WHEN BOY SCOUTS GO TO CAMP:
EXPERIENCING AND LEARNING – MAPPING – THE ENVIRONMENT

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What can we learn about nine- and ten-year-old Boy Scouts – they are called Webelos – from their first camping experiences? Particularly, what changes occur in their knowledge of the environment? The underlying process is basically quite simple. First, everyone interacts continually with the environment.

> Knowledge of one's location in the environment is of primary functional significance, and environmental orientation skills are an important type of behavioral competence. Apart from extrinsic pressures to be oriented in the environment. Berry (1971) has shown that different ecologies put different amounts of extrinsic pressure on spatial abilities. There are a host of intrinsic motivations that are exercised in good sense-of-direction people. [Kowalski and Bryant 597]

There is, in one direction – from the environment to the person, a flow of information and, in the other –from the person to the environment, behavior. This can be presented as a simple model. The model considers the human as an information processor. If we accept that everyone has sensors, perceptual processors, cognitive processors, and memory, then there is the mental (or cognitive) map.

> Cognitive maps are hypothesized knowledge structures embodying people's assumptions, beliefs, "facts," and misconceptions about the world. [Kearney and Kaplan 580]
>
> … the frequent use of a term like 'cognitive map' may lead to the impression that there really is a 'map' in the head. This is obviously not the case literally, but the casual use of the term map is often a barrier in attempts to understand the mental representation of the environment. [Spencer, Blades and Morsley 8]

We do not actually store maps in our heads. Human spatial storage is "wired," as information about the environment coded into our long-term memory. When we deal with a mapping problem (a spatial problem, an environmental problem), we devote what Liben calls "spatial thought" to the problem – we mentally manipulate the information in our spatial storage. The result of this manipulation is one or more of several things: It can be following a familiar pathway. It can be matching some part of the environment that we are observing with the representation of that environment on a map. It can be recalling from memory and then manipulating information in order to draw a map.

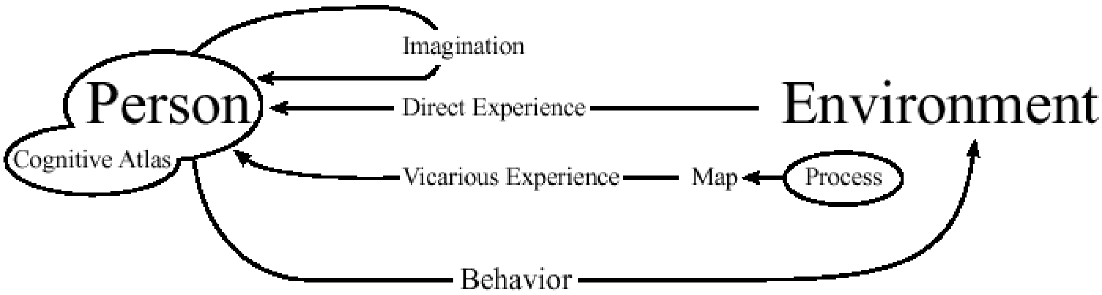
There are problems here, and Golledge and his colleagues provide a daunting perspective:

> … There appears to be substantial evidence that error varies differentially across a cognized area and that one may expect holes, folds, cracks, tears and other disruptions to occur in the knowledge fabric of a place. Such interruptions appear to be almost a logical outcome from things such as asymmetric distance judgments, spatial applications of the power function for distance distortion and translation invariance and triangle equality violations. In addition there appears to be some conflict over the preservation of fully metrical properties of cognitive information with varying evidence supporting hypotheses of Euclidean properties, other Minkowskian properties, hyperbolic spaces and various nonmetric spaces. [Golledge, Smith, Pellegrino, Doherty and Marshall]

Consider now the following diagram of the environmental information – or mental mapping – process.

Everyone is involved, all of the time, in direct experiences with the environment. We are continuously interacting with the space around us: sensing, organizing, and storing in memory. There are many related associations in memory … the problem is how to recall them, how to remember something about the environment. Most of the information that we have about the places where we live and work and play comes from direct experiences with the environment.

Vicarious experiences come in many forms: verbal, graphic or numerical. Someone tells us about a place they have visited or gives us directions for getting from here to there. More formally, there are books that describe places, in words that generate images of never-before-seen landscapes. You can give directions by sketching a map, describe the environment using a picture, or show a movie or a television program. Our knowledge of the earth as a whole, or of large places that we cannot experience totally (such as "Kansas" or "China"), is derived vicariously as secondary information, or opinion, but it is still information about the environment.



In the model, there is "imagination." Imagination involves fabrications, illusions, fantasies … creations, conjectures, deductions. Perhaps some might be considered more than imagination; they are products of "imagineering" – conceptualizations and inventions.

The bottom line, in the diagram and in the real world, is behavior. Behavior is any form of action, response, reaction, performance, or simply functioning. We can classify human environmental behaviors into two groups, navigation and environmental management. Navigation is clear: how do you get from here to there, or just around? Simple, you use a map … and if it's not one on paper (or some other medium), it's one in the head. Navigation -- wayfinding – activities range from informal pathfinding to the formal activities used when driving a car or flying an airplane. Environmental management involves a similar range, from architecture and engineering (building a highway) to, simply, at your level and mine, developing an attitude, an opinion or a slant, organizing knowledge, about some place. The variety of activities between include considerations such as personal space and territoriality, property ownership and right-of-way, state's rights and international territorial disputes.

Consider the individual mental map. How can we learn about the mental map that an individual Webelos has on the first day at camp and how this has changed two days later?

The Freehand Sketch Map

There are a number of ways to get the information about an individual's mental map … we chose to use the freehand sketch map. The process is really quite simple. Give each Webelos a blank sheet of paper (ours was 28x28 cm) and a pencil, and ask them, as simply as possible (very little coaching), to "draw a map of the camp." The boys draw, while we observe and encourage (and discourage leaders from helping too much!). This process works, and it provides useful results, but there are problems.

> … although the cognitive maps of adults have been investigated by getting subjects to externalize them by drawing sketch maps

> … such exercises are much less appropriate for children who lack the drawing skills to produce a map of sufficient clarity and accuracy to represent their environmental knowledge. [Spencer and Darvizeh]

If Spencer and Darvizeh are correct, then why we would we use this method? Are there alternatives?

> Golledge (1976) characterizes four distinct methods for the "extraction" of environmental cognition information: (1) experimenter observation of behavior in naturalistic or controlled situations; (2) historical reconstructions; (3) indirect judgment tasks; and (4) analysis of descriptions, sketch maps, photo recognition, modelling, etc. While analysis of sketch maps produced by study participants was likely the most commonly used self-report technique in early cognitive mapping research, Golledge argues that "the resulting analyses were frequently invalidated by investigators trying to compile information from such sketches at a data level that was highly inappropriate." Specifically, he criticizes the failure of many studies to control for participants' cartographic knowledge or skills which confound efforts to measure or categorize the exact information contained on the maps. ...
>
> It may be, however, that the abandonment of the sketch map as a viable research tool was premature … Both studies suggest that sketch maps are relatively reliable and, at least in terms of distance judgments, relatively valid as well. … [Rovine and Weisman]

There are, for the Webelos project, many reasons to use the freehand sketch map. The goal is to obtain as much information as simply and easily as possible; this is not a part of the camp activities program and it will be a free-time, informal venture.

> The use of sketch maps has been one of the most frequent methods of testing environmental knowledge and it allows subjects the opportunity to include whatever information they want to put on the map. This can be both an advantage, because subjects may include unexpected places and details and a disadvantage, because subjects who know more about an area than they actually draw must select from their store of knowledge. This selection will include what the subject considers important and the experimenter can have little control over the selection criteria applied by the subject. [Spencer, Blades and Morsley 14]

Here we have a key point: "… what the subject considers important …" Any mapping process is selective, and what the dominant mapping elements of a society or culture consider to be important will become the standard method for mapping activities of that culture. In our case, the focus is on the Webelos, and what they feel to be important will become part of – if not the major feature of – their maps.

Landmarks and Routes: The Legacy of Kevin Lynch and *The Image of the City*

Few books in the literature of cartography and environmental psychology (and all of the related disciplines) are as important as *The Image of the City* by the architect/planner Kevin Lynch, published in 1960. This volume established a different perspective for describing the environment, handling environmental perceptions and the characteristics of mental maps.

> Central to Lynch's analysis of the images of major American cities was an interest in discovering the relative imageability or legibility of different urban environments. Lynch defined the legibility of an urban environment as the ease with which its features can be recognized and organized into a clear and unified pattern. … Cities differ in terms of their features' ability to attract attention and to be organized into unified mental images. [Holahan and Sorenson 279]

Lynch identified five components of the urban environment: paths, nodes, districts, edges and landmarks. The city is not a static image of spaces, buildings, streets, and the like, but rather a combination of these physical features with human activity and movement. This view emerges during the mid-twentieth-century activity by landscape architects and planners (such as Gorden Cullen) to define “townscapes” and “environmental corridors” (Philip Lewis). One fundamental aspect of Lynch’s work is the relationship between the five physical characteristics of the environment and the “image” – the mental map – that theurban dweller forms. How are these elements used in the organization of a person’s mental map?

> … landmarks and routes are the predominant elements of cognitive maps. Landmarks are first noticed and remembered. While acting in the context of these landmarks, routes linking them are formed. Finally, routes are integrated within an overall framework as configurations or survey maps. The maps of adults and children probably differ in detail, but the underlying developmental sequence is the same: landmarks to route maps to configurations.
>
> Within the model, the three elements are hierarchically related, that is, routes or linear maps are superordinate to landmarks, and subordinate to configurations. In children, one should find that landmarks are salient, and that route maps should be organized around them. Additional experience should permit children and adults to scale and metricize the distances between landmarks, resulting in more accurate route maps. Finally, with the development of coordinated frames of reference (possibly involving the functional maturity of parietal neocortex) in children (and additional experience in adults), routes should become integrated into configurational or survey maps.
>
> There is also a strong indication that all children were relying on topological cues; buildings isolated from the paths and/or endpoints were placed less accurately than buildings with clear topological positions. Thus, it appears that when young children are given repeated encounters with, and opportunities to perform in, a large-scale environment (as they typically are in the real world), their performance improves dramatically and their inferred spatial “incompetence” seems to diminish markedly. Things are never that simple, however. … [Siegel, in Liben, Patterson and Newcombe]

Landmarks are memorized and organized first, then connected with the paths, and from these emerge the structure of the environment as a whole: the configurational or survey map.

> … the concept of landmark has multiple referents. The term has been used to denote (a) discriminable features of a route, which signal navigational decisions; (b) discriminable features of a region, which allow a subject to maintain a general geographical orientation; and (c) salient information in a memory task. These different referents suggest that landmarks may play a role in a variety of spatial abilities. [Sadalla, Burroughs and Staplin 516]

There are other aspects of the environment that we cannot deal with here, such as whether the physical space is natural or artificial (man-made) and what types of activity spaces and levels of residential desirability and economic opportunity are present. There are a number of ways that the Lynch perspective can be applied to the present study.

Looking at the Webelos Scout

Given the environment, what can we say about 9- and 10-year-old Webelos Scouts. How are they equipped to handle the environment and to confront the mapping task?

> … young children may well have much more at their disposal than they know how to use unaided when locked in confrontation with a blank page. One aspect of this consideration may now be generalized; subjects may have more material available in store than they spontaneously access for themselves. … Now we can specify two dominant task demands of drawing. One is that memory is involved: the subject must call to mind what it is that has to be drawn. Another is that he must not only produce things on the page but use them as cues for the production of later items.
>
> So the basic approach is to regard drawing as a problem-solving exercise for the child. … [Freeman 7-8]

This is a very important concern when dealing with mental maps. Beck and Wood have provided a detailed explanation of what occurs as the environment is experienced and the information is organized and stored. Another major consideration here is the development of children, both in drawing and in spatial skills.

> At about the age of 7 years, the child enters the stage of objective spatial understanding. He becomes able to structure some of the relationships of his spatial environment, but not of integrating them into a whole. He has a well developed understanding of familiar spaces and can represent these fairly accurately, but is unable to co-ordinate the relationships between the number of micro-areas within the "region" in his representation. Thus, parts of his neighborhood cognitive map drawing would be well structured, but the general configuration would not. Rarely earlier than at 10 years old, and often rather later, the child's representational ability evolves to the stage of abstract spatial understanding, at which point he becomes aware that all the parts are parts of a whole and that the elements retain their identity despite transformation, capable of extrapolating routes from within the general structure, and able to reverse mental operations undertaken on his spatial and environmental knowledge. The child's cognitive map drawing of his neighbourhood will not, structurally, resemble a map. [Catling 291]

Krampen, in his *Children's Drawings: Iconic Coding of the Environment* (1991), explains stages of development in picture drawing, not map drawing. Nevertheless, his summary of work on child development is helpful. Combining the work of Piaget and Luquest, he describes a state of drawing that involves "intellectual realism" (4-8 years); this parallels the transition from the preoperational stage to the stage of concrete mental operations.

> Topological relationships are completely acquired at this stage, whereas projective and metrical relationships (i. e., perspective and proportion) just begin to emerge without being coordinated. Proximities are correctly rendered … Order is presented in the drawings of landscapes or houses, although not yet in accordance with the coordinates … In a group of buildings, each may be shown from a different view. In intellectual realism, the elements of space just begin to become projective and metrical, but their relationships still obey the topological laws of proximity, separation, order, and continuity. Between the objects in space and the drawing there can be only element-to-element correspondence of the features. But this correspondence is qualitative, and no coordination of the emerging projective or metric relationships can be seen. There is no understanding of perspective or proportion. No external or vertical coordinate systems combine perspectives and proportions into coherent wholes; hence, the result is a confused (though charming) medley of viewpoints.

In the stage that follows (8-12 years), the child handles concrete mental operations.

> … free drawings start to unite perspective, proportion, and distance. This stage is called "visual realism." Visual realism appears relatively late, since it requires the concepts of projective and metric space (perspective, proportion, metrical distance), which in turn presuppose advanced concrete mental operations. … The projective relationships preserve the true relative position of shapes and figures as against the pseudo-perspectives and pseudo-rotations of intellectual realism. True proportions and relative or coordinate distances between shapes and figures are guaranteed by metrical relationships. Systems of mental operations merely replace empirical constructions.

Hart and Moore (1973) explain in detail the characteristics of the sensorimotor, preoperational, concrete operational, and (beyond the age level here) formal operational stages. Concrete mental operations involve on the one hand a coordination of spatial perspectives: the topological with the projective and the metric (Euclidean). Egocentric orientations are replaced by fixed and, eventually, coordinated systems of reference. Route-type representations yield easily to survey-type representations.

> There is a general progression from landmark to route to configurational knowledge … the relational information contained in the individual's representation of the environment progresses from topological to projective to metric properties. The emergence of these properties also depends upon the availability of referential frameworks that are nonegocentric. A child's knowledge of his environment is both a function of cognitive capacities (i. e., general cognitive developmental level) and amount of experience in the environment. [Golledge, Smith, Pellegrino, Doherty and Marshall 129]

Hypotheses

Even though the camping period was only two days, the growth of knowledge of the environment would be extensive. It would be greater for first-year Webelos, first-year campers, who have never been to the camp before. The "content" on their maps will be significantly greater on the second map than the first. Not only would the amount increase, but the integration of features on the maps would improve as well. If the landmark-route-configuration evolution operates efficiently, there should be very significant changes. The geometry – geography -- would improve. Locations and locational relationships – topological relationships -- would be shown more accurately. Whether major projective or metric improvements would occur was uncertain.

Results would probably not be as consistent as in other studies; these studies have been conducted in smaller areas, in cities. Urban environments offer a different type of landmark structure and a significant degree of path regularity. Further, these studies have involved direct navigation tasks. Complicating the situation here is the development level of the participants. There should be a range of not only spatial cognition skills, but also a variety of skill levels exhibited in drawing performance.

> A frequent problem for environmental research is often the experimenter's lack of control over subjects' experience, and many reports have to assume that the individuals taking part all had equivalent experience … There are many inherent difficulties in such an assumption … [Spencer, Blades and Morsley 16]

We did not assume that! None of the Scouts would have the same experience, even during the two days. But, we are, for the basic part of the study, comparing two maps by the same individual. There will be differences, at the personal level, but these, like the following issue, are not critical.

> Distance estimates of locations in a camp setting were obtained from 9- and 10-year-olds and adults. …Data were analyzed for the effects of certain environmental features – buildings, trees, and hills. Subjects at all ages seemed to judge distances on the basis of ease of travel (functional distance). The presence of environmental features which added to the effort necessary to move between locations led to overestimations of distance, while the absence of these features led to underestimations of these relatively less effortful distances. While the effect of hills was consistent, distortions of distance with intervening buildings and/or trees differed between tasks. [Cohen, Baldwin and Sherman 1216]

Finally, the maps – and the knowledge that they reflect – will indicate clearly different personal values. Personal preferences should be clear in many cases, particularly in the level of graphic importance assigned to different camp activities.

> … fifth graders … drew sketch maps of familiar environments. … most subjects did not draw items they disliked on their sketch maps. These results suggested a dissociation between indirect (map drawing) and direct (specific recall) approaches to expressing preferences. [Seibert and Anooshian 607]

Ultimate hypothesis: We should learn a great deal from these campers – these mappers.

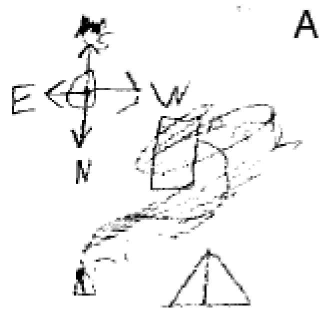
Methodology

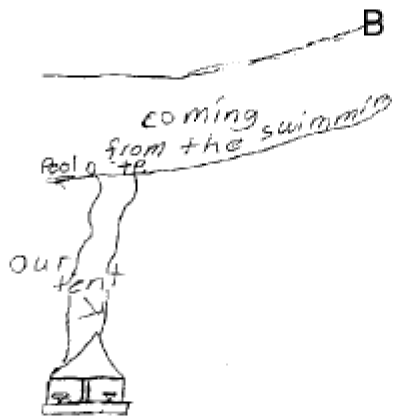
Since there had been no announcement of this project to the leaders of the Webelos dens before they arrived at camp, I approached them in their campsites, explained briefly the goals of the project, and enlisted their support. In some cases the project was welcomed enthusiastically and, in the midst of all of the opening-day activities (check-in and the swimming test being most critical), they gathered the Webelos at tables in the campsite and the mapping began.

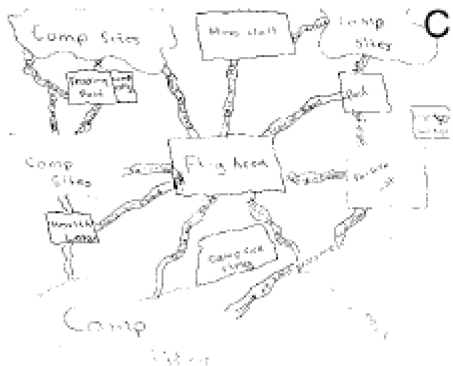
Maps were drawn on 28x28 cm paper using a pencil. Instruction was minimal: “draw a map of the camp …” and, as necessary, elaborated. Some boys finished quickly, while others took longer. In some cases the groups did the activity at tables, sharing ideas amongst themselves; in other situations, adults became actively involved – at the extreme, considerable coaching occurred!

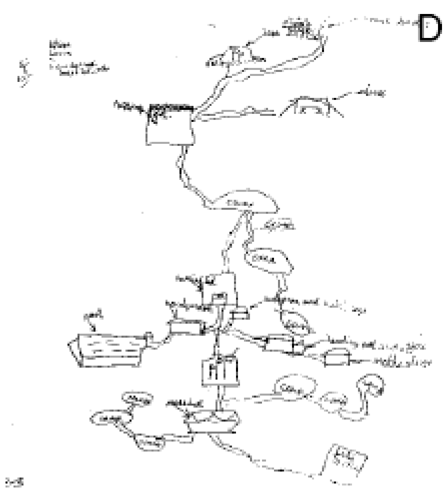
For units that participated initially, I returned to the campsite on the last day (after the activities for the day had been completed and the main activity in the campsite was getting ready to go home) to get the second set of maps. In some cases this was a simple process -- the goal was met. Other instances were less successful.

This process yielded over 250 maps. There were 63 pairs of maps, and these (with a selection of some interesting single examples) provide the basis for the following conclusions.









Results

First, there was a significant difference in the number of features mapped on the two days. When the boys took the time, and this turned out to be a significant problem, they included many more features on their second maps. This is true for both first-year and second-year campers.

We had expected that first-year maps would be dominated by imagination and vicarious information, and on the second maps this information would be overrun by the data gathered in the forty-eight hours of direct experience with the camp environment. This was not the case, for most of the maps produced on the first day were drawn after the campers had driven into camp, had moved their gear to the campsite, and then had taken a tour of the principal camp facilities. The first maps often reflected the information gathered from the tour [maps A and B].

We expected that second-year campers would, on the first maps, reach into their memories and map what they could recall from the previous year. Their second maps would add to this previous knowledge of the camp, yielding not only significant detail but also an integration of all of these features. Again, they were, upon arrival, immediately refreshed with the tour, and so many of their first maps were quite detailed [maps C and D].

The first-year Webelos, younger and less mature than the second-year group, were expected to map in a less sophisticated way, their abilities not having reached those of the second-year group. This view is hard to support, for there is much more to deal with when addressing the issue of age and intellectual development.

Second, there was, overall, more integration. As previous research has suggested, first maps were often limited to landmarks, and the second maps included landmarks and routes. Again, however, this is complicated by the variety of skill levels involved.

Third, geometry/geography seems to have improved. The question here is how did these wooded and (by Lynch’s terms) less legible environments affect the mapping process.

There was a remarkable variety in the level of development of these 9- and 10-year-old scouts. While some produced maps of great sophistication, clearly operating at a “formal operational” level (an adult level of development), others seemed to carry out the mapping task at a level that can only be considered as immature for their age. Consider, again, one of the aspects of the sketch map situation; recall the issue described earlier:

> Unfortunately, [sketch maps] tend to lead to underestimates of children’s spatial competence because they confound spatial knowledge with externalizing ability and other theoretically nonrelevant task loads (e. g., translation of scale, etc.). [Siegel, in Liben, Patterson and Newcombe]

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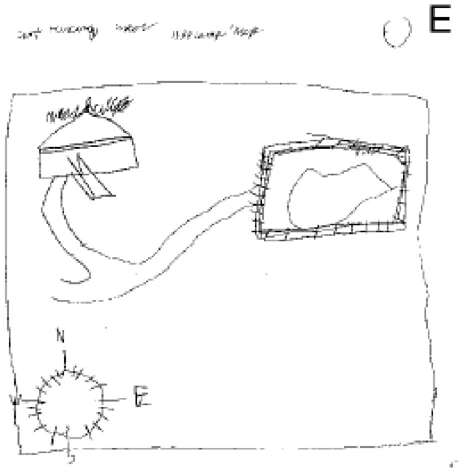

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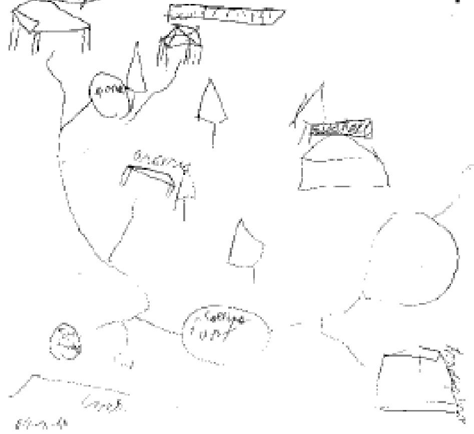

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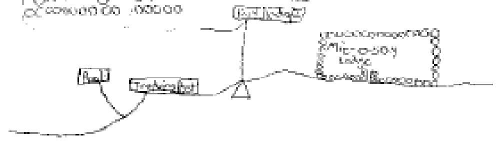

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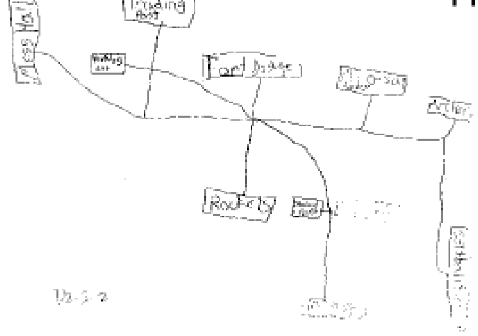

It is important to recognize that few, if any, of the Webelos had ever been involved in a task of this type before. Thus it is necessary to expect that the second map would be better, simply because they had done the first map! What was unexpected, however, were the instances in which there were distinct differences in level of map performance, the first map from a preoperational/topological level and the second with a more concrete operational/metric space approach. This was not a common occurrence, but it further underscores the variability encountered when working with children. See the first and second maps by a first-year camper, E and F; compare those with G andH, by a second-year camper.

Who, then, were the superstars, those whose maps were well beyond the average? Generally it was whose favorite subject in school was mathematics; few noted interest in maps, but it was not art, it was math that was associated with exceptional performance on the project.

For the cartographer, the lessons here are exciting: this is a dynamic and exciting group with which to work; working with them, it is possible to gain a great understanding of map use and the relationships between maps and the environment. For the Scout leader, the concern is much greater, for this group of boys harbors many differences, and there is a need to create better approaches to meet their diverse abilities and interests.

Bibliography

Robert J. Beck and Denis Wood. “Cognitive transformation of information from urban geographic fields to mental maps.” *Environment and Behavior* 8, 2, 1976, 199-238

S. J. Catling. “Maps and cognitive maps: The young child’s perception.” *Geography* 64, 4, 1979, 288-296

Robert Cohen, Lawrence M. Baldwin and Richard C. Sherman. “Cognitive maps of a naturalistic setting.” *Child Development* 49, 1978, 1216-1218

R. M. Downs and D. Stea, eds. *Image and Environment: Cognitive Mapping and Spatial Behavior*. Chicago: Aldine, 1973

Norman H. Freeman. *Strategies of representation in young children: analysis of spatial skills and drawing processes* London: Academic Press, 1980

Nathan Gale, Reginald G.. Golledge, James W. Pellegrino and Sally Doherty. “The acquisition and integration of route knowledge in an unfamiliar neighborhood.” *Journal of Environmental Psychology* 10, 1990, 3-25

Marie Dominique Giraudo and Jean Pailhous. “Distortions and fluctuations in topographic memory.” *Memory and Cognition* 22, 1, 1994, 14-26

Reginald G. Golledge, Terence R. Smith, James W. Pellegrino, Sally Doherty and Sandra P. Marshall. “A conceptual model and empirical analysis of children’s acquisition of spatial knowledge.” *Journal of Environmental Psychology* 5, 1985, 125-152

R. A. Hart and G. T. Moore. “The development of spatial cognition: a Review.” In R. M. Downs and D. Stea, eds. *Image and Environment: Cognitive mapping and Spatial Behavior*. Chicago: Aldine, 1973

Stephen C. Hirtle and John Jonides. “Evidence of hierarchies in cognitive maps.” *Memory and Cognition* 13, 3, 1985, 208-217

Holahan, Charles J. and Paul F. Sorenson. “The role of figural organization in city imageability: An information processing analysis.” *Journal of Environmental Psychology* 5, 1985, 279-286

Anne R. Kearney and Stephen Kaplan. “Toward a methodology for the measurement of knowledge structures of ordinary people; The Conceptual Content Cognitive Map (3CM).” *Environment and Behavior* 29, 5, 1997, 579-617

Stephen M. Kosslyn, Herbert L. Pick, Jr., and Griffin R. Fariello. “Cognitive maps in children and men.” *Child Development* 45, 1974, 707-716

Lynn T. Kowalski and Kendall J. Bryant. “Sense of Direction, Spatial Orientation, and Cognitive Maps.” *Journal of Experimental Psychology: Human Perception and Performance* 3, 4, 1977, 590-598

Martin Krampen. *Children’s Drawings: Iconic Coding of the Environmen*t. New York: Plenum Press, 1991

Lynn S. Liben. “Children’s large-scale spatial cognition: Is the measure the message?” *New Directions for Child*

Development 155, 1982, 51-64

Lynn S. Liben, Arthur H. Patterson, and Nora Newcombe, eds. *Spatial representation and behavior across the life span: theory and application.* New York: Academic Press, 1981

6 Roger M. Downs, "Maps and Mappings as Metaphors for Spatial Representation"

7 Alexander W. Siegel, "The externalization of cognitive maps by children and adults: In search of ways to ask better questions"

8 Roger A. Hart, "Children's spatial representation of the landscape: lessons and questions from a field study" 11 Seymour Wapner, Bernard Kaplan and Robert Ciottone, "Self-world relationships in critical environmental transitions: Childhood and beyond"

Kevin Lynch. *The Image of the City.* Cambridge: MIT Press,1960

David M. Mark and Andrew U. Frank, eds. *Cognitive and Linguistic Aspects of Geographic Space.* Dordrecht: Kluwer Academic Publishers, 1990

M. H. Matthews. *Making sense of place: Children's understanding of large-scale environments.* London: Harvester Wheatsheaf, 1992

Debra Murray and Christopher Spencer. "Individual differences in the drawing of cognitive maps: the effects of geographical mobility, strength of mental imagery and basic graphic ability." Institute of British Geographers *Transactions* 4, 3, 1979, 385-391

Ileana M. Quintero. "Understanding children's conceptions of geographical space." *Dissertations Abstracts International A* 57,10A, 1997, 4251

Michael J. Rovine and Gerald D. Weisman. "Sketch-map variables as predictors of way-finding performance." *Journal of Environmental Psychology* 9, 3, 1989, 217-232

Edward K. Sadalla, W. Jeffrey Burroughs, and Lorin J. Staplin. "Reference Points in Spatial Cognition." *Journal of Experimental Psychology: Human Learning and Memory* 6, 5, 1980, 516-528

Pennie S. Seibert and Linda J. Anooshian. "Indirect expression of preference in sketch maps." *Environment and Behavior* 25, 5, 1993, 607-624

M. Jeanne Sholl and Howard E. Egeth. "Cognitive correlates of map-reading ability." *Intelligence* 6, 1982, 215-230

Christopher Spencer, Mark Blades, and Kim Morsley. *The child in the physical environment: The development of spatial knowledge and cognition.* New York: John Wiley & Sons, 1989

Christopher Spencer and Zhra Darvizeh. "The case for developing a cognitive environmental psychology that does not underestimate the abilities of young children." *Journal of Environmental Psychology* 1, 1981, 21-31

David L. Weatherford. "Spatial cognition as a function of size and scale of the environment." *New Directions for Child Development* 15, 1982, 5-18

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