Thinking spatially is a part of everyday living. It is also endemic to all manner of sciences, from astronomy to zoology, and at all scales from the nanoscale to the universal scale. What do we know about spatial thinking?

Geography is a self-professed spatial science. The geographic metaphor, however, is but one of many that incorporates spatial thinking into the rubric of a knowledge base. Because of their essential interest in human-environment relations, geographers have "spatialized" non-spatial data they extract from the real world. In addition to regarding the earth and the people on it as their eminent domain, this allows them to reason spatially about phenomena by representing it in spatial formats, particularly by representing phenomena on maps. But they also spatialize by representing data in graphic formats. For example, they draw population pyramids of the non-spatial demographic data on age structure; they draw pie graphs to indicate how state or federal budgets are allocated among categories; they build bar charts of temperature, and income levels by occupation; and they draw charts of stock prices over time or the number of hamburgers sold by McDonalds. In each of these cases, they "spatialized" information. This is often done to highlight the data visually."Visualization" is the process of making a representation of data such that they are turned into information and presented in an easily interpreted and non-threatening manner.

But other areas use spatialization processes also. In fact, virtually every knowledge domain contains spatial metaphor. In the arts, sculptors and painters spatialize their ideas of form and emotion (e.g., beauty, love, mystery).Dance historians recreate the spatial patterns of movements that were the essence of modern or long forgotten dances. Choreographers carefully spatialize ballet movements and dance steps. Novelists create striking word pictures of places in which characters act and interact. Biologists map out genetic structures in double helix form. Astronomers search for spatial patterns among the stars. Physicists claim to be the king of spatial thinking, and their domain covers both abstract and real spaces. Mathematicians not only have geometry, topology, and integral calculus as spatial structures, but embed space in number sequences, just as lexicographers accept the spatial nature of the alphabet (e.g., the "distance" between letters) and the frequencies of word use. Librarians spatialize non-spatial variables such as author's name, date of publication, title, and place of publication into an electronic storage system and a spatially structured physical display system that helps the user find the shelf "place" where a reference is stored. And we can go on and on. Essentially, where spatial information is not inherent in a data set, we often spatialize it to increase its interpretability. Of course, when data does have a spatial component, it (likewise) can be represented in a map image or graphic form to increase its coherence.

Ok. So now that we realize how widespread spatial thinking really is, let's learn a little more about it. Spatial thinking includes the following:

* Translating from one dimension to another (as in creating 2-D maps from 3-D environments).
* Realizing distance properties (such as adjacency, proximity, similarity, nearest neighbor, crow-fly distance, or "over-the-road" distance).
* Comprehending orientation and direction (e.g., as in using global references such as North, South, East, and West, angular bearings, or clock-face directions-as in "the statue is at two o'clock from you").
* Using frames of reference (such as latitude and longitude or local street numbering systems).
* Realizing spatial geographic associations (such as downhill snow skiing and mountains, the relative lack of cities in desert areas, the denser patterning of cities in fertile agriculture areas, or the association between dairy areas and cheese and butter factories).
* Realizing that nations are "carved" into regions that may be geographic, economic, social, or political (such as ethnic neighborhoods, production regions, school districts, census tracts, and zip code areas).
* Being aware of, and using effectively, the spatial networks of roads and highways.
* Recognizing systems of landmarks that anchor one's cognitive maps.
* Developing map-reading skills.

Obviously, there is a longer list of such processes that give evidence of spatial thinking. While it can certainly be regarded as an academic process, it must also be realized that it is an essential part of everyday life. When you read the newspaper, you realize that it has a spatial layout. When driving to work or shopping, when searching for a place of leisure or recreation, when trying to find a place to smoke a cigarette, when trying to find a bathroom in a hotel, or when trying to find your car in a parking lot, be aware that you are constantly making spatial decisions about where to go and what you do.

Unfortunately, the world doesn't make it easy to be a competent spatial thinker. There are things we must do to attain a suitable level of comprehension. And, so, humans make "accommodations" so that spatial reasoning can be used to help understand a given situation. For example, the specifics of spatial knowledge in one place do not always readily transfer to another place. Learning a path to schools or shops in one neighborhood may not help you get to a school or shop in another area, unless you understand the spatial reasoning process you went through to find your way. Finding your car in one large parking lot may not help you find your car in another one, unless you develop a strategy for thinking spatially about location. Unless you learn to reason spatially and to recognize general principles about searching and wayfinding, you will continue to be "spatially disabled."

Geographic units are almost always irregular (postal or zip code areas, census districts, states, neighborhoods, school districts, and city shapes all can be used as examples).So what do we do when we want to "put things together?" We spatially "smooth" things out so they're more easily recognized and remembered. On maps, we simplify and generalize to remove unwanted indentations (e.g., coastlines, river bends, "snaky" country roads); we turn shallow curves into straight lines; we impute regular shapes to irregular features to make them more memorable (e.g., "it's sort of circular").Geographic phenomena have unaccommodating irregular forms, so we perceptually accommodate this by making forms simple and regular. But often we find they are oriented in a haphazard way. Thus, we perceptually "align" features-as in "pushing" South America underneath North America (whereas it is mostly to the east).We give streets labels of "North" and "South" when they may run more to the east or west. We may thus mentally rotate geographic features to fit some schemata or template that we find easy to use.

Our knowledge about a geographic area is never perfect, but we still make effective decisions in that area because we use mental processes of perceptual closure (interpolation), or overlay (aggregation), or dissolve (disaggregation), and summarization. When we start to get overwhelmed with detail, we spatially classify (as by proximity) or cluster (as in "next to") so as to collapse lots of separate bits of information into meaningful "clumps" or "chunks." Sometimes, we make gross classifications ("all cats are gray in the night," or "all these trees are the same" when looking at a eucalyptus forest).We mentally cluster food stores, clothing stores, bars, beaches, and other phenomena into largely undefined generic classes and then give place-specific identifiers to single out particular members (e.g., "Albertson's is the supermarket that has fresh Maine lobsters;" "Google's is the beach with the bad undertow").And we all realize that geographic data can be perceived at a variety of scales. We might use the same thought processes to reason about a colony of ants or bees as we do to think about people's activities in cities. We may use the same concepts when looking at our neighborhood as we would when studying San Francisco or Sydney (Australia).And, often, we use the vaguest of principles to guess about where things might be found (e.g., from trying to find a missing glove to searching for a bus stop in an unfamiliar area).

It should be clear by now that geographic knowledge is fragmented and incomplete, and that we use spatial thinking and reasoning to help us comprehend and use the different environments in which we live. Equally as obvious is that these processes have been with us since the earliest days of humanoids. In fact, they're so much a part of everyday life that we take spatial thinking and reasoning for granted. Why should anyone have to learn these skills by learning geography, for example? The plain truth is that: (i) we really don't know much about how our mind works, and (ii) without learning, our spatial skills can be pretty terrible. How many people say they "hate geography" and are terrible at answering "geographic" questions in Trivial Pursuits or Jeopardy? But what you are talking about here is the declarative or "factual" part of geography-which you can get from an atlas, globe, or map. At the same time, you probably think of yourself as a "good shopper," "a good athlete," or "a good navigator." If that is true, then you are a good geographer! To be good at these things, you must be able to think and reason spatially. And that's what today's geography tries to accomplish in its classes and its literature. You can always look up facts, but, if you understand the spatial concepts that are part of nearly every facet of everyday life-from using spatial principles when packing the trunk of your car for a family vacation to walking safely out to the kitchen sink in the middle of the night without turning on the lights-you are thinking spatially.

Now, how about figuring out who have been some of the world's great spatial thinkers! Some of my favorites include Eratosthenes (who first calculated the circumference of the earth); Euclid (for his formalization of a geometry); Kandinsky (for his beautiful spatial art); the designer of the Great Wall of China; Copernicus, Tycho Brahe, and Kepler who figured out the movements of the earth and other planets around the sun; Vasco da Gama, Columbus and Captain James Cook for ocean exploration and seeking distant lands; Einstein; the developer of the U.S. Interstate System (I don't know the name); Michael Jordan and Michelle Kwan for spatial thinking in their respective sports; Walter Christaller and August Lösch for their conceptualization of settlement patterns.

How do you spatialize data in your daily life?

One way is by making mental maps…

Use the rest of this page to draw (by hand) a map of your daily route today. In other words, draw a map of your route to school, then maybe to work, a friend’s house, and then back home. It doesn’t have to be pretty, but you will need to include landmarks (waypoints) and route markers of some sort, and a legend so that the reader knows what you are referencing.

This is THINKING SPATIALLY!