Street-scape and Way-finding Performance

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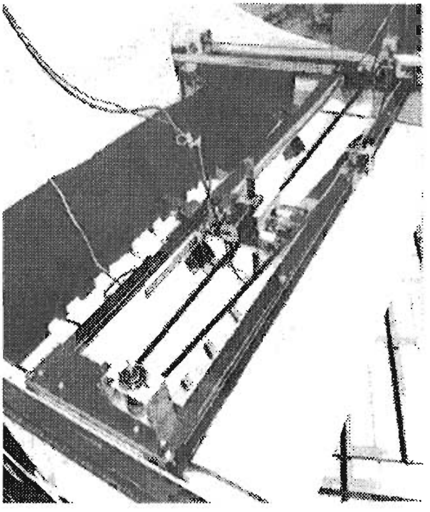
Abstract

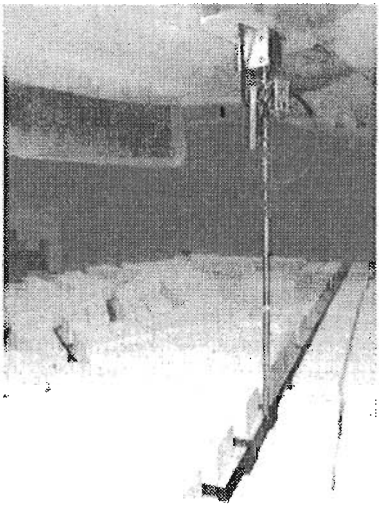
The hypothesis that way-finding performance depends on the visual characteristics of the street-scape was investigated by an experiment using a user-controlled space-sequence simulator which was designed to allow a subject to move through a model space and visually experience a travel sequence. Three scale models (1:150) of an identical maze pattern each with a different street-scape were used in the simulator. The three types of street-scapes were: (1) no characteristics, with monotonous surfaces, (2) each corner distinguished with a different building, and (3) streets furnished with trees, columns or fences. Each subject was first asked to memorize the route by viewing a predetermined continuous sequence of model streets, as shown on the screen, then asked to take the instructed route. This procedure was repeated until a subject successfully reached the end of the route. Subjects were allowed to try up to five times. After the experiment, the subjects were asked to draw a cognitive map of the route. Three male and three female subjects were tested in each of three street types. An analysis of the results generally supported the hypothesis that a route in streets with significant visual characteristics was easier to memorize, although there was a large difference in performance between subjects. With an analysis of the cognitive maps drawn by the subjects, it was noted that subjects seemed to rely more on incoming visual information on the changing scene than on structured knowledge of the route, as is emphasized in conventional theory of way-finding.

Introduction

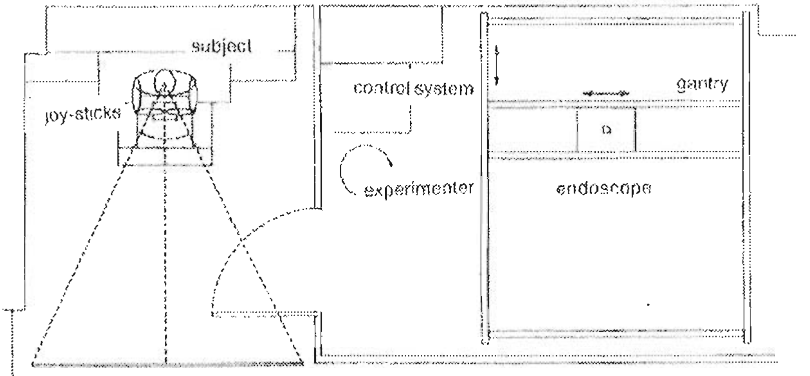
Urban landscapes in modern Japanese cities are notorious for their poor visual environment: they are often chaotic and sometimes monotonous, and people suffer both sensory overload and sensory deprivation. Under these conditions, people need many signs and other aids for orientation and way-finding. These additional visual elements make the situation worse. Are there any more natural and architectural means to guide people's navigation in space? In this study, it was hypothesized that way-finding performance depends on the visual characteristics of the street-scape, i.e., the more visual information identifying a given place the easier it will be for people to find their way. This relationship was investigated by an experiment using a user-controlled space-sequence simulator and an analysis of the subjects' behavior recorded by the simulation system.



(gantry)



(endoscope connected to camera)



(floor plan)

Fig. 1 The user-controlled space sequence simulator.

A User-Controlled Space-Sequence Simulator

This simulator was designed to allow a subject to move through a model space and visually experience a travel sequence. 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 100-inch CCTV screen (see Fig. 1). The maximum size of the scale model is 2.36m x 2m in horizontal dimensions and 0.5m vertically. The movable area of the CCD camera head is 1.5m x 1.5m. Maximum speed of movement is 30mm/sec, and the angular velocity of rotation is 72 deg./sec. The control system of the simulator records all signals generated by the joy-sticks every 0.01 second, while operating three stepping-motors: two for horizontal movement and one for rotation. The exact position within the model space and the viewing direction at a given moment can be stored in a computer memory, providing data for the analysis of the subject's behavior.

An Experiment

Using the user-controlled space-sequence simulator, an experiment was conducted to examine the influence of the physical characteristics of street-scape on people's performance in way-finding.Eighteen undergraduate students (nine male and nine female non-architectural students) were employed to participate in the experiment. Three scale models (1:150) of an identical maze pattern (300m x 300m; see Fig. 2) each with a different street-scape were used in the simulator. The three types of street-scapes were:

(1) no characteristics, with monotonous surfaces (N-type; see Fig. 3, 4),

(2) each corner distinguished with a different building (C-type; see Fig. 5, 6), and

(3) streets furnished with trees, fences, arcades or columns (S-type; see Fig. 7, 8).

Procedure

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 by the simulator along the programmed route, at walking speed, the viewing direction could be controlled by the subject. Thus the experience of the route was not in a absolutely passive mode, but the subject could voluntarily acquire information. After five minutes of instruction, a subject was asked to take the instructed route. Each trial continued until the subject choose a wrong direction and deviated two blocks from the correct route. This procedure was repeated until a subject successfully reached the end of the route. Subjects were allowed to try up to five times. After the experiment, the subjects were asked draw a cognitive map of the route. Three male and three female subjects were tested in each of three street types.

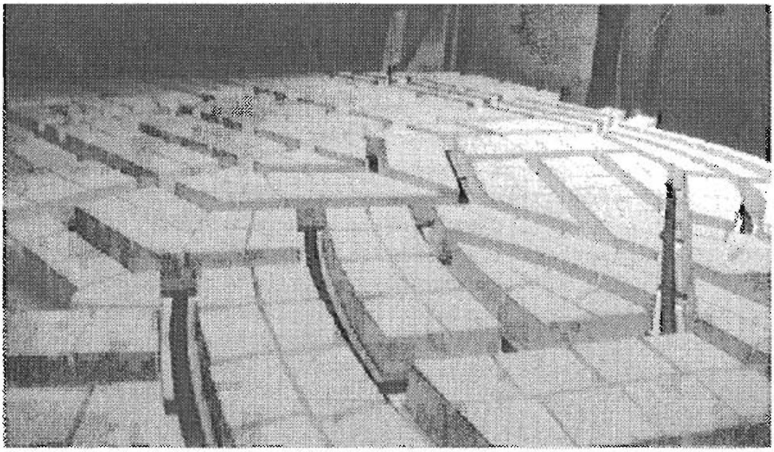


Fig. 2 Overview of the scale-model.

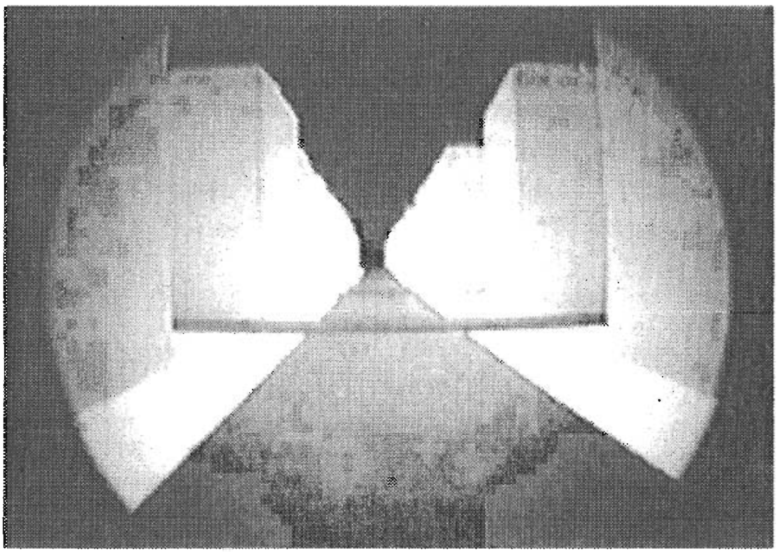


Fig. 3 The N-type street-scape (no characteristics, with monotonous surfaces).

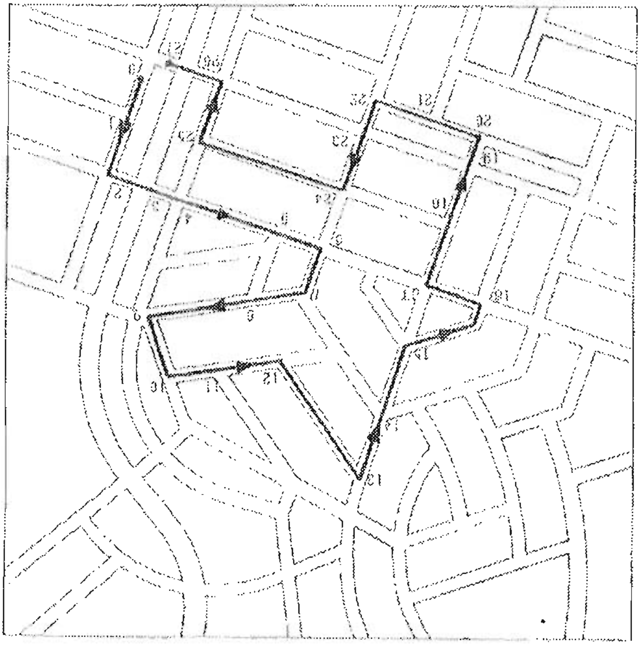


Fig. 4 The predetermined route and numbering of intersections.

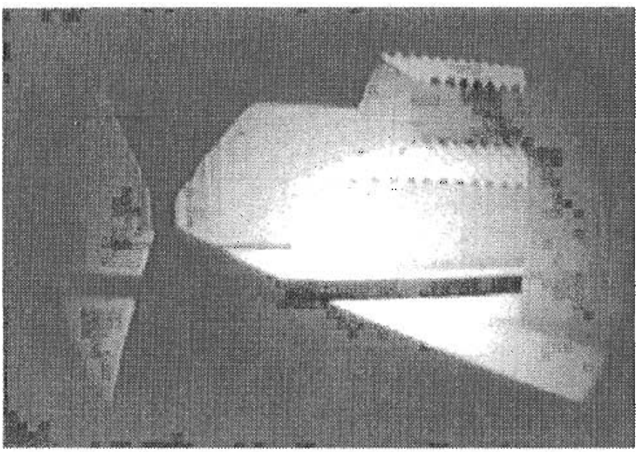


Fig. 5 The C-type street-scape
(each corner distinguished with a different building).

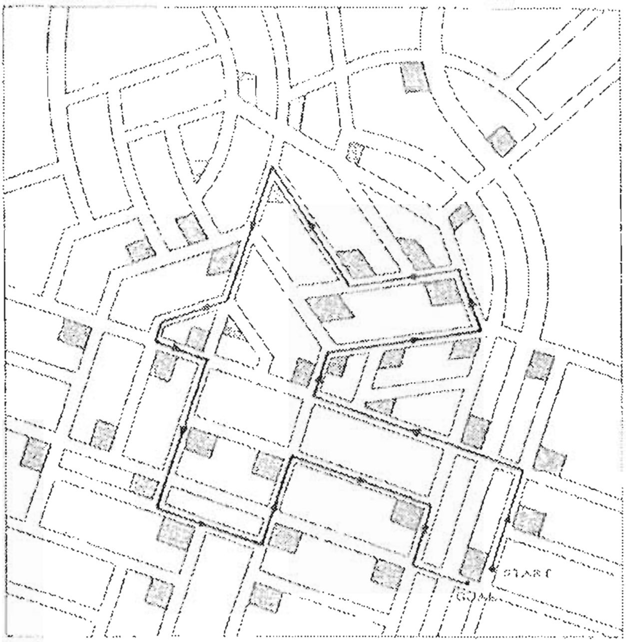


Fig. 6 Layout of buildings of different form in the C-type model.

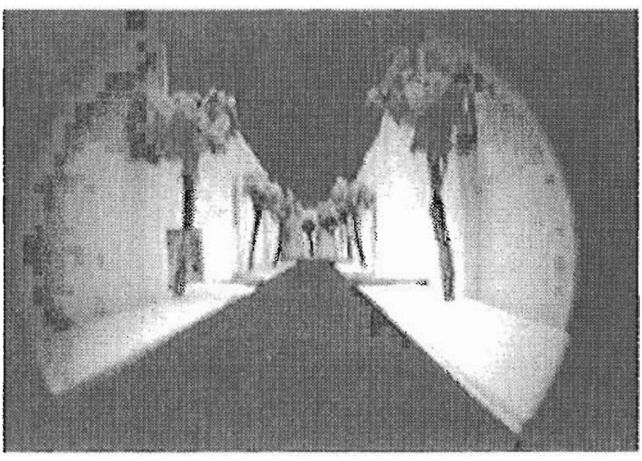


Fig. 7 The S-type street-scape
(streets furnished with trees, fences, arcades or columns).

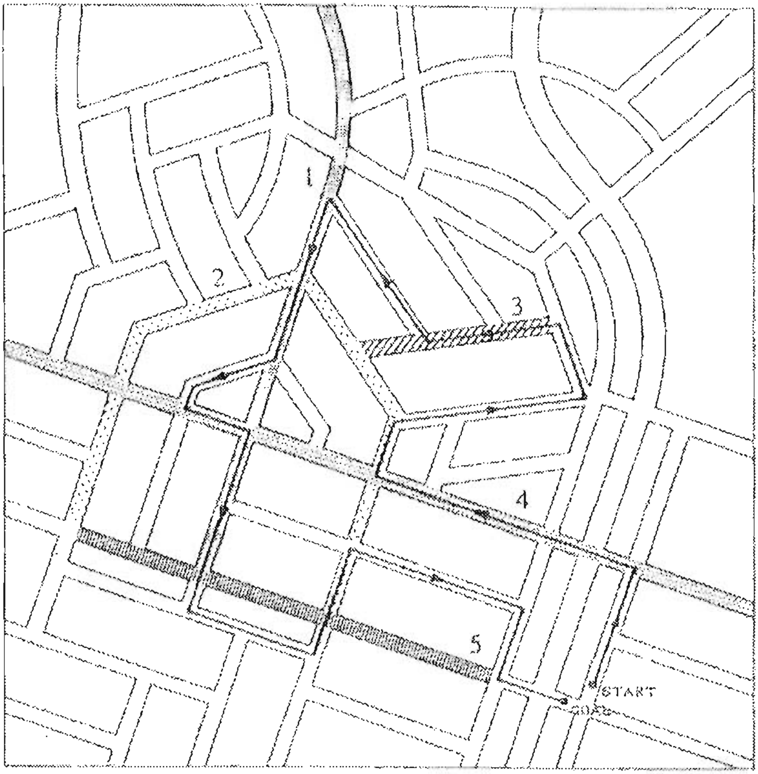


Fig. 8 Layout of streets with different elements in the S-type model
(1: trees of yellow leaves, 2: fences, 3: arcades, 4: trees of green leaves, 5: posts).

Results and Discussions

The trace of movements and viewing directions for each of the eighteen subjects were examined by the printouts of computer display. Figure 9 shows an example of one result. Figure 10 shows the frequency of error occurring at each of twenty-seven intersections along the route. It is noted that at some intersections it seemed more difficult to find the right direction than at others, and the intersections where errors frequently occurred were different between the three street types. At intersection No. 7, for instance, errors occurred frequently in the N-type, but rarely in the other types. In this "Y"-shaped symmetrical intersection, the sense of right/left direction seemed to be enhanced by the characteristics of the street scape. However, since the data is limited, the cause of the results in other cases is not very clear.

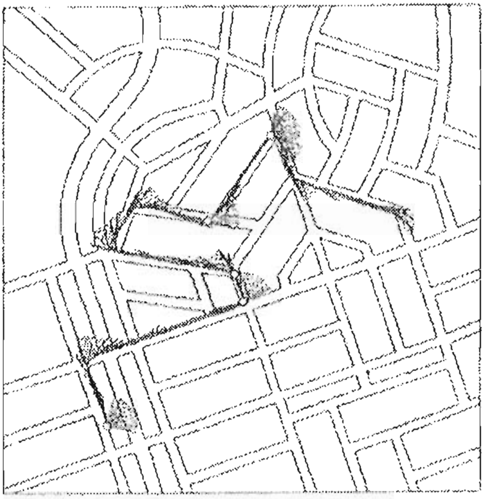


Fig. 9 An example of experimental results
(The trace of movement and viewing directions)

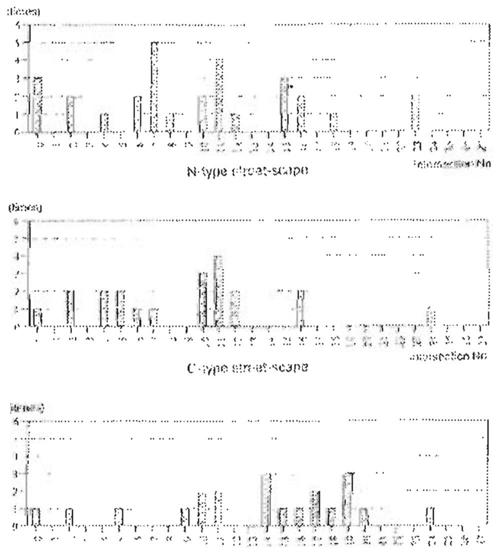


Fig. 10 The total number of errors occurred at each intersections.

Figure 11 shows how many intersections were successfully passed by each subject in each trial. Comparing the results of first and second trials, we noticed as a general tendency that subjects could only go a short distance in the N-type, i.e., it was most difficult to memorize this route. The C-type was easier, and S-type was easiest. After the third trial, personal differences in way-finding performance became evident. Some of the subjects could not reach the goal even in the C-type and S-type, while some could reach the goal in the N-type.

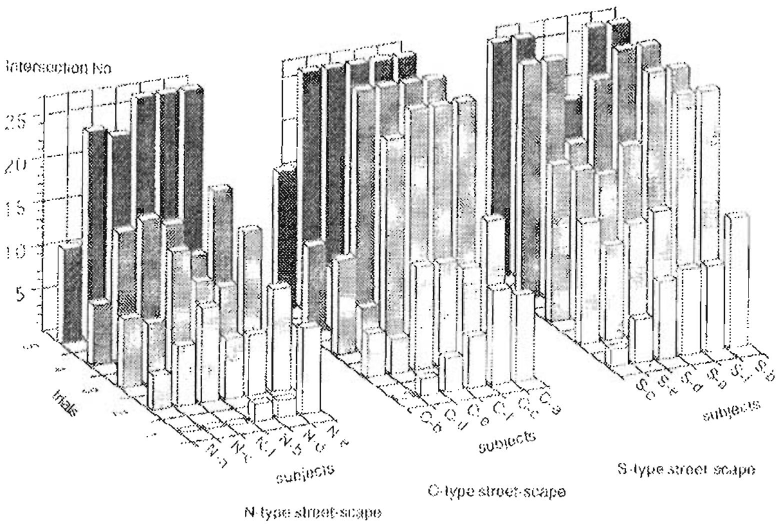


Fig. 11 Number of intersections reached by each object.

The cognitive maps drawn by the subjects who could reach the goal were examined (see Fig. 12). It was found that none of them was geometrically correct, and only five among the fourteen were topologically right with minor errors. This indicates that many of the subjects could find their way without having a map in their mind. This may suggest that we need not have complete knowledge about the route in advance, and that we can choose the right direction based on a sequence of visual scenes as we move along the street. In other words, a part of our knowledge about the place is inherent in the environment, and it is used as necessary in way-finding.

Conclusion

The way-finding experiment using a user-controlled space-sequence simulator generally supported the hypothesis that a route in streets with significant visual characteristics was easier to memorize, although there was a large difference in performance between subjects. With an analysis of the cognitive maps drawn by the subjects, it was also noted that subjects seemed to rely more on incoming visual information on the changing scene than on structured knowledge of the route, i.e., a cognitive map, as is emphasized in conventional theory of way-finding. Although this study deals with an early stage of environmental knowledge, and limited data was extracted from the simulated spaces, it may suggest a dynamic relationship between information inherent in the environment and that in the human mind.

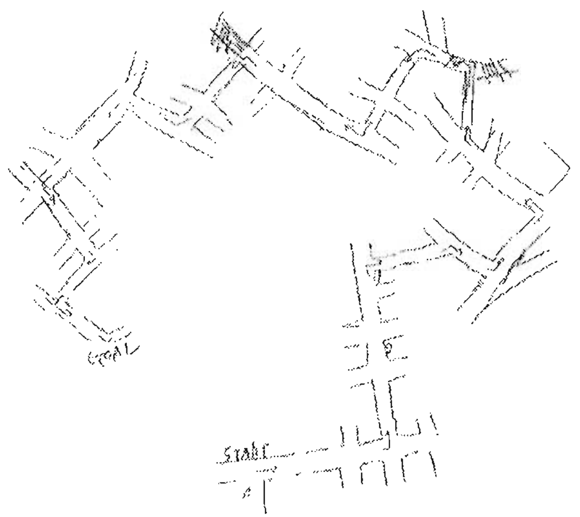


Fig. 12 An example of the cognitive maps drawn by subjects.