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A Study on an Information Sign System related to Users' Wayfinding Behavior in Interchanging Above-ground Stations

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Abstract：

The purpose of this study is to understand how information signs corresponding to users' various wayfinding behavior and how the signs serve their needs such as safety, pleasure and smooth passage when walking between above-ground train stations. In order to find out how information signs work in diverse situations, interchange routes were set up for the subjects in two wayfinding experiments: one long-distance and the other short-distance. The results of the experiments showed a variety of behavior, even though the subjects had no time constraints. On the long-distance routes, the subjects requested maps or signs showing the particulars along the routes. It is evident that the subjects were generally in a lighthearted mood wandering about and really care about the effectiveness of self-orientation. On the other hand, directional signs were requested for the short-distance route. Unfortunately, few signs were provided between the train stations. The subjects had to keep making decisions along the routes especially when they were at intersections, where the information sign system should be enhanced by providing a great number of signs. For these reasons, user needs suggested by the subjects' wayfinding behavior should be considered when planning information sign systems.

Keywords: Information sign system, Wayfinding behavior, Interchange stations

1. Introduction

In order to understand the variety of wayfinding behavior among people interchanging train stations, the experiments will conducted to explore wandering and non-wandering wayfinding behavior. As we know, landmarks or buildings above-ground can provide wayfinding clues, and are more useful than man-made information signs. That is one reason for this study, which is to try to determine the real wayfinding behavior when people interchanging stations: how users find their destination without anyone's help, and what wayfinding problems they are up against in man-made surroundings. In this study, wayfinding experiment will conducted between above-ground stations. Users' varied wayfinding behavior when changing stations and what an information sign system should do can be identified by experimenting in a real environment. Comparing the results of experiments involving different interchanging distances will help to understand how an information sign system corresponds to users varied wayfinding behavior.

2. Present situation of sign system at sites

Table.1 Classifications of present signs

Classification of SIGN								
Contents				Presentation		Installation		
Identification	Direction	Orientation	Explanation	Temporary Poster	Printing	Upper hanging	Standing	Hanging
C-I	C-D	C-O	C-E	P-T	P-P	I-U	I-S	I-H
Sample								

01 C-I(P-T)I-U	02 C-D(P-T)I-U	03 C-O(P-T)I-U	04 C-E(P-T)I-U	05 C-I(P-P)I-U	06 C-D(P-P)I-U	07 C-O(P-P)I-U	08 C-E(P-P)I-U
09 C-I(P-T)I-S	10 C-D(P-T)I-S	11 C-O(P-T)I-S	12 C-E(P-T)I-S	13 C-I(P-P)I-S	14 C-D(P-P)I-S	15 C-O(P-P)I-S	16 C-E(P-P)I-S
17 C-I(P-T)I-H	18 C-D(P-T)I-H	19 C-O(P-T)I-H	20 C-E(P-T)I-H	21 C-I(P-P)I-H	22 C-D(P-P)I-H	23 C-O(P-P)I-H	24 C-E(P-P)I-H

The signs examined in this study are classified by content, presentation and installation, and each is marked with a specific number. It is very useful to mark the location of a sign with a specific number. For example, sign contents are classified in terms of identification, direction, orientation and explanation. The presentation of signs is classified in terms of temporary poster or printing. Installed signs are classified in terms of as upper hanging, standing or hanging. There are in total 24 numbers. For instance, type01 indicates a sign contains identification that is temporary and upper handing. Each number represents a sign type as shown in Table1.

2.1 The sign system between Jinbocho station and Ochanomizu station

The present system of information signs installed between Jinbocho station and JR Ochanomizu station is introduced below. Jinbocho station is a metro station, with the distance to JR Ochanomizu station being 793m. There are so many restaurants and bookstores along the route between the two stations that it is known as a bookstore street. Meji University is also on this route. Almost all the signs on the route have a map orientation and include information on the history of the street. It is an interesting environment for tourists or for locals to just wander about in.

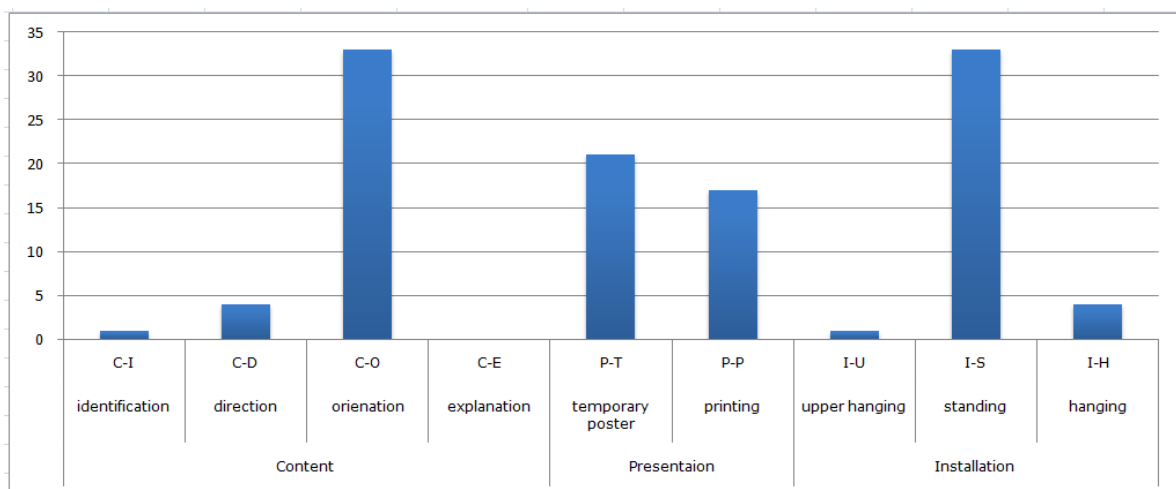Fig1. Location of classified signs

Fig.2 Number of classified signs

Fig1 shows the location of the signs. The signs are located at regular intervals between Jinbocho station and JR Ochanomizu station, especially on the main road. Most of the signs (Fig2) were type-11 ones, with type-15 signs being the next most numerous. Type-11 signs provide printed information as a means of orientation, and are installed in a standing position. But the purpose of type-11 is to explain the legal condition for parking bicycles and for no-smoking zones, instead of giving wayfinding information. For this reason, a lot of the same signs were set up along the main road. Type-15 signs are those that map users usually discover are installed by public or commercial stores. They are not temporary posters. The information on type-15 signs is richer than that on type-11 ones. Then there are type-14 signs, which provide printed directions and are installed in a standing position for drivers, or users wandering along the streets.

2.2 The sign system between Ochanomizu stations

There are three stations in the Ochanomizu area. Two Metro stations around the JR station which is nearby a river. It is known that numerous passengers travel between these three stations every day. The distance between Marunouchi and Chioda stations is about 286m and it takes about 5minutes to walk at a normal speed from one to the other.

There are six routes between these three stations. In opposite directions from the JR Ochanomizu stations are the two metro stations. It is not too difficult to walk form the JR station to Marunouchi or Chiyoda station because there are a large number of signs located at the JR station. Also, the distances are not too far from the JR station to the other two stations. For this reason, users do not often lose their way walking from the JR station.
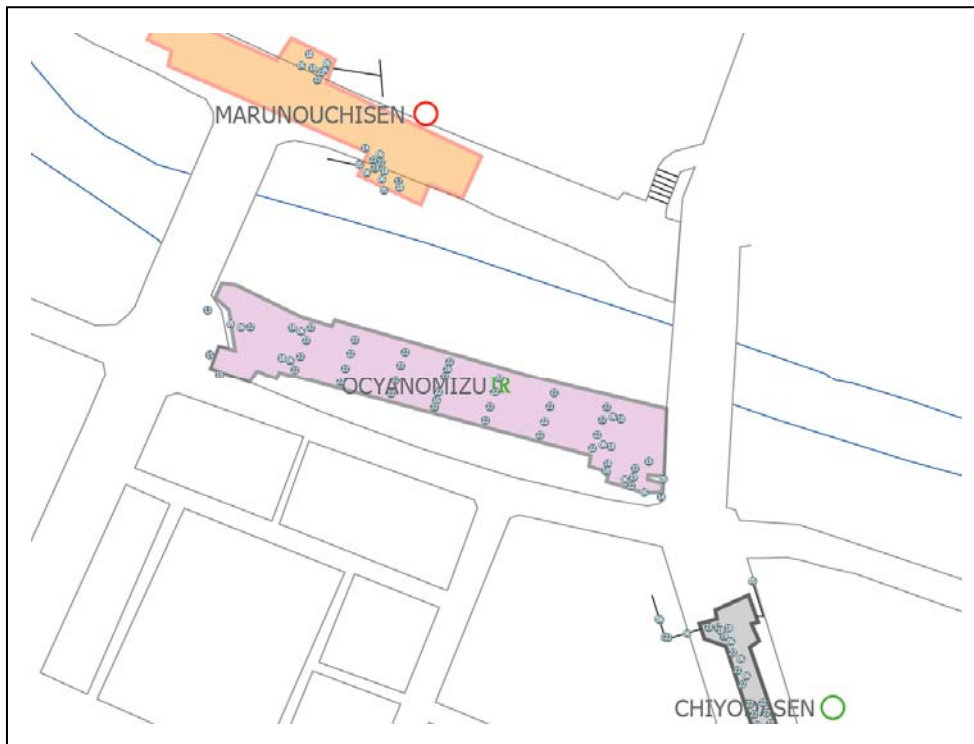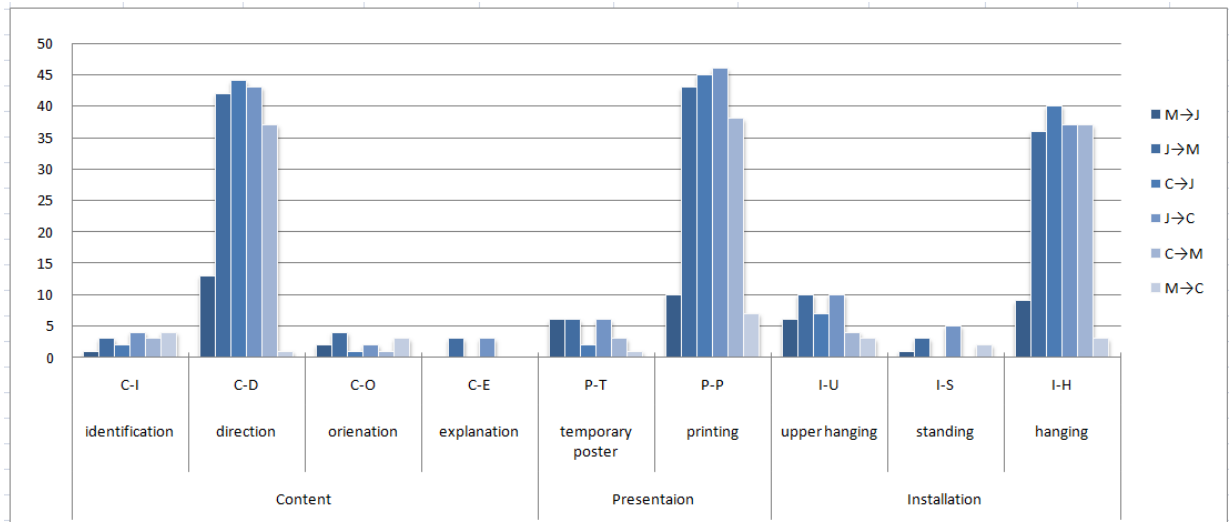

Fig3. Location of classified signs

Fig4. Number of classified sign

On the way from Chiyoda to Marunouchi stations, many maps are located in Chiyoda station but few are at the entrances. However, two directional signs near the service counter of the JR station show which direction to go to Marunouchi station. Some maps are provided on stands near the corner of the JR station. In other words, it is essential to make an identifiable sign system which is recognizable by users (Fig3).

The main signs are directional, printed and hanging. A great majority of the signs are provided by the JR station. In contrast, the signs located between Marunouchi and Chiyoda stations are fewer. On the way from Marunouchi to Chiyoda stations are orientation type signs mostly located at the station entrances as well as the intersection in front of the JR station, while some conspicuous signs are also located near the corner. On the other side, signs related to Chiyoda station are located at the barriers of the JR stations. In fact, users can see the Chiyoda station directly. (Fig4)

In brief, a large number of the signs installed by the JR station provide directions or orientation information. As well signs showing the way to the JR station were also provided by Marunouchi and Chiyoda stations, but the number of signs between Marunouchi station and Chiyoda station are fewer and all are maps. So the whys and wherefores regarding the number of signs will be examined in the next wayfinding experiment.

3. Method of a wayfinding experiment

The purpose of a wayfinding experiment is to understand users' wayfinding behavior when finding their their's way with the use of information signs system.

After recording the detailed information of a set of signs including their location, content and installation, and inspecting the subjects' wayfinding behavior to determine whether or not the sign system corresponds to their behavior, the design factor should be carefully considered.

In the long-distance wayfinding experiment, eight subjects started from Jibocho station and headed towards JR Ochanomizu station. 4 of the subjects had a map and 4 of them did not. The subjects' routes, what they said while on the move then in interviews after words were recorded.   In order to understand the process of wayfinding, an interview was conducted to explore the physiological and psychological aspects.

In the short-distance wayfinding experiment, ten subjects participated. 4 subjects walked from Marunouchi station and proceeded to Chiyoda station, 4 subjects walked from Chiyoda station to Marunouchi station, and 2 subjects walked from the JR station to the other two stations.

4. Results of the wayfinding experiment

4-1. Wandering priority

4-1-1. Subjects' individual wayfinding
Table2 Protocol of wayfinding experiment

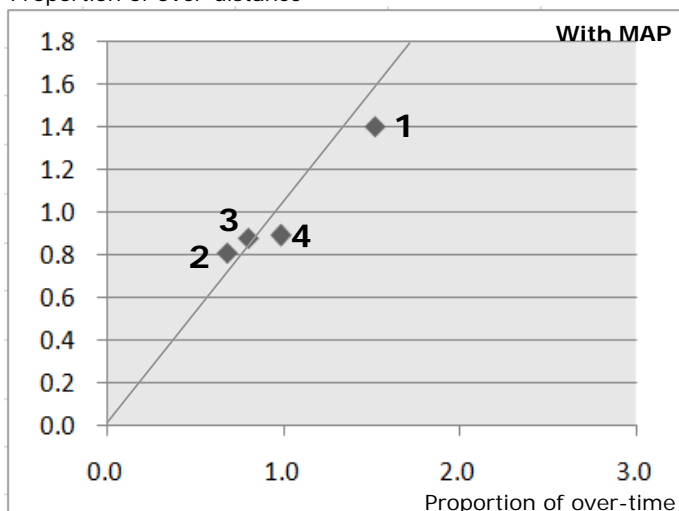| Subjects' individual wayfinding	1	2	3	4
wayfinding time in experiment(min : sec)	27:54	10:14	13:01	16:13
average time	16:50			
Proportion of over-time	1.66	0.61	0.77	0.96
the shortest distance(m)	792.6			
wayfinding distance in experiment	1607.1	900.0	964.2	878
average distance	1087.3			
Proportion of over-distance	1.48	0.83	0.89	0.81

Fig.5 Relationship between proportion of over-time and over-distance in the wayfinding experiment

Fig5. shows that the subjects behaved similarly in this long-distance experiment without map support, especially in terms of their walking speed if none of them had made any mistake when reading information. In this experiment, the subjects depended almost entirely on their memory, but each subject had different memorizing abilities. Take subject-1 for example, he mistook Metro Ochanomizu station to be the destination and so his memorized information was not effective. Actually, a key point of this particular route is going straight ahead and then turning right, which was grasped by the other three subjects. Where they should turn right was the most important. Signs should be installed at such a place.

4-1-2. Subjects wayfinding with map

Table3 Protocol of wayfinding experiment

Subjects wayfinding with map	1	2	3	4
wayfinding time in experiment(min : sec)	11:01	16:05	24:41	13:00
average time	16:10			
Proportion of over-time	0.68	0.99	1.52	0.8
the shortest distance(m)	792.6			
wayfinding distance in experiment	793.0	878.6	1371.4	870.0
average distance	978.3			
Proportion of over-distance	0.81	0.89	1.40	0.88
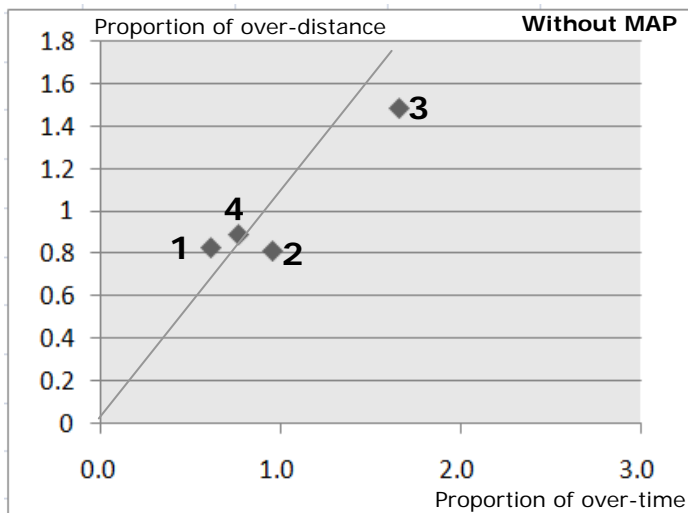
Fig.6 Relationship between the proportion of over-time and over-distance in wayfinding experiment

Similar to the wayfinding experiment without map support, the subjects' walking speeds in the experiment without map support were almost the same. The four subjects were really clear about where they should walk straight ahead and where to turn right often reading the information guide from a map. However, the key point is whether they were able to locate the corner where they should turn. In

fact, the route nearby MacDonald's is the shortest way to the destination but fewer people walk there and fewer signs are installed. So the subjects all chose the main road, because they felt at ease there, rather than finding other routes. Uneasiness about the location of the right corner was obvious with subject-3. Subject-3 believed that she had to turn right somewhere and attempted to find the corner. Actually, lack of cognitive ability in wayfinding made her take the farthest route. The only reason she arrived at the destination was that the route she chose was parallel to the shortest route and she finally got to the other side of the destination. So in long-distance wayfinding, knowing which direction of the destination is right is more effective for users than which exact way they should go.

4-1-3. All subjects

Subjects' location drawn in each 30secs to find out where the decision-making places are due to they find information sign with slower walk speed.
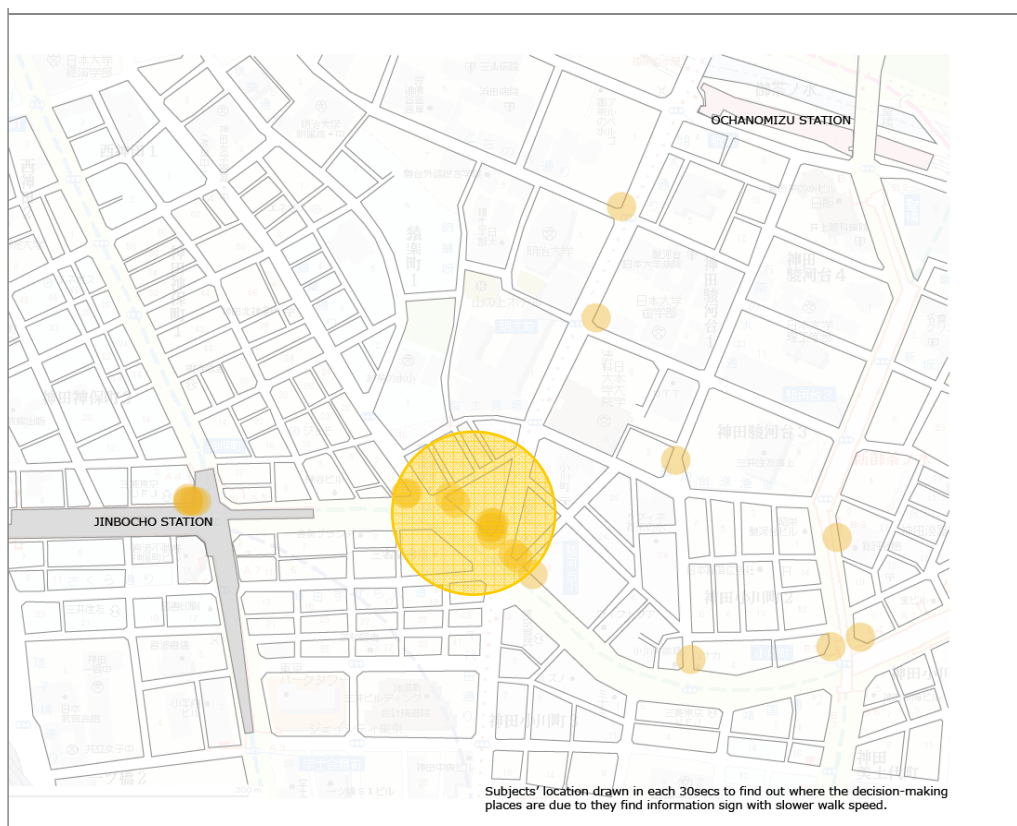
Fig.7 The areas where a sign system should be enhanced

Fig7 shows where the subjects slowed down. It suggests that the intersection is a key spot for a sign to be set up. In this case, at least one sign hanging above is necessary. Actually, at present the signs are installed at the center of the road instead of an alleyway. The only fly in the ointment was that the subjects seemed to have no way to confirm direction in the shorter route. In brief, the yellow area is area where a sign should be installed, according to subjects' wayfinding behavior. It is also essential that maps not only provide complete information on the surroundings but help the users find their way swiftly everywhere by being available of suitable locations and in sufficient quantity.

Fig.8 Location of present sign and yellow spots where subjects are slow down

The round yellow areas indicated spots that should be considered when planning a sign system. The wayfinding experiment established that the subjects looked for information centers at the station entrances, intersections or someplace near an intersection. The subjects obviously slowed down at such spots. Besides the main road, some temporary signs posted in front of commercial stores also make wayfinding interesting.

4-2. Non-wandering priority

4-2-1 Subjects who interchange from Marunouchi station to Chiyoda station

Table3 Protocol of wayfinding experiment

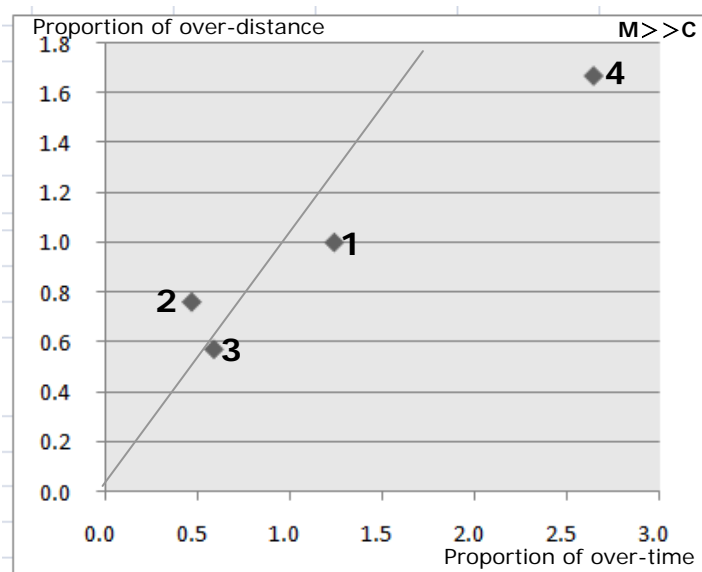| Subjects form MARUNOUCHI St. to CHIYODA St.	1	2	3	4
wayfinding time in experiment(min：sec)	11:52	4:31	5:40	25:21
average time	9:36			
Proportion of over-time	1.24	0.47	0.59	2.64
the shortest distance(m)				
wayfinding distance in experiment(m)	554.0	420.0	316.0	920.0
average distance	552.5			
Proportion of over-distance	1.00	0.76	0.57	1.67

Fig.9 Relationship between the proportion of over-time and over-distance in the wayfinding experiment

Table3 shows the relationships between the subjects' wayfinding distance and wayfinding time, including the proportion of over-time and over-distance. The line indicates the average the individual wayfinding distance when time is common. It is found that only in the case of subject-2 is the proportion of over-distance greater than proportion of the over-time. If inspecting subject-2's wayfinding route can reveal that subject-2 hurried to find the way, then subject-2 may be a wayfinding person who hurries while walking and looking for signs at the same time. Subject-2 also read the information from signs quickly. On the other hand, subject-1, subject-2 and subject-4 are below the average line in Fig9, showing that they spent more time reading information rather than moving. This suggests that people tend to spend time making sure they are in the right direction rather than looking for signs while moving. Subject-4 spent a lot of time looking for signs and has a proportion of over-distance that is below the average because an awful mistake happened but subject-4 also spent more time reading information than moving, the same as subject-1 and subject-t3.

4-2-2 Subjects who interchange from Chiyoda station to Marunouchi station.

Table5 Protocol of wayfinding experiment

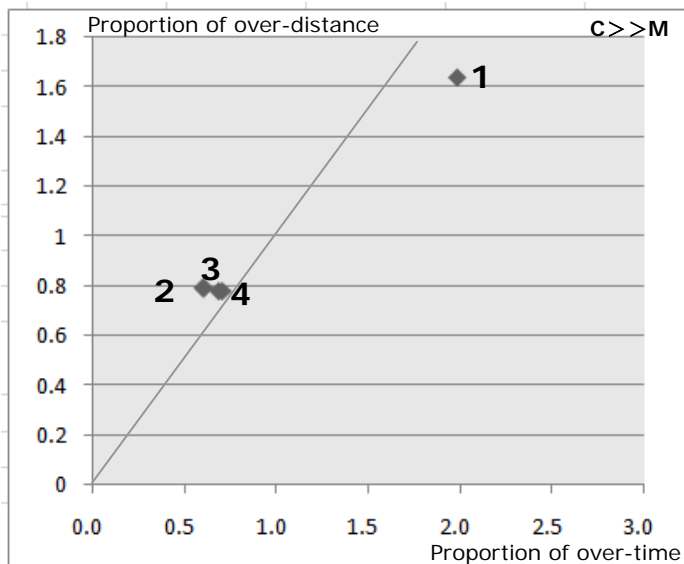| Subjects form CHIYODA St. to MARUNOUCHI St.	1	2	3	4
wayfinding time in experiment(min：sec)	17:42	05:19	06:30	6:14
average time	8:56			
Proportion of over-time	1.98	0.60	0.68	0.70
the shortest distance(m)				
wayfinding distance in experiment(m)	680.0	330.0	324.0	326.0
average distance	415			
Proportion of over-distance	1.64	0.79	0.78	0.78

Fig.10 Relationship between the proportion of over-time and over-distance in the wayfinding experiment

The proportion of over-distance in the case of subject-2, subject-3and subject-4 is greater than the proportion of over-time indicating that they walked and looked for signs at the same time, and also read information from signs quickly. It deserves to be mentioned that these 3 subjects' wayfinding behavior and wayfinding times are similar because they all found the key sign, type18. Besides, subject-1 experienced poor wayfinding by missing the key sign and making a mistake when reading the map. It was revealed that type18 is the essential sign for users who walk between Marunouchi and Chiyoda stations. In addition, the first sign that users can find is very important.

4-2-3 All subjects

Fig.11 Wayfinding routes from Maru. to Chiyo. Sta.   Fig.12 Wayfinding routes from Chiyo to Maru Sta.

Fig11 and Fig12 show the routes between Marunouchi and Chiyoda stations, and the round yellow areas which were drawn every 30 seconds in the wayfinding experiment. The round yellow areas indicate that the subjects walked at a slower speed in order to read or find information. As the figures show, the subjects always stayed around or walk slowly down the nearby station entrances, especially at the first intersection during wayfinding. Moreover, the intersection of the JR station was a place where the subjects had to again confirm the direction. Their wayfinding speeds were also down.

Fig.13 All the routes of all of the subjects

In general the yellow areas are the spots where installing an integrated sign system should be considered. The round yellow areas are where the subjects hesitated and slowed down. These include station entrances or intersections as the places where users have to confirm their direction.   It is worth mentioning that the subjects' worst mistakes always occurred by missing or misunderstanding the first sign. In this case, a sign system centered around the JR station should be installed.

5. Discussion
5-1. Subjects' physiology
5-1-1. Wandering priority in wayfinding
Subjects' routes

All the subjects turned right and then next straight ahead while when they had reached the intersection. If they had misunderstanding when reading the information related to the key idea, then they knew from the installed map or mobile map they had to go straight ahead then to turn right.

As we mentioned before, the subjects who could not confirm the information just depended on their memory. So they walked around the intersection because fewer signs were available.

Stopping spots

So the subjects slowed down around the intersection, and the number of stopping spots increases as well. The users did this in order to find useful information which would help them confirm the next direction.
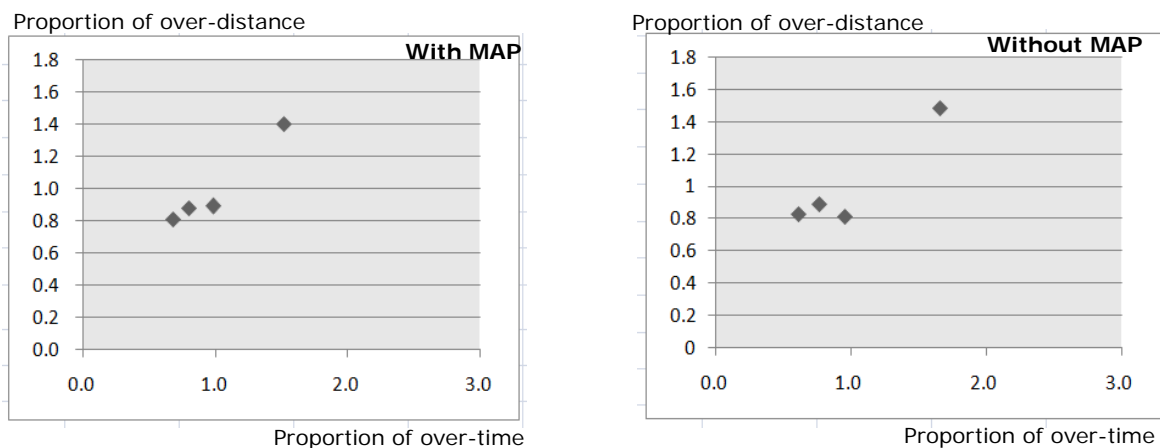
Fig.14 Subjects' behavior in wander-priority wayfinding

No matter if the subjects were wayfinding with a map or not, their wayfinding patterns are similar because a mobile map did not, in this case, seem to have really affected their wayfinding. Overall, the two subjects who were poor in wayfinding , due to a misunderstanding when reading the information on a sign, were still able to finally get to their destination. Both subjects used the same memorized direction: going straight first, and then turning right.

For this reason, rather than spending more time finding other possible routes, they followed the memorized direction to the destination. This suggests that how to make subjects confirm directions and what the memorized sign system provides are essential for wayfinding, as well as providing by a map to show the way to the destination.

5-1-1. Non-wandering priority wayfinding

Subjects' routes

The subjects' routes were different but they all needed signs to tell them when to change directions. Because there were fewer signs at Marunouchi station and the subjects had to spend more time finding them and confirming their information, the proportion of over-time is greater than that of over-distance. On the other hand, wayfinding would be easy if the subjects who came from the Chiyoda station would find the key sign. For this reason, the proportion of over-distance is greater than that of over-time. Finding a suitable sign is really essential in wayfinding.

The signs they saw are of three types: orientation signs positioned around the JR station such as a map with much information about the surroundings, directional signs, and an integrated sign with directions and a map located at the JR station. At present, who decides where the signs at each station should be located is not clear, and the areas between the stations are ambiguous as regards the provision of sign systems.

It is a difficult to choose where to install a map because users could easily misinterpret the information on orientation signs.

Stopping spots

The subjects all stopped for a while when they were thinking about or finding signs. When they were near an intersection, and some where they needed to again confirm their direction, or in the yellow areas, the subjects slowed down. Therefore, such places should be taken into consideration when planning a sign system.
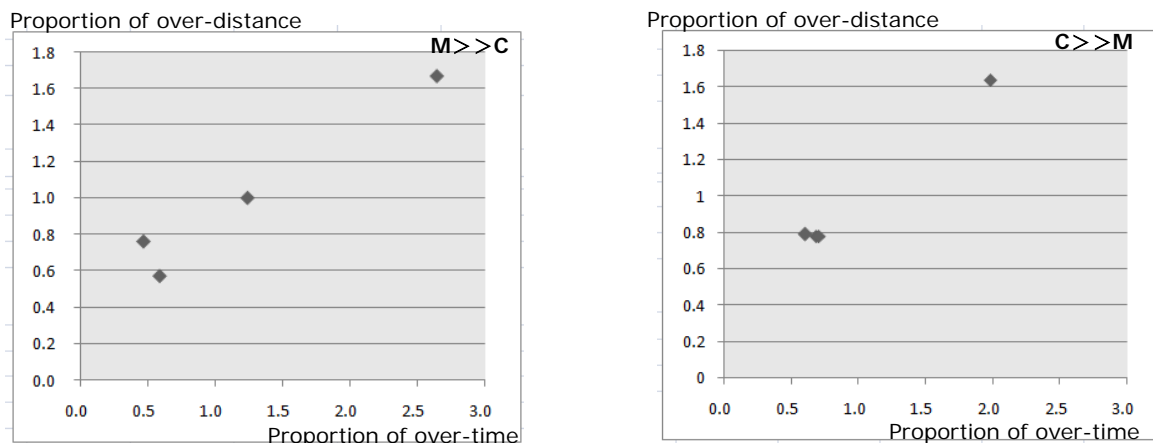

Fig.15 Subjects' behavior in non-wandering priority wayfinding

Fig.15 shows various wayfinding behaviors when the subjects were interchanging station. Some people became cautious without the support of signs and losting their way, due to personal diversities and individual experience. Therefore, users can spend too much time wayfinding unless a suitable sign is installed at the right place.

5-2. Subjects' psychology

5-2-1 Wandering-priority in wayfinding

Most of the subjects thought that it was not difficult to understand the information in a map, to choose a direction, or confirm a location, but the signs installed around the intersections should be improved in terms of quantity and location. In addition, the subjects relied on some conspicuous landmarks such as bookstores and banks. It may help wayfinding if such landmarks are integrated in the information sign system. Moreover, the effective memorized way for the subjects was to choose to go one way first then turn a corner when they saw something. The subjects always found out where the destination was first, and then found out where they were when they read the map. Next they tried to memorize something, such as a landmark, on the route between the start and finish. However, supporting information is most essential until this kind of decision-making process is finished. In the interviews, the subjects indicated that, if they could confirm the direction with a sign or landmark, they will feel at ease and not worry about losing their way. It was revealed, and remains essential, that in long distance wayfinding how to make subjects feel at ease is also related to how busy the street is. Furthermore, long-distance wayfinding is tiring, which also influenced the subjects' effort to find signs.

5-2-2 Non-wandering priority wayfinding

Table 6 Subjects' recommendation for sign system

Type 22	Type 18	Type 15
Direction Printing Hanging.	Direction Temporary poster Hanging.	Orientation Printing Standing
Highly Recommended	Recommended	Lowly Recommended

Having few signs and hard to find signs near station entrances were common complaints from the subjects. The importance of the first sign seen by users was also revealed. Wayfinding may become difficult and complicated if users misunderstand that initial sign. Station entrances are the first place where users look for signs. The ideal location and number of signs and the ideal sign types that the subjects hoped for are as follow: around entrances, where they need to confirm direction, and at intersections; Type-22 is an ideal sign because two different signs which are integrated on the same sign and users can choose what information they really want (Table6), another ideal sign is directional sign

which is legible for users can read, and another is an orientation sign such as a map with information about the surroundings. A Type-18 sign hangs at the service counter of the JR station as a temporary sign and some users who want to get to Marunouchi station must still ask at the service counter. Unfortunately, directional signs are at the intersection of the JR station instead of an orientation sign such as a map. Directional signs may be more suitable for users who need to walk a short distance between stations, especially when they are under time constraints.

6. Conclusion

This paper discusses wayfinding experiments on finding the way between aboveground train stations to understand the needs of the uses of information signs. Some findings of the wayfinding experiments are reviewed below:

1. In an aboveground environment, wayfinding should ideally be done with enjoyment in pleasurable surroundings. It was found that many of the subjects did not take the shorter route to the destination because there were no conspicuous signs installed and fewer people walked along that route. Therefore, effort to bring about a better wayfinding experience between two places must be based on putting the users' at ease by providing information signs to confirm the users is on the right way. It also involved how many people are present and what enjoyable surroundings can be created. Integrating the essential details about the surroundings in an information sign system is indeed good for users traveling between two places. The importance of making decisions about intersections was also shown in the experiments. According to previous wayfinding research, people always make decisions at intersections or where they have to change direction. However, it is hard to decide where and what kind of signs should be installed to suit different users. The wayfinding experiments discussed in this paper revealed that directional signs integrated with orientation signs are the best, with the next best being simple signs such as directional signs. For these reasons, there is no doubt that it will be useful for all wayfinding if the kind of signs such as type-22 or type-18 can be provided at some critical locations such as intersections or places where users make decisions in the process of finding their way.

2. The multiplicity of the wayfinding behavior seen in the wayfinding experiments also shows that people behave in varied ways as everyone has a different personal experience. Therefore, an information sign system should provide for suitable kinds of diversity to support, and satisfy the different needs of, the largest number of users as much as possible.

3. An orientation sign such as a map is suitable for long-distance wayfinding. How to ensure good long-distance wayfinding depends on what information users can memorize. The subjects' protocol in the wayfinding experiment revealed that users' location relative to their surroundings is really important. Signs or mobile equipment can not facilitate wayfinding if users lose their sense of relative location. The information contained within a map, such as a Y-A-H map, has to correspond effectively to the orientation of users in terms of their location relative to their surroundings. For this reason, users of a

map or a mobile device, such as a PDA need this kind of orientation information. Besides, it is also essential that maps not only provide information on the surroundings as a whole but help users find their way quickly by being available in all suitable locations.

4. Temporary signs to attract users installed by commercial stores make wayfinding interesting. More time is spent on wayfinding along a long-distance route. So information signs not only provide accurate information for wayfinding but refer to other information that makes the wayfinding activity enjoyable. It is found that famous spots and other pleasant spots visible on the landscape, such as bookstores, are good clues for orientating oneself, according to the subjects' behavior in the wayfinding experiments. Such a kind of key spots must be shown on maps and the information constantly updated.

5. Information provided by a sign system to re-confirm is related to a users' ability to memorize. Everyone has a different capacity for remembering information, and diverse personal experiences. In the case of the non-wandering priority experiment, the subjects took about 9.3 minutes to travel from the first sign to the next location revealing that they needed information to confirm their direction, especially when they were at intersections. The information sign system should take the distance between signs into serious consideration, and it must correspond to the ability of the users to keep information in their memory.

6. Directional information related to information on the destination and corresponding to other information such as landmarks can make for a better wayfinding experience. It was found that subjects who were good at wayfinding usually remembered two things. One was the direction, and the other was what things they saw when they found the first sign. For example, some subjects said "Half way to the destination, on my left, I saw a building called Meji University." Such kinds of uncertain information carry two connotations: one is it might be a key clue for the subjects' wayfinding, and the other is it make it possible to discover another new world even if they had lost their way. Therefore, memorizing the directional information of the destination and then finding other information which can be used to confirm the direction is right may be a better way of recognizing the information that signs provide. Such findings in the wayfinding experiment reveal that better directional signs and conspicuous signs such as maps are two decisive factors in making wayfinding easier.

7. The different effects of directional signs and orientation signs. Maps with a lot of information about the surroundings situated near station entrances were found in many cases. For users in a hurry, it saves on the time spent on looking for the right direction. Some of the experimental subjects said, as well, that it would help their wayfinding if some simple directional signs were put at the right locations. It was also found that a directional sign was more helpful than an orientation sign when walking between stations which were near each other. Therefore, sometimes it may be better to provide various choices of signs with different content somewhere at the right places, to suit various situations.

8. Integrated signs can be provided in the form of hanging or standing signs. The purpose of an information sign system is to satisfy unspecified users as much as possible, so it should ideally suit different situations. In the case of this study, even a directional sign helps understanding and saves users' time. The signs can be integrated to provide two forms of orientation. Maps and directions should satisfy not only people who are in a hurry such as commuters, but also users who wander around sightseeing in the city. Hanging or standing signs are easily recognized by people because they can be seen from a distance. Besides, other forms of support may satisfy more users. For example, more station staff can assist users to change stations by providing brief introductions and maps to supplement a multiple sign system.

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