

THE DEVELOPMENT OF ELECTRONIC MAP VISUAL COGNITION EXPERIMENT SYSTEM

Chen Yufen Cai Shaohua

Institute of Geographic Sciences and Natural Resources

CAS, Beijing, 100101, PR China

Email: cyfen@371.net

ABSTRACT

Visual cognition experiments in electronic maps is an important part of map spatial cognition theory research. Spatial cognition research on electronic maps needs validating through experimentation. Visual cognition is a major aspect of spatial cognition, and visual cognition experiments in electronic maps will be a breakthrough of map spatial cognition research.

In order to make visual cognition experiment in electronic maps on a computer, the author developed a set of experimental system of electronic map visual cognition in Visual Basic 5.0 programming language. The system includes three main functions: the function of testing on screen, the function of database, and the function of test data analysis and result show.

This paper introduces the functions and the integrand of experimental system of electronic map visual cognition and presents four experimental designs of electronic map visual cognition.

1 Introduction

Most cognitive researches in cartography were carried out in accordance with printed paper maps, and there was little spatial cognition research on electronic maps, especially visual cognition experiments in electronic maps. Electronic maps have many features differed from traditional paper maps, therefore, the mental process of gaining spatial information by using an electronic map as a spatial cognition tool is somewhat different from that by using a paper map. The differences between them could be verified through visual cognition experiment in electronic maps.

Visual cognition experiments in electronic maps is an important part of map spatial cognition theory research. In order to use the experimental method of map spatial cognition to carry out visual cognition experiment in electronic maps on a computer, the author developed a set of experimental system of electronic map visual cognition test (EMVT) in Visual Basic 5.0 programming language. The author used the system make four visual cognition experiments and explored the way of visual cognition experiment in electronic maps. This paper introduces the main functions of EMVT and experimental designs of visual cognition experiments in electronic maps.

2 The flowchart of EPVT

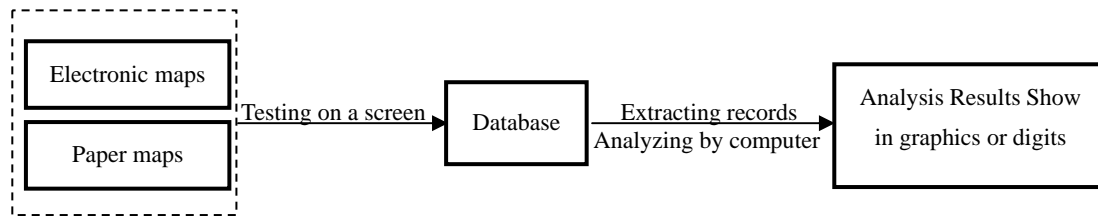


Figure 1 the flowchart of EPVT

The technological process of visual cognition experiment in electronic maps includes making test maps (electronic maps in raster or in vector), testing on a computer screen, extracting some records from result database and analyzing test data by a computer, and showing analysis results in graphics or digits on a screen.

3 The functions of EPVT

There are three functions in EPVT, that is the function of testing on screen, the function of database, and the function of test data analysis and result show.

3.1 The function of testing on screen

As an electronic map is shown on computer screen, the function of testing on screen is the most important. In order to make comparable between the test data on an electronic map and a printed paper map, we use the method of testing on screen for either electronic maps or paper maps.

3.2 The function of database

The function of database is necessary to automatically analyze test data on a computer screen. It conveniences the management of test data, and increases the practicality of the system. There are two forms of data record in the function of database in this system, one record form is in digit, and the other is in graphics.

3.3 the function of test data analysis and result show

This function may allow analyzer extract the test record from database at will, such as name, date, sex and education, analyze reaction time and correct radio with probability, process test data in real time, and show experimental results in graphs or digits.

4 Experiment design of visual cognition on electronic maps

4.1 Experiment 1

Objectives

The goal of Experiment 1 was to further confirm different mental process of spatial cognition between electronic maps and paper maps as spatial cognition tool through comparing the differences in mental images formed by reading two kind of maps. The special objectives were to determine:

- 1 what effect on transmitting spatial information using an electronic map;
- 2 the difference in efficiency of communication spatial information between those using the electronic maps and those using paper maps.
- 3 how different the spatial information gained from the same electronic map by users with different spatial cognition abilities.

Subjects

Subjects in Experiment 1 were 6 postgraduate students and 20 undergraduate students from cartography department in Zhengzhou Institute of Surveying and Mapping, with an age range of 18 to 30 years old. All subjects were normal in vision. Subjects were divided into two groups. One group carried out experiment in electronic maps, which was called Group A, and the other one called Group B in paper maps.

Experimental map

The map used in Experiment 1 was an administrative map in Zhumadian region, Henan province, China. The paper map was an actual map at the 1:65000 scale. The electronic map was produced on a Tulip computer and a 14-inch monitor. This provided a graphics screen with 800*600 resolution for displaying the map. Scanning the same paper map and making it have function of electronic map like roam, twinkling, zoom out and zoom in, through Visual Basic language programming producing an electronic map for test. Two administrative counties and three different grades of settlement places on the electronic map were displayed highlight.

The Procedure

Participants were tested individually. The experimenter told the instructions to the subjects, then the experiment began.

In the experiment, the electronic map (for Group A) and instruction were presented on the computer monitor, and the paper map for Group B was put on the table. The subject was asked to study the

experimental map carefully and to memorize the information on the map. Subject was told he could have as much time as necessary to memorize spatial information by roaming the map. After a subject thought he had memorized the information on the test map, he could press the left button on the mouse to switch the map window to the question window.

In order to operate conveniently by the mouse or the keyboard, the first question was answered by means of choices. That is, “ Please recall the map you have just read and answer the question as quickly as possible.” There were three answers to be chosen: (1) Shuiping county is in the northeast of Zhengyang county; (2) Zhengyang county is in the northwest of Shuiping county; (3) Shuiping county is in the northeast of Zhengyang county. The subject chosen the correct answer by clicking the right command button. The timer began to work when the question window was presented and stop when the subject clicked the “certainty” command button, and then switched to the next question window. The timer ended working

The second question was answered by means of filling blanks. That is, “Please judge the grade of Zhumadian, Runin and Magutian according to a legend.” The legend with graduated circle symbols was presented on the screen. The subject compared the symbols of settlement places on the mental map with those on the legend, then answered the question by pressing the number key on the keyboard.

4.2 Experiment 2

Experiment 2 was made to compare mental maps formed from an electronic map with that from a paper map. Mental map is an important content in map spatial cognition research. Because mental map run through complete process of cartographic communication, we may know how the people recognize maps by researching on mental image and improve maps.

Objectives

There are different between information presentations and map reading environment using electronic maps and paper maps. The objectives of Experiment 2 were to determine how these differences result in different mental feature of user’s using map. What influences do the different mental feature on map using? The mental map has the features of incomplete, distortion and diversity. Has the mental map formed from reading an electronic map these features? This study is to probe into the above problems and make an attempt to some conclusions from the experiment.

Subjects

Subjects in experiment 2 were divided into two groups. Group A carried out the experiment using an electronic map. Group B worked the experiment using a paper map.

Materials

The maps used in experiment 2 were a screen map and a paper map. The paper map was a published Zhengzhou map. The screen map was a map in raster by scanning the same paper map and producing the basic functions of electronic map by MapInfo and Visual Basic. There are three different ways from Zhengzhou Institute of Surveying and Mapping to Zijinshan park on the screen map which were marked in blue color and all important targets along the way were shown highlight by twinkling.

The Procedures

Participants were tested individually. The subject was told to study the experimental map first, then answer the questions. The test map and direction were presented on the computer screen (the paper map was put on the table before the computer). When a subject had memorized the contents of map he could press “next page” key and switched the screen to the question window. The subject in Experiment 2 was asked recall the map just read and select a route from Zhengzhou Institute of Surveying and Mapping to Zijinshan Park, and draw the route he chosen and mark the important objects along the way on question window using drawing tool given by EPVT. There are some operations with drawing, Erasing, object moving and deleting. Then pressing the “enter” key, the experiment finished.

4.3 Experiment 3

Objectives

Map orientation is an important content in map spatial cognition research. The objective of Experiment 3 was testing the mental process in orientation memorizing cartographic objects by using an electronic map.

Owing to electronic maps with the functions of roam, zoom out and zoom in, and inquiry. The size and the resolution of computer monitor limited the reading of electronic maps, and we have to read an electronic map by roaming or zoom out. Whether does the way of electronic map reading effect on map users’ memorizing orientation of map? What mental strategy used by map users in memorizing orientation? We tried to resolve these question through Experiment 3.

Materials

The map used in Experiment 3 was 1:500,000 topographical map in vector. The map was modified using MapInfo and Visual Basic.

The Procedures

Subjects were asked read the direction firstly, according to the direction learn the map purposefully and keep the contents of the map in heart as much as possible, then answer the questions.

The direction was “pay attention to the orientation of each settlement on the left map, please press the answer key in toolbox and answer the questions when you think you have memorized the contents on the map. The state will be automatically shift to answer after four minuets.”

When subject thinks he has memorized the contents of map, pressing “next page” key, then switching the screen to the question window. The experimenter asked subjects recall the map just had read, and selected a right answer according to four given answers: which settlement is in the most eastern, the western, the northern, the southern position on the map? And which settlement is the largest graphics on the map? After selecting the right answers, subject was told to press “confirm” key and end test.

The database records all five answers given by subjects and reaction time, and provides the correct answers.

The result analysis is analyzing statistically the correctness radio of answers and reaction time, and asking subjects recall the mental strategy used in accomplishing task when test ending.

4.4 Experiment 4

Objectives

The information processing of spatial relationship is an important content of map spatial cognition experiments. The goal of Experiment 4 is testing the mental feature of subject in reproducing the spatial relationship among information from mental map formed by using electronic map.

Materials

The map used in experiment 4 was an electronic map in vector. There are four roads, two railways, eight settlements, one reservoir and two rivers on the test map. The test map had basic functions of an electronic map.

The Procedures

The experimental map was shown in a graphic frame on a computer screen when Experiment 4

began, subjects was told to read the map using the tools of roam, zoom in and zoom out, and inquiry in toolbox on the top of screen. Subjects were asked to memorize the contents of test map as much as possible. The screen will switch automatically to the question window after four minutes. Subjects also may press the answer window, and switch the screen to the question window. Subjects were asked to recall the contents of map he just had read and draw all contents of test map as much as possible. In order to make the test simple and effective, the positions of road, river and reservoir on test map were fixed, only the initial position of eight settlements were put the left and top of screen. In the test, subjects were asked to press the graphics in little circle of settlement using a mouse and drag the graphics to the right position according to his mental map.

The answer database in Experiment 4 is recorded in graphics. The method of result analysis is to compare the answer subject chosen with the right answers, and give four simple evaluating according to the degree of tallying the answer of subject with the correct answer. The four evaluations are “complete correct”, “basic correct”, “deviation” and “error”. On the base of all answers of a subject, the system gives five results with “excellent”, “good”, “medium”, “pass” and “failure”.

5 Conclusion

Visual cognition researches on electronic maps just begin, and there is a long way we have to go, but we have explored a way of studying spatial cognition on electronic maps. By developing EPVT and having made four visual cognition experiments in electronic maps, we may have such an conclusion: spatial cognition experiments in electronic maps must be carried out on a computer, and the design of experimental scheme and the development of test software are the key to successful tests.

6 References

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