P-092

THE EFFECTIVE DESIGN AND VISUAL COMMUNICATION OF DYNAMIC MAP SYMBOLS:A CASE STUDY WITH TRAFFIC MAPS

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BACKGROUND AND OBJECTIVES

The digital era poses new challenges to cartography. While cartographic animation has become a practical alternative, it is mostly used to depict both spatial-temporal and non-temporal changes. Dynamic map symbols constitute the foundation of dynamic animation and dynamic cartography. It is the rich dynamic symbols making the strong visualization function of dynamic map come to the real world. Details of spatial information can be delivered more vividly with the help of dynamic map symbols. And dynamic map symbols build a highway between readers and geographic information, through which readers can accurately and quickly percept or discover the changing rules or features of spatial phenomenon happened during a period, not just a time point. As the words of map language, the effectiveness of dynamic map symbols is the key of dynamic cartography and visual communication.

Various cognitive and usability studies of animated or dynamic maps in recent years could be a sign of rekindled interests in the study of map design. French cartographer Jacques Bertin (1967; and translated to English in 1983) propose seven visual variables initially by the and later extended by various cartographers. Ai Tinghua proposed four dynamic visual variables (1998). Poh-Chin Lai assessing the effectiveness of dynamic symbols (2004). But this paper concentrates on the use of dynamic symbols on a static base map. Unfortunately, there is very little empirical evidence on the effectiveness and efficiency of these visual variables (MacEachren, 1995). How can Geoscientists, geo-visualizers, and cartographers be sure that their design decisions produce effective and efficient displays? What color classification is effective? What Size (the width of a line) classification is effective? Color or size expression which is more effective? What change frequency is effective? What color, size and change frequency are effective in different scale?

This paper concentrated on the influence of visual variables for dynamic map symbols, such as the way of express, color and size classify, changing frequency and scale of display, on users' cognition or perception for dynamic traffic maps.

METHODS

The proposed methods are applied to the assessment of four commonly used visual variables for designing 2D maps: size, color, frequency, scale. We adopt the user perception-based empirical study (50 students, 25 male and 25 female; 25 cartographers, 25 other disciplines) to test the visual variable by using efficient (fastest) and effective (accurate) visual variable to detect change under flicker conditions. We use the user's Average Deviation method to test effective (accurate) which can be calculated by equation (1).

$$D = \min(P_{ik} - P_i) \quad (1)$$

Where D is the results after data processing, i.e. average deviation, Pik is the number k subject to answer the i-item question, Pi is the standard answer to i-item question.

Another, we use Linear standard Approach—extreme method to test the efficient (i.e., response time) which can be calculated by equation (2).

$$t_i' = \frac{t_i - \min(t_i)}{\max(t_i) - \min(t_i)} * 100\% \quad (2)$$

Where ti' is the results after data processing, i.e. response time, ti is the response time to answer the i-item question, max(ti) is the maximum response time answer to i-item question. min(ti) is the minimum response time answer to i-item question.

DISCUSSION AND CONCLUSION

By the case study on dynamic symbols of Hong Kong traffic maps, we achieve the most effective and efficient visual variables. The visual variable size proved to be more efficient and effective than color. Class 10 is most effective under color expression and class 20 is most effective under size expression. For the visual variable frequency, 3-6 frames per second is most effective and efficient under color expression, and 6-12 frames per second is most effective and efficient under size expression. With the scale smaller and smaller, the effective color, size and frequency become lower and lower.

A visual test was carried out to figure out the most suitable designing of symbols which stand for traffic flow through a quantitative way of analysis. This paper tries to provide cartographers quantitative support or basis when designing dynamic map symbols.