza” in House of the Single Elderly: A Study on Appropriation of Places in the House for the Staying room (Fig. 9).
8. Since the balcony was considered a part of the adjacent room, the movement from a certain room to the balcony was taken as a movement between rooms, and the duration was not counted.

<table>
<thead>
<tr>
<th>Date and time</th>
<th>Staying room</th>
<th>Status of acceleration</th>
<th>Counts of received signals in each room</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009/6/26 11:20</td>
<td>Living room</td>
<td>Yes</td>
<td>45</td>
</tr>
<tr>
<td>2009/6/26 11:21</td>
<td>Living room</td>
<td>Yes</td>
<td>60</td>
</tr>
<tr>
<td>2009/6/26 11:22</td>
<td>Living room</td>
<td>No</td>
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<tr>
<td>2009/6/26 11:23</td>
<td>Living room</td>
<td>Yes</td>
<td>60</td>
</tr>
<tr>
<td>2009/6/26 11:24</td>
<td>Outside</td>
<td>Yes</td>
<td>60</td>
</tr>
<tr>
<td>2009/6/26 11:25</td>
<td>Outside</td>
<td>No</td>
<td>60</td>
</tr>
<tr>
<td>2009/6/26 11:26</td>
<td>Outside</td>
<td>Yes</td>
<td>60</td>
</tr>
<tr>
<td>2009/6/26 11:27</td>
<td>Outside</td>
<td>No</td>
<td>60</td>
</tr>
<tr>
<td>2009/6/26 11:28</td>
<td>Outside</td>
<td>Yes</td>
<td>60</td>
</tr>
</tbody>
</table>

The empty cells above are missing values.

### Table 8. Example of correction of data

<table>
<thead>
<tr>
<th>Time</th>
<th>Living room</th>
<th>Kitchen</th>
<th>Dining room</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:29:00</td>
<td>1</td>
<td>3</td>
<td>60</td>
</tr>
<tr>
<td>8:29:00</td>
<td>45</td>
<td>2</td>
<td>13</td>
</tr>
</tbody>
</table>

Fig. 8. Example of correction of data

Fig. 9. Complete the missing values
和文要約

本論では、高齢の中国人夫婦世帯の集合住宅の住戸内での起床から就寝までの主な室利用の型を明らかにした。アクティブ RFID を利用して、いつ、どの部屋に被験者が滞在しているかを連続的に記録したデータを分析することによって、朝、昼、晩の各々で最長の時間滞在する部屋をベース、最も頻繁に往来自のある部屋の組をメインリングとして被験者夫婦のベースとメインリングを特定した。また、この指標をもとに室利用の型を明らかにした。この型に基づく知見は以下に示す通りである。

1) 全ての被験者にとって終日、居間が最もしばしばベースに選ばれる。次に主寝室がベースに選ばれる。食事室と居間の間はしばしば往来され、この２室は共に、往来のある室の総数が多いベースとして使用される。台所はこの２室との往来がしばしばあり、とくに食事室との往来が多い。食事室は、主寝室との往来も同じく多い。朝、被験者は居間と主寝室に滞在する傾向があり、食事室をハブとして使う。午後に、食事室はややリハブとして使用されるが、居間も同じく多くの部屋との間で往来がある。晩には、被験者は居間に滞在する傾向があり、居間をハブとして使用している。主に比べると、主婦の室使用では、台所が他の多くの部屋との間、中でも、主寝室と居間との間で、より往来が多い。

2) 夫婦の主な室利用は、夫婦共用のベースの住戸内での位置によって２つの型、つまり夫婦で共有のベースとしている室がハブになる場合とハブにならない場合に分けられた。後者では夫婦で共有のベースはリビングとなり、ハブが台所になっていた。

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