# Large-Scale Representation: Some Characterizations and Educational Implications



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*Researchers are finding that people use large-scale representations as frames of reference. It probably has something to do with their problem-solving style.*

How long has it been since you last misplaced your car in a large parking lot? Or had difficulty finding the elevators in an unfamiliar building after visiting an office? Or found yourself lost in a new city even though you had a map?

A growing number of urban planners, geographers, and psychologists claim that what these experiences have in common is the fact that knowing where you are requires some kind of large-scale spatial representation of your environment—some kind of cognitive map, mental model, or spatial image of your surroundings. If your efforts to find your misplaced car, to locate the elevators, or to orient yourself in a new city are frustrated by an incomplete or inadequate representation, imagine how frustrating incomplete or inadequate large-scale representations must be for children.

Although the existence of large-scale spatial representations makes intuitive sense to most of us, we actually know very little about how such representations develop or are acquired, the degree to which they are unique or general forms of thought, and the extent to which they serve as a frame of reference to other behavior. The study of such representations has evolved slowly because of the primitive state of theory and because we lack the methods and instruments for measuring large-scale representation. A further complication is the fact that, as adults, we tend to be aware of our large-scale representations only when they are inadequate or when we are lost. It may be that we underrate the significance of such representations in our daily life because we are not necessarily conscious of our reliance upon them. It may be that large-scale representations

are in fact meta-representations that channel behavior even though they remain implicit.

The purpose of this essay is two-fold: (a) to consider briefly the characteristics of large-scale spatial representations from three viewpoints, and (b) to discuss a few implications of the existence of these representations for educators. This essay is not intended as a comprehensive review. The emphasis throughout is upon human, not animal studies; upon research and speculation from developmental psychology, not from other disciplines.

## Characteristics of Representation

At the present time, there is little consensus regarding the nature of representation. Theorists debate whether our representations depend upon schema, verbal associations, holographs, or categories of experience. Even though the existence of all representation must be inferred from patterns of behavior and we are largely unaware of our large-scale representations until we find them inadequate or incomplete, it should not be surprising to learn that considerable controversy surrounds efforts to study and to characterize large-scale representations. Three such characterizations are summarized here because each has caught the public's imagination, and each has triggered some interesting research.

The first group of theorists contend (Tolman, 1948) that our large-scale representations are map-like because we learn about our environment and translate this spatial information in ways functionally analogous to mapping behaviors. They say that we re-present to ourselves cognitive maps or overviews of the spatial relations implicit in a space instead of remembering the specific relationships within a scene. Our cognitive maps are said to contain more than just knowledge of the physical perceptible forms of our surroundings. We also give them all sorts of distorting preferences and prejudices. According to Downs and Stea (1977), our cognitive maps are "complex, highly selective, abstract, generalized representations of some part of the spatial environment."

Cognitive mapping, the process by which we translate spatial information into representations for later use, is said to entail changes in scale, rotation of perspective from a horizontal to an orthographic view, and a two-stage operation of abstraction and symbolization as we shift from three to two dimensions. Stea and Blau (1973), in particular, cite evidence for the coordination of these operations in preschool children's interpretations of aerial photographs and in their manipulation of landscapes in toy play.

Unfortunately, although the mapping analogy may appeal to geographers and urban planners, it is misleading in its simplicity. As with the study of all representation, our characterization is constrained by the fact that we must ask subjects to use particular processes so that they may then demonstrate, in turn, the characteristics of those very same processes. As Downs and Stea (1973) point out, we often cannot be certain that the behaviors we observe are not artifacts of the techniques or methods used to generate those same behaviors.

A different group of theorists contend that our large-scale representations are model-like constructions of our environment. Influenced by Piaget (1956) and Werner (1948), these theorists say that, in our daily movement from place to place, we build some kind of model of our surroundings and then, with increasing age, move about our environment in terms of our model or large-scale representation. They say that we represent to ourselves a container or spiderweb model of place references based upon our repeated and varied encounters with objects and the routes we use to go from place to place.

According to Pick *et al.* (1973), adults operate in terms of a large set of nested or partially nested frames of reference when identifying an object's position. They can identify an object's position by referring to its opposition to themselves, by referring to its relation to other objects in a room, by referring to its relation to a room as a container, by specifying the object's geographical relationship to external features such as a street, or by reference to its compass orientation. Although adults may use all of these frames of reference according to circumstance, it is not clear whether children do likewise.

Of course, not all constructed models are necessarily container-like as large-scale representation. As indicated earlier, some models may be characterized as spiderwebs of experience. Siegel

and White (1975), for example, insist that the sequence of going from landmarks to route-representations to configural-coordinated representations is a process of going from association to structure (Mandler, 1962), and of deriving simultaneously from successivity.

In a more recent paper, Siegel, Kirasic, and Kail (1978) point out that we are still unclear about how we store all the way-finding information about an environment (where routes cross, which landmarks are common to two routes, which routes are adjacent) in a single cognitive structure. Such gestalt or configurational knowledge, they add, would provide its possessor an edge in organizing environmental experience and, further, may be a necessary condition for the investigations of new routes.

Critics of the container and spiderweb characterizations have wondered if in fact the structures underlying large-scale spatial representations are similar to those underlying other cognitive processes. As Gibson (1972) and Ittelson (1973) have both pointed out, most studies of spatial representation have examined an observer's response to the location, movement, or distance of objects. It is not possible, however, to "observe" the surrounding environment as such because it is multimodal, and contains redundant and often contradictory information. Instead, environments must be explored to be understood. Our large-scale constructions or representations may be unique forms of thought and not simply poorly integrated conglomerations of small-scale, observer-object representations.

The third and last group of theorists contend that our large-scale spatial representations are image-like records of our awareness of the relative distribution of things in our environment. They say that we re-present to ourselves an image of places and routes in different scales, depending upon a given situation, and then proceed to "read-off" locational or directional information from our image. Our spatial images are conceived of as both products and processes simultaneously in that we refer to our image (product) in order to act sequentially (process). The assumption is that we solve spatial problems by referring to an image-like representation of our environment.

Among those who stress the organizational qualities of imagery, perhaps the best known is Kevin Lynch (1960). In *The Image of the City*, for example, Lynch describes an organizational role to imagery as a kind of thought:

> Wayfinding is the original function of the environmental image, and the basis on which its emotional associations may have been founded. But the image is valuable not only in this immediate sense in which it acts as a map for the direction of movement; in a broader sense it can serve as a frame of reference within which the individual can act, or to which he can attach his knowledge. In this way it is like a body of belief, or a set of social customs: it is an organizer of facts and possibilities.

A number of psychologists, Shepard (1978), Beech (1978), and Kosslyn *et al.* (1978), by contrast, have made considerable headway in the study of properties of images. Kosslyn and Pomerantz (1977), for example, have argued that when we visualize a scene, we keep the center of our image of that scene in focus and "move" the image so that different parts appear in the center. More recently, Kosslyn demonstrated experimentally that our scanning of the distances between objects in images is similar to the way in which we preserve spatial relationships between objects in pictures. Indeed, Kosslyn *et al.* (1978) report evidence that we preserve distance in an image even when we "zoom in" on one part of that image.

A difficulty with this psychological research is that, while it advances our knowledge about the properties of visual imagery, it tells us little about the large-scale representations of those who lack visual imagery. Does the possession of verbal imagery lead to a functionally different kind of large-scale spatial representation? And what happens to those of us who are equally adept with visual and verbal imagery?

### Implications for Educators

If large-scale spatial representations are forms of thought that serve as frames of reference for many of our everyday behaviors, then indeed such representations have implications for educators. In the discussion that follows, three implications are chosen for consideration because they reflect back upon the problem of characterizing large-scale representations, and they relate to our interest in styles of learning and teaching. The first implication is that the study of large-

scale representations is rapidly becoming an important new dimension to our understanding of thinking. The second implication is that the acquisition and refinement of large-scale representations may be more related to a student's comprehension and attitudes than we suspect. And the last implication, derived from the fact that we are most conscious of our large-scale representations when they don't work, is that the systematic study of a student's errors in solving large-scale spatial problems could provide valuable clues about the student's style in problem solving.

With respect to the first implication, it is important to stress that our large-scale representations are not simply extended collections of small-scale representations, but are forms of thought in their own right. Although there has been increased interest in large-scale representations within the last decade, we desperately need new methodology and new measures for studying large-scale representations. Even though sketch maps, verbal reports of preferences and impressions, and home or school layouts are valuable additions to putative measures of spatial ability, the fact remains that we need imaginative measures designed with large-scale environments specifically in mind. Perhaps such measures will include role-playing or simulations requiring students to participate in both real and imaginary surroundings.

With respect to the second implication, large-scale representations may play a larger role in comprehension of school subjects than many realize. If large-scale representations are maps, models, or images of environments whose contextual meaning cannot be deduced from the characteristics of separate parts or events, then perhaps we underestimate the significance of context when teaching history or literature. For example, how we imagine the colonial world in America constrains our understanding of our own history. Similarly, how we represent the geography of Tolkien's imaginary kingdom affects our appreciation of his novel.

The third implication deals with the possibility that a systematic study of a student's errors in solving large-scale spatial problems could provide useful clues about a student's style or approach to general problem solving. Donaldson (1963) and Clinchy and Rosenthal (1971) distin-


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guish between two general categories of error in problems. The first category includes intake or registration errors where a person fails to see some aspect of the structure of the problem. The second category consists of response or sequential execution errors. Clearly, response errors are secondary to registration errors because regardless of our efforts to refine execution, errors will persist if our initial registration is incomplete or inadequate. As teachers we tend to focus upon execution patterns and to take registration behaviors for granted. A systematic study of errors in large-scale representation, in brief, could provide valuable clues about a student's style of problem solving as well as information about the student's awareness of his or her own large-scale spatial representations.

In conclusion, we have discussed three characterizations of large-scale representations and considered three implications of these representations for educators. As adults, we acquire or develop large-scale spatial representations of our environment that, in turn, enable us to orient ourselves in a variety of surroundings, to execute judgmental preferences about locations and routes, and to generate impressions about distance and metric characteristics of our surroundings. Our large-scale representations are forms of thought that, like a style of learning or teaching, must be inferred from patterns of behavior. It is suggested that, as educators, we need to encourage further study of large-scale representations, we need to be sensitive to their influence on students' comprehension and attitudes about various school subjects, and we need to examine errors in locational or way-finding behaviors as clues to students' styles of problem solving in general.

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