A Study of Wayfinding Strategies Using a Visual Simulator

Masashi Soeda
Ryuzo Ohno

Ohno Laboratory / Department of Built Environment / Tokyo Institute of Technology, Japan

Abstract

In the previous study, the influence of the visual characteristics of the street-scape on wayfinding performance was investigated by an experiment using a user-controlled space-sequence simulator. Since it revealed that the performance was quite different among the subjects, the present study intends to clarify the influence of wayfinding strategies which are expected differ with individuals. Three scale models (1/150) of an identical maze pattern each with different visual information were used in the simulator which was designed to allow a subject to move through a model space and visually experience a travel sequence. Three conditions of visual information were : 1) no characteristics, with monotonous surfaces and uniform width of streets, 2) variations in spatial arrangements, with changes of street width and corner shapes, 3) symbolic information, provided by letters and photos of newspaper on the walls. Each of three male and three female subjects was first asked to memorize the route by viewing a predetermined continuous sequence of model street as shown on the screen, and were then asked to take the instructed route. This procedure was repeated until the subject could reach the end of the route. After the subjects reached the goal, they were asked to draw a cognitive map of the route. This series of experiment was conducted five times: 5, 12, 36, 128 days after the first experiment. On and after the second experiment, the subjects were asked to explain the route verbally at the beginning of the experiment. An analysis of the results shows that some people shift their wayfinding strategies reasonably according to visual information on the route, and other people tend to rely on mainly one type of information to memorize the route at any situation. It also showed that people can take the right route by obtaining elemental information on the spot even if they have no clear memory in advance.

Introduction

The previous study (Ohno, Sonoda and Soeda, 1995) investigated the influence of visual characteristics along streets on wayfinding performance, and found that a route with significant visual characteristics was easier to memorize, although there was a large difference in the performance among the subjects. In this study, it was hypothesized that wayfinding performance depends on wayfinding strategies that are different in person and spatial characteristics.

Many studies have been made concerning the individual difference in wayfinding performance. Galea (1993) and Lawton (1996) investigated gender difference in wayfinding, and Anooshian (1996) explored diversity within spatial cognition. Kozlowski (1977) and Bryant (1982) examined the relationship between self-reports of spatial cognition and actual wayfinding behavior. These studies have tried to classify people according to their knowledge for understanding spatial configuration, but have not discussed how individual wayfinding strategies shift as the visual information available along the route varied.

Experiment

An experiment using a space-sequence simulator was conducted to examine individual wayfinding performance and strategies. The User-controlled Space Sequence Simulator was designed to allow a subject to move through a model space and to experience travel sequence visually. With a set of "joy-sticks", the subject controls an endoscope connected to CCD color TV camera supported by a gantry while viewing the model scene as projected on 40-inch TV screen. The maximum size of the scale model is 2.36m x 2m in horizontal and movable area of CCD camera head is 1.6m x 1.6m. Maximum speed of movement is 30mm/sec, and the angular velocity of rotation is 72 deg/sec. The control system of the simulator records a exact position and a viewing direction of the endoscope within the model space every 0.01 second. This record provides data for analysis of the subject's behavior.

Visual information which were considered to be available in wayfinding were classified according to their characteristics as shown in Table 1. Based on the classified information, three scale models (1:150) which had different street plans and different street-scape were made (see Fig.4 and Fig.5). Table 2 shows the spatial characteristics and available information of each model. Each route of the three models are different in plans and total number of intersections, but are same in the number of 12 intersections which the subjects have to make a turn.

Figure 1. The endoscopy and a scale model. [see Fig.1.PICT on floppydisk 1]

Figure 2. 40-inch TV screen and a subject. [see Fig.2. PICT on floppydisk 1]

Figure 3. Floor plan of the simulator. [see Fig.3. PICT on floppydisk 1]

Table 1. Classification of available information for wayfinding. [see Table 1.PICT on floppydisk 1]

Table 2. Characteristics of the three models. [see Table 2.PICT on floppydisk 1]

Figure 4. Plans and Street-scape of the three models. [see Fig.4.PICT on floppydisk 1]

Each subject was first asked to memorize the route by viewing a predetermined continuous sequence of model streets as shown on the screen. While the movement of the endoscope was controlled along the programmed route at walking speed, the subject can stop the endoscope motion and control viewing direction. Thus the experience of the route was not in a absolutely passive mode, but the subject could voluntarily acquire information. After viewing the sequence of the street scenes, each subject was asked to take the instructed route by oneself. This procedure was repeated until the subject could take the instructed route to the goal successfully. After the subjects reached the goal, they were asked to draw a sketch map of the route. Each subject were asked to do the same task in three models on different days. This series of experiment was conducted five times: 5, 12, 36, 128 days after the first experiment. On and after the second experiment, the subjects were asked to explain the route verbally at the beginning of experiment and then to take the route by oneself without the route instruction. Six graduate students (three male and three female, non-architectural students) were employed.

Results and Discussions

Figure 5 shows two examples of sketch maps of "Streets with symbolic information" drawn by the subjects. The sketch map drawn by Subject C shows much information about the number of intersections but not so much about symbolic information at each intersections. On the other hand, in the sketch map drawn by Subject F, the symbolic elements have been drawn at almost all the intersections, but little information about the number of intersections was drawn. These differences in the sketch maps seem to reflect individual differences in the wayfinding strategies. Therefore, we examined the content and amount of information on the sketch maps to analyze individual wayfinding strategies.

Figure 5. Examples of sketch maps drawn by the subjects. [see Fig.5.PICT on floppydisk 1]

We first counted number of each type of information separately, and then calculated the ratio of drawn information to the number of available information at the intersections. The reason for calculating the ratio is that all intersections have information of "Sequence of numbers" but do not necessarily have information like "Plan configuration" and "Spatial variation". Figure 6 shows the ratio of each information type drawn on sketch maps of each subject. Subject A and Subject B have frequently drawn every type of information in all types of street. This suggests that they have remembered the routes by various types of information. Subject E and Subject F have drawn "Sequence of numbers" frequently in "Streets with no characteristics", but hardly in "Streets with symbolic element". In this street model, they drew much "Symbolic information" in stead of "Sequence of numbers". It is clear that they shifted their wayfinding strategies reasonably as the change of available information along the streets. On the contrary, Subject C and Subject D have drawn "Sequence of numbers" frequently in all types of street and have not drawn much information of other types. This shows that they always tend to rely on only one type of information, namely such numerical memory as "turn the third corner", even if available information along the route have been changed.

As for the recognition of "Spatial variation", there were some subjects like Subject B and Subject F who drew it at almost all the intersections which have information of spatial variation. However, other subjects like Subject C hardly drew it. This suggests that there are large individual difference in utilizing such spatial information as changes of street width for memorizing a route.

Figure 6. Ratio of information drawn on the sketch maps. [see Fig.6.PICT on floppydisk 1]

Protocol about memorized elements along the route, which were mentioned by the subjects at the beginning of each experiment, were compared to actual wayfinding behavior recorded in the control system of the simulator. In the experiment using "Streets with symbolic element", it was noted that all the subjects could take the right route by looking around at intersections, even though they couldn't tell any clue elements. This suggests that people can take the right route by obtaining information on the spot, even if they have no clear memory in advance.

Conclusions

This study resulted in following conclusions.

1. There are at least four types of information used for wayfinding.

2. Some people can utilize various types of information and shift their wayfinding strategies reasonably according to visual information along the route.
3. Some people tend to rely mainly on one type of information to memorize a route at any situation.
4. People can take the right route by obtaining symbolic information on the spot, even if they have no clear memory in advance.
5. Referring various types of information along the route is essential for successful wayfinding.

References

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Table 1. Classification of available information for wayfinding

Classification	Characteristics of Information
Sequence of numbers	Information for numerical memory of intersections, e.g. "third corner"
Plan configuration	Information based on plan configuration like T-shaped intersections and oblique ways
Spatial variation	General information based on spatial volume
Symbolic information	Elemental information like signs and characteristic objects

Table 2. Characteristics of the three models

type	name of the model	spatial characteristics		available information for wayfinding			
		street width & corner shape	wall surface	sequence of numbers	plan configuration	spatial variation	symbolic information
I	Streets with no characteristics	same	white monotonous wall	○	○	×	×
II	Streets with spatial variation	vary	monotonous dot pattern	○	○	○	×
III	Streets with symbolic information	same	newspaper	○	○	×	○

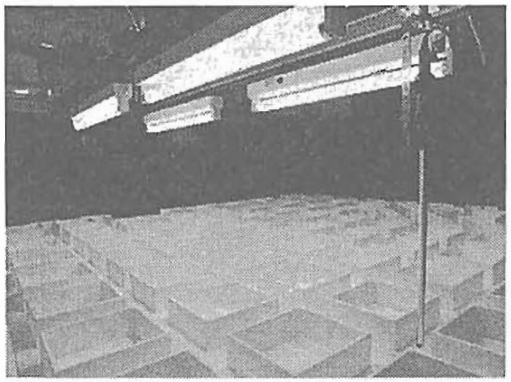


Figure 1. The endoscopy and a scale model. [see Fig.1.pict on floppydisk 1]

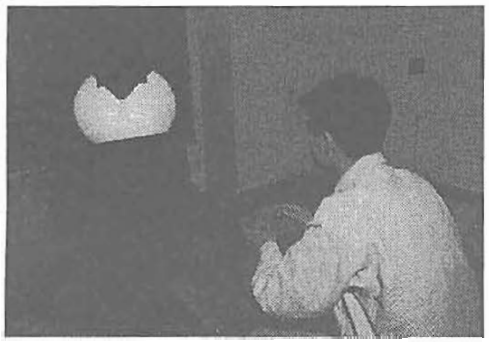


Figure 2. 40-inch TV screen and a subject. [see Fig.2.pict on floppydisk 1]

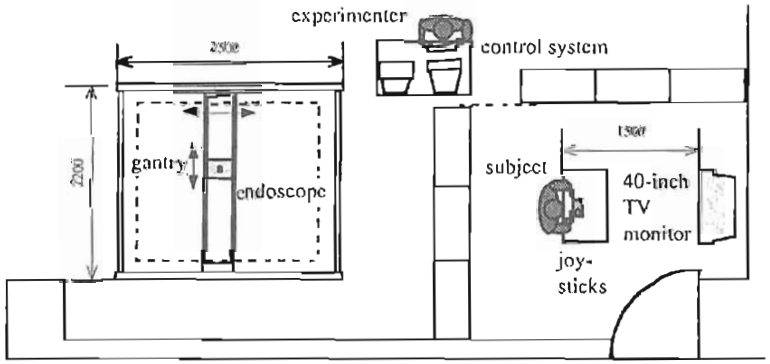
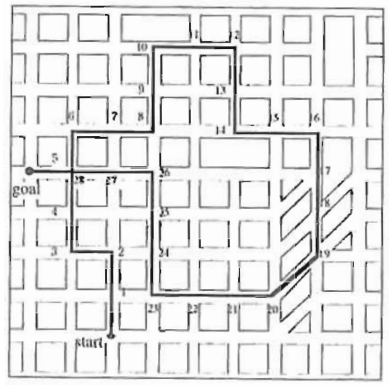
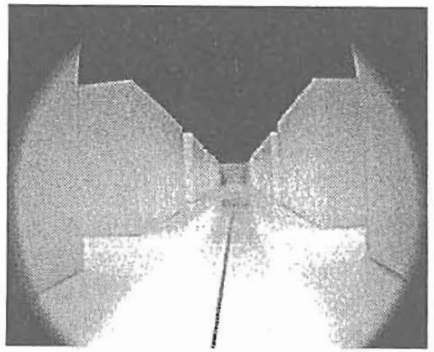
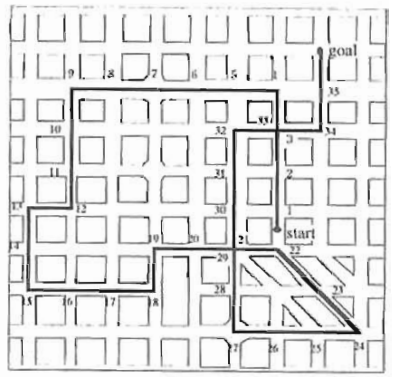


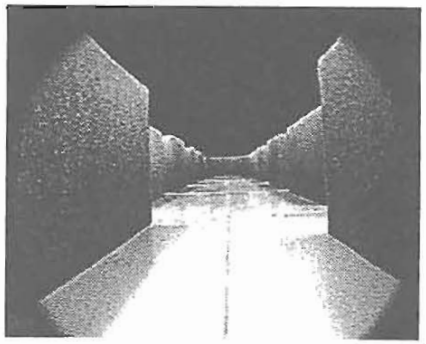
Figure 3. Floor plan of the simulator. [see Fig.3.pict on floppydisk 1]



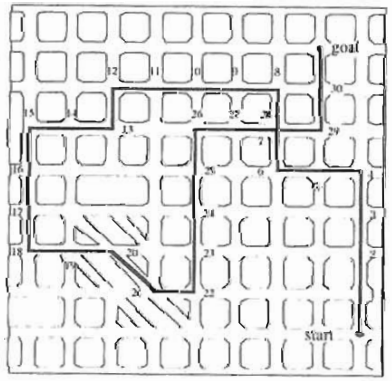


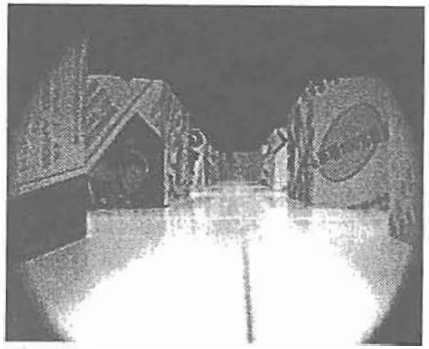
I . Streets with no characteristics





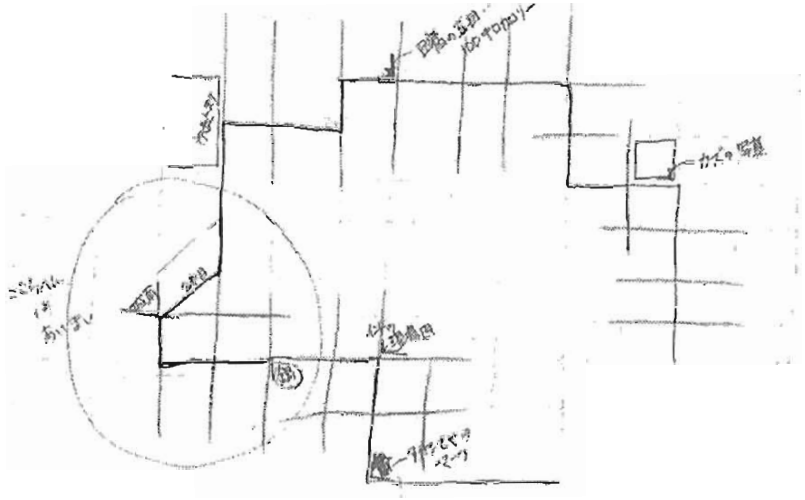
II . Streets with spatial variation



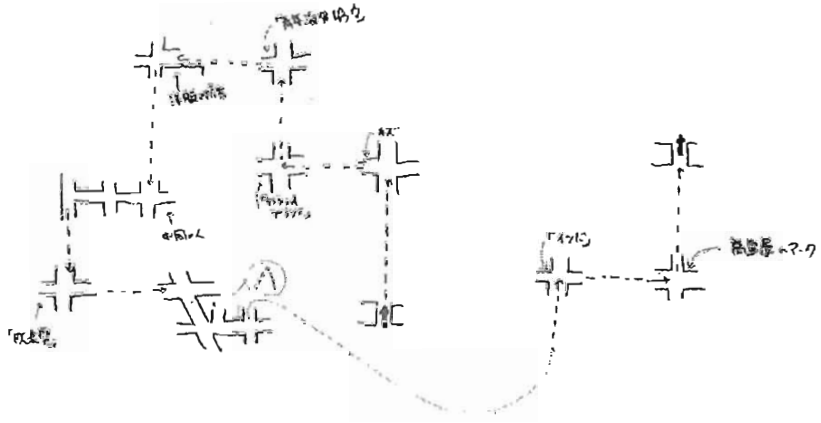


III . Streets with syblic information

Figure 4. Plans and street-scape of the three models



Subject C



Subject F

Figure 5. Examples of sketch maps drawn by the subjects.

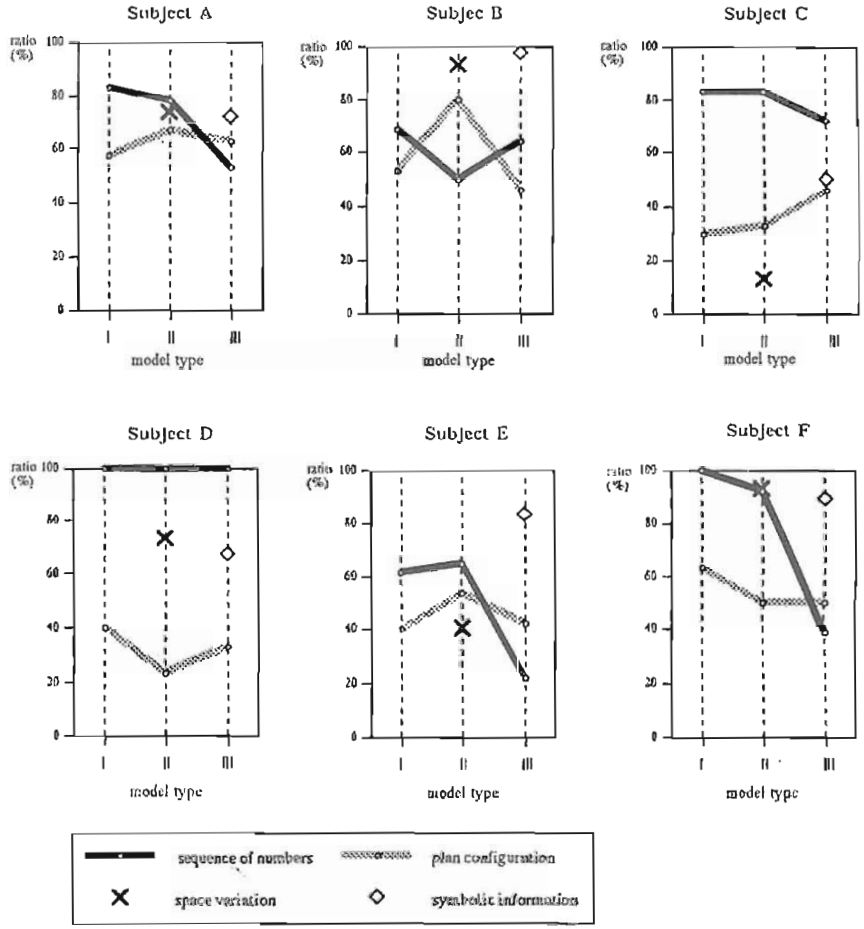


Figure 6. Ratio of information drawn on the sketch maps.