The human activity of visualization

cultural and psychological factors in representation of geographic phenomena

Oregon State University
Geovisualization Seminar
January 23, 2007

Rob Edsall
School of Geographical Sciences
Arizona State University
Visualization is an inherently **human** activity

- **what visualization is:**
  - a process, a methodology
  - an activity of interaction between a human and a computer
  - the use of computerized representations of data to **learn**, **connect**, **gain insight**, **generate hypotheses**, **construct knowledge**

- **what visualization is not:**
  - pretty pictures, virtual worlds
  - maps (by themselves)
  - technology (by itself)
Geovisualization
A change in map use

Presentation: use of low-interaction graphics to present known ideas to the public

Exploration: use of high-interaction graphics to uncover unknown features or relations to the analyst

Cartography: always has the map reader in mind
Cartography: a history of user-centered research

- academic cartography:
  - how map readers perceive, recognize, interpret maps (static, paper)
- psychophysical, cognitive studies
User-centered Geovisualization

emphasis on matching graphics to the user’s needs

- usability studies of geovisualization environments necessary to prove effectiveness
- only recently has GIScience considered usefulness of dynamic representations and environments for viz. uses

Griffin et al 2006
Human-Computer Interaction: Software of the Mind

- each user has a set of established patterns of thinking, feeling, and acting that govern how new information is understood and assimilated (Hofstede, 1991)

- visualization is
  - a private activity: individual differences in users must be accounted for, now more than ever
  - a cognitive process most successful when users are given an opportunity to think creatively about a data set or phenomenon
Usability engineering and visualization design

- targets:
  - typical users of geovisualization
  - experts (not novices)
  - individuals (not groups)

  typical uses of geovisualization
  - exploration (not communication)
  - deliberation (not speed)
  - creative (not conventional or conformal) thinking
Usability test for a visualization environment

- Decision Theater (ASU)
- Comparative study vs. 2D PowerPoint in classroom
- Users: decision-makers
- Uses: exploration of physical and abstract 3D surfaces
Usability test for a visualization environment

- **results:**
  - DT affective more than effective
  - differences in responses based on:
    - prior experience and familiarity with subject
    - complexity and abstractness of phenomena
    - spatial/visual expertise of subjects
  - user interaction vital missing feature
Learning / understanding modes

- not all people are spatial thinkers
- how can we accommodate verbal learners/users?

Conventions in conflict:

Graphic (map): top = farther away
Verbal: top = closer
Cartographic implications

- conventions of Western maps

- how committed should we be to these for
  - designing for diverse users?
  - designing for diverse uses?
Cultural factors in map design

- User groups more diverse and international: scientific community and general public (Day 1998; Gibbon 1998; Marcus 2000)

- Conventions and metaphors of Westerners may not hold worldwide
  - Colors, symbols, interface elements
  - Conceptions of space and time
  - Individualistic vs. community orientation
Designing for experts

- old dog and new tricks

experts:
- more likely to assist the development of new tools
- more likely to spend more time with new tools, but
- prefer representations they’ve used before

(McGuinness 1994)
Interface metaphors: “blinkering” users and designers?

- over-reliance on metaphors may serve to
  - constrain the interface design of the creator
  - constrain the mental models developed (and knowledge constructed) by the user

(Nelson 1990; Preece, Rogers and Sharp, 2003)
left-to-right motion  
right-to-left motion  
top-to-bottom motion
Maps: necessary biases, indispensable deficiencies

- representation: a series of choices
  - selection, generalization, aggregation, classification, description... modes of abstraction

- limited space, limited visibility (resolution), invisible themes (e.g., density), adherence to convention

- geovisualization can alleviate some of these biases: user interaction
Increasing user interaction: enabling multiple perspectives

- Interaction plays multiple roles in visualization:
  - Overcomes inherent deficiencies in the display
    - Dynamic reclassification, filtering, highlighting, zooming, linking displays
  - Help to discover non-obvious patterns in data
    - Data transformations, color scheme manipulation, rotation and re-projection
  - Support "drill-down" in data
    - Changing abstraction levels for detailed (or more general) examination of selected features
Expanding the mental models: novel representations

- borrowed from EDA, InfoVis
- abstract non-spatial representations for geographic information
Expanding the mental models: music and animation

- music, animation: both art forms that occur in time
Expanding the mental models: music and animation

- what makes us respond to music? to cinema?
  - representations of tension and release
  - what might silence mean? what might extended duration of sameness? what might rapid but non-periodic changes?
  - can we “play” data in such a way that we “hear” change, build tension, listen for climaxes?
Geographic experiential

- representations of geographic phenomena that:
  - align with user knowledge, expertise, experiences
  - are sensitive to individual differences: adaptive user interfaces, multiple perspectives, novel representations
  - adapt multiple sensory channels for differing learning styles
Geographic experience

- potential for virtual worlds, immersive environments for experiencing representations of the environment
- the science of visualization lies in the understanding of the influence on the representations on the human viewer (and vice versa)