Spatial Cognition, Environmental Perception, & the Future of Modern Technology

A PhD Dissertation & Future Research, January 2016

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Presentation Outline:

- What is spatial cognition?
- What is environmental perception?
- The background research & future plans.
- How will our cognitive mapping perceptions be influenced by advancing technology?
- Audience Response Survey.

✓ PollEv.com/nikolassmilo937
Spatial Cognition:

- “is concerned with the acquisition, organization, utilization, and revision of knowledge about spatial environments.” (Wikipedia)

- “A geographical information system is a construct designed to capture, store, manipulate, analyze, manage, and present all types of spatial or geographical data.” (Wikipedia)
THE PSYCHOLOGICAL REVIEW

COGNITIVE MAPS IN RATS AND MEN 1

BY EDWARD C. TOLMAN

University of California

Plan of maze
14-Unit T-Alley Maze


14-Unit T-Elevated Mazes

Fig. 2

(From C. H. Honzik, The sensory basis of maze learning in rats. *Comp. Psychol. Monogr.*, 1936, 13, No. 4, p. 4. These were two identical mazes placed side by side in the same room.)
Spatial Cognition:

- Spatial Cognition is often referred to as Mind Mapping, Mental Mapping, Sketch Maps, and Cognitive Mapping
- Cognitive distance = Basis of arrangement, activity space
- Designative vs Appraisive
  - Designative - Cognitive organization of space, how we know & understand the environment around us
  - Appraisive – How we experience and make sense of the world around us, personal preference

(Lynch, 1960)
Spatial Cognition:

(Lukinbeal, 2015)
Spatial Cognition:

- Waldo R. Tobler (born 1930)
- American-Swiss Geographer & Cartographer
- “First Law of Geography”
- Everything is related to everything else in physical space, but near things are more related to each other than objects further apart

Spatial Autocorrelation Analysis: Join Count

There is a distinction that is made in all spatial autocorrelation measures (as well as in, for example, point pattern analysis) that can be differentiated using various spatial analysis methods. This distinction is among three kinds of patterns:

- Clustered
- Dispersed
- Random

(Klippel, Hardisty, & Li, 2011)
What is the biology behind spatial cognition?

Spatial learning, spatial cognition, & action planning (behavior) is performed by the interplay between the hippocampus and prefrontal cortex (PFC) in the human brain. (Martinet, Sheynikhovich, Benchenane, & Arleo, 2011)
Spatial Cognition:
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(Martinet, Sheynikhovich, Benchenane, & Arleo, 2011)
Spatial Cognition:

(Martinet, Sheynikhovich, Benchenane, & Arleo, 2011)
“The underlying rationale for environmental perception and behavioral research lies in the assertion that understanding the geography of space and place requires knowledge of the way in which people experience, perceive, organize, and ascribe meaning to information about the environment, as well as how people act upon this information. Often this research seeks to identify general patterns of perceptions, cognition, and action common to all humans, or to members of particular social groups.” (Aitken, Cutter, Foote, & Sell, 1989)
Environmental Perception:

- The study of how the brain perceives the environment... spatially...

- Influencers of EP – auditory perception, depth perception, visual perception

- Where do you feel safe?
- Where do you spend your time?
- What is your activity space?

(Lopez & Lukinbeal, 2010)
<table>
<thead>
<tr>
<th>Source</th>
<th>Perceptual Space</th>
<th>Data Collection</th>
<th>Representation</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceccato and Snickers 2000</td>
<td>where people feel unsafe in Jordbro</td>
<td>participants are given a survey which asked them to define their neighborhood, to identify places they visit regularly, and perceptions of these areas; they could also mark places they felt were unsafe</td>
<td>polygons</td>
<td>overlay</td>
</tr>
<tr>
<td>Matei, Baill-Rokeach, and Qui 2001</td>
<td>places where people are fearful; places where people are comfortable</td>
<td>black-and-white map; colored markers; instructions for color-coding comfort level; digitized into ArcView; participant maps interpreted into grid cells and coded based on color; digitized data in ArcGIS 3.x</td>
<td>polygons</td>
<td>regression using average comfort score by zip code as dependent variable</td>
</tr>
<tr>
<td>Doran and Lees 2005</td>
<td>avoidance of areas based on fear of crime</td>
<td>participants were asked to mark on a map of the CBD areas where they feared certain types of crime and therefore avoided the area; they were also asked what time they avoided the area and how hard they tried to avoid the area</td>
<td>not specified</td>
<td>aggregation</td>
</tr>
<tr>
<td>Dennis 2006</td>
<td>avoidance of certain corners due to presence of drug dealers</td>
<td>some youth drew maps of the neighborhood to illustrate spatial aspects; youth also took photographs to complement narratives about the neighborhood</td>
<td>hand-drawn map (labels, roads, etc.)</td>
<td>illustrative</td>
</tr>
<tr>
<td>Kwan 2008</td>
<td>unsafe areas before and after 9/11</td>
<td>an activity diary was collected and an oral history was conducted with each woman; a sketch map was included as part of the oral history</td>
<td>features were digitized into a GIS, but what form they were given is not specified</td>
<td>illustrative</td>
</tr>
<tr>
<td>Kohm 2009</td>
<td>unsafe areas in the Spence neighborhood of Winnipeg</td>
<td>face-to-face interviews that collected demographic data and used a map instrument to capture places in the neighborhood where they felt “unsafe”; 11x17 inch neighborhood maps; instructed to draw circles around areas where they felt unsafe; asked why they felt unsafe in these areas</td>
<td>polygons</td>
<td>aggregation</td>
</tr>
<tr>
<td>Lopez and Lukinbeal 2010</td>
<td>safe/low crime areas; dangerous/high crime areas</td>
<td>base map of neighborhood with 0.5 mile buffer; color safe areas and unsafe areas using blue and red, respectively; police mapped high and low areas of crime and described types of crime; scanned and georegistered maps, and digitized data in ArcGIS 9.x</td>
<td>polygons</td>
<td>aggregation</td>
</tr>
</tbody>
</table>
Environmental Perception:

Garfield Police Officer Response

Garfield Resident Response

(Lopez & Tukinbeal, 2010)
Environmental Perception:

- What would you define as your personal neighborhood?
- Would your best friend agree with you?
- Is there a systematic way to define a geographic neighborhood?
- Is the neighborhood based on environmental perception?
The Research:

I. A Collaborative Effort

II. The NSF Grant

I. The Dissertation Project

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The Research:

Dissertation Goals:

- To codify all data and aggregate it for both statistical analysis and spatial analysis
- Survey data, cognitive maps, & background GIS data
- To statistically test individual variables that contain significance in regards to spatial cognition & environmental perception
  - Gender, age, education, location, & activity space
- To create cognitive-psychological profiles based on statistical findings
- To lead the discussion on the future of spatial cognition and how technology will influence it
The Research:

The data consists of three parts, from three sample areas:

- Survey Collection
- Demographics (Census 2000)
- Cognitive “Mental” Maps

(Lopez & Lukinbeal, 2010)
The Research:

Garfield, Phoenix – Sample 1

- Total Population = 9,935
- Surveys Collected = 388
The Research:
Garfield
The Research:

Pilsen, Chicago – Sample 2

- Total Population = 33,783
- Surveys Collected = 400
The Research: Pilsen
The Research:
Little Havana, Miami – Sample 3

- Total Population = 54,646
- Surveys Collected = 400
The Research:
Little Havana
The Research:

- Recap of project
- Introduction
- Literature Review
- Methodology
- Results
- Discussion
Cognitive Mapping and the Effect of Technology:

- Moore’s Law states that over the history of computers that integrated circuits and transistors double approximately every two years. - Meaning that computing capacity is growing at an extremely fast rate!
How does the brain store, process, and code spatial environments that are virtual or augmented?
References:

- Cyr, A., andre.cyr1@videotron.ca, & Thériault, F., ftheriault@cvm.qc.ca. (2015). Action selection and operant conditioning: A neurorobotic implementation doi:10.1155/2015/643869
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Audience Online Survey

PollEv.com/nikolassmilo937

To Follow the Project Connect with me on LinkedIn

https://www.linkedin.com/in/nikolas-smilovsky-gisp-a831511b