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Journal
Proceedings of the Annual Meeting of the Cognitive Science Society, 5(0)

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Publication Date
1983

Peer reviewed

The Role of Grid Schemata in Memory for Large-scale Environments

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Although large-scale urban environments are complex and rich in information, most of us successfully navigate such environments every day. In order to perform such a task, we must have memory representations for such environments. The present study examines how we remember large-scale urban environments.

Memory research suggests that we use higher-order knowledge structures, called schemata, to remember rich sources of information, such as stories (Thorndyke, 1977), people (Snyder and Uranowitz, 1978), rooms (Brewer and Treyens, 1981) and the complex skills involved in chess playing (Chase and Simon, 1973). Schemata may also be used to remember large-scale urban environments. Most environments of this kind comprise a grid pattern of rectangular or square shaped blocks formed by intersecting streets. A useful way to remember such areas would be in terms of a grid schema (Kuipers, 1978; Moar and Carleton, 1982). However, most urban areas do not fit perfectly into a grid pattern. For example, unlike the lines in a grid, streets are not always at right angles or parallel to each other. If we do use a grid schema to remember an urban area, such a schema may cause features of the area to be distorted in memory. In fact, we can make predictions of the kinds of distortions which may occur if we do remember urban areas using grid schemata. Five such predictions are listed below and are referred to collectively as the grid hypotheses.

1. Right-angles hypothesis. Lines in a grid always intersect at right angles. The hypothesis predicts that intersecting streets that do not meet at right angles will be falsely remembered as right angled intersections.

2. Parallel-lines hypothesis. Lines in a grid are either at right angles or parallel to each other. According to the hypothesis, if streets in an urban area travel in roughly the same direction but are not parallel, they will be misremembered as being parallel.

3. Parallel-subsets hypothesis. A single square in a grid is contained within a larger square made up of several single squares. The sides of the single square are parallel to the respective sides of the larger square in which it occurs. For example, in a 3 X 3 square grid, the sides of the center square are parallel to the respective sides of the larger square formed by all nine squares. The hypothesis predicts that if the sides of a building in a block are not parallel to the respective streets forming the block, the sides of the building will be falsely remembered as being parallel to the respective streets of the block. Here the building comprises a single square of a grid contained within a larger square, the block.

4. Straight-lines hypothesis. All lines in a grid are straight. It is predicted that streets containing bends will be remembered as being straight.

5. Alignment hypothesis. Each single square in a grid is perfectly aligned on the grid's vertical or horizontal axis with each of the four other single squares with which it shares a side. In an urban area, buildings sometimes face each other but are not perfectly aligned. Thus the middle of one building may not directly face the middle of the other building. The hypothesis predicts that such buildings will be falsely remembered as being directly aligned. In other words, the buildings will be misremembered so that the middle of one building directly faces the middle of the other building.

The five grid hypotheses were tested in three experiments. In the first experiment, students of Bucknell University drew from memory a map of part of the campus. In Experiment 2, students of the uiversity drew a map of the whole campus from memory. Preselected features of the campus were examined on students' drawn maps to determine if the features were distorted in the manner predicted by the grid hypotheses. In both experiments, significant distortions were found for all five hypotheses, supporting the use of grid schemata in memory for the campus. In addition, half the students in Experiment 2 were freshmen and half were seniors. The seniors' drawn maps were significantly more elaborated, in terms of the number of buildings, streets or place names, than those of the freshmen. However, no significant difference was found between the freshmen and seniors in terms of the degree to which their drawn maps were distorted towards a grid pattern. The results suggest that amount of experience with an urban area does not change the way it is remembered in terms of a grid schema.

The third experiment involved a recognition task. Students of Bucknell University were presented with maps, each of a single feature of the Bucknell campus (eg., an intersection, two streets, etc.). Nine alternative maps of each feature were presented; one correct map and eight with various degrees of distortion. For each feature, students had to choose the map which they considered was the most accurate. For each of the five grid hypotheses, students showed a significant tendency to choose the map in which the feature was distorted in the manner predicted by the appropriate grid hypothesis. Therefore, the recall results of Experiments 1 and 2 and the recognition results of Experiment 3 support the use of grid schemata in memory for the campus.

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