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ABSTRACT

Generally, environmental cognition is concerned with understanding (1) people's perceptions of, representations of, and attitudes towards their own ecological niches, and (2) how these perceptions, cognitions, and attitudes develop over time. The scope and foci of environmental cognition are largely defined by its practitioners--investigators who come from diverse disciplines (e.g., psychology, geography, city planning) and who have diverse scientific and social agendae. In one sense environmental cognition is applied cognitive psychology; in another, it is applied social psychology; in a third sense cognitive and social psychology can be subsumed by environmental cognition. The major part of the presentation is concerned with the specification of a number of major conceptual and research issues which, when considered jointly, seem to differentiate environmental cognition from other subdisciplines of psychology. Current research germane to these issues is discussed briefly. (Author/SJL)

The place of environmental cognition in psychology (or vice versa)[1]

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Environmental cognition is an emerging and viable area of theory and research interest in the social and psychological sciences. Broadly considered, concern with environmental knowing--man's understanding of his own ecological niche--is not new. It was a central concern in the psychologies of Dewey, Baldwin, and Mead, and is prominent in more recent conceptualizations by Brunswik and Barker. The scope and foci of environmental cognition are largely defined by its practitioners--investigators who come from diverse disciplines (e.g., psychology, geography, urban planning) and who have diverse scientific and social agendae. Much of the current work in the area is situated at the boundary between basic and applied research, as well as at the interfaces of different disciplines. Craik (1973) in trying to provide an overview of the field, listed a diverse series of twelve topics under the heading of environmental psychology. The topics range from environmental perception to attitudes about the environment to behavioral effects of density. Obviously, it is hard to draw a distinction between environmental cognition and environmental psychology.

From the perspective of a developmental psychologist, environmental cognition seems concerned with understanding 1) people's perceptions of, representations of, attitudes towards, and behavior within their own ecological niches, and 2) how these perceptions, cognitions, and attitudes come to be that way. Definition is in the mind of the beholder: Some consider

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environmental cognition as a subdiscipline of psychology; some consider psychology as a subhead of environmenal knowing; for others environmental cognition is applied cognitive psychology; for still others it is applied social psychology.

I do not think we will ever get consensus on a formal definition or the precise boundary conditions of environmental cognition, so let me go right out on a limb and give you my own biased view on the nature of the beast. The core issue in environmental cognition is the nature and development of internal representations of that environment. Adaptive action in an environment, decision-making in an environment, attitudes towards that environment, and feelings about that environment are all fundamentally based on internal representations of that environment constructed by the "cognizer." As in any other scientific discipline, there are only two real questions to be asked about any phenomenon--How does it work? and How did it come to be that way? These are also the core questions about the nature of cognitive representations of the environment. The emergent discipline of environmental cognition has both the opportunity and the scientific obligation to attack both problems, and may be able to attack them simultaneously.

Given these preliminary considerations and biases, in the remainder of this paper I would like to try to specify a number of major conceptual and empirical characteristics which seem to currently define the "practice" of environmental cognition, and which also foreshadow the field as it might be some years from now. Considered separately, these characteristics or issues can be found in the culture of other subdisciplines, and are thus not unique to environmental cognition. However, when considered jointly, their intersections may well functionally define the new discipline.

First, cognition of the environment implicates an extraordinarily complex system in which there is a reciprocal interaction of the observer and that which is observed. Although antecedent-consequent analyses may be useful in testing and refining hypotheses about functional relationships between persons (cognizers) and environmental characteristics (cognates), such analyses are inadequate to describe or understand systemic structures and their interrelationships. A structural perspective, as exemplified by Wapner's research (Wofsey & Wapner, 1974) on the relationships between college students' career aspirations and their changing perceptions of their environment, may prove more useful for understanding such a complex organization.

Second, this complex system is dynamic, not static. Changes in the environment, in persons, and their interactions (i.e., changes in system organization) are of central concern. These changes, which are both quantitative and qualitative, need to be conceptualized and studied within a developmental framework. The developmental framework, stemming largely from the nineteenth century writings of Herbert Spencer, James Mark Baldwin, and Henri Bergson and from the twentieth century writings of Herrick, Werner, and Piaget exists. More than that, it is becoming pervasive in many areas of psychology. Indeed, scientists in such theoretical camps as the "dialecticians" and cognitive psychologists in the tradition of F.C. Bartlett argue that <u>all</u> psychology is fundamentally developmental psychology. By analogy, I would argue that all environmental cognition is <u>developmental</u> environmental cognition in which we are concerned with the development of internal representations over time spans as diverse as milliseconds (as in the development of a percept), or in months (as in the development of children's representations of the environment), or in eons (as in the evolution and increasing adaptive significance of spatial representational ability from the apes to man). Recent work by a number of individuals represent serious attempts to conceptualize environmental cognition within this broad developmental framework. Wohlwill's (1975) work on the development of preferences for real-world scenes over short periods of time; Lynch's groundbreaking (1960) work, Appleyard's studies (1970), and Florence Ladd's (1970) research on the changes in adults' and children's representations of their environments (as reflected in sketch maps) as a function of length of residence in a given area; Steven Kaplan's (1972, 1973) recent conceptualizations of the development of cognitive maps within the context of the modern synthetic theory of evolution, the paleoanthropological record, and the adaptive significance of this ability for early hunter-gatherer societies. These are but a few examples. Related to the need for developmentally based theories of environmental cognition is the concomitant need for careful consideration of the interaction between methodology and the developmental status of those individuals being "measured." Put simply, there is no one experimental paradigm, survey-assessment technique, or piece of apparatus which can be employed blindly to get at the internal representations of little kids, bigger kids, and adults. I will elaborate on this point later.

A third characteristic or central issue of environmental cognition is that it is fundamentally concerned with macro-space (large space), and human's representations of large-scale, variable, and "non-standard" environments.

Fourth, and closely related, such representations of macro-space, requiring in their construction the integration of successive percepts over both short and long periods of time, demand that they be studied over time. These time spans are considerably longer than the spans of seconds and minutes typically studies in most laboratory research. Current experimental techniques, derived mainly from the learning theory-point-of-view, which sit a kid in front of a better mousetrap, are simply inadequate tools with which to investigate the development of internal representations of large-scale space.

Let me get concrete for a few moments, and try to provide evidence that a study, however well-intended, which loses sight of what it takes to construct a representation of a large-environment, may at best be peripheral, and at worst misleading. I want to describe the "developmental history" of a study (Siegel & Schadler, 1976) that, although well-intended, took us down a relatively fruitless alley, at least as far as environmental cognition is concerned. (It is easy to say that now, since I have a "theory," which I developed after the fact, that predicts that the study was doomed to failure.)

In a bar, in Philadelphia, at the 1973 mettings of the Society for Research in Child Development, I convinced a colleague of mine (Maggie Schadler, now at Kansas) that somehow Tolman was right, and the core problem for developmental psychology was understanding the development of cognitive maps in children. In a kind of naive, simplistic, frontal assault on the problem we figured out that we needed to look at the development of little kids' cognitive maps of a large-scale complex, ecologically valid environment. We had little help from the experimental literature of child psychology. With a very few exceptions (notably Florence Ladd's 1970 study) in 1973 experimental research on the development of children's knowledge of big space had been limited to the study of knowledge in novel, artifical, and/or simple environments (e.g., Maier, 1936; Piaget, Inhelder, & Szeminska, 1960). At the time, little attention had been paid to the investigation of children's knowledge of actual and familiar large-scale spaces, yet it is within these domains that children develop, acquire, and utilize their spatial representations.

The child's classroom is prototypic of such domains, especially the pre-school or kindergarten classroom (which typically is more complex and varied than a classroom whose central feature is multiple rows of desks). Surely, we thought, one would expect that kindergarteners somehow "know" more about their classroom in June than they do in September.

Where to start? Much of our interest in this problem was piqued by Kevin Lynch's (1960) classic study--The image of the city. Lynch asked city residents to draw sketch maps of their cities (Boston, Los Angeles, and, Lord protect us, Jersey City) in an attempt to derive a modal representation of those cities; he supplemented this information with the subjects' verbal descriptions. We also noted that Appleyard(1970) had found qualitative differences in the sketch maps and verbal protocols of city residents as a function of length of residence in that city. But from here, we were thrown back on our own resources.

We were interested in what young children knew and remembered about the arrangements of objects and furniture in their own classroom (i.e., their spatial representation or cognitive map) and how this changed over a school year. Since we did not want to rely on tasks which depended on drawing ability or verbal fluency, the experimental task we chose involved the construction by the child of a model of his or her classroom.

Children were tested in either the Spring, after some eight months of experience in the classroom, or in the Fall, after about one month. We expected that increased experience in the classroom would produce a more accurate spatial representation, which would be reflected in a more accurately constructed model. One of the groups of children tested in the Spring was given four accurately placed landmarks prior to model construction. According to Lynch's argument, we expected that the landmarks would serve as organizers and facilitate performance.

We tested 30 kindergarteners, all from a classroom in which the arrangement of furniture remained constant over the period of the study. Ten boys and ten girls were tested individually in the Spring, and five boys and five girls were tested in the Fall. We used scale models of the kindergarten classroom and its contents. The model of the 24 X 40 foot classroom was a 12 X 20-inch Masonite from with walls. Forty models of the furniture and other major items in the classroom were cut from balsawood (on the same one-inch = two-feet scale), and the primary identifying features were inked on them--kids easily recognized the items.

The child was shown the model, was told that it represented his classroom, the doors leading to the hall and street were pointed out, and children were required to identify each of these doors before proceeding. In the cued condition only, the experimenter then named and accurately placed four items in the model--this part of the procedure was omitted for children in the uncued condition.

The child was then asked to tell the experimenter some of the things that belonged in his classroom. Both recall and recognition methods were used--when the child named or was shown an item of furniture, he was given the model of that item and was told to put it in the model were it belonged, "just like it goes in your classroom." We continued this until all 40 items had been identified and either placed in the model or rejected. No feedback as to accuracy of identification or placement was given at any time. An observer recorded each item the child named (or was given) and its location in the child's model on a small grid-map not visible to the child. The final production was photographed from above; all measurements and scoring were performed on the basis of the photographs.

Three performance measures were devised: A Euclidean measure was designed to reflect the absolute accuracy with which the child placed a given item in the model with respect to that item's spatial location in the classroom. A <u>topological</u> measure was designed to reflect the accuracy with which the child placed a given item with respect to items adjacent to it (clustered) in the classroom. A <u>projective</u> measure was based on the relationship between pairs of such item-clusters. In general, the results supported the notion that both increases in experience and the provision of significant landmarks enhanced young children's spatial representations of their classrooms. By comparing younger and older subjects in each condition, we found that these effects could not be attributed to maturational factors alone. Increased experience significantly facilitated the Euclidean accuracy of the child's model, but had relatively little effect on their topological and projective accuracy. Providing "landmarks" for the children had only a slight facilitatory effect on their Euclidean accuracy, but had a marked effect on the topological and projective accuracy.

Surprisingly, on all three measures boys had higher mean scores than did girls--20% higher on the topological and Euclidean measures and 100% better on the projective measures. Now, sex differences in a variety of tasks have been documented (Maccoby & Jacklin, 1974), and consistent differences favoring males have been found on a number of spatial tasks (Harris, 1976). However, these sex differences have <u>not</u> been typically found much before nine or 10 years of age. Thus, the striking performance differences between boys and girls of kindergarten age was surprising.

We were bothered by this. Let me try to say why. When we watched the children in action in the classroom, there were no obvious differences in the boys' and girls' patterns of interaction with the environment. Both boys and girls, even after one month seemed to know their way around;

certainly none of the children had trouble locomoting in the space of the classroom, or locating objects in the room.

There are some qualitative data that I should have showed you before, but didn't. Somehow we too "repressed" it during the scoring and in our attempt to jam the data into an ANOVA program. We ignored the data possibly because we were super-pleased that the children's scores were as high as they were. Given the demands for minification, translating the child's eye view of the classroom to an aerial perspective, and the possible difficulties in children's understanding that the model was to "represent" their classroom, and given the stringent scoring criteria, the levels of performance obtained indicated that 5-year-olds have a fairly rich cognitive representation of their classroom--and far more accurate than previous research had indicated.

What had we overlooked? Here is a slide of the model--with the furni-

Slide 1

ture arranged exactly as it was in the classroom. Let me show you some extreme performances. The following slides represent the performance of two children, a boy and a girl, tested in the Spring after eight months of experience, but given no cues or landmarks to guide their performance. The next slide is the model produced by David--a quiet, intelligent, blue-eyed boy who knew his way around the classroom and was rarely seen bumping

Slide 2

into walls. The next slide is the model produced by Buffy--a quiet, intelligent, blue-eyed girl who knew her way around the classroom and was rarely

Slide 3

seen bumping into walls. By the way, I tested this little girl, and could have sworn to you that she understood the instructions. So, something is screwy. And what is screwy is the method. We had overlooked our initial goal, and had, from the beginning lost sight of what it takes to construct a representation of a large environment. To be sure, we were studying the development of spatial representations of a familiar environment--but we had neglected to test that representation of a large environment in a large environment!

Everyone realizes that 5-year-olds demonstrate daily their competence in spatial representations by not getting lost on the way from home to school and back again. They "act out" their representations in large scale space. Clearly, this is at least one way in which children's spatial representational abilities should be tested: In a large space in which, in fact, their behavior tells you something about the way in which they have integrated successive percepts over time. Using a 20-inch, scale model does not test this--from two or three feet away, even a child can take in a 20-inch space in about four saccades or eye fixations. And that is not the way children, or adults for that matter, develop spatial representations of large-scale environments.

How do they do it and how can we test it? Is there now relevant theory which will help us with this problem, and are there more adequate means to test the hypotheses derived from the theory? Hopefully, yes.

Sheldon White and I (Siegel & White, 1975) have recently proposed an initial, albeit speculative, conceptual framework for understanding and studying the development of spatial representations of the large-scale environment. On the basis of empirical and theoretical literature in neurology, urban design, and psychology we suggested the following analyses: Descriptions of space reflect models of the environment. These models can be called spatial representations and are constructed by the integration of successive percepts over time. It seems likely that humans are neurologically disposed to create and organize such models (Herrick, 1956; Jackson, 1874). The capacity to build such models develops (Bergson, 1946; Gladwin, 1970; Werner, 1948). The models are initially figurative constructions which arise and jell out of a foundation of perceptions and practical activity. Eventually, they become coordinated to social terminology and become schematized and scaled. These representations guide all spatial behavior; they function to facilitate location and movement in the environment and act as organizers of experience (Lynch, 1960). Landmarks and routes are the predominant elements of these representations; higher-order configurational elements are also used, but they develop late (Downs & Stea, 1973; Shemyakin, 1962).

On the basis of a variety of conincidences, analogies, and parallelisms between the available psychological literature on children and adults and literature in urban design, we argued that the development of spatial representations in children conforms to the sequence identified in the construction of spatial representations in adults: Landmarks are first noticed and remembered; the child acts in the context of these landmarks, and given landmarks and action-sequences, route formation is accomplished. Landmarks and routes are formed into clusters, but until an objective frame of reference is developed, these clusters remain uncoordinated with each other. Although there are significant differences in detail between the spatial representations of adults and the development of these representations in children, the underlying process-sequence is the same: The sequence of going from landmarks, to route-representations, to configurational-coordinated representations is a process of going from association to structure (Mandler, 1962), and of deriving simultaneity from successivity.

Given this framework, given that a fundamental problem for environmental cognition is the study of the development of internal representations of the large-scale environment over time, what form might new methodological inquiries take? Let me briefly describe a study Jim Herman and I are doing now, and some preliminary results. In a large area, 20- by 20-feet, we have set up a model town, with a road and a railroad track going through it, and eight buildings placed in a relatively naturalistic arrangement. We "walk" the children through the model, along the road, pointing out to them in sequence each of the eight buildings and say something about each one ("here is the old lady's house; she's nice to them and gives them cookies") during which time we strip the floor of buildings leaving only the road and railroad tracks. Then, we give the child 11 buildings (the eight plus three decoys) and tell him to reconstruct the model from memory, exactly like it was. Sound complicated? Seven-year-olds reproduce it nearly perfectly after one trial, and most 5-year-olds even have it pretty well together after two trials. We had originally planned to test an older age group, but realized after running a pilot 12-year-old that the task was so trivially easy that testing 20 kids would have been an utter waste of time. By the way, none of the five-year-olds produced, if you can remember the last slide, a "Buffy-like" model.

Perhaps this study represents an example of experimental research that is derived from a developmental framework, and that is concerned with macrospace and representations of that space over time. Certainly, it is only _one_ instance of a paradigm with which one can study the development of spatial representations of the large-scale environment. If I am not mistaken, the other members of this symposium will shortly describe alternative and/or complementary research paradigms which will contribute greatly to an expanded developmental view of environmental cognition

(Acredolo, Pick, & Olsen, 1975; Hart & Moore, 1973). This kind of research is not easy, and often has "slop." However, rigorous as we may try to be, the study of environmental cognition will not be adequately addressed by the quickie half-hour experiment with the subject sitting in front of a better mousetrap. Neither the environment nor the cognizer is that simple.

In 1970, Wohlwill described "the emerging discipline of environmental psychology" as "embryonic"; it would be extremely optimistic to consider the discipline of environmental cognition as having reached more than the "fetal" stage in 1976.

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