spatial@ucsb
Perspectives for Teaching and Research

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Specialist Meeting on Spatial Concepts in GIS and Design
University of California, Santa Barbara
15-16 December 2008
Applying Concepts of Spatial Thinking

to Describe, Analyze, Understand &
Predict, & to Create, Plan & Design . . .

Space-time Patterns & Processes
Established 2007 to integrate a campus-wide community of spatial thinkers at UCSB

Mike Goodchild, director of spatial@ucsb

“spatial@ucsb aims to change what people think of spatial thinking – from something that only experts need to know about, to something that everyone should use.”

UCSB is Spatial
A Natural / Structural View on the Space of Knowledge

Goodchild & Janelle
An Empirical / Pragmatic View on the Space of Knowledge

- Discipline Cores
- Organizations and Institutions
- Individual Career Paths

Goodchild & Janelle
Spatial thinking is transformative
GIS, Design, & beyond

• **Value** for daily living and for problem solving in society and science
• Transcends **disciplinary boundaries**
• Unites **quantitative and qualitative thinking**
• Allies with **multi-media graphic display and communication** of information
• A domain of continuing significant **knowledge development**
• Not necessarily easily and intuitively acquired
• Candidate for inclusion in general education
Contrasting but Complementary Perspectives

Spatial Intelligence Learning Center

Focus:
• spatial cognition
• understanding spatial learning
• Improve K-12 education practices to foster spatial skills & spatial functioning

Methodology:
• Identify basic elements of spatial thinking
• Controlled experiments to measure understanding, learning, & skill development

spatial@ucsb

Focus:
• Spatial concepts in social, environmental, behavioral, & design sciences
• Curriculum development for undergraduate education

Methodology:
• Identify fundamental spatial concepts
• Context dependent applications (re: disciplines, theories, problems, policies)
• Tools of spatial analysis (e.g., GIS)
Geo-spatial Concepts for Spatial Reasoning

- **Location** – Understanding formal & informal methods of specifying “where”
- **Distance** – The ability to reason from knowledge of relative position
- **Network** – Understanding the importance of connections
- **Neighborhood & Region** – Drawing inferences from spatial context
- **Overlays** – Inferring spatial associations by comparing mapped variables by locations
- **Scale** – Understanding spatial scale & its significance
- **Spatial Heterogeneity** – The implications of spatial variability
- **Spatial Dependence** – Understanding relationships across space (Tobler’s First Law)
- **Objects & Fields** – Viewing phenomena as continuous in space-time or as discrete
Context Dependence across Disciplines

Disciplines claim uniqueness of theories, problems, and areas of application; yet also share fundamental objectives and methodologies

• **Sciences** seek identification and understanding of patterns and processes about the physical world and its phenomena

• **Social sciences** focus on interdependence among people & groups, grounded in place, space, & time and the need to understand patterns & processes of human behavior

• **Engineering and design sciences** focus on problem solving and product development that frequently entails the (re) arrangement of spatial entities and the consequences

• **Humanities** focus on human creativity and aesthetic renderings (stories, visualizations, sounds) that often affirm affinity to sense of place and regional identity, use spatial metaphor, and rely on spatialized languages for communication
# ThinkSpatial

The UCSB brown-bag forum on spatial thinking

informal noon-time sessions that feature theories, concepts, tools, and applications for spatial thinking

## 2007 – 2008 Program

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<td>Diana Sinton (University of Redlands)</td>
<td>One Approach to Bringing Spatial Thinking to Higher Education</td>
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<td>22 January</td>
<td>Bill Jacob (Mathematics, UCSB)</td>
<td>Working with the Array, Mathematical Models</td>
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<td>Tobias Höllerer (Computer Science, UCSB)</td>
<td>When Computers get Physical—A Path to “Anywhere Augmentation”</td>
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<td>22 February</td>
<td>Paul Van Zuylen (Westlake GIS and Ventura College)</td>
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<td>Kun Lee (Sociology, University of Seoul)</td>
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<td>Dan Montello (Geography / Psychology, UCSB)</td>
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<td>The Role of Spatial Cognition in Medicine: Applications for Selection and Training of Professionals</td>
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<td>21 May</td>
<td>Reg Golledge (Geography, UCSB)</td>
<td>Knowledge of Spatial Concepts is the Key to Enriched Spatial Thinking</td>
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2008–2009 Program

22 October Helen Couclelis (Geography, UCSB) *Polyplicity: a complexity science for the social and policy sciences*

29 October Michael Goodchild and Donald Janelle (Geography, UCSB / spatial@ucsb) A spatial literacy initiative for undergraduate education at UCSB

25 Nov Karl Grossner (Geography, UCSE) *IssueBrowser: The first (spatial) history of 2008 US presidential election campaign speech*

9 December Benjamin E. Reese (Neuroscience Research Institute, UCSB) *Spatial Analysis 3D — software tools for point pattern analysis in the nervous system (and beyond)*

21 January Martin Rauhal (Geography, UCSB) *Cognitive engineering for GI Science*

11 February James Frew (Donal Brey School of Environmental Science and Management) *Geographic information provenance*

25 February Rajan Gupta (High Energy Physics, Los Alamos National Laboratory) *Spatial cognition of global energy systems*

4 March Jim Marston (Geography, UCSB) *Enhancement of spatial cognition and wayfinding for vision-impaired travelers using remote infrared audible signage*

TBA April Lisa Jevbratt (Art, UCSB) *Mapmaking as art*

20 May Lisa Weckbacher and Yukari Okamoto (Child Development, CSUN / Education, UCSB) *The role of visualization in geometric problem solving*
Initiatives by spatial@ucsb

- **Workshop on spatial curriculum**
  (hosted by University of Redlands, coordinated by Diana Sinton, June 2008)

- **Specialist meeting on Spatial Concepts in GIS and Design** (Dec 2008)

- **TeachSpatial.org** (coming soon)
What can be accomplished at UCSB?

• Multi-disciplinary **Minor** in spatial thinking

• **Emphasis** or **Specialization** in spatial thinking within existing degree programs

• **Independent Studies** (98/99; 198/199)

• Introduction to **spatial thinking as part of existing courses**

• **General Education Course**

• **Freshman Seminar** (Interdisciplinary 94)

• **Multi-discipline Graduate course** (NSF IGERT ?)

January 2009 planning meeting (computer science, environmental science, geography, history of art and architecture, mathematics, physics, psychology)
teachspatial.org is a collaborative, interactive, web site devoted to improving our understanding of how spatial thinking contributes to science and society, and to providing resources that promote applications of spatial concepts and spatial tools in teaching and learning. The site features three parts:

**Part 1** enumerates and defines the core concepts of spatial thinking, presented in the original words of authors from source frameworks used by these authors. Users of the site are invited to read the original publications to appreciate the contextual frameworks represented by suggesting additional source documents for inclusion.

**Part 2** will feature schemas that interpret, synthesize, and model aspects of spatial thinking that draw on and interact with selected concepts from part 1. Please submit your own schema and explanatory text; and please join others with commentary and questions for on-line discussion.

**Part 3** will provide an archive of user-contributed resources for teaching and learning. Please share your pedagogic strategies, exercises, demonstrations, and course syllabuses for use and consideration by others in their efforts to enhance spatial literacy.

**CORE CONCEPTS OF SPATIAL THINKING**

http://sand.spatial.ucsb.edu/teachspatial/
Thank You

Please check [www.spatial.ucsb.edu](http://www.spatial.ucsb.edu) for information on applications of spatial thinking
Integrating Concepts for Spatio-temporal Reasoning

Scientific and civic applications generally integrate multiple spatial concepts simultaneously to engage general types of spatial reasoning to:

• (1) detect changes in the uses of space(s)
• (2) measure arrangements and clustering
• (3) document patterns over time to infer process
• (4) study flows as indicators of spatio-temporal interactions
• (5) assess space-time associations to test hypotheses
Questions (from the Redlands workshop)

- Why is there interest in a general course on spatial thinking?
- Can we define “spatial literacy”?
- Who (what disciplines) should teach a course like this?
- Objectives?
- What spatial thinking concepts would be covered?
- How much should this course be guided by cognitive science?
- What might the syllabus look like?
- What online resources support development and delivery?
- What are valid and interesting forms of assessment?
Questions (from the Redlands workshop) 2

- Is there a role within the general education framework for a course on spatial thinking?
- Are there institutional impediments?
- Who are the other major players with interest in spatial thinking?
- Who might like to be aware of our activities?
- What types of funding could support this initiative?
- Other unanswered questions?
- Next steps?