Map Use Education and Geovisualisation

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Key words:

1. INTRODUCTION

My thesis is that surveying engineers are overestimating the human ability to grasp the meaning of geospatial data when presented to them. I know that surveying engineers are diversifying, are trying to provide added value to the geospatial data they collect. But, like beauty, added value is in the eye of the beholder. And if our client in the geospatial data provision process does not perceive the added value, when she cannot immediately grasp the meaning of the data, a sales opportunity might be lost. Geospatial information is still most easily grasped when visualized. There are many instances in which we do not need visualization, for instance during various analytical procedures. But in order to decide what types of analysis to engage in, in order to perceive the patterns or anomalies in the geospatial information we need, the geospatial data should be visualized. Some of the analytical procedures for geospatial data call for visualization as well, for instance for re-expression, having geospatial data in either relative or absolute mode, depending on our wish to compare numbers, trends, densities, proportions, distributions or patterns. For all of them we can apply specific visualization modes. Further visualization examples are animation and 3D rendering, which can be applied as well for analysing socio-economic data as physical data. Finally, beyond the analyses, the results of our geospatial data processing need to be communicated, and here again visualization is still the most effective and efficient way of presentation.

My contribution is on map use education and research: just as a reminder to show that it is not sufficient to collect the geospatial data required, and process them and get them to the client. In the mapping sciences we have to do more, we have to make sure to offer the client the data in a form she can deal with in order to allow her to understand the data as well.

2. MAP USABILITY RESEARCH

Several research methods have been developed for getting more information on the way people use maps to derive spatial information from them. Board (1978) was the first to present a model of map use tasks. On the basis of the objective the geospatial information was to be used for (to answer a specific query, to site a waste dump, to develop the resources, to navigate through a wilderness), the appropriate map reading tasks were set, and operational questions like *What performance measure to use,* or *What method of scoring the answers to use* and *What method of analysing the scores to use* were answered. Thus the maps most suitable for doing a specific task by a specific user public in a specific situation could be assessed and selected. The percentage of correct answers or the time within which the correct answers could be given was usually used as yardsticks.

Morrison categorized the ways maps were researched in order to check their ability to secure the user's attention and their fitness for use, borrowing terminology from communication theory: the sender must secure the attention of the receiver and, secondly, must pass on the content of the intended message (Morrison, 1981). He discerned between:

- Verbal forms of feedback, such as reviews by experts, comments by users, or questionnaires,
- Visual forms of feedback, such as eye movement studies, semantic differential and psychophysical testing, and
- Behavioural forms of feedback, such as direct observation or protocol analysis.

Eye movement studies consist of the recording of fixation points and scan paths. The methods to collect information on eye movements are rather intrusive, as they consists at least of electrode placement on eyelids, or the application of contact lenses. Tests have not yielded the information cartographic designers have wished for until now, as eye movement patterns have proven to be too individual to derive useful task-related information from.

The semantic differential technique has been used in order to make user comments, that are unstructured at best, comparable, by presenting scales bounded by two extremes (e.g. warm/cold, generalised/specific, gross/detailed, clear/blurred, etc that had to be marked by test persons that are asked to indicate the characteristics of specific maps.

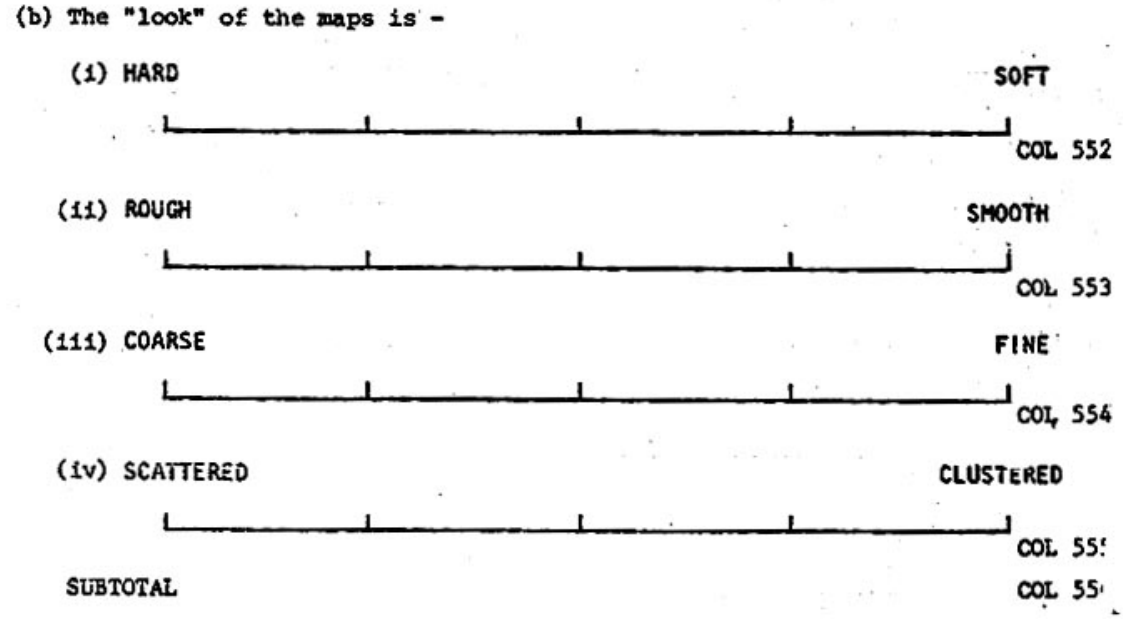

Figure 1: Example of the semantic differential scales for visual evaluation

Psychophysical testing is the technique in which test persons are confronted with a physical stimulus, such as a test card with circles in different sizes or shades, and then for instance are asked to estimate the differences in size of these circles. Consecutively, these (psychological) responses are compared to the actual sizes of the physical objects. As the information on map

use that could be derived from psychophysical testing was disappointing however, it gradually was replaced by cognitive map use research.

It is only through behavioural evaluations that the cartographer can be assured that the correct message has been communicated (Morrison 1981). Even so, this consisted of following the test person about, when he was navigating through a city on the basis of a town plan, and this might be rather expensive in terms of time and petrol consumption. A good alternative, frequently applied nowadays, seems to be the thinking aloud method.

3. MAP USER RESEARCH

The thinking aloud method was pioneered in cartography in the 1990s by McGuinness, who researched map use in a GIS environment. She tested the ability to describe distributions of variables and to explore their relationships. She found a distinct difference between novice and expert map users, and this she attributed to the emergence of map use strategies in expert users. Subjects with more prior knowledge and expertise followed a more systematic search strategy (McGuinness 1991).

The thinking aloud method now involves the analysis of recorded verbal and action protocols that result from asking test subjects to speak out their thoughts when executing particular problem-solving tasks. The performance of these tasks is recorded using audio and video equipment, and these can be used to derive protocols. The result of a typical test set up would be a combined image on which, simultaneously, the monitor image of map accessed would be presented, as well as the video image of the test person, and the result of his analysis. At the same time, the sound of his comments would be rendered, so that really an overall view of the activities of the test person would be possible, and verbal and action protocols could be derived from those, and analysed in order to find out how the tasks in the field of dealing with geospatial information were dealt with.

The thinking aloud method has been applied (Elzakker 2004) to learn more about strategies blind people would use for acquiring knowledge from tactile maps, in the recognition of regions from topographic maps, in assessing contour line pattern reading strategies (how do we make sense of contour lines), the ability to understand orienteering maps or way finding tasks, or the strategies for developing a model of a region on the basis of the geospatial data they select.

4. MAP USE EDUCATION

The fact that expert map users perform better than novice map users, the fact that they have developed strategies to do so, leads us to the possibility to enhance map use by map use education. What map users observe on a map will very much depend on their ability to use map skills, and, really, map skills can be regarded as an operationalisation of map concepts. We can differentiate between the map use phases of map reading, map analysis and map interpretation. During map reading someone who does not understand the legend concept or the scale concept cannot identify phenomena on maps. On the other hand, it can be surmised that what users come up with during map analysis will depend on their operationalisation of

geographical concepts. During map analysis, someone who cannot classify facts into spatial distribution and areal differentiation (by using the generalisation and regionalisation concept) or who cannot discover areal association is not able to analyse a map (see box). With horizontal association the relation between different occurrences of the same phenomenon would be indicated, with vertical association the relation between distributions of different phenomena.

underlying skills	**relevant concepts, sub concepts**	
describing/identifying	-spatial location	-site -situation
classifying	-distance	
	-spatial distribution	-group
relating	-spatial association	-horizontal -vertical
	-spatial interaction	
	-spatial system, region	
interpreting	-spatial structure	

Programmed instruction, for instance for performing a map-analysis task of relating phenomena on a map, consist of a number of steps (Schee 1987):

- what is on a map (identify),
- what is where on a map (classify)
- what relationships are visible on the map (relate)
- is this relationship valid all over the map (check, monitor)

etc.

Again to follow such steps presupposes the ability to deal with a number of geographical concepts.

In the map interpretation phase we find that amongst experts, combined with growing map use expertise there is the growing knowledge of a phenomenon or field, which would also assist them in deriving information from maps. The more information one already has about a region, the more additional information one would be able to derive from a map of that region. A geologist for example might even be able to derive geological information from a contour map.

ICA has the only commission of all mapping sciences organizations to be concerned with the general education of children and students in graphicacy that is the ability to deal with and use geospatial information. This it does through its Commission on Cartography and Children. This commission is very active, just had a successful conference in Glasgow, will have a preconference in Madrid in July next year prior to our main conference in A Coruña, and will have another conference in Brisbane in 2006, together with the IGU Commission on Geographical Education, prior to the IGU regional conference in Australia.

5. ICA'S CONTRIBUTION

In December 2003 ICA's Commission on Mapping from Satellite Imagery organized a seminar in Bangkok for agronomists, teaching them to derive the data they need for agricultural planning from satellite imagery, aerial photographs and maps. They were able to state the accuracy (both positional accuracy and attribute accuracy) they needed, and we were able to show what imagery answered their requirements, and how they should derive the required data from those. We are right now setting up an ICA Working Group on Early Warning and Risk Management, working on the same principle of getting people the data they need in a format they can handle and understand to base their decisions on.

Next year ICA will probably organize jointly with the FIG education commission, if I am correctly informed, at the International Conference on the History of Cartography in Budapest, at the end of July, a joint seminar on the development of manuals in the mapping sciences. We look forward to other opportunities for cooperation.

REFERENCES

Board, C. –1978 Map reading tasks appropriate in experimental studies in cartographic communication. Canadian Cartographer vol 15-1, pp 1-12

Elzakker, C.P.J.M. van, (2004), The use of maps in the exploration of geographic data. PhD thesis, Utrecht University; Netherlands Geographical Studies vol. ..(forthcoming)

McGuinness, C., A. van Wersch and P.Stringer (1991), Map design and map use: experts and novices in a GIS environment. In: K.Rybaczuk and M.Blakemore (eds.), Mapping the Nations. Proceedings, vol. 2, of the 15th International Cartographic Conference Bournemouth 1991, London: BCS.

Schee, J.A. van der (1987) A view of maps. PhD thesis, Free University of Amsterdam, Netherlands Geographical Studies no 36, Amsterdam/Utrecht

Morrison, J. L. (1981), Systematizing the role of feedback from the map percipient to the cartographer in cartographic communication models. International Yearbook of Cartography vol XXI, pp 125-132

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