

# 5. Field Study

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## 5.1. Introduction

In recent years, communication networks and computer technologies have made it possible to create various types of network services on the Internet, e.g. e-mail, streaming video, chat services, BBS services, the WWW, and MUSVEs. However, network services still have a relatively short history, especially the network services over the Internet. Most research in this area during this short history has focused on the underlying systems (such as network protocols, system architectures, payment systems, user interfaces, and security systems) to realize the service.

The network service itself being realized using the technologies however has not fully been studied, especially in research on MUSVEs. In particular, a lot more studies need to be done from the viewpoint of the virtual environments, which MUSVEs can realize, enabling social interaction in network services. For example, what happens in a virtual society, how people act and organize social activities in the environment, or what encourages people to access there. These research are important to realize network services enabling social interaction like PAW<sup>2</sup> and also realize a “better” virtual society. We also believe that this area of research will become more important as the Internet becomes more widely used and accepted. We focus on this area and investigate several user-oriented aspects of network services by using PAW<sup>2</sup> in this chapter and the following chapters.

In this chapter, we investigate user activities taking place in the PAW<sup>2</sup> world based upon usage information to clarify what happens there. As described in the previous chapter, PAW<sup>2</sup> is a 3D virtual society and improved upon past virtual spaces by providing autonomous personal agents within a social and environmental infrastructure. Therefore, it can create a 3D place where many people can stay and support broader user activities with increased flexibility compared to other network services. In the environment, user activities consist of not only communication

based upon natural language but also activities including interaction with a personal agent or participating in events. In addition, the social infrastructures provided by PAW^2 help users to organize various social activities among them. These activities are also carried out in context with other people in the environment. We consider that these activities play an important role in user's access to PAW^2.

This chapter consists of two parts. The first part focuses on the statistical analysis of user activities and the second part focuses on the analysis of social activities based upon observations.

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## 5.2. Analysis of User Activities

User activities in PAW^2 are classified into four types: personal agent-related activities, communication-related activities, events and games-related activities, and item-related activities. We modified PAW^2 to monitor these activities for about one month and stored their usage information into a database. Based upon this information, we performed statistical analysis to clarify the basic characteristics of user's activities, user structure, activity-based usage patterns, and which elements or activities play an important role in encouraging users to access PAW^2 repeatedly.

### 5.2.1 Methodology

In this section, we describe the target activities categorized into the four categories, investigation periods, target users, and the implementation about monitoring the activities.

#### Target activities

Similar to other network services, each user uses a PC to access PAW^2, navigates around the world for a while, and carries out some activities in context with other people. It means that user activities consist of user's access behavior to PAW^2 and user activities taking place within PAW^2. We have gathered usage information about twenty-seven user activities in total.

In terms of user activities to access PAW^2, we counted how many times each user accessed PAW^2 during the investigation period. In terms of user activities taking place within PAW^2, we counted how many times each user carried out each activity during the investigation period. The latter are grouped into four categories: personal agent-related activities (nine activities), communication-related activities (four activities), events and games-related activities (ten activities), and item-related activities (three activities). These categories cover most of the main user activities

available to users in PAW^2. As an example for communication-related activities, we counted how many messages each user sent to other users, since communication in PAW^2 is carried out using text messaging. In the following section, we describe each activity and the method to gather its usage information.

## (1) Personal agent-related activities

The PAW^2 system allows users to interact with their personal agent in several ways. We grouped the following nine types of user activities as personal agent-related activities.

- **Greeting:** is used to offer a greeting, such as “Hello” or “Goodbye” to a personal agent. PAW^2 provides predefined greeting messages to allow users to communicate with their personal agent. The personal agent reacts to a greeting with predefined speeches and behaviors, such as “Hello” and wagging her tail. We counted how many times each user said (entered) the greeting messages.
- **Instruction:** is giving an instruction to a personal agent to carry out a specific task. PAW^2 system provides predefined instructions (See also Section 4.3.3). We counted how many times each user gave the predefined instructions.
- **Question:** is asking a question to a personal agent. PAW^2 accepts predefined questions. For example, “Weight?” is a question to ask the weight of a personal agent. The personal agent will respond accordingly, such as “I am 10 kg.” We counted how many times each user asked the questions.
- **Name calling:** is calling out the name of a personal agent. A user can name her personal agent at registration time to PAW^2. When a personal agent is called by name by her owner, the agent will respond with a speech and gesture of delight. We counted how many times each user called the name of her personal agent.
- **Rescuing:** is giving medicine to help sick personal agents. A user can obtain medicine free of charge from hospitals within PAW^2. A personal agent can fall sick by eating a bad food in PAW^2 while her owner is absent from the world. Also, a user can give medicine to heal another user’s sick personal agent. In this case, the personal agent sends a thank you mail to the user who rescued her (see Section 4.3.5) and notifies that to her owner in mail. We counted how many times each user helped personal agents.
- **Quiz:** is participating in a quiz with a personal agent. PAW^2 allows a user to play a quiz anytime with her personal agent by entering “Let’s

play a quiz game!” Then the personal agent gives a quiz to her owner and the owner responds. Then the personal agent checks the answer, and if the answer is correct, the personal agent will give another question until her owner fails to answer. At the end of the game, the personal agent will say “Thank you!” and show the score of the game. Four kinds of quiz games are provided, such as a Japanese idiom quiz and an English word quiz<sup>1</sup>. We counted how many times each user played this game.

- **Shiritori game:** is playing a Japanese “Shiritori” word chain game with a personal agent. PAW<sup>2</sup> allows a user to play the game anytime with her personal agent by entering “Let’s play Shiritori game!” At the start of the game, the personal agent says the word category and then the first word. Then, the user needs to reply with the word related to the category that begins with the last character of the word provided by the agent (see Figure 4.4). Four word categories are provided, i.e. food, child, flower and place names. We counted how many times each user played this game.
- **Feeding:** is feeding a personal agent. A user can give a food to her personal agent anytime by interacting with a control panel (see Figure 4.1). We counted how many times each user gave food.
- **Gesture:** is giving an instruction (“gesture” command) to a personal agent to one of perform predefined behaviors, such as wagging her tail or dancing. These behaviors are usually automatically performed according to the internal state of a personal agent. When user gives the command, the personal agent will select one of the behaviors and then carry out it. We counted how many times each user executed the command.

## (2) Communication-related activities

Besides communication by chatting, the PAW<sup>2</sup> social infrastructure allows users to communicate with others in several ways. We summarized the following four types of activities as communication-related activities.

- **Chatting:** is a basic communication activity to chat with other on-line users. PAW<sup>2</sup> allows users to broadcast a text message to surrounding users by entering text and a carriage-return. When a user pressed carriage-return, the entered text will be shown as one chat message and shared among surrounding users. We counted how many messages each user sent.

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<sup>1</sup> “四字熟語クイズ” and “英単語クイズ” in Japanese.



- **In-world mail:** is using an in-world mailer to exchange in-world mails to other users. See Section 4.4.1 for details. We counted how many in-world mails each user sent.
- **In-world pager:** is using an in-world pager to page other on-line users. See Section 4.4.1 for details. We counted how many pager messages each user sent.
- **In-world BBS (Bulletin board system):** is corresponding to others using an in-world bulletin board. See Section 4.4.1 for details. We counted how many articles each user read or wrote.

### (3) Events and games-related activities

As described in Section 4.5, we hosted several events and mini-games in PAW^2 to avoid users becoming disinterested. We gathered the following ten types of activities as events and games-related activities. There are two types of events and games: seasonal types and always-available ones.

- **“Search for a cat!” game:** is playing a “hide-and-seek” game. When a user clicks a special cat in PAW^2, the cat runs away to a random location in PAW^2. To win the game, the user must walk around PAW^2 and find the cat and click it within a certain time. A user can participate in the event by clicking a special signboard located in PAW^2. We counted how many times each user participated in this event.
- **“Buru-Piko” game:** is playing a Japanese “Buru-Piko” game by using a game machine located in PAW^2. “Buru-Piko” is a single-user mole attack arcade game. The player competes for how many times a randomly-moving “Buru” (mole) can be hit during a preset time. A user can play the game anytime by clicking the “start” button on the machine. We counted how many times each user played this game.
- **“Daruma stacking” event:** is participating in an item (“Daruma” tumblers) stacking event with other users. To play the “Daruma stacking” game, teams consisting of three players compete to stack three “Daruma” tumblers vertically in the fastest time. A user can start the game by placing a “Daruma” item or can join the game by clicking on the “Daruma” item placed by other user. The results ranking of every event was announced on PAW^2’s home page. We counted how many times each user participated in this event.
- **Fortune teller:** is getting a fortune from an in-world oracle. A user can consult an oracle by clicking a fortune teller box located at each shop in PAW^2. When a user clicks the box, it will display an oracle in a pop-up window. We counted how many times each user consulted an oracle.

- **Beckoning cat:** is interacting with a 3D cat. When a user clicks a cat with a beckoning paw in PAW^2, it will walk away from the user and say “Follow me!” The user has to follow the cat to obtain a special item (called “Mahou-no-Ranpu”). We counted how many times each user participated in this event.
- **Spring event:** is planting a flower seed in PAW^2 during the spring season. See Section 4.5 for details about this event. We counted how many seeds each user planted.
- **Summer event:** is participating in the PAW^2’s summer event. See Section 4.5 for details about this event. We counted how many times each user participated in this event.
- **Autumn event:** is gathering maple leaves in the PAW^2’s autumn event. See Section 4.5 for details about this event. We counted how many leaves each user collected.
- **Winter event:** is participating in the PAW^2’s winter event. See Section 4.5 for details about this event. We counted how many times each user participated in this event.
- **Changing avatar color:** is changing the user’s avatar head, body or feet color. We counted how many times each user changed the color of her avatar.

#### (4) Item-related activities

As described in Section 4.4.1, an item is a fundamental element in PAW^2. We summarized the following three types of activities as item-related activities.

- **Obtaining items:** is simply picking up items in PAW^2. A user can pick up only one item at one time. We counted how many items each user picked up.
- **Recycling:** is recycling an item into virtual money. A user puts an item into a recycling box in PAW^2 to convert the item into virtual money. A user can recycle one item at one time. We counted how many items each user recycled.
- **Shopping:** is purchasing items at shops in PAW^2. Virtual money is required to purchase an item. A user can purchase only one item at one time. We counted how many items each user purchased.

## Investigation periods and target users

Our investigation was carried out for about one month from September 5 1999 to October 3 1999. One month is equivalent to one year in PAW^2 (see Section 4.4.2) and during the investigation period all four seasons and all events previously described were available to all PAW^2 users.

Target users (sample population) are those who registered prior to the first day of the investigation period and then accessed PAW^2 world at least once. Accordingly, the sample population for this investigation was 6,497 users. However, this target population includes outliers. We separated the outliers from the target population based upon the frequency of their activities in PAW^2. Therefore, the number of target users was 5,170 users (about 79.5% of the original population). We will describe the outliers in Section 5.2.2.

## Implementation

It was considered important to investigate user activities without influencing the activities themselves. In a MUSVE like PAW^2, user activities in the environment can be associated with shared objects in the environment. In PAW^2, as described in Section 4.7, all user activities other than chatting are associated with AOs that make up the PAW^2 system. For example, personal agent-related activities are associated with an Agent AO and item-related activities are associated with an Object AO and its derived AOs. Therefore, we modified each AO's server-side script (Section 3.4.2) to log user activity as described in this section. We did not need to modify its client-side software, so users were unaware of our investigation. In terms of gathering usage information about user's chatting, we used the built-in logging function of CP bureau for recording chat messages.

### 5.2.2 Results and considerations

We analyzed the captured information about user activities by using several statistical methods. The results of this investigation are shown in the following sections classified by basic characteristics of user activities, heavy users, basic user's behavior model, and temporal transition of user's behavior.

#### (1) Basic characteristics of user activities

Table 5.1 shows the basic statistical characteristics about user activities in PAW^2, such as average value, standard deviation, minimum value, maximum value, and outliers.

Table 5.1 Basic statistical information about user activities

| Category   | Personal agent-related activities   |                  |                 |                |               |                         |              |                |              |
|------------|-------------------------------------|------------------|-----------------|----------------|---------------|-------------------------|--------------|----------------|--------------|
| Activity   | Greetings                           | Instruction      | Gesture         | Question       | Name calling  | Rescuing                | Quiz         | Shiritori game | Feeding      |
| Average    | 8.8                                 | 10.4             | 0.6             | 6.3            | 28.9          | 1.8                     | 10.2         | 7.4            | 10.8         |
| SD         | 22.1                                | 40.1             | 3.9             | 22.1           | 105.2         | 7.5                     | 47.3         | 22.1           | 32.9         |
| Range      | 498                                 | 989              | 131             | 1,002          | 4,813         | 216                     | 1,780        | 468            | 1,615        |
| Min. value | 0                                   | 0                | 0               | 0              | 0             | 0                       | 0            | 0              | 0            |
| Max. value | 498                                 | 989              | 131             | 1,002          | 4,813         | 216                     | 1,780        | 468            | 1,615        |
| Total      | 57,193                              | 67,499           | 4,202           | 40,876         | 187,699       | 11,869                  | 66,339       | 48,218         | 70,237       |
| Outlier    | ≥ 53                                | ≥ 89             | ≥ 9             | ≥ 50           | ≥ 235         | ≥ 17                    | ≥ 103        | ≥ 51           | ≥ 76         |
| Category   | Events and games-related activities |                  |                 |                |               |                         |              |                |              |
| Activity   | "Search for a cat!"                 | "Buru-Piko" game | Daruma stacking | Fortune teller | Beckoning cat | Spring event            | Summer event | Autumn event   | Winter event |
| Average    | 1.9                                 | 0.3              | 0.1             | 1.2            | 2.1           | 16.1                    | 6.1          | 0.5            | 0.3          |
| SD         | 15                                  | 1                | 2               | 8              | 6             | 138                     | 39           | 3              | 5            |
| Range      | 548                                 | 39               | 63              | 402            | 198           | 7,000                   | 1,403        | 142            | 287          |
| Min. value | 0                                   | 0                | 0               | 0              | 0             | 0                       | 0            | 0              | 0            |
| Max. value | 548                                 | 39               | 63              | 402            | 198           | 7,000                   | 1,403        | 142            | 287          |
| Total      | 12,172                              | 1,717            | 787             | 8,065          | 13,809        | 104,694                 | 39,591       | 3,506          | 1,812        |
| Outlier    | ≥ 31                                | ≥ 3              | ≥ 4             | ≥ 16           | ≥ 15          | ≥ 287                   | ≥ 82         | ≥ 7            | ≥ 11         |
| Category   | Communication-related activities    |                  |                 |                |               | Item-related activities |              |                | Access       |
| Activity   | Changing avatar color               | Chatting         | In-world pager  | In-world mail  | In-world BBS  | Obtaining items         | Recycling    | Shopping       |              |
| Average    | 0.4                                 | 620.4            | 3.4             | 2.0            | 0.1           | 94.1                    | 55.8         | 32.3           | 35.3         |
| SD         | 1                                   | 1636.6           | 15.0            | 6.4            | 0.8           | 340                     | 201          | 177            | 59.8         |
| Range      | 16                                  | 23,867           | 378             | 121            | 25            | 12,615                  | 5,803        | 7,230          | 804          |
| Min. value | 0                                   | 0                | 0               | 0              | 0             | 0                       | 0            | 0              | 1            |
| Max. value | 16                                  | 23,867           | 378             | 121            | 25            | 12,615                  | 5,803        | 7,230          | 805          |
| Total      | 2,287                               | 4,030,744        | 21,864          | 13,051         | 720           | 611,362                 | 362,659      | 209,677        | 229,043      |
| Outlier    | ≥ 3                                 | ≥ 3,828          | ≥ 33            | ≥ 15           | ≥ 3           | ≥ 761                   | ≥ 450        | ≥ 379          | ≥ 153        |

SD: Standard Deviation

The table indicates that the most frequent user activity was “chatting” which is one of the communication-related activities. The second one was “obtaining items” and the third one was “recycling” in the item-related activities. We consider the reason for this ranking is that these activities relate to basic PAW<sup>2</sup> functions and are easy to learn by observing other users. Obviously, the nature of 3D MUSVE contributed to this result, since it is possible to share each user’s activities naturally among multiple users.

Another interesting point is that personal agent “name calling” was carried out much more frequently than other personal agent-related activities. All personal agent-related activities have similar characteristics to “chatting” and item-related activities, i.e. they are also easy to learn by seeing other users. However, the “name calling” activities are prominent in terms of frequency of personal agent-related activities. We consider the reason is that “name calling” is a very natural activity in the real world and is easier to understand than other personal agent-related activities. Additionally, the personal agent’s reaction to the activity can make some users

happier than others. When user calls the name of her personal agent, the personal agent says something like “I like my name” and displays a delightful animated behavior.

Looking at user activities as a whole, we saw that the degree of distortion of each activity is negative. This observation indicated that the frequency of activities carried out by most users was low, but for some users it was very high for each activity. This result could be one of the characteristics of user activities taking place in a network service like PAW<sup>2</sup>. Therefore, in case of providing a PAW<sup>2</sup>-like network service, we need to take account of both types of users for designing all functionalities provided by the service.

It should be noted that the frequency of all activities contains an extremely large variance. For example, the average value of the “quiz” activity is 10.2 times. However, its maximum value is 1,780 times, i.e. at least one user played the game about 59 times a day on average ( $1780 \div 30 \doteq 59$ ). In other words, these large values indicate that all activities have users who were hooked on the activity. We will refer to these users as “heavy user” and discuss them in the following section.

## **(2) Communication with a personal agent**

In PAW<sup>2</sup>, a user can communicate with other users by using text messages. In addition, the user can communicate with her personal agent in the same way. We compared these two activities based upon the results in Table 5.1. It shows that the total value of the communication-related activities with other users is 4,066,379 times. Meanwhile, that of communication activities with a personal agent (i.e. “Greetings”, “Instruction”, “Gesture”, “Question”, “Name calling”, “Quiz”, and “Shiritori”) is 472,026 times. These results indicate that one user communicated with her personal agent at rate of one per ten text messages on average (i.e.  $472,026 \div (472,026 + 4,066,379) \doteq 0.104$ ).

## **(3) Heavy users**

Due to the observation that heavy users existed for each activity taking place in PAW<sup>2</sup>, we analyzed the percentage of the heavy users for each activity. Statistically, we defined heavy users as a user who repeatedly carried out an activity more than “outlier” number of times. We use the definition of outlier in a normal distribution, i.e. (average value + 1.96 x standard deviation). Table 5.2 shows the number of heavy users and percentage per each user segment categorized by their registration date.

Table 5.2 indicates that the percentage of heavy users is approximately 20% for almost all user segments. This means that there were a certain proportion of users

who could easily adapt themselves to network service like PAW^2. Several reasons for this result can be proposed, i.e. the widespread nature of the Internet, and the growing rate of usage of other Internet services, such as chat system and 3DCG games. We can understand that a network service can not exist as a standalone service but other network services surrounding the service influence the service. When building a new network service, we need to design future underlying systems and network services to cater for heavy users.

Table 5.2 Percentage of heavy users.

| Registration date | Number of users | Number of heavy users | Percentage of heavy users |
|-------------------|-----------------|-----------------------|---------------------------|
| June, 1998        | 223             | 34                    | 15%                       |
| July              | 127             | 33                    | 26%                       |
| August            | 143             | 28                    | 20%                       |
| September         | 120             | 23                    | 19%                       |
| October           | 130             | 21                    | 16%                       |
| November          | 94              | 18                    | 19%                       |
| December          | 116             | 25                    | 22%                       |
| January, 1999     | 158             | 37                    | 23%                       |
| February          | 257             | 48                    | 19%                       |
| March             | 381             | 90                    | 24%                       |
| April             | 473             | 94                    | 20%                       |
| May               | 492             | 84                    | 17%                       |
| June              | 883             | 165                   | 19%                       |
| July              | 1,054           | 215                   | 20%                       |
| August            | 1,430           | 306                   | 21%                       |
| After September   | 416             | 106                   | 25%                       |
| Total             | 6,497           | 1,327                 | 20%(Average)              |

#### (4) Basic behavior of users

In order to clarify which user activities played an important role in encouraging users to access PAW^2 repeatedly, we performed a basic multiple regression analysis based upon the frequency of user activities. We calculated a regression expression and its standardized partial regression coefficients using the obtained results. In this analysis, the criterion variable is user’s accesses and explanatory variables are user activities taking place in PAW^2.

We selected 1,000 sample users from all target users by using the stratified sampling method based upon the number of user’s accesses to PAW^2. From the

sample users, we calculated a regression expression and the standardized partial regression coefficients by using the backward elimination method.

Regression expression:

$$y=0.4041x1+0.0166x2+2.6717x3+1.9713x4+0.4290x5+1.0540x6+0.0828x7+0.1022x8+0.6882x9+0.7037x10+5.3417$$

Based upon the result, we calculated the standardized partial regression coefficients:

$$y = 0.1288x1+0.3418x2+0.0473x3+0.0967x4+0.0322x5+0.1373x6+0.1264x7+0.0679x8+0.0558x9+0.2183x10$$

y: user’s accesses to PAW^2, x1: greeting, x2: chatting, x3: changing avatar color, x4: “Search a cat!” event, x5: fortune teller, x6: in-world pager, x7: recycling, x8: spring event, x9: in-world mail, and x10: feeding.

Multiple correlation coefficient: R = 0.8749

Contribution rate: 76.5 % (level of significance 1%)

In a regression expression, explanatory variables with larger coefficients indicate stronger influence to the criterion variable, i.e. user’s accesses to PAW^2. This expression indicates that user activities related to “chatting” (x2), “feeding” (x10), and “in-world pager” (x6) were the top 3 access factors. In addition to the expression, we used the same sample data to calculate several regression expressions corresponding to the local maximum of contribution ratio. Table 5.3 shows standardized partial regression coefficients for each expression and its contribution rate to the criterion variable. We can see a general trend of contributing factors to user’s access behavior.

Table 5.3 shows that “chatting”, “feeding”, and “in-world pager” affected user’s access behavior significantly. In addition to them, each regression expression contained the following common seven activities: “greeting”, “recycling”, “search a cat!”, “spring event”, “in-world mail”, and “changing avatar color”. We can see that these nine activities played an important role in user’s access behavior to PAW^2.

Based upon the result shown in Table 5.3, we analyzed the percentage of the degree of influence about each activity category as follows:

- (1) For each expression, we calculated a weighted value of each activity by multiplying each activity’s standardized partial regression coefficient by the contribution rate of the expression.
- (2) Next, we calculated a total weighted value per each activity category by accumulating the weighed values belonging to the activity.

Table 5.3 User activities influencing user access behaviors

| Activities                   | Exp. 1 | Exp. 2 | Exp. 3 | Exp. 4 | Exp. 5 | Exp. 6 | Exp. 7 | Exp. 8 | Average |
|------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|---------|
| Chatting (C)                 | 0.342  | 0.344  | 0.345  | 0.337  | 0.342  | 0.339  | 0.343  | 0.342  | 0.342   |
| Feeding (P)                  | 0.218  | 0.216  | 0.212  | 0.212  | 0.224  | 0.223  | 0.224  | 0.224  | 0.219   |
| In-world pager (C)           | 0.137  | 0.137  | 0.141  | 0.142  | 0.138  | 0.139  | 0.138  | 0.138  | 0.139   |
| Greetings (P)                | 0.129  | 0.127  | 0.124  | 0.123  | 0.126  | 0.126  | 0.128  | 0.128  | 0.127   |
| Recycling (I)                | 0.126  | 0.125  | 0.124  | 0.110  | 0.130  | 0.130  | 0.129  | 0.129  | 0.125   |
| "Search for a cat" event (E) | 0.097  | 0.098  | 0.098  | 0.093  | 0.096  | 0.098  | 0.097  | 0.098  | 0.097   |
| Spring event (E)             | 0.068  | 0.063  | 0.063  | 0.064  | 0.068  | 0.067  | 0.069  | 0.068  | 0.066   |
| In-world mail (C)            | 0.056  | 0.060  | 0.063  | 0.062  | 0.060  | 0.060  | 0.061  | 0.061  | 0.060   |
| Changing avatar color (E)    | 0.047  | 0.049  | 0.047  | 0.046  | 0.047  | 0.047  | 0.047  | 0.047  | 0.047   |
| Written oracle (E)           | 0.032  |        |        |        |        |        |        |        | 0.032   |
| Summer event (E)             |        |        |        |        |        |        |        | 0.002  | 0.002   |
| "Buru-Piko" game (E)         |        |        |        |        |        |        | 0.008  |        | 0.008   |
| Instruction (P)              |        |        |        |        | 0.010  |        |        |        | 0.010   |
| Question (P)                 |        |        |        |        |        | 0.010  |        |        | 0.010   |
| Rescuing (P)                 |        |        | 0.028  |        |        |        |        |        | 0.028   |
| Beckon cat (E)               |        | 0.033  |        |        |        |        |        |        | 0.033   |
| Obtaining items (I)          |        |        |        | 0.045  |        |        |        |        | 0.045   |
| Contribution rate            | 0.766  | 0.766  | 0.765  | 0.765  | 0.765  | 0.765  | 0.765  | 0.765  | 0.765   |

C: Communication, P: Personal agent, I: Item, and E: Events and games

(3) Finally, we got four total weighted values for activity category and calculated each category's percentage based upon the total values of them.

Figure 5.1 shows the percentage of each activity category based upon the result. It indicates that communication-related activities and personal agent-related activities play an important role in encouraging users to revisit PAW<sup>2</sup> frequently.

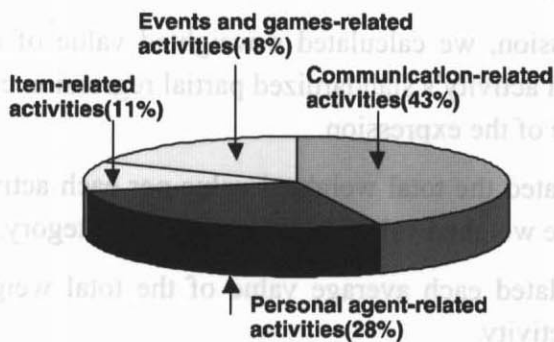


Figure 5.1 The percentage of contribution per activity category



## (5) Transition of user's behavior

In the previous section, we recognized the general characteristics of user's behavior in PAW<sup>2</sup>. Basically, communication-related activities and personal agent-related activities influenced user's access behavior to PAW<sup>2</sup>. In the next step, we analyzed the temporal transition of user's behavior based upon their amount of PAW<sup>2</sup> experience.

We divided 5,170 target users into the following five groups of a constant number (1,000 users) of users using the amount of their experience with PAW<sup>2</sup>:

- **Group1:** consisted of users whose total PAW<sup>2</sup> experience was less than one month (users who were registered from August 1999 to September 1999)
- **Group2:** consisted of users whose total PAW<sup>2</sup> experience was one to two months (users who were registered from July 1999 to August 1999)
- **Group3:** consisted of users whose total PAW<sup>2</sup> experience was two to four months (users who were registered from May 1999 to July 1999)
- **Group4:** consisted of users whose total PAW<sup>2</sup> experience was four to seven months (users who were registered from February 1999 to May 1999)
- **Group5:** consisted of users whose total PAW<sup>2</sup> experience was more than seven months (registered from May 1998 to February 1999)

We performed a basic multiple regression analysis for each group and calculated regression expressions and their standardized partial regression coefficients. In this case, the criterion variable is also user's access behavior and the explanatory variables are user activities in PAW<sup>2</sup>. Table 5.4 shows the standardized partial regression coefficients for four regression expressions for each group, which resulted in the four highest contribution rates.

Based upon the result shown in the table, we analyzed the average value of each activity category as follows:

- (1) For each expression, we calculated a weighted value of each activity by multiplying each activity's standardized partial regression coefficient by the contribution rate of the expression.
- (2) Next, we calculated the total weighted value per each activity category by accumulating the weighed values belonging to the category.
- (3) Then, we calculated each average value of the total weighted values for each category activity.

Figure 5.2 shows the temporal transition about user behaviors for each category based upon the results.

Table 5.4 Transition of user activities influencing user access behaviors

|                              | Group1 |       |       |       | Group2 |       |       |       | Group3 |       |       |       | Group4 |       |       |       | Group5 |       |       |       | Average |
|------------------------------|--------|-------|-------|-------|--------|-------|-------|-------|--------|-------|-------|-------|--------|-------|-------|-------|--------|-------|-------|-------|---------|
|                              | Exp.1  | Exp.2 | Exp.3 | Exp.4 | Exp.1  | Exp.2 | Exp.3 | Exp.4 | Exp.1  | Exp.2 | Exp.3 | Exp.4 | Exp.1  | Exp.2 | Exp.3 | Exp.4 | Exp.1  | Exp.2 | Exp.3 | Exp.4 |         |
| Chatting (C)                 | 0.303  | 0.307 | 0.299 | 0.289 | 0.164  | 0.164 | 0.163 | 0.166 | 0.358  | 0.385 | 0.383 | 0.383 | 0.431  | 0.452 | 0.446 | 0.439 | 0.415  | 0.418 | 0.438 | 0.444 | 0.342   |
| Changing avatar color (E)    | 0.034  |       | 0.033 | 0.036 | 0.077  | 0.077 | 0.077 | 0.078 |        |       |       |       |        |       | 0.019 | 0.020 | 0.098  | 0.100 | 0.100 | 0.102 | 0.065   |
| "Search for a cat" event (E) |        |       |       |       | 0.019  |       | 0.019 | 0.030 | 0.041  | 0.052 | 0.055 | 0.054 | 0.014  | 0.033 | 0.036 | 0.041 | 0.090  | 0.084 | 0.129 | 0.123 | 0.055   |
| Written oracle (E)           | 0.104  | 0.105 | 0.113 | 0.114 |        |       |       |       |        |       | 0.043 |       |        |       |       |       | 0.081  | 0.054 | 0.070 | 0.063 | 0.081   |
| In-world pager (C)           |        |       |       | 0.010 | 0.150  | 0.148 | 0.151 | 0.154 | 0.080  | 0.072 | 0.074 | 0.074 |        |       |       |       | 0.138  | 0.133 | 0.129 | 0.124 | 0.111   |
| Recycling (I)                | 0.063  | 0.061 | 0.078 | 0.102 |        |       |       |       |        | 0.041 | 0.045 | 0.042 |        |       |       |       | 0.012  | 0.013 | 0.086 | 0.067 | 0.054   |
| Spring event (E)             |        |       | 0.014 | 0.047 |        |       | 0.002 | 0.077 | 0.033  | 0.062 | 0.062 | 0.064 | 0.045  | 0.052 | 0.054 | 0.057 | 0.078  | 0.067 | 0.095 | 0.082 | 0.056   |
| Summer event (E)             |        | 0.021 |       |       |        |       |       |       |        |       |       |       |        | 0.026 |       |       | 0.058  |       | 0.085 |       | 0.042   |
| Obtaining items (I)          |        |       |       |       |        | 0.020 |       |       | 0.182  |       |       |       | 0.228  |       |       |       | 0.214  | 0.221 |       |       | 0.173   |
| Feeding (P)                  | 0.205  | 0.215 | 0.205 | 0.213 | 0.324  | 0.319 | 0.328 | 0.353 | 0.172  | 0.240 | 0.244 | 0.234 | 0.190  | 0.254 | 0.254 | 0.274 | 0.124  | 0.117 | 0.159 | 0.147 | 0.229   |
| Rescuing (P)                 |        |       |       |       |        |       |       |       |        |       |       | 0.039 | 0.026  | 0.112 | 0.113 | 0.107 |        |       | 0.081 | 0.093 | 0.081   |
| "Buru-Piko" game (E)         | 0.039  | 0.046 | 0.047 | 0.044 |        |       |       |       |        |       |       |       | 0.073  | 0.084 | 0.083 | 0.081 |        |       |       |       | 0.062   |
| Shopping (I)                 | 0.062  | 0.060 | 0.067 |       | 0.102  | 0.099 | 0.105 |       |        |       |       |       | 0.010  | 0.045 | 0.045 | 0.045 |        |       |       |       | 0.064   |
| Beckoning cat (E)            | 0.073  | 0.073 |       |       | 0.019  | 0.016 |       |       | 0.033  | 0.048 |       |       | 0.020  | 0.044 | 0.045 |       |        | 0.054 |       | 0.061 | 0.044   |
| In-world mail (C)            | 0.154  | 0.155 | 0.155 | 0.152 | 0.144  | 0.142 | 0.143 | 0.138 | 0.145  | 0.150 | 0.147 | 0.150 | 0.095  | 0.101 | 0.101 | 0.103 |        |       |       |       | 0.136   |
| Greetings (P)                | 0.111  | 0.111 | 0.118 | 0.122 | 0.105  | 0.104 | 0.107 | 0.102 | 0.095  | 0.091 | 0.083 | 0.090 |        |       |       | 0.009 |        |       |       |       | 0.096   |
| Name calling(P)              |        |       |       |       |        |       |       |       | 0.045  | 0.053 | 0.058 | 0.052 |        |       |       |       |        |       |       |       | 0.052   |
| Question (P)                 |        |       |       |       | 0.139  | 0.137 | 0.138 | 0.135 |        |       |       |       |        |       |       |       |        |       |       |       | 0.137   |
| Instruction (P)              |        |       |       |       |        |       |       | 0.021 |        |       |       |       |        |       |       |       |        |       |       |       | 0.021   |
| Contribution rate            | 0.654  | 0.654 | 0.650 | 0.649 | 0.759  | 0.758 | 0.758 | 0.756 | 0.709  | 0.697 | 0.697 | 0.696 | 0.726  | 0.715 | 0.715 | 0.713 | 0.660  | 0.659 | 0.647 | 0.646 | 0.696   |

C: Communication, P: Personal agent, I: Item, and E: Events and games

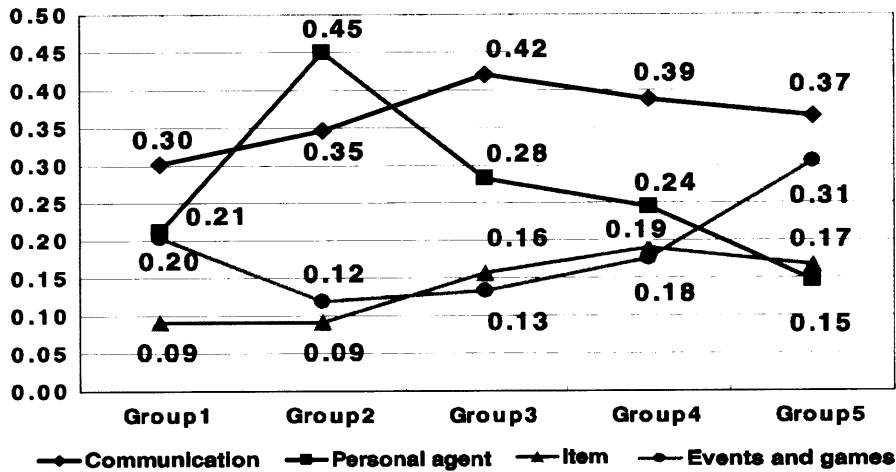


Figure 5.2 Temporal transitions of user activities influencing user access behavior

Figure 5.2 indicates that communication-related activities and item-related activities show a similar tendency in terms of their contribution to user’s access behavior to PAW<sup>2</sup>. Initially, both activities are gradually increasing their influence upon users and after some time this influence is reduced. However, the contribution of events and games-related activities had the inverse effect. The contribution of personal agent-related activities indicated some interesting characteristics. Initially, the activities had a drastically-growing influence.

This observation indicates that a personal agent had a strong influence on the behavior of first-time users whose total PAW<sup>2</sup> experiences were less than two months. Then, the user’s behaviors gracefully shift from personal agent-related activities to communication and events-related activities. Especially, in Group5, events and games-related activities came to have a similar strong influence to communication-related activities. We consider that PAW<sup>2</sup> users started out by interacting with their personal agents, and then they gradually joined the society and mingled with other users. After that, they become familiar with other users and communicated with them or participated in events together to have their shared experience. The experience makes them to become more familiar. We believe personal agent have an important role in encouraging users to revisit PAW<sup>2</sup>. Therefore we felt the personal agent accomplished the desired effect described in Chapter 4.

We performed the same evaluation of the temporal transition of user’s behavior based upon the two statistics from October 4 1999 to November 2 1999 and from November 11 2001 to December 10 2001. Both results also showed that personal agent-related activities had a strong influence on the first-time users whose total experience with PAW<sup>2</sup> are less than two months and then user’s behaviors gracefully shifted to communication and events and games-related activities.

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## 5.3. Analysis of Social Activities

We observed that initially most users were accessing PAW^2 simply to enjoy the service provided by the system. However, we have gradually made several observations about the unique social/cultural phenomena and creative activities in PAW^2 while operating the system. For example, several communities were formed in PAW^2, dedicated rules were established about life in PAW^2, users hosted their own events in stead of participating in the original events provided by the system. We also observed several anti-social behaviors which hinder social life in PAW^2. These observations derived from e-mails posted to user support for PAW^2 users, communications in a mailing list for PAW^2 users, and reports from PAW^2 supporters.

In this section, we conducted empirical research about these social phenomena and anti-social activities in detail to explore the question of whether 3D MUSVEs can be regarded as social systems. We consider that one criterion of social systems is the presence of social activities including establishment of social conventions which serve as a basis for common communication. From the results of observation and statistical data, we analyze what sort of phenomena/activities was occurred and what sort of anti-social activities was occurred. We can understand that these phenomena/activities also could influence users' social activities in PAW^2 and suggest the possibility of forming/developing original culture/content in a virtual environment.

### 5.3.1 Methodology

We made several observations about the unique social or cultural phenomena in PAW^2 as we operated the system. Having determined that such phenomena tend to be observed in the activities related to communities about PAW^2, we decided to investigate the social or cultural phenomena, focusing on the communities. We investigated communities, home pages, user mail, and performed field studies in the virtual world.

In this investigation, to collect information in the most natural possible form, we mainly used the non-participant observation method (Valerie, 1998), which is often used in cultural anthropology or sociology. In this method, investigators do not participate in the target society itself but observe from outside. We investigated users' social activities for about one and a half years from October 1998 to March 2000. During this period, we observed that there were about four hundred simultaneous user accesses per day and about five thousand user accesses in total per day and the average access length was 1.5 hours.

Notice that PAW^2 users consented to their activities were being studied by EULA (End User License Agreement) and we used user's e-mail with a permission of its sender.

## **(1) Investigation of communities**

We gathered the information about PAW^2-related communities based upon the following questionnaires.

- Name of the community
- Gender and age of the community founder
- Number of the community member
- URL of the community's home page (optional)
- Theme (or purpose) of the community
- Activities of the community

We used PAW^2's official home page and the users' mailing list to ask users to report about their communities when they established them. Then, we also asked them to provide above information. For each community that replied, we added a link to its home page from the PAW^2's official home page after confirming its home page did not offend against any public policy or morals.

We designated the communities that had not been active for more than two months as inactive communities and excluded them from our investigation. We gathered information continuously to check the changes in community activities in October 1998, January 1999, July 1999, December 1999, and March 2000.

## **(2) Investigation of home pages**

With the spread of the Internet and home page technology, home pages have become a convenient medium for people to present their activities. PAW^2's users are no exception to this trend and we found many user home pages dedicated to PAW^2. In this investigation, we targeted the PAW^2-related home pages and examined their contents of home pages. We gathered the URLs for:

- Home pages linked from PAW^2's official home page,
- Home pages linked from the above home pages, and
- Home pages found using an Internet search engine with the keys "PAW^2" and "chat."

Then, we categorized their contents and examined which home pages provided which categories of content.

### (3) Investigation of user mail

As described in the previous section, we observed that information about user's social or cultural activities was often sent to PAW^2's mail service. Therefore, we also gathered information about them from the following mail services provided by PAW^2.

- **User mailing list (paw-users@\*\*\*.\*\*.jp):** A mail service using the Internet mail system to enable PAW^2 users to exchange information with each other. We did not directly intervene in their communication activities on the mailing list. This list had 505 registered users as of March 2000.
- **User support mail (paw@\*\*\*.\*\*.jp):** Another mail service using the Internet mail system to provide support to users. Users can ask questions or make requests about PAW^2. The mail posed to the service is always answered within a few days. Some user's requests have been accepted and incorporated into PAW^2.
- **User support mail by using in-world mail ("Takepon" mail):** A unique mail service using PAW^2's in-world mail system (see Section 4.4.1) to support users. In this service, we have created the persona "Takepon" as a virtual PAW^2 administrator. Users can send questions or requests about PAW^2 to him and replies come back from him. We expected users to use this mail service in a less formal manner.

### (4) Field work in the virtual world

Field work is also often used in cultural anthropology or sociology for investigation of real societies. However, it needs direct access to the target society. From the initial operation of PAW^2, PAW^2 provides in-world user support to novice users via an avatar called "supporter," who writes up a report about her user support activities. We used these supporters as field workers to gather information about users' social activities inside PAW^2. In addition, we gathered information about users' activities in the real world by their participating during the users' off-line meetings

## 5.3.2 Results and considerations

The results of our investigations are shown in the following sections, classified by social phenomenon: communities, home pages, user events, manners, handle names, user support, and anti-social behaviors. We will discuss the each phenomenon compared with that of other virtual world.

# (1) Communities

From the questionnaire responses and results of investigation of home pages, we found that various communities were established and the number of the communities related to PAW^2 increased with time (Figure 5.3).

We classified PAW^2's communities according to the questionnaire responses for "theme of the community" and "activities of the community". In these results, we found out that PAW^2's communities consist of the following three categories:

- **PAW^2's feature-oriented communities:** are communities which are based upon PAW^2's feature or attributes. Community members have a special purpose related to PAW^2's features, such as a game or event. For example, "Treasure hunters" (whose members like to gather items), "Cat hunters" (whose members like to participate in the event known as "Search for a cat!"), and "Rescuers" (whose members like to help sick personal agents).
- **User's attribution-oriented communities:** are communities which are based upon the member's attributes, such as age, gender, and home town. For example, "30s/40s" (whose members are in their 30s or 40s), "Workers" (whose members mainly access from their offices), and "KANTO" Army (whose members mainly live in the Kanto, the region containing Tokyo).
- **Chat-with-friends communities:** are informal groups whose members have no special purpose except chatting. The membership is based upon users who know each other through communication in PAW^2. For example, "Omanuke club" (Booboisie club), "Saborinzu" (Wags), and "Shounen-tai" (Boys) <sup>1</sup>.

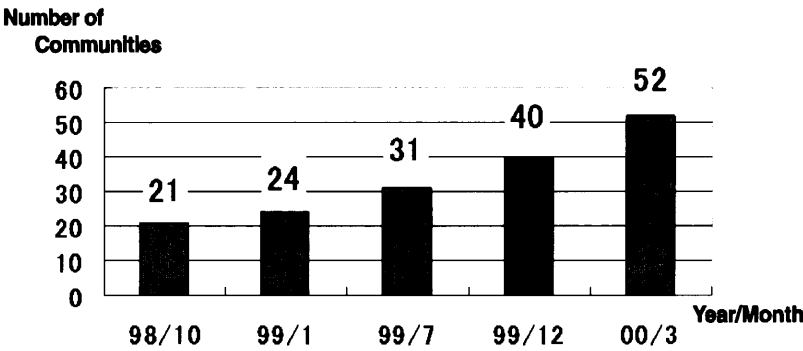


Figure 5.3 Number of communities.

<sup>1</sup> In Japanese, "おまぬけくらぶ", "さぼりんず", and "少年隊".

Figure 5.4 shows the changes in the number of communities per category. The number of chat-with-friends communities increased significantly.

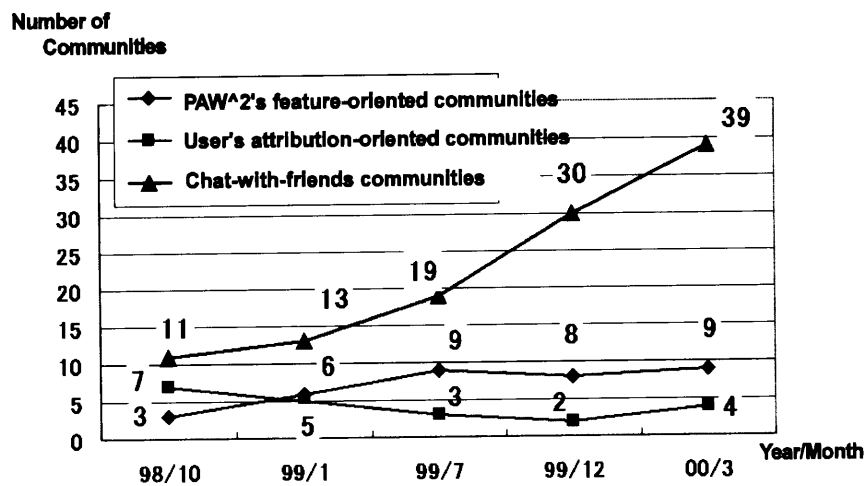


Figure 5.4 Communities per category.

We compared this result with the characteristics of communities in a game-oriented multi-user dungeon (MUD) (Muramatsu and Ackerman, 1998). In the game-oriented MUD, communities about game content were predominant. However, in PAW^2, as Figure 5.4 shows, there are more chat-with-friends than that of PAW^2's feature-oriented communities. Since we can think the PAW^2's feature-oriented communities correspond to the game content communities, we can see that, in PAW^2, communities without a special purpose (i.e. chat-with-friends communities) are predominant. This is a particularly interesting aspect of PAW^2 communities, because PAW^2 is based upon a society not on a game.

Meanwhile, we observed a new category of community based upon the attributes in the real world: the hobby-oriented community. For example, "Hot spring team", whose members like to visit hot springs in the real world. As similar types of communities in other virtual worlds, religious communities (e.g. Christian community in the Dreamcast) were observed (Tayler 2002; Schroeder et al., 1998). However, we did not observed such communities in PAW^2.

Most communities have from 10 to 40 members; the largest has 132 ("Treasure hunters"). They were founded by people ranging in age from 12 to 39, with a mean age of 24 and the gender split was 50%. Figure 5.5 shows breakdown of communities: gender of each community founder, the number of community members, and the number of communities per each category.

During the observation period, we noticed several common attributes of PAW^2 communities, such as most users using the community name in their user handle names, and most of them having their own home pages. In addition to online meetings in PAW^2, more than half the communities often hold off-line (i.e. real)



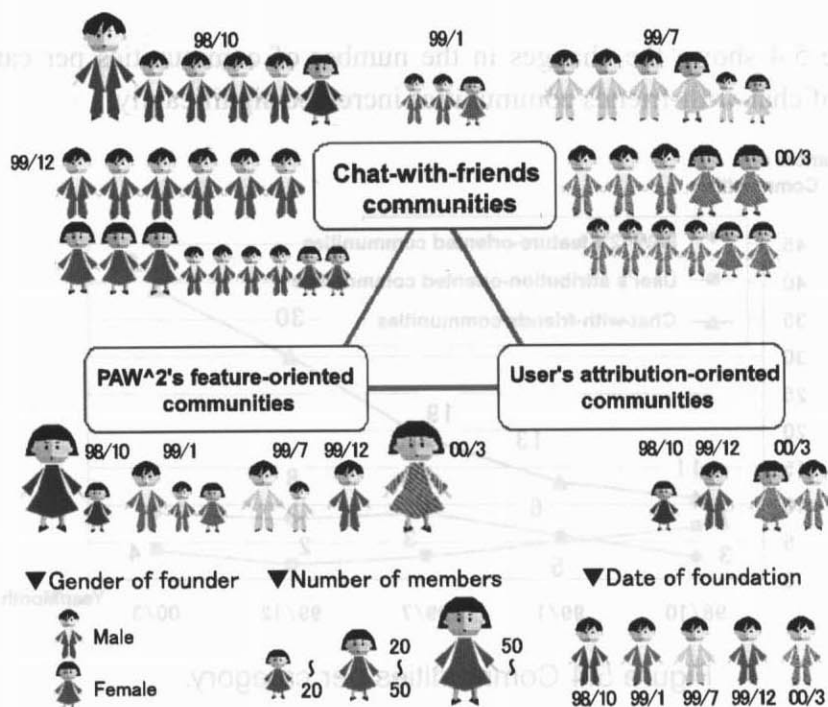


Figure 5.5 Breakdown of communities.

meetings in the real world. We also observed multiple communities hosting a joint event together in PAW^2. We will discuss these attributes later in this section.

## (2) Home pages

We found 152 home pages about PAW^2, and 51 home pages (about 30% of all PAW^2 home pages) were operated by communities. This means that 98% of community had their own home page. Figure 5.6 shows the contents of the home pages. Most home pages include a bulletin board system (BBS) for sharing

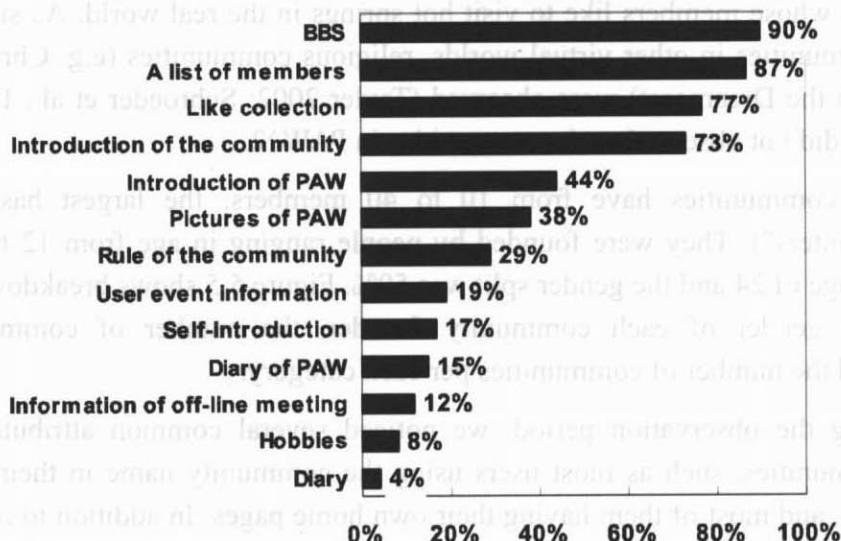


Figure 5.6 Contents of community's home page

information among members, a members list, and a description of the community. Recently, most home pages support BBS and PAW^2's community is not an exception. Some characteristic contents of community home pages are a list of all members, introduction of community, and rules of community. These items must be essential to maintain community. We can find social conventions in PAW^2 in the rules of community. We will discuss them later in this section. Also, we can see that user's events hosted by community are noticed by using home pages. Figure 5.6 shows 19% of community hosted their own events. We will discuss the user events later in this section.

Although there were not many examples, we found some characteristic content in the home pages: web-based magazines about PAW^2 (Figure 5.7). Three types of magazines were published: “PAW^2 sports”, “Weekly PAW^2”, and “Evening PAW^2”<sup>1</sup>. The names of these magazines are named after famous Japanese sports newspapers. Typically, the content of these magazines consists of interviews with the users who participated in events in PAW^2, PAW^2 street talks, fictional stories related to PAW^2, and factual reports of the results of user events. As of March, 2000, “PAW^2 sports” was at issued No. 137 (issued approximately every two days), “Weekly PAW^2” was at No. 28 (every five days), and “Evening PAW^2” was at No. 15 (every two weeks). These are good examples to show that users created their own content based upon PAW^2.

### (3) User events

From the results of investigating home pages and communications in mailing lists, we found out that PAW^2 users were hosting events of their own creation in PAW^2. We call such events “user events” in contract to the original events provided

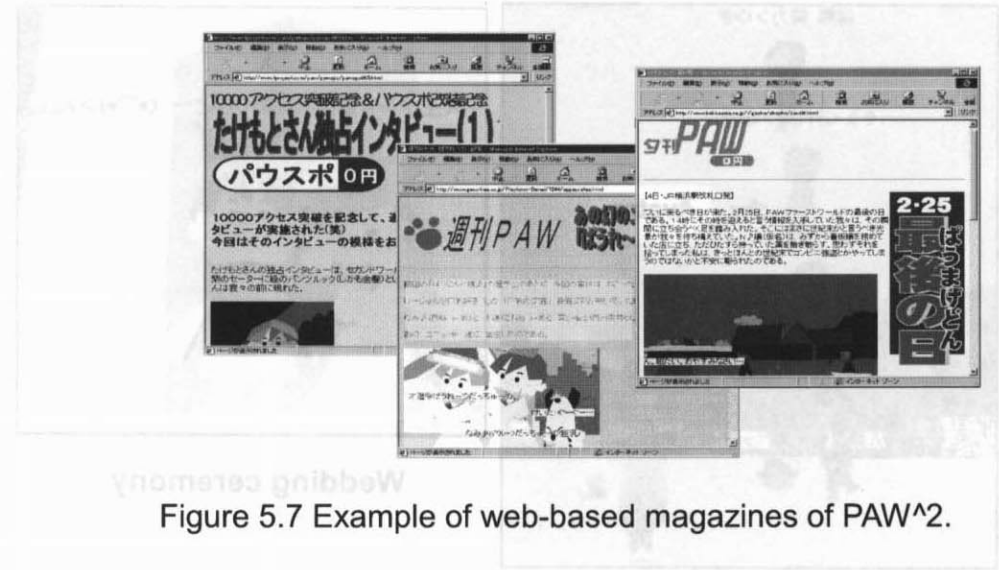


Figure 5.7 Example of web-based magazines of PAW^2.

<sup>1</sup> In Japanese, “PAW^2 スポ”, “週間 PAW^2”, and “夕刊 PAW^2”.

by the system. For example, they were hosting a traditional Japanese “Bon-odori” dance festival, a pyramid championship (the left-side image of Figure 5.8), a hide-and-seek game, a wedding ceremony (the right-side image of Figure 5.8), a tag game, and a dance convention. Most of them were held by communities in PAW^2 rather than by individuals. It is because that it seems to be easy to gather participants in the events.

These events shows that users are taking advantage of the spatial characteristics of the 3D shared virtual world to host events. In particular, the pyramid championship was being played by a user riding on top of another user to build a human (avatar) pyramid. It takes advantage of the 3D-oriented function “Terrain Following” (Section 3.3.1) skillfully provided by the PAW^2 system (i.e. CP browser). Virtual wedding ceremonies are often found in other virtual worlds, such as MUD, MOO, Habitat (Farmer, 1994) and ActiveWorlds (Damer, 1998), which shows that they are common social events in media that enable social interaction. Although the development of dance team was also observed in other virtual worlds (Taylor, 2002), PAW^2’s “Bon-odori” dance festival was interesting that it was hosted as a festival in conformity to Japanese custom (it is held in summer in Japan).

Besides user events held by communities, we also observed several events hosted by individual users. Although there were not many examples, one example was a “Flower Garden Plan”. This event utilized PAW^2’s spring sowing event (see Section 4.5) to create virtual flower gardens at specific places in the PAW^2 world. It was done by the event’s host appealing to other PAW^2 users via a mailing list to plant flower seeds at specific places. This event has been held every spring in the

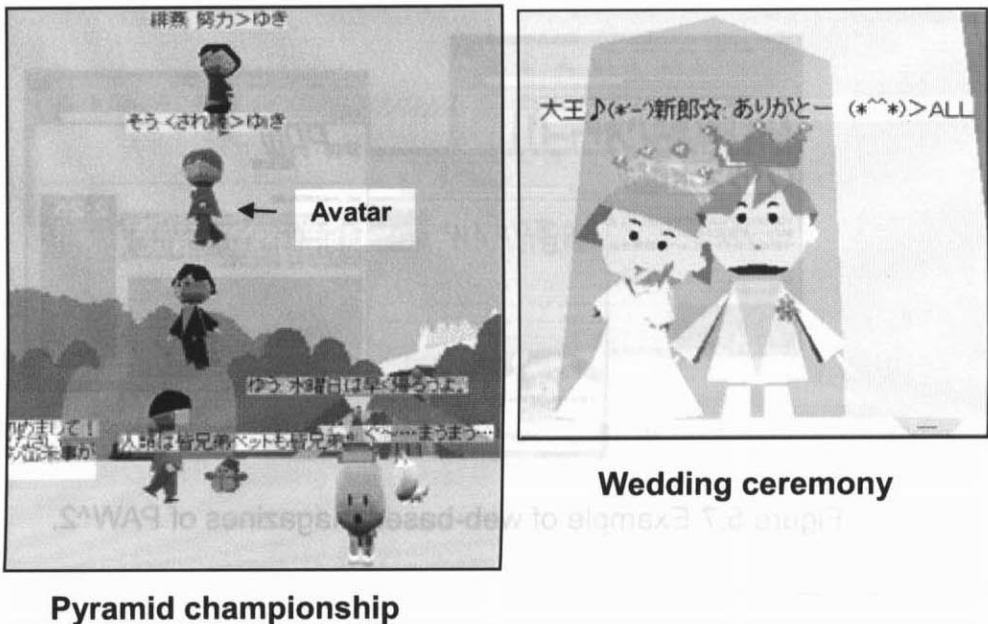


Figure 5.8 Examples of user events

PAW^2 world (i.e. every four weeks in the real world) and the results (how many flowers bloomed and who planted which type of the flower seeds) were reported via the mailing list every day after the spring season, i.e. in the following summer in PAW^2 (Figure 5.9). These are also good examples to show that users have created their own content based upon PAW^2.

In addition, we observed that a “Search for a cat!” game and a “PAW^2 card” event were held in off-line meetings as a user event in the real world. Basically, both of them were based upon the same events provided by PAW^2. These events were played by all participants in the off-line meeting. The former is a game in which one participant walks around in the real world holding a stuffed toy cat and other participants tried to catch him/her. The latter is a game in which all participants try to collect the PAW^2 cards, which are made of paper and stuck on walls or benches in the real world where the off-line meeting is being held. In both games, the winners got a real prize from the sponsor of the off-line meeting.

#### (4) Manners (PA-nners)

We observed that users have established dedicated conventions (or manners) about social life in PAW^2. This is the virtual society version of “netiquette”. For example, they include the following rules: “Say hello back, when someone say hello to you”, “Don’t pick up the dung of other user’s personal agent”, and “Write a short profile about yourself on your name card”. These manners were called “PA-nners” (for PAW^2’s manners) by users and were mainly maintained in the home pages of PAW^2’s communities, although, more often, social conventions are implicit in real life. These social manners are also observed in other virtual worlds (Becker and Mark, 1998; Taylor, 2002; Cherny, 1999). Especially, the conventions about greeting

```
To: paw-users@***.co.jp
Subject: [paw-users:09294] The 3rd day report of blooming flowers
...
Hi, everybody in this mailing list ♪
I'm Kagari&Yuki.
☆☆☆ Today, four flowers are blooming!!! ☆☆☆
★ Haran-san's <Morning glory> ♪
★ Yoko-san's <Morning glory> ♪
★ (^_^) My <Morning glory> ♪
★ Kenjiro-san's <Sun flower> ♪
Congratulations on your blooming flowers~ ♪
(*^^)//. . :*: . ° '★,. . :*: ♪ . ° '☆
```

```
We can see cute flowers♪
The flower gardens are for all of us♪Please check them out♪
```

Figure 5.9 Mail reporting a user event (Courtesy of Kagari&Yuki)

and features of MUSVE are a common manner in media that enable social interaction. It is interesting in PAW^2 that common conventions and original manners based upon characteristics of community are co-existed in its home page.

In terms of conventions related to features of MUSVE, for example, the manners related to dung are unique to PAW^2. They are originated in the trouble occurred between the user who picked up the dung of other user's personal agent and the other user. The problem is due to the fact that dung can be recycled into virtual money of PAW^2 (Section 4.4.1). To deal with the problem, we need to improve PAW^2's Object Manager (Section 4.7.1) to allow only owner of a personal agent to pick up the dung of her personal agent within three minutes after the personal agent did the dung.

## (5) Roof climbers

We observed users who chatted each other on the roof of houses in PAW^2 world. As we described in Section 4.3, a personal agent always follows her owner and waiting for her owner's instruction in front of her. However, when users are hooked on a conversation with other user, they seem to want to keep their personal agent away for a while.

PAW^2 system is not designed to allow a personal agent to climb up on the roof of a house. According to the report from field works, this was an activities originated by the users who found out the limitation of PAW^2 system. While a user is on a roof, her personal agent does not follow her and is sitting down with facing toward the wall of the house. It is because PAW^2 geographical manager (Section 4.7.4) does not support the paths over the house. To deal with this kind of user's requirement, we improved PAW^2 system to add a new command "Go play!" for a personal agent. When a personal agent receives the command, she will go to somewhere in PAW^2 world until her owner will call her again.

## (6) Handle name

Originally, the handle name system of PAW^2 (Section 4.4.1) was designed to identify each PAW^2 user. However, we observed several characteristic uses that we had not anticipated.

- **Community name:** By using the function for changing a handle name freely, most users belonging to a community appended the community name to their handle name with "@". For example, "Toto@Rescuers" was chosen by the user with the handle name "Toto" after she jointed the community name "Rescuers" which she belongs to. In the Dreamscape (Habitat), more general or longer-term affiliations are expressed via an

embodiment through avatar's color choices, bodies, accessories, and heads (Taylor, 2002). Users also often choose a name that indicates group affiliation or partnership with another avatar by adopting a name with a related theme. PAW^2's restricted function to customize avatar and PAW^2's chat message with handle name (Figure 4.3) seem to create this characteristic use.

- **User status:** Most users used the handle name system as a kind of communication tool to unspecified users by taking advantage of the function to change a handle name and display the change in real time. For example, a user could use the function to change her handle name "Toto@Rescuers" to "Toto@I\_am\_unavailable\_for\_a\_moment"<sup>1</sup> to announce her current status when she was away from her PC while still accessing PAW^2. Another example was "Toto@I\_am\_hooked\_on\_Italian\_cuisine"<sup>2</sup>, used to show that she found something of great interest. When her status changed, she changed her handle name back again. This dynamic real-time changing of handle names lets other users know a user's status easily from a modified handle name displayed in the user's chat message, scouter<sup>3</sup> of avatar, and her name card. Similar social phenomena using attributes of virtual world in a handle name have also been observed (e.g. in Habitat) (Farmer, 1994). However, the interesting point is that the handle name system acted as a new communication tool — neither a text chat system nor an e-mail system — for giving short messages to unspecified users. In MUD, Churchill and Bly (1999) reported that users felt that MUD is an intermediate system between phone and e-mail because both modalities apply. From the viewpoint, PAW^2 handle name system can be seen as further intermediate system. Meanwhile, similar to the first example, a social convention about silences during conversation is also observed in other virtual worlds (Taylor, 2002). For example, in Onlive Travelers (DiPaola and Collins, 1999), such silences are generally explained after or beforehand, e.g. "Excuse me, I have to take a telephone. I'll be back in a minute." We can see that PAW^2's handle name is also used to explain and keep the status.
- **In communities:** Some community users created unique handle names for their communities using an HTML tag, which can be specified in chat message. For example, "Mimi-zoku"<sup>4</sup> members created unique face

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<sup>1</sup> In Japanese, "とと@離席中".

<sup>2</sup> In Japanese, "とと@イタリア料理に夢中".

<sup>3</sup> Special user interface to display text information over 3D object. See Appendix A.

<sup>4</sup> "Mini-zoku" means "ears gang" based on their handle names. In Japanese, "耳族."

marks as their own community names. A cat face was generated by specifying the text string “Ω Ω<BR>(=^=)” in handle name (Figure 5.10). Here, the tag <BR> inserts a new line. You can see “Ω Ω” as a ear of a cat and it is the reason of their community name. We can understand that this function allows users to create more unique handle names. However, this handle name needs two lines in one chat message. Some users can not accept that. Therefore, we need to provide the additional function to ignore the HTML tag or guidelines for handle name.

- **In off-line meetings:** As described in the previous section, PAW^2 communities often held off-line meetings in the real world. These communities used their home page and/or a mailing list to call for participation in the meeting. We observed that, in the off-line meeting, participants all referred to each other by their PAW^2 handle names instead of their real names. Thus, we can understand that they tried to bring their relationship in PAW^2 into the real world. This gives participants a base of mutual knowledge for breaking the ice and communicating with each other in the real world.
- **In mailing lists:** When writing e-mail, most users used their handle names together with name of their personal agent. For example, “Toto” concatenated her handle name with her personal agent’s name “Wanta” by using “&” as “Toto&Wanta” (see also the fifth line of Figure 5.9). We often observed this phenomenon in user mailing lists. This is a good example that illustrates the presence of a personal agent was widely accepted by PAW^2 users.

We regard these activities as a kind of social or cultural activities formed based upon the use of PAW^2’s functions that we never anticipated.



Figure 5.10 Example of unique handle name.



## (7) User support

User support is one of important issues for operating network services like PAW^2 and it is important how we provide more user-oriented support. As described in Section 5.3.1, we provide two types of mail services to support users: paw@\*\*\*.\*\*.jp and “Takepon” mail.

Comparing them, we found that users tended to post more intimate messages to “Takepon” than to paw@\*\*\*.\*\*.jp. This helps us to gather more user-oriented information and carry out more intimate user support. In addition, “Takepon” received more messages (about 20 per day) than paw@\*\*\*.\*\*.jp (about 10 per day). We conclude that “Takepon” is a good way to provide user support in parallel with a conventional user support mail service like paw@\*\*\*.\*\*.jp.

## (8) Anti-social behaviors

Like a real society, the virtual society like PAW^2 experienced several social phenomena which should be called social problems. They affected the social life of other users in PAW^2 as the number of users increased. This type of behaviors is also observed in other virtual worlds (Dibbell, 1994; Becker and Mark, 1998).

- **Rude speech:** This is a virtual society version of the problem observed in traditional chat systems and BBSs, where some users say unpleasant things to others. Most communication media have the same problem. We dealt with this problem by providing a mute function described in Section 4.7.8.
- **Stalking:** We observed some users stalking a specific user by using the “Meet” function provided by PAW^2’s name card system. This function allows a user to fly directly to a specific user and meet them by selecting the user’s name card from the PAW^2’s control panel. We dealt with this problem by changing the function so that it could not be used unless both users have each other’s name card (Section 4.7.8).
- **Dung throwing:** We observed some users throwing their personal agent’s dung at other users by using PAW^2’s “Throw” function. We regard this behavior as equivalent to hurling abuse or physical objects in the real world. However, the problem was alleviated by recommending the user, who was thrown the dung, to exchange them for the PAW^2’s virtual money by user support (see also Section 4.4.1).
- **Suppressing the speech of others:** In text chatting, we observed some users interfering with other users’ conversation by typing blank characters (e.g. a carriage-return) or using a <FONT> tag function (see Section



4.4.1) to input black characters<sup>1</sup>. In the PAW^2 system, multiple users' conversations in one area (aura) are displayed in a sequence in each user's multi-user window, so such behavior can easily disrupt the sequence. To deal with this problem, we improved the PAW^2 system by disabling the input of such invisible messages and showing a warning message to any user trying to do so when the system detects her from the server-side.

- **Invisible human:** Existing WWW BBSs or chat systems allow read-only members (ROMs) or guests who can only read other users' messages but not post their own. To implement ROMs in PAW^2 — 3D MUSVE, we introduced a function to create invisible humans in the first stage of PAW^2. We considered that a ROM is a user invisible to other users in 3D MUSVE. ROM (invisible human) can see other users' avatars and read their chat messages but the other users cannot see her avatar. We naively thought that this would help novices or users who want to participate in PAW^2 without chatting or being disturbed by other users. However, we removed this function after receiving complaints from users about voyeurs invading their privacy. Many users like to chat intimately about private topics on the assumption that they know who is listening: this is quite unlike BBSs or Internet chat rooms where people know that messages might be read by anyone, it's more like a private real-world conversation behind closed doors. Our user support tried to ascertain the reason. We found that the awareness provided by chatting with other users with seeing their avatar (appearance) could increase a degree of privacy of conversations in PAW^2, even though the PAW^2 world is the media in which everyone can participate like a BBSs or chat systems. They did not appreciate having invisible watchers whose presence they could not detect.

Except for the above, we also observed some users who barred other users' way or dashed themselves against other users by using their avatar.

Based upon these observations, we regard that the flexibility that is provided by the social system has a strong possibility of being used for anti-social behavior which the flexibility makes possible. Also, we can see similar tendency in other virtual worlds. For example, LambdaMOO (Cherny, 1999) provided manners to prevent anti-social use of the LambdaMOO's functions. It includes the following manner: "Shouting (sending a message to all connected players): Don't shout unless you have something everyone needs to hear. This basically means emergency system messages from wizards."

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<sup>1</sup> As showed in Figure 4.1, background color of a multi-user window which displays user's chat message is black, so black characters are invisible to readers.

In terms of user's reaction to these anti-social behaviors, we observed that users were very sensitive about them and tended to post complaints about them to user support mail, such as "I was thrown dung. Stop <user name> doing that!" Although, in reality, there were limited, small numbers of users who behave anti-socially in PAW^2, most users who have met with them become sensitive, tend to think that most other users are doing the same things, and have terror of them. According to the number of the complaints posted to user support mail, we consider that the number of users who behave anti-socially seems to be much less than that in other virtual worlds. One of several possible reasons for that is that autonomous chat messages in infantile expressions from a personal agent and her behaviors seem to be helpful. For example, when users unwillingly get into an altercation, their personal agents often say something independent to that (e.g. "I made a poop!") in infantile expression. It can create a friendly atmosphere among them.

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## 5.4. Summary of this Chapter

PAW^2 is a social space with various infrastructures. In PAW^2, a user can participate in various activities, which is an improvement over other simpler virtual spaces based upon avatars and text communication alone. In addition, PAW^2 provides several types of events and games. These allow users to organize various activities in PAW^2. In this chapter, we focused on user activities carried out in PAW^2 and described about them from the two viewpoints: statistical characteristics of user activities and social activities based upon observation.

In terms of statistical characteristics of user activities, we observed that the most frequent user activities were basic system functions plus activities picked-up by user's observing other users' behaviors, e.g. "chatting", "obtaining items", and "recycling" items. In terms of personal agent-related activities, "name calling" was the most frequent activities. Based upon trend analysis, we found that the rate of heavy users was independent of the previous PAW^2 experience. In addition, we found that the combinations of user activities changed gradually. We learned that a personal agent, which is one of the characteristic features of PAW^2, had a significant impact on first-time users. Afterward, user activities gradually shifted to communication and events and games-related activities.

In terms of social activities, we observed many social phenomena, such as formation of characteristic communities, interesting home pages provided by PAW^2 users, user events, and PAW^2's manners. In these observations, we found a kind of cultural/creative activity formed based upon the PAW^2's functions, that we never anticipated and provides a positive feedback loop to enrich the environment. Users took advantage of the limited PAW^2's functions skillfully and utilized them

to help their life in PAW^2. In addition, other Internet technologies, such as home page, help them. We compared our observations with other virtual worlds and found some commonality.

These results show that initially most users are accessing PAW^2 simply to enjoy the service provided by the system but they gradually organize the unique social/cultural phenomena and creative activities in PAW^2 while operating the system. PAW^2 is functioning as a kind of medium for these phenomena/activities.

On the other hand, we observed anti-social behaviors hinder social life in PAW^2. We regard that the flexibility that is provided by the social system has a strong possibility of being used for anti-social behavior which the flexibility makes possible. We also showed our approach to deal with these behaviors technically.

## 6. E-commerce Extension

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### 6.1. Introduction

E-commerce has been defined as a transaction between two or more parties through an electronic medium (Kalakota and Whinston, 1997). Rapidly growing figures for online sales of real goods (e.g. computer hardware and software, travel, books, music, videos) show that e-commerce is becoming increasingly popular (Meeker and Pearson, 1997). For example, in January 1999, Dell Computer Corp. sold an average of 14 million dollars worth of equipment per day online (Dell Computer Corp., 1999). Amazon.com has become the third largest bookseller in U.S. in only 5 years (Lohse and Spiller, 1998). In these cases, the Internet functions as an additional distribution channel for real goods, and research in the area of e-commerce has focused mainly on this type of electronic distribution.

Few researchers have looked at the relation of e-commerce and network services, especially regarding the role of e-commerce “within” network services (Koike, 1997). However, it is important to realize e-commerce within a MUSVE for enhancing existing e-commerce with virtual environments. It could also bring about new social activities in MUSVEs. From the e-commerce point of view, a virtual society offers great possibilities for the creation of a new market besides the real world, because it can take the function of an alternative real world. Of course many real goods such as clothes, books or movies are bought and sold in the real world, so it is conceivable that users would consider buying desirable or necessary goods in a virtual world. If we can sell these goods in the virtual world like real goods, it should therefore be possible to extend activities that are classified as B2C (Business-to-Consumer) e-commerce from the real world to a virtual world. E-commerce involving virtual commodities will make it possible to introduce a new type of goods into not only a virtual world but also the real world.

To investigate that possibility, first of all, we evaluated business models using a virtual society. Next, we extended a virtual society (i.e. PAW<sup>2</sup>) for realizing the business model. Then, we conducted e-commerce experiments to evaluate the business model and its impact on PAW<sup>2</sup> users. In the experiment, we focused on selling virtual goods for real money in PAW<sup>2</sup>. The goods for sale are available only in the virtual world and do not have any meaning in the real world. Our underlying hypothesis for this experiment is that defining the meaning or value of a virtual object in a virtual society makes it possible for that object to be successfully sold like real goods using real money.

In this chapter, we describe the possible business models based upon a virtual society. Then, we describe the design and implementation of the e-commerce extension to PAW<sup>2</sup>. Next, we describe the outcomes of experiment that was conducted over a period of about two months, and analyze the gathered statistical information about the users' purchase behaviors. We also discuss the possibilities of conducting e-commerce in a virtual world and the creation of a new market in networks.

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## 6.2. Business Model

Various business models can be constructed based upon a virtual society (PAW<sup>2</sup>). In the following sections, we describe the possible business models by using PAW<sup>2</sup> as an example and which business models were selected for the e-commerce extension to PAW<sup>2</sup>.

### 6.2.1 Possible business models

Since a virtual society is a network service, basically there are two types of business model for the virtual society: general business models for network services and virtual society-oriented business models.

The following points are general business models for network services. These business models can be applied to general network services.

- Selling software: in case of PAW<sup>2</sup>, for example, CP browser and PAW<sup>2</sup>'s client software can be sold as a software package.
- Membership fees: Like ISPs (Internet Service Providers), membership fees can be collected per month or per access to the service. In this case, the software should be provided free of charge.
- Advertisements: Commercial or personal advertisements within the service, similar to banners in Web pages. For example, advertising rates

can be collected for showing 3D signboards in PAW^2 that display advertisements for real goods.

- Revenue sharing with ISPs: Some ISPs collect membership fees based upon access duration. For example, the average length of a PAW^2 user's access time is three hours per day (see Table 4.1). We could share a portion of membership fees with ISPs by providing PAW^2 as part of their network service.

The followings are virtual society-oriented business models. The important point for these models is that we can apply business model to something existing "within" a virtual society.

- Selling virtual goods: For example, items provided by PAW^2 (see Section 4.4.1) can be sold as goods using real money, such as various accessories for avatars.
- Selling houses or renting rooms: Selling houses or collecting rental fees of rooms in a virtual society. For example, PAW^2's communities (see Section 5.3.2 (1)) could use the rooms for on-line meetings.
- Selling personal agents: Collecting fees for possessing personal agents or selling new types of personal agents, such as cats or birds.
- Selling avatars: Selling new shapes of avatars.
- Events participating fees: Collecting fees for participation in events provided within a virtual society. For example, as described in Section 4.9.4, participation of events was high and heavy access patterns were observed on days when an event was held in PAW^2.
- Charging for using communication functions: Similar to charging for cell phone usage in the real world, it is possible to collect rental fees for using communication functions in a virtual society, such as the in-world pagers, mail, and the BBS (see Section 4.4.1) in PAW^2.

## 6.2.2 Discussion

We evaluated these business models from the following viewpoints:

- **Impact of the business model upon PAW^2 users:** Since PAW^2 is a multi-user social system, it is important to maintain the existing communities and users in PAW^2. If the business model hinders the growth of the communities and number of users, the service itself is hard to keep running.

- **Easy to understand the business model:** If the existing PAW<sup>2</sup> users find it difficult to understand the business model, the model is hard to be accepted by the users. It should be easy for them to understand.
- **Easy to use the business model with other business models:** One of the advantages in terms of constructing business models based upon a virtual society is enabling the business model to co-exist together with other business models. We should avoid using exclusive business models.
- **Easy to implement the business model:** If the business model requires the negotiation with other business partners, such as other companies, the model can not be realized until completing the negotiation with these partners. For example, in the advertising business model, we need to find advertisers before starting the business.

Based upon these viewpoints, we selected the virtual society-oriented business models. However, we excluded the business model “charging for communication functions” from them because we think that the communication functions play an important role in maintaining communities and users. This is also supported by the results described in the previous chapters. Other virtual society-oriented business models have common characteristics in selling something that already exists in PAW<sup>2</sup> to users<sup>1</sup>. They do not hinder the growth of the communities and number of users, and can be easily implemented by ourselves. In addition, PAW<sup>2</sup>’s existing social infrastructure can be utilized for delivering the items sold in these models. In these business models, we can utilize a virtual society as a new market place.

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## 6.3. Design and Implementation

In order to extend PAW<sup>2</sup> to realize the business models described in the previous section, the PAW<sup>2</sup> system need to link with various ISPs’ e-commerce systems selling real goods, especially with their accounting systems.

### 6.3.1 E-commerce systems

Most e-commerce systems consist of the following three processes:

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<sup>1</sup> Renting rooms and event participation fees are slightly different from other virtual society-oriented business models. However, we can treat them as selling rights that exist in PAW<sup>2</sup>.

(P1) Inputting purchase information

Information about the goods, such as an image or price of the goods, is provided by a retail Web page. When a buyer purchases the goods, she<sup>1</sup> needs to select the goods and input both the required quantity and her ID. After inputting the information, the total price is displayed and she needs to push the “confirm” button to confirm and complete the purchase process. Then, this information is stored into a database and is also passed to a delivery service company.

(P2) Product delivery

After sending the information to the company, the goods are delivered to the buyer by using one of several delivery systems, such as a courier service or postal mail system.

(P3) Charging fees

After the buyer receives the goods, the total price of the goods is charged to her bank account or credit card.

As described in Section 4.7, PAW^2 system provides its own user management system and object management system. To realize the business model to sell something that already exists in PAW^2, essentially, the process described in (P2) needs to be developed anew. We could partially utilize the process described in (P1) and (P3) in case of selling something that exists in PAW^2. However, we need to extend the process (P1) to be able to send purchase information to PAW^2 system and for the system to receive this information. In addition, we need to extend the process (P3) to be able to receive delivery information from the PAW^2 system for notifying that buyers received the purchased goods in PAW^2.

## 6.3.2 Extension to PAW^2

Figure 6.1 shows the e-commerce extension to the PAW^2 system. In the figure, buyers purchase virtual goods using a retail Web page (1) like real goods. A buyer has to enter purchase information into the forms provided by the page (2). The information is stored into a database (3) and then passed to the purchase daemon (4). The purchase daemon encrypts the information and sends the encrypted information to the PAW^2 system (5). The purchase daemon in the PAW^2 system receives and decrypts the information. Then it stores the decrypted information (i.e. the buyer's purchase information) into the PAW^2 database (6). With these processes, inputting purchase information described in (P1) is completed.

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<sup>1</sup> Note: Both female and male buyers exist in the Internet, however for writing brevity we write simply “her” when referring to buyers of either gender.



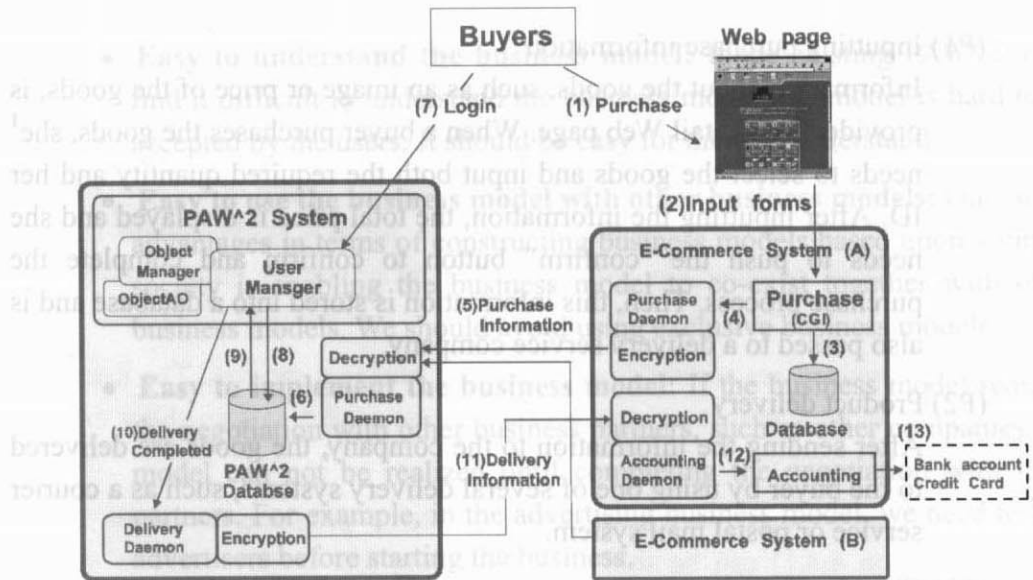


Figure 6.1 E-commerce extension to the PAW^2 system

When the buyer accesses PAW^2 (7), the User Manager in PAW^2 system retrieves her belongings information from the PAW^2 database (8). At this moment, the purchased goods are delivered to the buyer (9) and the User Manager notifies the completion of its delivery to the delivery daemon (10). The delivery daemon encrypts the delivery information and sends the encrypted information to the e-commerce system (11). The delivery daemon in the e-commerce system decrypts the data and passes the information to the accounting system (12). Finally, it charges the purchase price to the buyer's bank account or credit card (13).

### 6.3.3 Security

Clearly, security is important in any e-commerce system. As described in Section 4.7.7, in CP system, each user (i.e. CP browser) maintains only local cache data of either AOs or database in server-side while she is accessing PAW^2. The CP system does not need to rely on the local data. In addition, every user can not access the computer system in which the AOs or database is running when the computer system locates in separated network segment from the Internet. Therefore, PAW^2 can provide a secure business model in terms of selling something which exists in PAW^2.

Suppose that a user purchased something which exists in PAW^2. We referred to it as "goods." The user needs to access PAW^2 to obtain the goods. During accessing PAW^2, the user can confirm that she has it in her belongings. Even if she duplicates the goods dishonestly (e.g. from 1 to 2) in her browser, the number of the goods in a server-side database are not changed. It is because the browser does not send and store the updated number into the server-side database.

Even if she could duplicate the goods and give it to other user, the number of the goods in the server-side database will be simply decreased by 1 to 0 by PAW^2 system. This is because the system checks only the database but does not refer to the local cache data in the browser (Figure 4.17 (2)).

In case of selling items or a personal agent, a user may duplicate their component data, such as their polygon data or texture data since these data exist in her browser. However, these data do not work as an item or a personal agent as long as these data do not bind to an appropriate AO in PAW^2 system. In order to protect these data, we can take advantage of the watermarking technology (Benedens, 1999).

## 6.4. Evaluation

Based upon the business models described in Section 6.2, we conducted the following e-commerce experiment to evaluate them.

### 6.4.1 Methodology

Our e-commerce experiment consisted of selling PAW^2 items for real money. The items are virtual goods which are available only in the PAW^2. As we described in Section 4.4.1, an item is a fundamental element in PAW^2's economic system. They do not have any value or meaning outside the PAW^2. For example, a PAW^2 accessory item can function as an avatar's accessory (see Figure 6.2), but is just a bitmap data in the real world. Actually, it is implemented as a transparent GIF format (Shade et al., 1998) to define a non-rectangle image.

In our experiment, we sold these goods the same way real goods (e.g. books or music CDs) are sold on the Internet. We prepared a special Web page (see Figure 6.3) that allows users to buy a virtual item. The page contained the name of the goods, their image, their price, and a brief description of them. A user could buy an

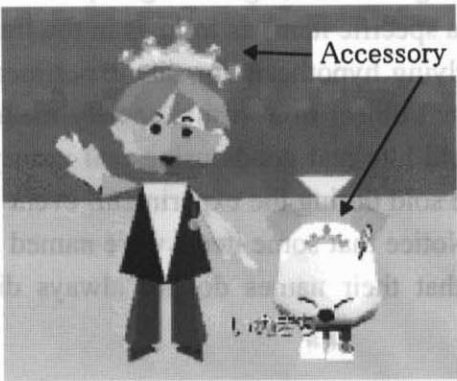


Figure 6.2 Avatar with accessory

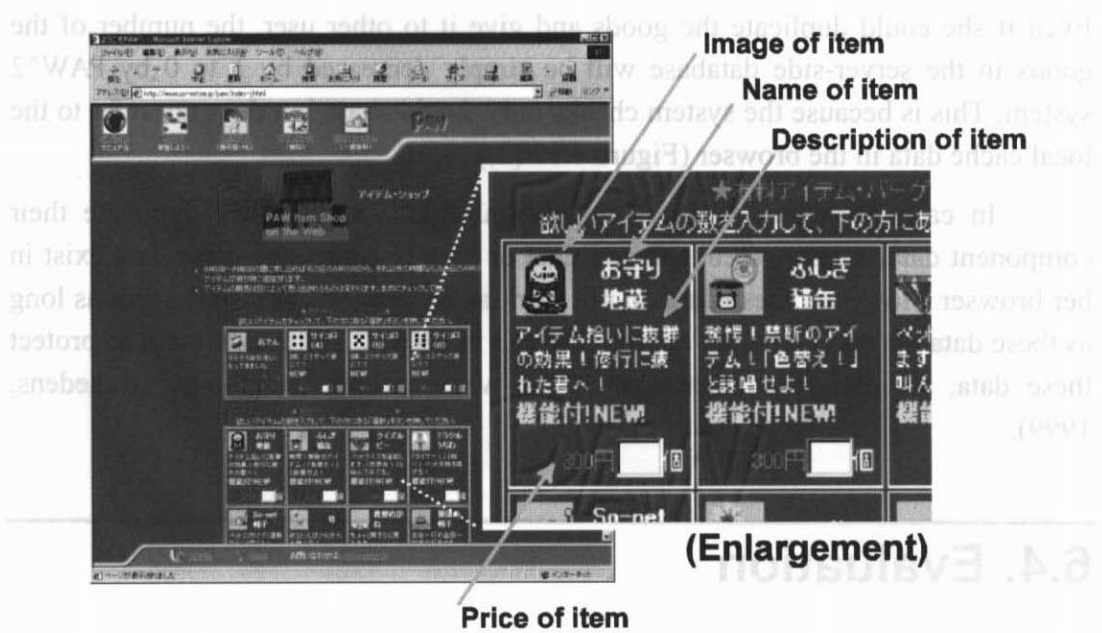


Figure 6.3 Retail web page for PAW^2's items.

item by inputting a number of the item and then clicking the submit button. The interface of this Web page is typical of the ones employed to sell real goods on the Internet.

During the experiment, we gathered statistical information about users' purchase behavior regarding these goods (e.g. who bought what and how many). The information was stored in PAW^2's database and subsequently analyzed.

The experiment was carried out for about two months from September 5 1999 to November 20 1999, a period that is roughly equivalent of two years in the PAW^2 time system.

## 6.4.2 Selling Item

As described in the previous section, each item is implemented as a bitmap data. We gave them a meaning or value (e.g. adding a special function, or increasing the likelihood of obtaining a specific item) as follows in the framework of the virtual society PAW^2. Our underlying hypothesis for this experiment is that defining the meaning or value of a virtual object in a virtual society makes it possible for that object to be successfully sold like real goods using real money. The following four types of PAW^2 items were sold during the experiment: event items, function items, accessories, and flowers. (Notice that some items were named after their appearance in the virtual world and that their names do not always directly relate to their meaning.)

# Event items

The two kinds of event items that were sold for 300 yen (about 3 US dollars) each were the “Omamori-Jizou” (guardian) and the “Mahou-no-Ranpu” (magic lamp)<sup>1</sup>. While users can obtain several types of event items as a reward for participating in PAW^2 events (see Section 4.5), these two items are much harder to get than other event items and provide a special function.

Users can obtain an “Omamori-Jizou” as a reward by participating in the PAW^2’s summer event. With the start of the summer season, “Omamori-Jizous” appear in the PAW^2 world. When a user clicks on one of them, it will say “You need to practice!” to her and fly her to a random place in the PAW^2 world. The user has to walk back to the place where the item is and click on it again to get it. It accumulates how many times it was clicked for all users but does not remember who clicked it. When a user clicks the item for the 100th time, she can finally obtain it, giving each user a 1% chance of getting such an item. Once in the possession of an “Omamori-Jizou”, the user can obtain other special items which users without an “Omamori-Jizou” are much less likely to obtain.

The “Mahou-no-Ranpu” is an item users can obtain as a reward in the Beckoning cat event. With the start of the spring season, several Beckon cats<sup>2</sup> (a cat with a beckoning paw) appear in the PAW^2 world. When a user clicks one of them, it will walk away from the user and say “Follow me!” The user has to follow the cat to get to the “Mahou-no-Ranpu”. With the 30th click, the user can get it as a reward. The possession of it prevents the user’s personal agent from getting sick.

Obtaining these two items requires a lot of practice, but once owned by the user their functionality adds special value to her.

# Function items

Among the seven kinds of function items sold for 300 yen (about 3 US dollars) each were the “Fushigi-Neko-Kan” (canned foods), the “Dejitaru-Geta” (Japanese wooden footwear), the “So-net Boushi” (So-net hat), the “Quiz Ruby”, and the “Quiz Sapphire” item<sup>3</sup>. Unlike other items, these items have capability to enhance a personal agent. When owned by a user, these items add a special functionality to her personal agent. “Fushigi-Neko-Kan” can change the color of a

<sup>1</sup> In Japanese, “お守り地蔵” and “魔法のランプ”.

<sup>2</sup> Small statuettes of cats with one raised paw. Usually depicted as a white cat with brown and black spots, it welcomes in customers and is a wish for business success and personal happiness. See <http://www.msgeek.com/cats.html>.

<sup>3</sup> In Japanese, “不思議な缶”, “デジタル下駄”, “So-net 帽子”, “クイズルビー”, and “クイズサファイア”.

personal agent, while “Dejitaru-Geta” functions as a calculator. The “So-net Boushi” provides a fortune-telling function<sup>1</sup>. The “Quiz Ruby” and the “Quiz Sapphire” are items which allow the owner’s personal agent to take part in a new quiz. This information is showed in the retail Web page for PAW^2’s items (see Figure 6.3).

The functionalities added to a personal agent by these items are initiated by the owner’s natural language commands. For example, when a user holds a “Fushigi-Neko-Kan” item, she can change the personal agent’s color freely by giving the command “Change color!” In case of “So-net Boushi”, it is “Tell my fortune!” Through natural language commands the new functionalities are seamlessly integrated into the range of existing services provided by a personal agent (Section 4.3.3).

### Accessories

The twenty-six kinds of accessories that were sold for 100 yen (about 1 US dollar) each include glasses, several types of hats, caps, and badges. They can be worn as an accessory by the user’s avatar or her personal agent. Unlike the event and function items, they do not have a particular functionality. For example, when a user puts on glasses, she does not see a scene more clearly. Figure 6.4 shows some examples of accessories. By using them in combination with the PAW^2’s functions for customizing an avatar color, the user can become and play the role of Santa Claus, a gentleman with a silk hat, and a nurse (see Figure 6.5).

### Flowers

Six kinds of flowers were sold for 100 yen (about 1 US dollar) each, including chrysanthemums, roses, and balloon flowers. The flowers which users can get during the PAW^2 sowing event are hard to obtain. During the event, a user can



Figure 6.4 Examples of accessories.

<sup>1</sup> The function of the item utilizes a fortune-telling service in the WWW (so called “cgi service”). When it is carried out in AO’s server-side script, it connects to the service by using HTTP to execute the CGI scripts in the fortune-telling service. Then, it receives the results of the service through the http connection. This shows one of the flexibility of AO architecture.



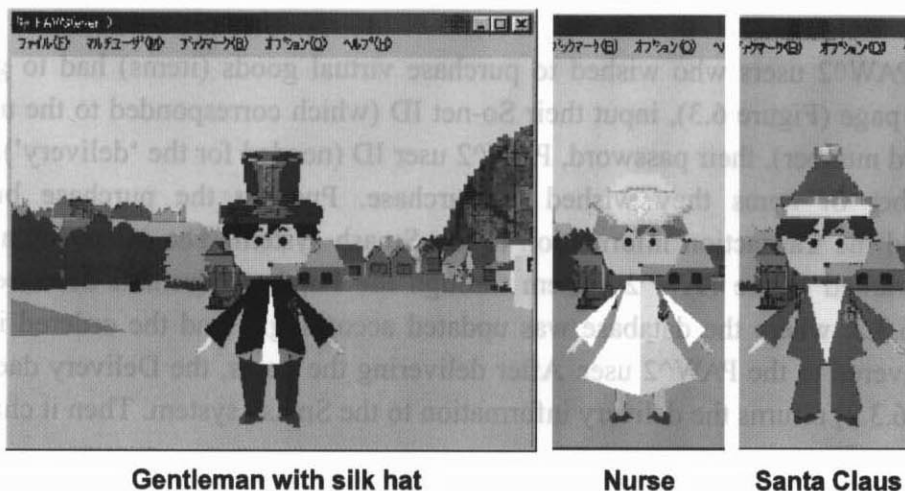


Figure 6.5 Role-play with accessories.

buy flower seeds at PAW^2 shops and plant them in the PAW^2's spring. The following summer, only up to 1,000 seeds planted will bloom. However, the 40,000 to 50,000 seeds are planted in the PAW^2 spring. This means that each user has about 2% chance of growing a flower from a seed. Unlike the event items, flowers merely functionality as accessories or presents. During the PAW^2's summer, for example, we can observe that users with a male-type avatar often present roses to female-type avatars in PAW^2 world.

In PAW^2, users can discard all items using a convenient “put” button from the control panel. The one exception to this are purchased items. This ensures that users do not accidentally discard an item they have purchased. However, purchased items can be passed on to other users (see Section 4.7.8). This allows users to give a purchased item as a present to other users who can not purchase it.

### 6.4.3 Payment system

In order to be able to collect fees, especially small amount of money, from PAW^2 users for our experiment, we used the Smash<sup>1</sup> payment system provided by So-net. It is originally for customers who use credit cards to purchase real goods from the So-net retail Web page. There are two reasons to use Smash system: It can collect a small amount of money and PAW^2 system is running in So-net network. So-net ID is required for purchasing goods by the Smash system. Therefore, in addition to PAW^2 user ID, PAW^2 users need the So-net ID in this experiment. Any user can freely get the So-net ID only to purchase goods by registering her credit card number.

<sup>1</sup> [http://www.so-net.ne.jp/smash\\_pro/](http://www.so-net.ne.jp/smash_pro/) (in Japanese)

PAW^2 users who wished to purchase virtual goods (items) had to go to that Web page (Figure 6.3), input their So-net ID (which corresponded to the user's credit card number), their password, PAW^2 user ID (needed for the 'delivery'), and the number of items they wished to purchase. Pushing the purchase button transferred the transaction information to the Smash system. The information was then forwarded to the PAW^2 system through the Purchase daemon described in Section 6.3.2, where the database was updated accordingly, and the ordered items were delivered to the PAW^2 user. After delivering the items, the Delivery daemon (Section 6.3.2) returns the delivery information to the Smash system. Then it charges the fees.

## 6.5. Results and Considerations

After the experiment was completed, we analyzed the database from several points of view. Table 6.1 shows basic statistical information gathered in the experiment: the total number of sales, the total amount of money from the sales, and the total number of buyers.

Table 6.1 Basic statistical information on user purchase behavior.

|                        |   |
|------------------------|---|
| Total number of sales  | 7,616 items<br>(about 101.5 items/day, about 9.2 items/user)                            |
| Total amount of sales  | 1,145,800 yen (about 11,458 US dollars)<br>(about 15,277 yen/day, about 1,393 yen/user) |
| Total number of buyers | 1,779 users (23.72 users/day)<br>822 users (number of one-time users)                   |

The number of registered PAW^2 users for the duration of the experiment was 80,019. User access log indicated that about 10% of the registered users (8,005 users) accessed PAW^2 more than once. We refer to these 8,005 users as “active users” in this chapter. The numbers show that about 10% of the active users purchased items.

However, 34.9% of the active users, i.e. 2,793 users already had So-net ID which allows them to purchase goods easily in the payment system (i.e. Smash system) in this experiment. The other users need the registration of the system for purchasing goods. We refer to these users as “So-net users”. The numbers show that 29.4% of the So-net users made purchased.

The maximum amount of money which one user spent in this e-commerce experiment was 51,100 yen (about 511 US dollars).

### 6.5.1 Break-down of sales figures

To identify the types of item that were most attractive to buyers, we broke down the sales figures. Figure 6.6 shows the number of buyers per types of item, Figure 6.7 the number of sales per types of item, and Figure 6.8 the total amount spent on each type.

The figures illustrate that function items and accessories were the best-selling lines of items in this experiment. Although there was less choice among function items and they were more expensive than accessories, the numbers show that they were very attractive to buyers. It is not easy to evaluate how a personal agent influences user's purchase decision. However, we consider that these results indicate that the agent influences the purchase decision.

Since these items add new functions to a personal agent, the good sales

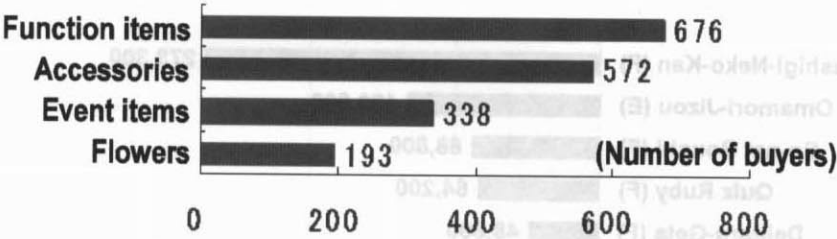


Figure 6.6 The number of buyers per types of item.

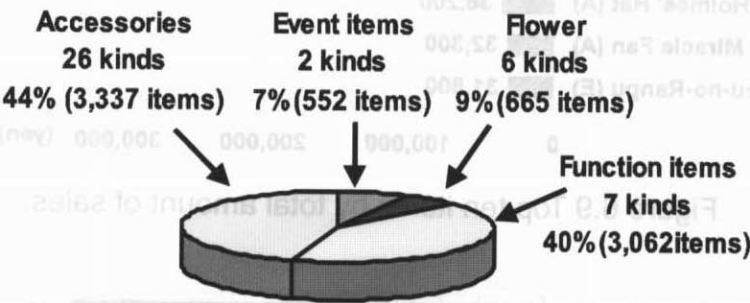


Figure 6.7 The number of sales per types of item.

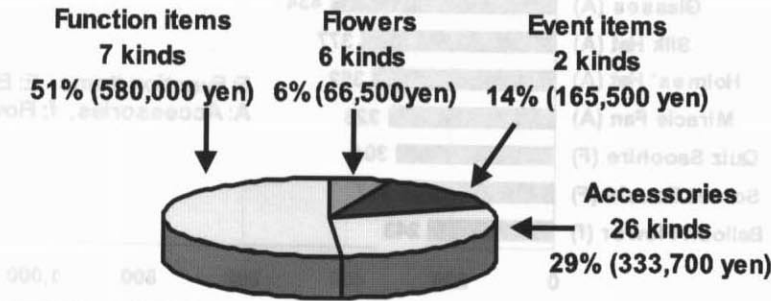


Figure 6.8 Total amount of sales per types of item.



results mean that functions of a personal agent are sold well. They indicate a special interest in a personal agent and point to a great potential for agent technology-based B2C business. We may be able to realize a new type of e-commerce based upon agent technology by selling functions of a personal agent.

### 6.5.2 Top ten items

We further analyzed the number of sales and the amount spent on purchases to find out which items sold well. Figure 6.9 shows the top ten items with regard to the total amount spent, Figure 6.10 the ten best-selling items. Figure 6.11 shows the top ten items with regard to the number of buyers.

The overall number one item was the function item “Fushigi-Neko-Kan” (see the left-side image of Figure 6.12) with 911 items sold for a total of 273,300 yen

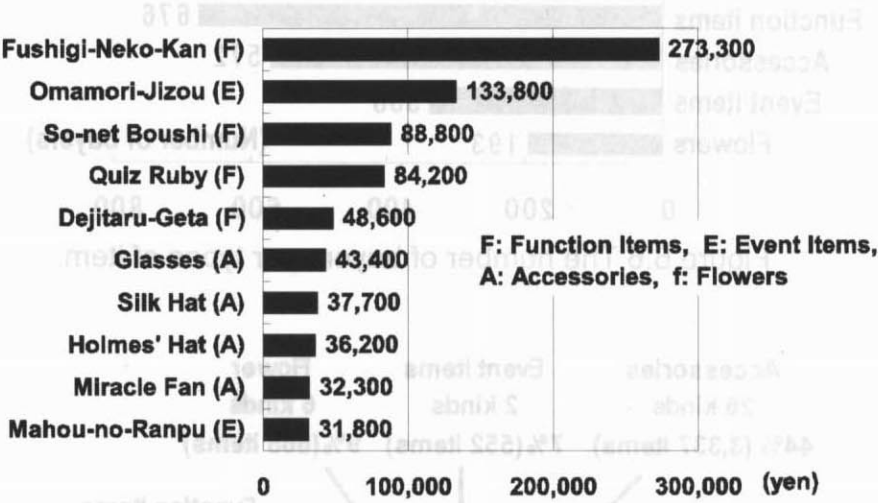


Figure 6.9 Top ten items by total amount of sales.

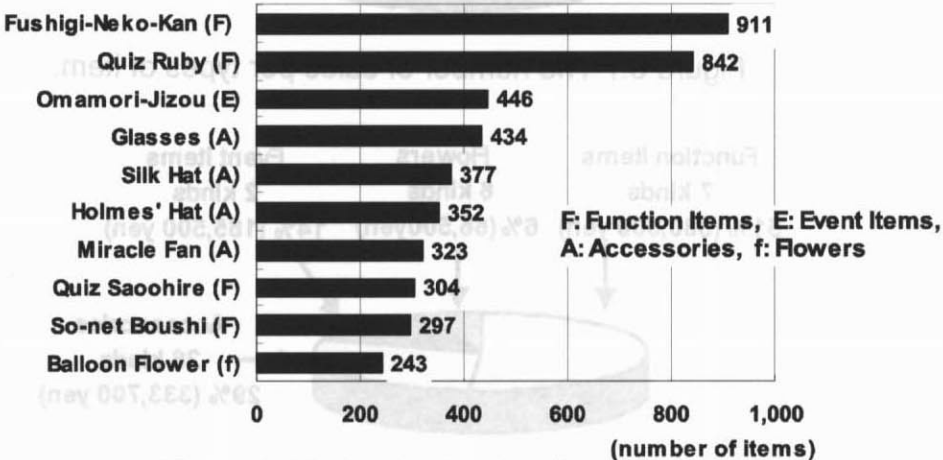


Figure 6.10 The ten best-selling items.

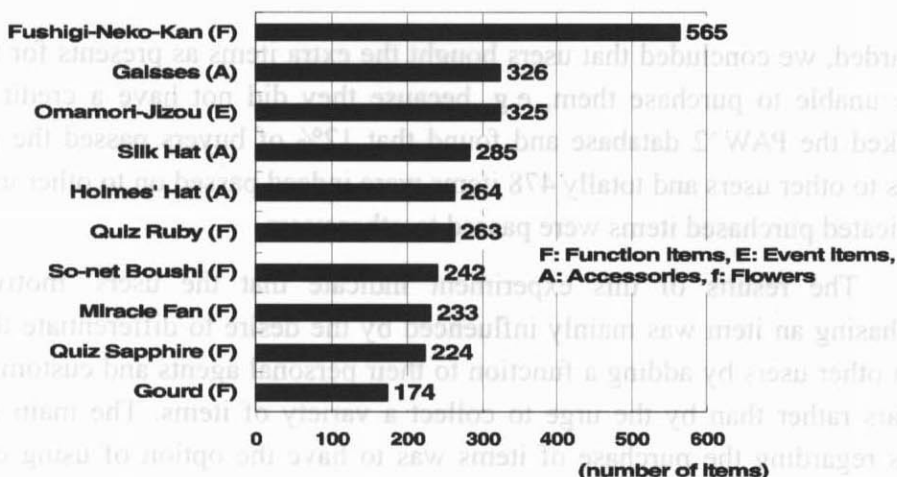


Figure 6.11 Top ten items by total number of buyers.

(about 2,700 US dollars). A comparison of these numbers to those of other function items illustrates that user purchase behavior depends on the degree to which a function enables the buyer to differentiate her appearance from that of other users. Other function items, such as the “So-net Boushi”, “Dejitaru-Geta”, “Quiz Ruby”, and “Quiz Sapphire” were also among the top ten.

The event item “Omamori-Jizou” (see the right-side image of Figure 6.12) also ranked in the top ten, with 446 items sold for about 133, 800 yen (about 1,300 US dollars). Figure 6.10 also contains “balloon flower”. Although the probability of obtaining a “balloon flower” (about 2%, Section 6.4.2) is slightly higher than (almost equal to) that for an “Omamori-Jizou” (about 1%), the total amount of sales for the latter was five times more than that for the “balloon flower” (243 items for a total of 24,300 yen or 243 US dollars). These results illustrate that the functionality of the “Omamori-Jizou” affected the user purchase behavior.

In addition, we compared the number of sales for each item to the number of buyers for each item (Figure 6.11) and found that the former tends to be larger than the latter. For example, 911 “Fushigi-Neko-Kan” items, and 377 “Silk Hat” items were sold to 565 and 285 users respectively, indicating that some users purchased more than two items of a kind. Since owning two items of a kind does not make sense in PAW<sup>2</sup> because an item which she bought is here to stay and can not be



Figure 6.12 The two best -selling items.

discarded, we concluded that users bought the extra items as presents for users who were unable to purchase them, e.g. because they did not have a credit card. We checked the PAW^2 database and found that 12% of buyers passed the purchased items to other users and totally 478 items were indeed passed on to other users. Most duplicated purchased items were passed to other users.

The results of this experiment indicate that the users' motivation for purchasing an item was mainly influenced by the desire to differentiate themselves from other users by adding a function to their personal agents and customizing their avatars rather than by the urge to collect a variety of items. The main request of users regarding the purchase of items was to have the option of using cash-based payment methods such as bank transfers.

### 6.5.3 User activities

Table 6.2 shows the comparison between buyers and non-buyers in terms of their activities taking place in PAW^2. It consists of the average frequently about each activity carried out by them for the duration of this evaluation. In terms of description of each activity, see Section 5.2.1 for detail.

Table 6.2 indicates that the buyers carried out activities in PAW^2 more frequently than the non-buyers. Also, it shows that buyers accessed PAW^2 repeatedly.

Table 6.2 Statistical information on user activities in PAW^2.

| Activity                           | Buyers | Non-buyers | Ratio |
|------------------------------------|--------|------------|-------|
| Chat                               | 3317.1 | 767.5      | 4.32  |
| Interactions with a personal agent | 163.2  | 39.8       | 4.10  |
| Obtaining items                    | 640.5  | 119.7      | 5.35  |
| Shopping                           | 222.9  | 36.8       | 6.06  |
| Beckoning cat                      | 7.8    | 2.6        | 3.00  |
| Spring event                       | 117.3  | 17.3       | 6.78  |
| Summer event                       | 45.6   | 7.0        | 6.51  |
| Autumn event                       | 4.5    | 0.7        | 6.44  |
| Winter event                       | 2.9    | 0.3        | 9.67  |
| Changing avatar color              | 2.0    | 0.5        | 4.00  |
| Access                             | 162.7  | 49.8       | 3.27  |

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## 6.6. Discussion

In this section, we compare and discuss the results of our experiment with the investigative report on the digital content distribution<sup>1</sup> (see also Section 2.5) as both deal with selling virtual goods. The investigations for the report were carried out by Info Com Research, Inc.<sup>2</sup> from December 1 1997 to January 18 1998. The term digital content in that report refers to electric news flashes, news distribution, software, electronic mail distribution services (mail magazines), and so on. This report analyzed Internet user's purchase behavior about the digital content using questionnaire.

In terms of the number of buyers, the results of the report showed that 27.3% of all respondents purchased digital content via the Internet. In our experiment, 10% of the active users purchased items (Table 6.1). As the target goods in the report differ somewhat from those in our experiment, it is hard to compare these results directly. However, we speculate that there is room to increase the number of buyers in PAW<sup>2</sup>. Meanwhile, 65.1% of the active users (5,211 users) needed to get So-net ID which allows them to purchase goods in the payment system of this experiment and 29.4% of the So-net users made purchased (Section 6.5). This result indicates that getting the ID could be a barrier to purchase items.

The report illustrates that 96% of all respondents were more than 20 years old. While PAW<sup>2</sup> is accessible on the Internet for users of all age, Figure 4.19 showed that the age range for PAW<sup>2</sup> users was 11 to 48 years and the percentage of users greater than 20 years old was about 75%. It appears that users in the PAW<sup>2</sup> experiment were younger than the participants of the digital content investigation. We assume that the number of potential participants in our experiment was limited, as users could not choose payment methods other than credit cards. This assumption and the result are supported by the fact that many participants requested cash-based payment options, i.e. providing that facility could increase the number of PAW<sup>2</sup> commerce users.

In terms of user expenditure, the report showed that most users spent 1,000 to 10,000 yen (about 10 ~ 100 US dollars) to purchase digital content and that the average expense per year was about 8,000 yen (80 US dollars)<sup>3</sup>. This means an expenditure of about 1,333 yen (13.3 US dollars) for two months, which is very similar to the average 1,393 yen (13.9 US dollars) for PAW<sup>2</sup> users (Table 6.1).

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<sup>1</sup> <http://www.commerce.or.jp/minfo/enq/report11/dcon1.html> (in Japanese)

<sup>2</sup> <http://www.icr.co.jp/index.html>

<sup>3</sup> Since the report does not give details about the exact amount of money spent by users in the "over 50,000 yen (500 US dollars)" group, we treated them as a statistical outlier and used 50,000 yen as a basis for our calculations.

Based upon this result, we can see that similar purchase behavior comparable size to that of digital content was done in PAW<sup>2</sup>.

One of several possible reasons for the similarity of these results is that PAW<sup>2</sup> is a MUSVE in which multiple users can simultaneously access the same space. We consider that this feature was acted as an advertising medium for virtual goods in our experiment, creating a kind of positive feedback loop that can be realized quite easily within a virtual society. For example, seeing one avatar who wears a certain accessory could entice other users to purchase the same item. It is however unlikely for this kind of advertisement effect to occur in the case of digital content purchases, because once purchased, the goods in use are not visible to others. This type of advertisement effect is unique to a virtual society.

In terms of the influence of a personal agent, we consider that the personal agent played an important role in user's purchase behavior. In terms of the number of sales, accessories were more sold well than function items (Figure 6.7) but it was just a difference of 10%. Also, the largest group in terms of buyers was those who bought function items (Figure 6.6), and the largest category in terms of the amount of sales was function items (Figure 6.8). The top ten items with regard to the total amount spent (see Figure 6.9) includes four function items and the ten best-selling items (see Figure 6.10) also includes four function items. Also, both of the results show that the function item "Fushigi-Neko-Kan" was the top. These results indicate that a personal agent influenced user's purchase decision in this experiment. Especially, since the best-selling item "Fushigi-Neko-Kan" adds a special functionality to change appearance of the personal agent, it illustrates that the feature of the personal agent as interface agent also influences the decision. If a personal agent did not have her embodiment, we would lead to other results. As described in Section 6.5.1, also these results point to a great potential for agent technology-based B2C business.

In terms of the difficulty of obtaining items, we consider that it is difficult to mention how the difficulty influenced user's purchase decision. In this experiment, event items and followers are the "hard-to-obtain" items. There were only two hard-to-obtain items in Figure 6.9 and Figure 6.10. However, "Omamori-Jizou" was the second best-selling item. As described in Section 6.5.2, we consider that its function was more attractive to users.

The existing e-commerce has been focusing on providing electronic retail methods. However, the results of our experiment show that it is possible to introduce a new type of goods, such as virtual objects, into the existing e-commerce enhanced with virtual environments. In addition, we consider that this type of e-commerce based on virtual environment can also be enhanced by other virtual environments. It can be achieved by enabling buyers to move to other virtual environments with their purchased goods. This functionality allows them to show the goods and present them

to other users in the other virtual environments. It can provide a similar situation where a passenger bought a souvenir in Japan, and went back to United States to pass it to her friend.

In conclusion, we can say that the results of our e-commerce experiment illustrate that there is more room for improvement with respect to the percentage of buyers for PAW<sup>2</sup>'s content than for digital content but the amount of users' purchase behaviors were almost equal to that of digital content. However, the percentage of buyers for PAW<sup>2</sup>'s content per users who were easily enable to make purchased were larger than for digital content. Ultimately, PAW<sup>2</sup>'s items will have the same value as that of the digital content in a virtual society. Therefore, we consider that more people will purchase virtual objects with more value in a virtual society. We believe that the result can be improved more than that of digital content by improving the number of buyers in the future.

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## 6.7. Summary of this Chapter

In this chapter, we described the business models for a virtual society, e-commerce extension to PAW<sup>2</sup> based upon the models, and its evaluation by using real money.

We proposed new business models which use a virtual society as a market place. Then, we described our approach to extend PAW<sup>2</sup> system based upon the business models which enable selling everything that already exists in the virtual world.

By using the system, we experimentally sold virtual goods (four types of items with a different meaning or value: event items, function items, accessories, and flowers) for real money and evaluated the business model based upon the results. The results illustrated that virtual goods can be sold like real goods in the real world by giving them a meaning or value in the framework of a virtual society. A comparison between the results of this experiment and the results of an investigation on user purchase behavior for digital content showed that although the sales figures were similar for the two, user purchase behavior in PAW<sup>2</sup> has room for increasing the number of buyers.

An analysis of the statistical information showed that accessories for customizing an avatar or a personal agent and function items that add a new function to a personal agent were the most popular sales items. Considering there was less choice among function items and they were more expensive than accessories, the numbers show that they were very attractive to buyers and indicate that a personal

agent influenced user's purchase decision. The results also showed a business potential for agent technology-based B2C business.

We believe that the 21<sup>st</sup> century is the era for selling virtual goods in virtual societies.