The influence of attributes of shape in map reading process

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Introduction

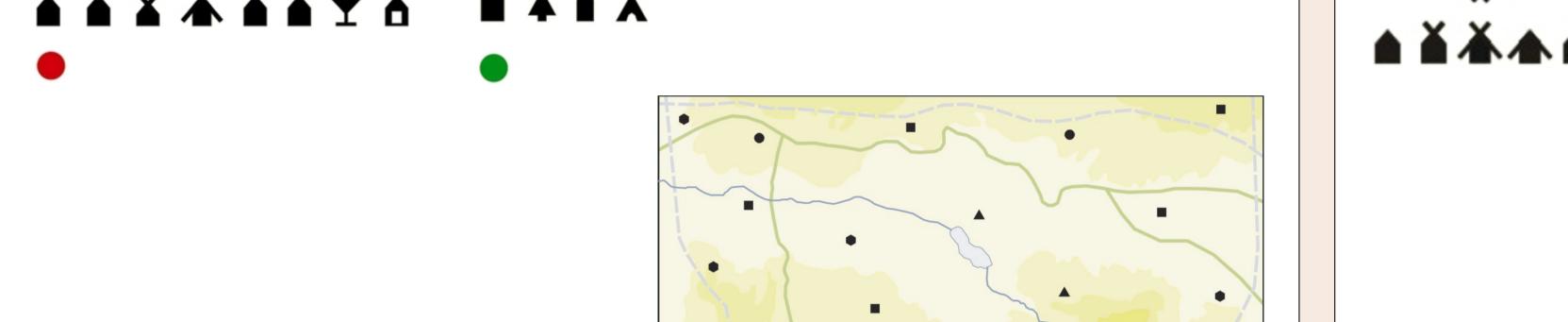
Cartographic research based on experiments analyzing eye movement appears since 1970s. Initially these studies were purely experimental, but later on, in 90's, cartographic studies on visual search were also based on theories of perception and cognition. The present study is based on Marr's theory of vision, according to which edges and blobs are elements of visual scenes that are preattentively processed. However, psychological studies suggest that "preattentive" or "basic features" are not clear issues and underline the need for further experimentation. The models that psychologists have developed to explain visual search process offer to cartographers a basis for studying how map users search for specific information on maps.

Four experiments (A, B, C and D) performed in the Cartography Laboratory of N.T.U.A. in order to examine the influence of attributes of shape, like terminations (edges according Marr) and the topological property of having a hole (blob according Marr), for which there are remarkable indications that are preattentively processed, and the structure of the way point symbols of different levels of abstraction are perceived.

Experimental Design

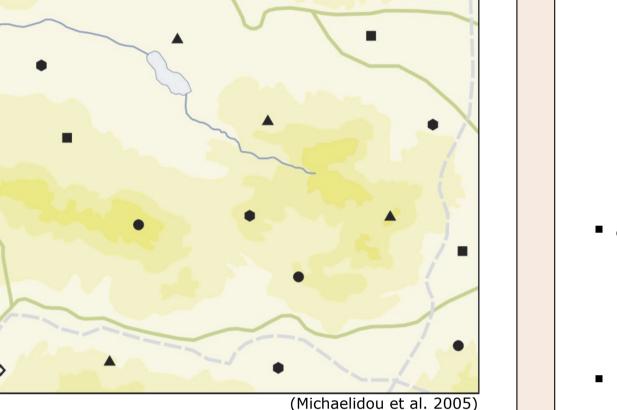
Subjects were asked to search on a computer monitor for a designated target symbol with a unique feature among geometric and pictorial distractor symbols on maps of different quantity of data. Targets were located in the center, the middle and the periphery of the base map. Also, the case where the targets were absent was also studied.

Experiment A		Experiment B	
Target symbols	Distractor symbols	Target symbols	Distractor symbols
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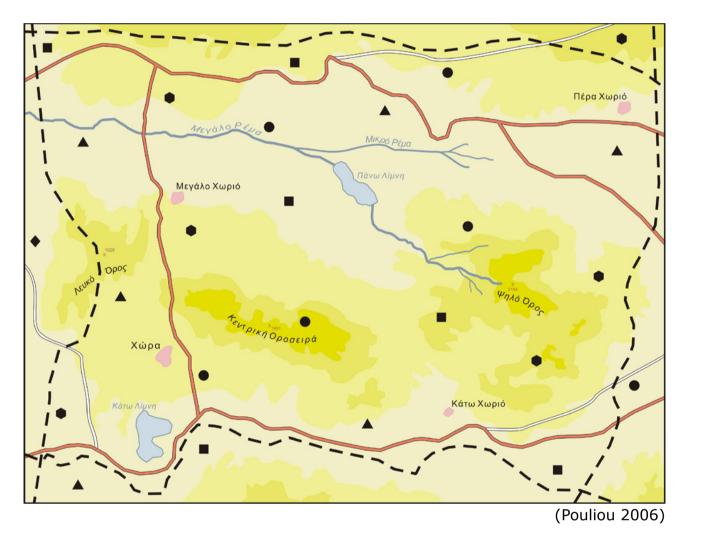
120 maps totally: 48 maps with abstract symbols 64 maps with pictorial symbols eight maps with the colorful symbols

63 subjects



80 maps totally: 40 maps with abstract symbols 40 maps with pictorial symbols

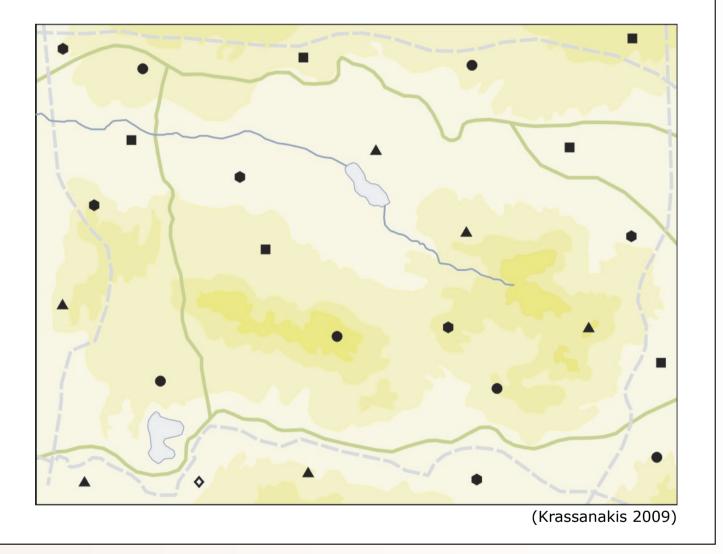
31 subjects



Experiment C Target symbols **Distractor symbols** Â A ы

Experiment D

Target Distractor symbols symbols



- 30 maps totally: 15 maps with abstract symbols 15 maps with pictorial symbols
- 60 subjects



- 16 maps totally: eight maps with abstract symbols eight maps with pictorial symbols
- eight subjects

Methods of Analysis

- Time recording and accuracy of the given answers (Experiments A, B and C)
- Eye Movement Analysis (Experiment D)

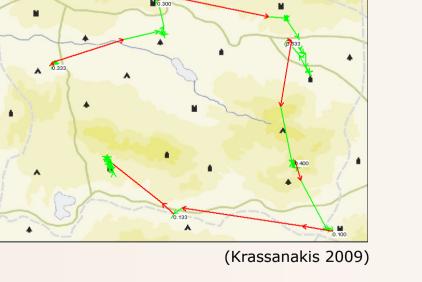
Results

- Geometric symbols were detected faster than pictorial ones in experiments A, B and C.
- In case of target-absent trial, search time was longer than for target-present one and the duration of search task was shorter for geometric symbols.
- In case of pictorial symbols, unique feature contributes to the faster detection of the target.
- In case of geometric symbols, the topological property of hole was the attribute that contributes to the fatser detection of the target

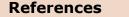
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- The topological property of having hole seems to be more robust for the target detection than the property of line terminations.
- Search time of a target-symbol was shorter when the target was located near the center and longer when near the periphery of the map.
- Experiment D indicated that in most of the scenes visual search started from the place where the target was located in the previous scene. In all other cases, the place where the target was located in the previous scene was included in the scan path.
- Scan path was complicated when target was located in the periphery of the map and simpler in the middle or in the center.
- Fixations corresponded to places of the background where point symbols were present. The process of visual searching through target and other symbols were depicted as saccadic movements of the scan path.
- Eye movements analysis did not reveal a special pattern of searching task when target was absent.



• The verification of target's detection was independent of the location that it was depicted.



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