CHILDREN'S UNDERSTANDING OF THE ENVIRONMENT FROM NAVIGATION AND MAPS

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ABSTRACT: This paper compares environmental knowledge acquired by direct exploration to environmental knowledge acquired through indirect means such as reading a map. Navigation through a space provides direct information about position of landmarks and routes, but without a vantage point for viewing the entire space, it may be difficult to integrate this information. Although children often have difficulty using maps, maps provide a bird's-eye view of space, which may facilitate development of configurational knowledge. To enhance the development and use of configurational knowledge by children, future geography education programs need greater emphasis on the connection between maps and places that have real value to children.

Much of our environmental knowledge is acquired by direct exploration, although some environmental knowledge is acquired through indirect means such as reading a map or receiving verbal directions. This paper compares children's understanding and use of spatial information from these two sources.

Spatial orientation is an ability that we use everyday. Some spatial orientation tasks require landmark knowledge. For example, when giving directions, we often refer to landmarks ("It's next to the green house."). Other problems require route knowledge. For example, when visiting a new city, we may be able to find our way around by using several specific routes between our motel and other points of interest. According to Siegel and White (1975), the endpoints of routes are landmarks, which are typically visual markers, while the routes connecting the landmarks are largely sensorimotor sequences.

Still other problems require configurational knowledge (i.e., survey or layout knowledge), which allows one to travel from place A to place C because of previous travel from place A to place B, and from place B to place C. In other words, one can make a spatial inference, which is a very useful ability that allows one to take short-cuts and alternate routes. These three levels of spatial representation or understanding are believed to develop in a stage-like manner with age and experience.

Research by myself and colleagues (Rider & Rieser, 1988) has addressed two questions regarding this third skill: 1) At what age are children able to make and act on spatial inferences? and 2) What information do subjects use to make a spatial inference? In one study, groups of children from 12 to 48 months of age were shown an object and then walked from the object out of the room and into an adjacent room where they were asked to point directly at the object. Successful performance in this condition required subjects to link several pieces of information together to infer the straight-line direction to the target. Results indicated that children as young as 3 1/2 years could make this simple spatial inference. Some 3-year-olds were also able to do this. Other 3-year-olds, however, performed similarly to the younger children (2-year-olds), who pointed at the doorway through which they walked (i.e., the last segment of their route).

A second study was conducted to determine what information children were using to base their response. The task used in the first study could be solved by using visual cues (e.g., landmarks and the structure of the environment), proprioceptive cues (e.g., the distance and direction of one's movement), or both. In the second study, we manipulated the information available to 2- and 4-year-olds as they walked from the object into the adjacent room. In the Eyes Open condition, subjects had visual-environmental cues and proprioceptive cues available, and could use one or both to solve the task. In the Eyes Closed condition, subjects had only proprioceptive cues available to solve the task. When adults are tested under these conditions, they perform more accurately in the Eyes Open condition, but they are able to perform reasonably well in both conditions. The 4-year-olds we tested showed a pattern of responses similar to adult performance, although their overall level of performance was lower. The 2-year-olds showed a pattern that was very different from 4-year-olds and adults. They performed better when their eyes were closed. This suggests that the two ages are using different information, or using the same information very differently to solve the task.

Several follow-up studies determined that the 2-year-olds were not simply misunderstanding the task they were being asked to do. They were instead basing their responses on the visual cues when these were available and on the proprioceptive cues when visual cues were not present. They were, in a sense, "led astray" by the perceptually salient cues in the Eyes Open condition.

These studies show that 4-year-olds have some basic understanding or use of configurational knowledge, as assessed by their ability to make spatial inferences. Two-year-olds show rudimentary use of configurational knowledge, at least under conditions where visual cues do not compete for their attention. There is still much development to occur in understanding and application of configurational knowledge during middle childhood. Throughout middle childhood, children's configurational knowledge is gradually applied to larger, more complex, and less familiar spaces.

In addition, configurational knowledge may not be easily acquired from navigation through an environment. On one hand, navigation through an environment provides direct information about the space. Cognitive-developmentalists believe that these actions on the environment are critical to learning. Maps, on the other hand, provide indirect information about the environment, which is not as useful. However, maps provide something that direct exploration normally does not provide, namely, a bird's-eye view of the space, which would seem to facilitate development of configurational knowledge. With maps, the user "sees" the entire space represented, rather than only specific parts of the environment experienced with actual navigation. Smyth, Morris, Levy & Ellis (1987) point out that maps may be more difficult to use while navigating than a list of directions, but a map "allows you to go back along a route, it allows you to use one of several routes to get to [your destination], and to construct a new route if an old one goes wrong" (p. 240). Thus, a map contains information needed for configurational understanding.

Some research on map use indicates that children as young as 3 years may be able to use simple maps to locate objects in an environment that is aligned with the map and by 4-5 years, children can use simple maps to successfully navigate a simple route (Blades and Spencer,

1986). However, flexible use of more sophisticated maps may be years away (Liben and Downs, 1989).

There is little research that has directly assessed differences in environmental knowledge based on maps versus actual experience with a space. Thorndyke and Hayes-Roth (1982) tested adult workers who had different amounts of navigation experience at their work place and compared their performance to adults who had never been in the building but who studied a floor plan of the building. In part, the results indicated that the navigation subjects performed more accurately than map-learning subjects when judging orientation between points with straight connecting routes, but judged object locations less accurately than the map-learning subjects. According to Thorndyke and Hayes-Roth,

> "Map learners acquire a bird's eye view of the environment that encodes survey knowledge sufficient to support performance on a variety of estimation tasks. The obvious advantage of acquiring knowledge from a map is the relative ease with which the global relationships can be perceived and learned. When using this knowledge to perform spatial judgments, individuals have direct access to the knowledge required to estimate distances and judge object locations." (p. 585)

Navigation subjects, on the other hand, store information about routes actually travelled and so must compute judgments based on their memories of circuitous routes through the space. Despite this need for computation, the navigation subjects do not have to change perspective as do the map-learning subjects.

Despite the recent interest in geography education and the research on children's understanding of maps, we know little about children's abilities to actually use maps as navigation aids. There are a few recent studies that have begun to address this issue as well as whether children's knowledge of an environment differs depending on whether they study a map of the space or travel through the space. Uttal and Wellman (1989) recently tested whether 4- and 5-year-olds' abilities to navigate a route through a playhouse would be affected by first learning a map of the space. Like the research with adults, children who learned the map first did show an initial advantage over children who did not learn the map, but after five trips through the playhouse, both groups performed similarly. The map may provide information that is useful in travelling through a new space, but once one is familiar with a space, this information may be just as easily obtained from direct experience.

Anecdotally, we observe little map use by children in "real life" navigation situations. Children may not be successful in using maps as a basis for navigation because they lack one or more of the requisite component skills, such as aligning the map and environment (mental rotation), understanding the symbol system, translating differences in scale, establishing a correspondence between the map and the environment that it represents, knowing where they are in the space, and directing their movement on the basis of this other knowledge.

The understanding and use of maps are integral components of the "Suggested Learning Outcomes" for young school children that are described in Guidelines for Geographic Education: Elementary and Secondary Schools (Natoli et al., 1984). If "use of maps" refers to being able to understand the components of the space and locating objects in space by using a map, then I think that we have achieved this outcome. But, if "use of maps" refers to being able to accurately navigate one's way through space by using information contained in a map, then I do not believe that we have successfully accomplished this goal. We may know what children know about maps, but we still do not know how children use maps.

We need future research that will help us understand how best to teach children more than simply what a map is and how it represents some space. We need to know how to enhance children's use of maps for orientation and wayfinding in environments. This has practical significance in that it increases children's exploration and reduces the likelihood of them getting lost. Currently, geography education programs spend little time on the connection between maps and places that have real value to children. Cognitive-developmental theory would suggest that this is an important facet of an overall program of geography education. Having children use maps to navigate in a space is an ideal way to provide direct and concrete experience that is believed to be such a critical part of the learning process by cognitive-developmentalists.

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