From "GIS for Design" to "Design for GIS": Preliminary thoughts on designing a curriculum for spatial thinking

[Position paper for the "Specialist Meeting on Spatial Concepts in GIS and Design" Santa Barbara, California, December 15-16, 2008]

Daniel Sui
Department of Geography
Texas A&M University
College Station, TX 77843-3147
E-mail: sui@geog.tamu.edu

1. GIS for Design: To what extent are the fundamental spatial concepts that lie behind GIS relevant in design?

The fundamental spatial concepts that lie behind GIS, such as location, distribution, neighborhood, scale, etc., are highly relevant in design–at least the landscape level. As demonstrated by Silbernagel (2003), the spatial concepts (such as composition, interspersion, and edge) embedded in Leopold's conservation design principles are quite compatible with those implemented in GIS. In fact, the development of GIS during the formative years was driven by a group of pioneers who were trained as landscape architectures and designers (Chrisman, 2006). Ian McHarg's manual overly technique, widely used in landscape design practices before the birth of GIS, provides the conceptual inspiration for the various versions of overlay functions in GIS, and is still the standard fair in core GIS training today. Because of this cartographic heritage rooted in landscape design, spatial concepts in GIS are quite relevant and compatible to certain design tasks, especially at the landscape level.

However, design is a much broader field than the pursuit of multiple map overlays at the landscape level. When we think about issues in architectural or industrial design or design problems in different domains (such as design of web sites or algorithms), I believe that the relevance of spatial concepts in GIS for design is rather limited for two reasons: 1) Spatial concepts beneath the field and object views of space as implemented in GIS are still rigidly defined by Cartesian coordinates following the axioms of Euclidean geometry, which may not necessarily be ideal for addressing many issues in design practices. The current generation of GIS is still unable to process data using spatial concepts as defined by non-Euclidean geometry; 2) The current GIS user-interface is not designed in a way that engages users in creative design processes. Some recent advances, such as the concept of a second earth (combination of Google Earth and Second Life) are changing the situation (Sui, 2008).

2. Design for GIS: To what extent can the fundamental spatial concepts of design be addressed with GIS?

I know at least two previous efforts by designers that try to engage the geospatial community with a focus on the convergence of design and mapping–The 2002 Yale Symposium on Mapping in the Age of Digital Media (Silver and Balmori, 2003) and the edited volume by Janet Abrams and Peter Hall (2006) on "Else/Where: Mapping new cartographies of networks and territories." From these two earlier efforts, it

seems to me that more and more designers have come to realize that the process of design has been increasingly converged with the process of mapping. Since the most important end product of GIS operations is maps (among many other things), not surprisingly GIS has been used for addressing issues related to design from a mapping/visualization perspective. More precisely, these efforts reflect the trend of growing efforts of using space/place as a metaphor to map/visualize non-spatial data –a process known as "spatialization" within the geospatial community (Skupin and Fabrikant, 2003). As demonstrated by both GIS researchers and designers, lots of interesting work have been conducted following the "spatialization" tradition. My concern is that "spatialization" implicitly assumes that we can translate any design problems or non-spatial data into a Cartesian coordinate system as defined in Euclidean geometry, which does not necessarily have adequate ontological or epistemological justification. Gunnar Olsson (2007) warned the danger of committing such a fallacy dictated by pure cartographic rationality.

If not all the fundamental spatial concepts of design can be adequately addressed with the current generation of GIS, it seems to me that one viable path to move forward is to consider and discuss the following question during this meeting: to what extent the fundamental spatial concepts of design can be used to facilitate the development of GIS? I believe many fruitful results can be achieved if we pursue this route of research. Spatial concepts embedded in the design process are quite diverse and some of them are not necessarily Euclidean in nature, but I believe many of them are relevant for GIScientists to rethink about some of the fundamental issues GIScience. Just like Ian McHarg's spatial concept in design inspired the development of GIS as we know it today, a quite different GIS may be developed if the fundamental spatial concepts were grounded in, let's say, Kevin Lynch's work. Several researchers have demonstrated the potential of using Lynch's conceptualization of space to develop GIS (Banai, 1999; Al-Kodmany, 2001; Stevens, 2006).

Generally speaking, fundamental spatial concepts in GIS are rather narrowly defined, only reflecting a fraction of the vast human spatial experience and conceptualization (Sack, 1980). In contrast, spatial concepts embedded in the diverse design practices are rather fluid, open, imaginative, and even emotional (Jenks, 1997; Puglisi, 1999; Norman, 2004), which can be a new source of inspiration for developing future GISystems and GIScience. I think the key issue is how to transform GIS from being an analytical tool for problem-solving to becoming a more creative tool for design and creation. For example, Corner (1999) proposed four thematic ways of realizing mappings' projective/creative capacities by drawing on diverse design practices, which may be used as a springboard for us to think about developing a versatile GIS:

- *Drift:* where mapping acknowledges open-ended, even goal-less, movement across space;
- *Layering:* which superimposes spatial elements and experiences, less exposing than intervening imaginatively in their inter-connections;
- *Game-board:* which recognizes and enables the actions of contesting agents across a design space;
- *Rhizome:* realizing graphically the metaphor of non-centric, organic spatiality.

Instead of McHarg's concept of overlay, we need to develop a new GIS that is capable of performing design tasks that are related to drift, layering, simulation (game-board), and rhizome.

3. Thoughts for a New Curriculum: Developing spatial thinking in both GIS and design

Designers have recognized the crucial importance of spatial thinking in their curriculum (Dillion et al, 2003). The common thread for a new curriculum that stimulates spatial thinking in both GIS and design will be a renewed emphasis on creativity–one of the defining characteristics for future minds (Gardner, 2006). We need to develop a new strategy that transcends disciplinary boundaries and motivates students to think critically about the dynamic relationship between space, time, and our social practices. I have argued else where some time ago for a more humanistic GIScience in the context of the emerging third culture (Sui, 2004, 2005). The core argument is that so far, the development of GIScience has been squarely grounded in traditional science and engineering. The next phase of GIS research and education should be broadened and involve fields in arts and humanities, especially the diverse, creative design practices. Humanistic GIScience attempts to integrate multiple, alternative human conceptualizations of space and time with the key issues related to spatial data representation, analysis and visualization. Instead of emphasizing accuracy by trying to minimize or eliminate uncertainty, humanistic GIScience adds the human subjective and imaginative dimensions of experience to facilitate the processing and understanding of the world.

Artists' renditions of the world–real and imagined–in novels, poems, paintings, movies, music and songs can be rich sources of inspiration for GIScience researchers and students exploring alternative conceptualizations of space, place, time, environment, region and scale. In addition to the common representations of space framed by Euclidean geometry, humanistic GIScience is attempting to find novel ways to handle the textures of place as articulated in the humanistic tradition as well as the structures of space. As the quest for new means of analysis and modeling via computers has been increasingly intertwined with the persistent search for deeper meanings of such activities, we can reasonably expect more synergistic activities between GIS and design for both research and education.

References Cited

Abrams, J. and P. Hall, 2006. *Else/Where: Mapping new cartographies of networks and territories.* University of Minnesota Design Institute/University of Minnesota Press.

Al-Kodmany, K., 2001.Supporting imageability on the World Wide Web: Lynch's five elements of the city in community planning. *Environment and Planning B: Planning and Design* **28**(6): 805–832.

Banai, R., 1999. A methodology for *The Image of the City*. *Environment and Planning B: Planning and Design* **26**(1): 133–144.

Chrisman, N.R., 2006. *Charting the Unknown: How computer mapping at Harvard became GIS.* Redlands, CA.: ESRI Press.

Corner, J., 1999. The agency of mapping: Speculation, critique and invention. In D. Cosgrove (ed.), Mappings, 213–252. London: Reaktion Books Ltd.

Dillion, D., A. Kapur, and H. Carter, 2003. Teaching spatial concepts in the architectural design process. *Tech Directions.* 63: 18–19.

Gardner, H., 2006. *Five Minds for the Future*. Boston, MA.: Harvard Business School Press.

Jencks, C. 1997. *The architecture of the jumping universe: A polemic or how complexity science is changing architecture and culture*. New York: Academy Editions. .

Lidwell, W., K. Holden, and J. Butler, 2003. *Universal Principles of Design: 100 ways to enhance usability, influence perception, increase appeal, make better design decisions, and teach through design.* Gloucester, MA.: Rockport.

Norman, D.A., 2004. *Emotional Design: Why we love (or hate) everyday things.* New York: Basic Books

Olsson, G., 2007. *Abysmal: A critique of cartographical reason.* Chicago, IL.: University of Chicago Press.

Puglisi, P. P., 1999. *Hyper Architecture: Spaces in the electronic age*. [translation into English by Lucinda Byatt]. Boston: Birkhauser-Publishers for Architecture.

Sack, R.D., 1980. *Conceptions of Space in Social Thought: A geographic perspective.* Minneapolis, MN: University of Minnesota Press.

Silbernagel, J., 2003. Spatial theory in early conservation design: examples from Aldo Leopold's work. *Landscape Ecology* 18: 635–646.

Silver, M. and D. Balmori, 2003. *Mapping the age of digital media: The Yale symposium.* New York: John Wiley & Sons.

Singh, R. R., 1999. Sketching the city: A GIS-based approach. *Environment and Planning B: Planning and Design* **26**(3): 455–468.

Skupin, A. and S. I. Fabrikant, 2003. Spatialization Methods: A cartographic research agenda for non-geographic information visualization. *Cartography and Geographic Information Science* 30 (2), 95–115.

Stevens, Q., 2006. The shape of urban experience: A reevaluation of Lynch's five elements. *Environment and Planning B: Planning and Design* **33**(6): 803–823.

Sui, D.Z., 2004. GIS, Cartography, and the Third Culture: Geographical imaginations in the computer age. *The Professional Geographer* 56(1): 62–72.

Sui, D.Z., 2005. Beethoven, Picasso and GIS: Is spatial really special? *GeoWorld,* September issue, 22–24.

Sui, D.Z., 2008. Geography and GIS in Second Life. *GeoWorld,* September Issue, 19–21.