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INVESTIGATION OF DIFFERENT VISUALISATION METHODS FOR CRIME MAPPING[7]

ABSTRACT

There are a quite many GIS application available on the internet showing crime statistics all over the world. The usual visual methods for these statistics are generally pictograms and point symbols. These visualisation methods raise two problems that they are not able to transmit the real crime situations to the users, because it is not easy to interpret the content of it. The other problem is that they may harm the confidelity of the victims. Therefore in this study the authors tested the applicability and effectiveness of other visualisation methods.

Keywords: crime mapping, visualization, usability study

1. INTRODUCTION

Crime mapping recently is a very important communication platform between the citizens and police. This type of visualisation of crime data is widespread all over the world. In some countries it is also ubiquitously used among citizens when they would like to buy a flat, to decide where to find school for their children etc. If someone browsing the web the usual visualisation methods for crime maps is aggregation for a greater district level, point symbols, Crime information can be shown on a map shaded to show crime rates in each area compared to the average across London, or as text by clicking on the "Text view" tab. All the data is aggregated to the level of sub-wards. Sub-wards are the smallest areas shown on the map. Sub-wards are known formally as lower super output areas (LSOA), with an average of 633 households [3].

Another common solution of visualisation of crime on maps is using different symbols or points for showing crime locations. Leitner and Curtis [4][5] had found that point symbols can be reversed geocoding from maps, and that the preservation of someone's spatial confidentiality depends on population and structure of the neighbourhood independently from the scale of the

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map. From the visualisation point of view using point symbols is not a very good solution as spatial patterns cannot be revealed. On the contrary the public weal requires that the spatial patterns of crime should be available for safety purposes.

Also building a surface using geostatistical method, like kernel density estimation, has been already used [6] but only for scientific purposes. With using this method spatial differences between blocks become smooth. This method is mostly used in hot spot detection. Though for the citizens it would be interesting to see the spatial patterns of their surroundings also.

The authors think for crime mapping purposes other visualisation methods can be tested. A previous work of Pődör, A. already proved that contiguous cartogram can be a good alternative solution for showing spatial tendencies of crime in a city [7]. Although using this method a problem acquiring because some previous research showed that cartograms only be understood if there is a map showing original spatial reference [1][2]. Therefore the users need to use two maps: one with original polygons and one with distorted polygons. In this research the author found that creation of reference polygons can be based on the blocks of a city.

In this context the purpose of this study is to analyse the effectiveness of two very common and essential cartographic methods for visualising quantitative data: graduated colours and graduated point symbols for crime mapping purposes referenced on block polygons. In the study authors investigate (1) how successfully these two methods can be applied for visualising crime data in municipal surroundings and (2) how well users can define differences according the classification used on the maps.

2. MATERIALS AND METHODS

In fall semester 2013, 24 land surveyor BSc students participated in the introductory course on Cartography. The age of each students, taking part in the survey, were 18 to 25. This semester was the fourth semester at the University of West Hungary for the 90% of the students.

The city of Székesfehérvár was used as the pilot area. The city is a medium sized Hungarian settlement which can model the average circumstances of Hungarian cities. Crime statistics shows that usually there are 6-7 000 crimes happen yearly.

The test consisted of two parts. In the first part the participants got the map using graduated colours where the reference polygons were coloured according the total number of crime than they should also process the second map where graduated point symbols method were used. On both maps all the blocks inside the city was indicated and labelled with an ID number.

2.1. PREPARATION OF THE TEST MAPS

First the authors processed the crime data which was the main thematic attribute of the map. In the test all kind of crime data was used. The crime data were geocoded and it was stored as a point layer. The main purpose was to see how certain areas are affected by all type of crime in the city of Székesfehérvár and the test was a modelling the process how effectively can test persons retrieve information from the maps using different thematic cartographic methods.

In preparing the test maps the authors used a method previously used in a former research [7] where polygon blocks were created by using the street network. Then a spatial join were applied between crime data and polygon blocks of the city, so in this method crime data became the attribute of the polygon blocks. The structure of the city is irregular. In the inner city medieval part can be found with narrow streets, but also block houses are located there. These structure causes that there are a lot of irregular shaped polygons with a great variety in size, though regular forms are also presented. Not the whole city was used in the study. There were 724 blocks of polygons appeared on the maps.

The maps were prepared in ArcGIS at a scale 1:20000. In the case of both test maps the same classification method of natural breaks of Jenks were used and the data were sorted into 5 categories in order to be able to compare the result. The 5 categories were: 0-14; 14-46; 47-119; 120-270; 271-736.

On MAP1 (Fig 1.) the “Orange Bright” colour range were used. On MAP2 (Fig. 2) graduated symbols were coloured by dark blue and the symbol size were varied from 4 to 20 points.

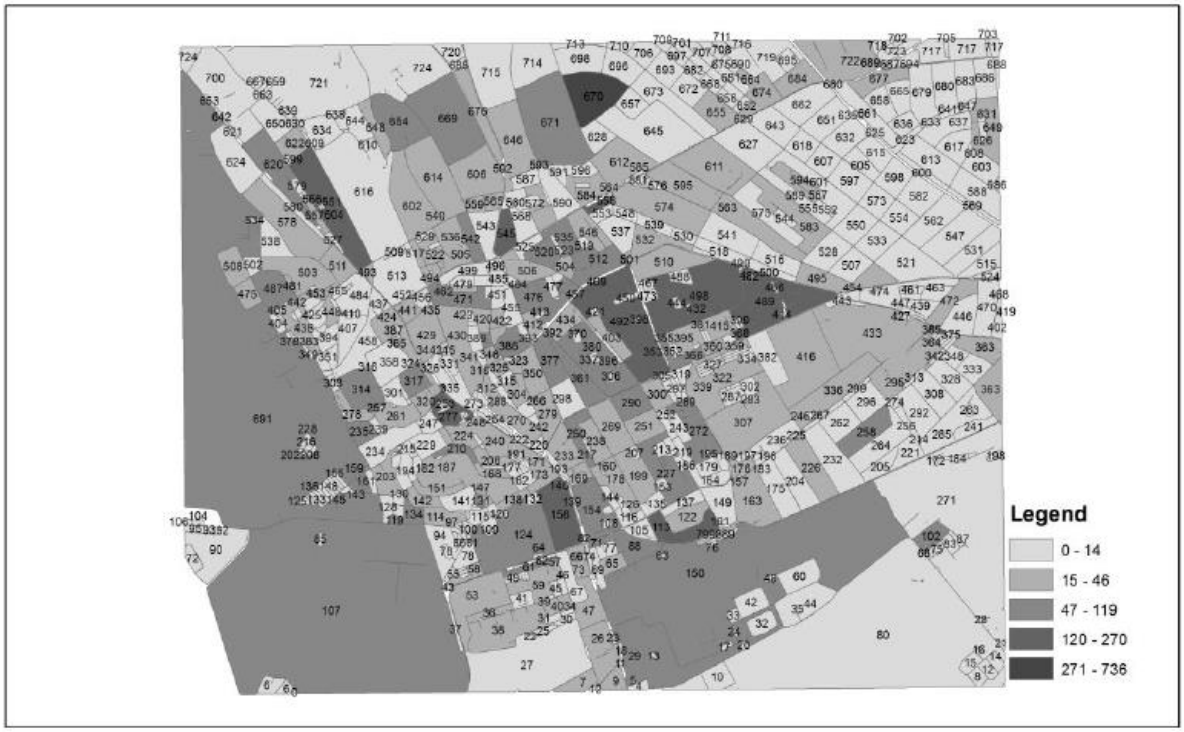

Fig. 1 Graduated colours method used in the study of test maps

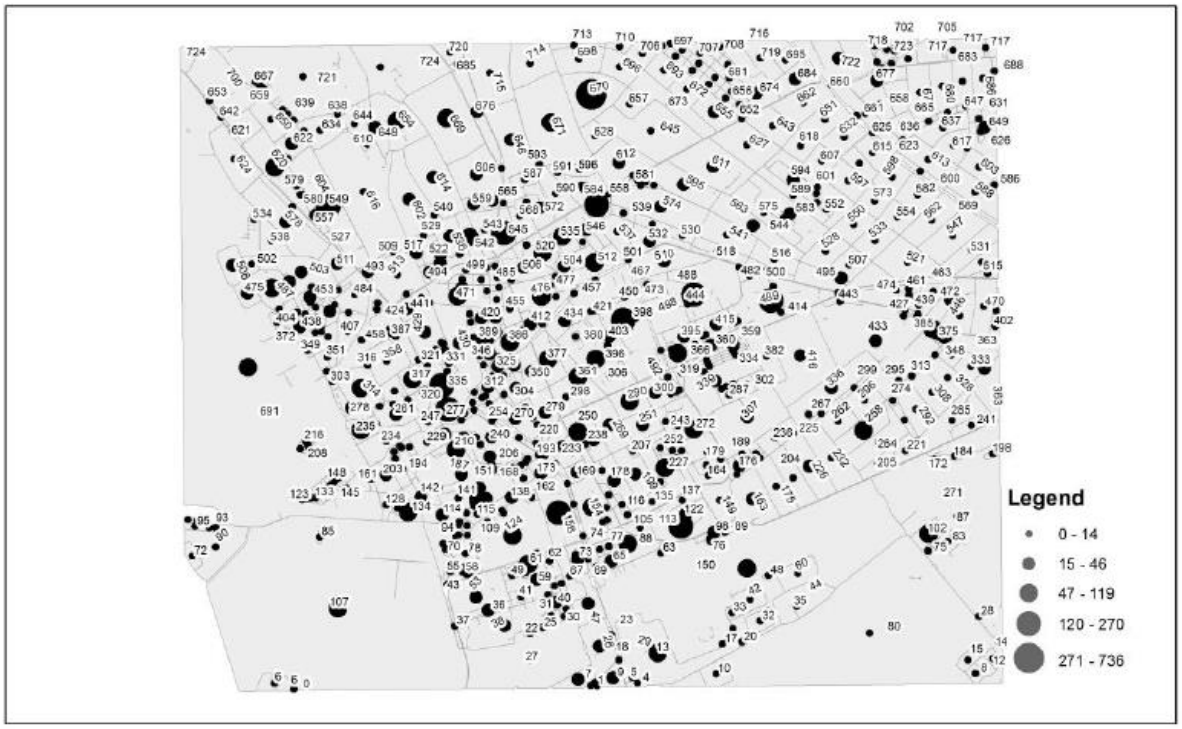

Fig. 2. Graduated point symbols method used in the study on test maps

2.2. EXPERIMENTAL TASK

The purpose of the test was to simulate the experimental phases when users studying the structure of the crime map and they try to reveal information connected to spatial patterns.

The participant conducted the experiment in a computer lab and an e-learning platform was used to store the maps, also the test participants had to upload their results to that platform. The test took minimum17 maximum 68 minutes for the participants.

In test they had to study MAP1 and when they were finishing they had to continue with studying MAP2. In the test their task was to define five polygons using the ID number of the polygons written on the maps within each classification categories used on the maps. They had the freedom to choose any polygons which was classified into a certain class according their number of crimes. On the first maps they could use the colours as a graphic variable to identify each category and discriminates between polygons, on the second map they could refer to the size of the symbols which was generated according the previously mentioned classification method. In the case of the second map, where graduated symbols were used to show the quantities, the maximum and the minimum size of the symbols were dependent on the size of the blocks inside the city. As it was mentioned before the sizes of the blocks were showing a great variety and therefore could not be too much difference generated in the size of the symbols, because the most crime are usually occurs in the inner cities where blocks are relatively small.

3. RESULTS

The results of the overall performance of each participant can be seen on Fig.3. Investigating the most simple statistical values of the two data files, it is evident there are quite a big similarity between them. Concerning mean values in case of MAP1 it is 68, 9% in the case of MAP2 it is 71, 1 %, also the values of standard deviations are quite close to each other 24,43 in case of MAP1 and 24,46 in case of MAP2.

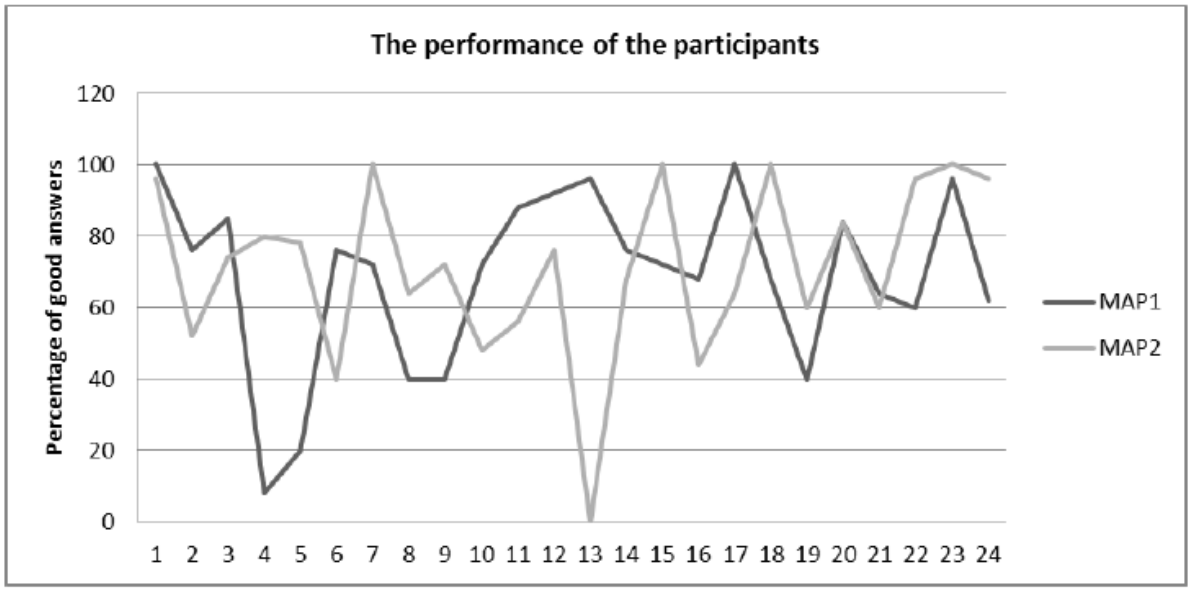

Fig. 3. Comparison of the overall results of the test participants

If we analyse in detailed both results we can see that in case of MAP2 there were 7 person whose solution were above 95%, although in case of MAP1 only 4 of them were bale to reach this result. Analysing the personal performance of the test persons the result is very interesting beacuse it shows that only 3 person were able to fulfill both task at the same level, which means that only 3 person were able to produce the same results in both task the others made the task with different effectiveness, almost half of them were more succesful with graduated colors method, the others were more efficient with graduated symbols method.

If analysing the effectiveness of the test participants with defining the different categories, it can be seen that MAP1 proved to be a little bit more effective in the case of small quantities (Fig. 4.), on the contrary in case of high values of crime graduated symbol methods (MAP2) could be more helpful for analysing the map for the participants

For the participants the task of identifying small values first and second categories on the maps proved to be the more easiest task. As we can see from Fig. 4., the higher the values on the map the lowest the performance of the test participants were.

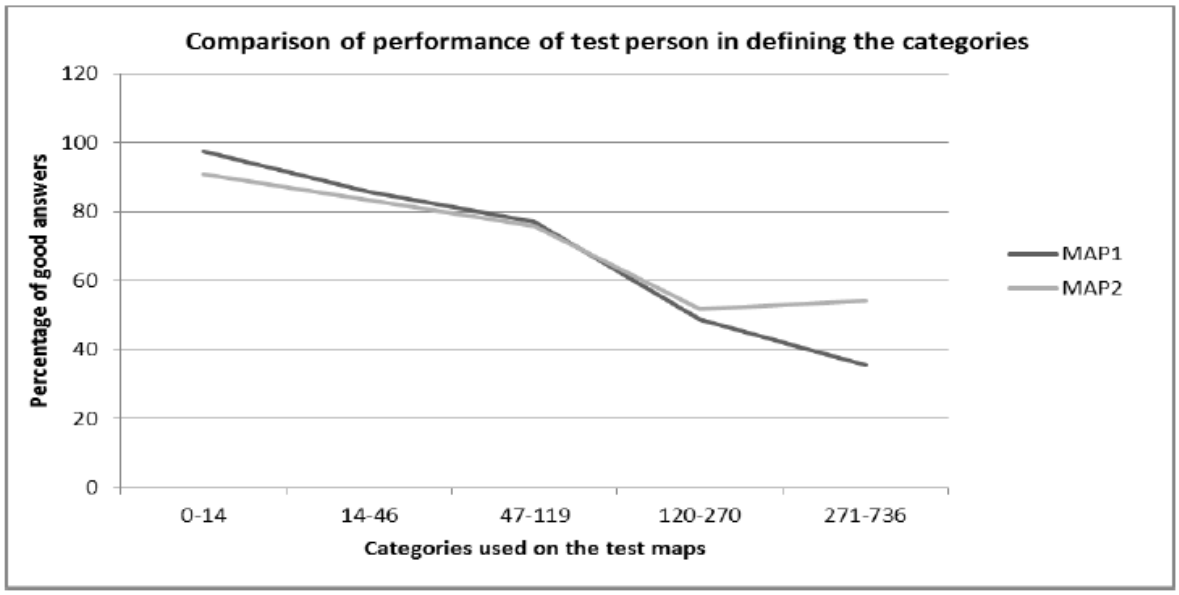

Fig. 4. Overall results of the identification of different categories on the test maps.

4. CONCLUSIONS

The results of test identified some essential problems in visualising crime data. As analysing the result of the experiment it can be clearly seen that with higher values (with more crimes) it was more difficult to identify the categories on maps although in this case, from the two tested methods, graduated symbols proved to be more effective. The results indicates that the combination of other visualisation method with the tested ones can be a good solution in visualising crime data on blocks in the cities.

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