Challenges to Integrating Spatial Thinking in the College Curriculum

THOMAS F. SHIPLEY
Department of Psychology
Temple University
Email: tshipley@temple.edu

In considering this specialist meeting and the challenges we face in developing an action plan for potentially developing a spatial thinking curriculum, I have been thinking back on my last 6-years of research on spatial thinking in geosciences education. What has developed in this time is a clear sense of the reciprocal relationship between what cognitive science can offer geosciences education and what geosciences can offer cognitive science. Here, I reflect on three challenges this interdisciplinary work has presented to me a cognitive scientist because I think they may offer guidance on analogous opportunities (and threats) in developing a spatial thinking curriculum.

**Understanding how the mind thinks about space will be a foundation to build a spatial sciences curriculum**

Collaboration spanning disciplines that do not traditionally work together requires the collaborators be able to communicate with a clear understanding of the concepts and principles that are central to both disciplines—this is often characterized as developing a common language. This requirement is not just coming to understand each other’s vocabulary—although this is not trivial and in our case it took at least a year to realize that in addition to learning each other’s terms of art we needed to be clear on our usage of common terms, which we were using in subtly different ways. We needed to develop a framework for thinking about problems that encompasses both research areas. My geology colleagues refer to this as our “handshaking protocol.” Our protocol, built on Chatterjee’s 2008 typology, links the variety of spatial structures described by the scientist to the categories of spatial structures visualized by the mind (of novice and scientist). From the perspective of the academy a handshaking protocol based on spatial structures offers a common ground for the physical scientists who describes the complexities of spatial and spatiotemporal patterns in the natural world, and social scientists who describes the minds that seek to understand and use these patterns (as scientist of the world or just a person people who want to act in a coordinated manner in the world).

**Intellectual tools are needed to aid spatial scientists communicate and think about problems**

The struggle experienced by scientists of good will to communicate across disciplinary divides gave us an appreciation of the limitations of language. Communicating about spatial relations in particular is difficult with spoken language, which is limited in its ability to represent metric
values. Geology, where metric spatial relations are central, has developed many terms of art to help experts communicate. The consequence for undergraduates learning geology is that they are exposed to more new words in an introductory geology course than they would in an introductory foreign language course. To supplement the discipline specific terms Geologists notably employ gesture. A common anecdote is to hear someone at a conference observe, “Oh, see X there across the room, she is talking about her field area,” a deduction based on the hand gestures that accompanied the unheard conversation. Gestures allow geologists to communicate, and perhaps even to think about, complex spatial relations. We have found that Geologists employ gestures in each of the cells of Chatterjee’s typology, but that novices and experts gesture in different ways. We hope to abstract general principles of using gesture to communicate about spatial relations that could be used to help bring gestures into classrooms where spatial information is featured to provide students with a strong way to communicate about spatial information.

**Spatial thinking includes the body**

Although the geologists knew they gestured, and the psychologists knew the gestures were representing spatial relations, none of us had a clear framework to think about how people represent complex motions and shapes with human movement. How much information could be conveyed in gesture? Which aspects of motion mattered? This thinking led us to a recent effort to expand the interdisciplinary group to include dance choreography. Dancers are aware of how many different aspects of human motion can influence the viewer. We hope to use this explicit spatiotemporal awareness to help develop clear gesture-based instruction for scientific concepts that require understanding complex spatial changes. To understand how humans making meaning from the spatiotemporal patterns of human movement we have searched for the triple junction where fine arts meet the social and natural sciences.