The human activity of visualization

cultural and psychological factors in representation of geographic phenomena

Oregon State University
Geovisualization Seminar
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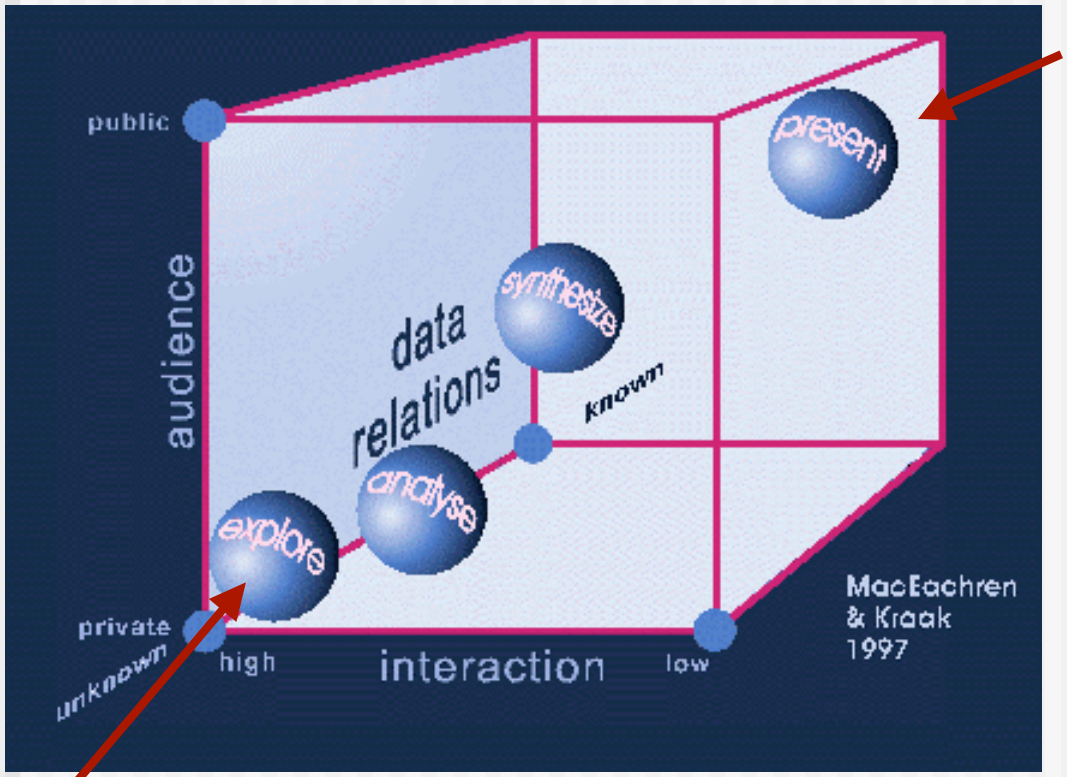
Visualization is an inherently human activity

- 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



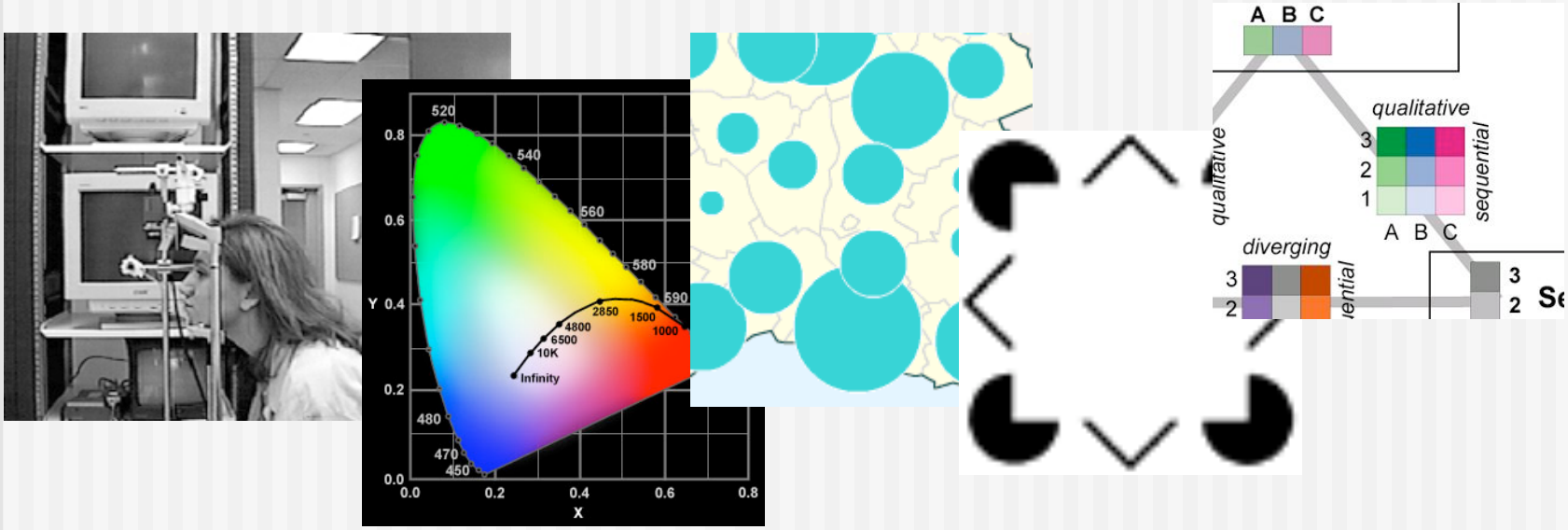
Presentation: use of low-interaction graphics to present known ideas to the public

Cartography: always has the map reader in mind

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

Cartography: a history of **user-centered research**

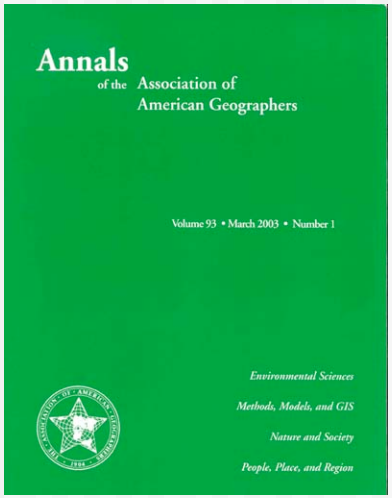
- academic cartography:
  - how map readers perceive, recognize, interpret maps (static, paper)
  - psychophysical, cognitive studies



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)

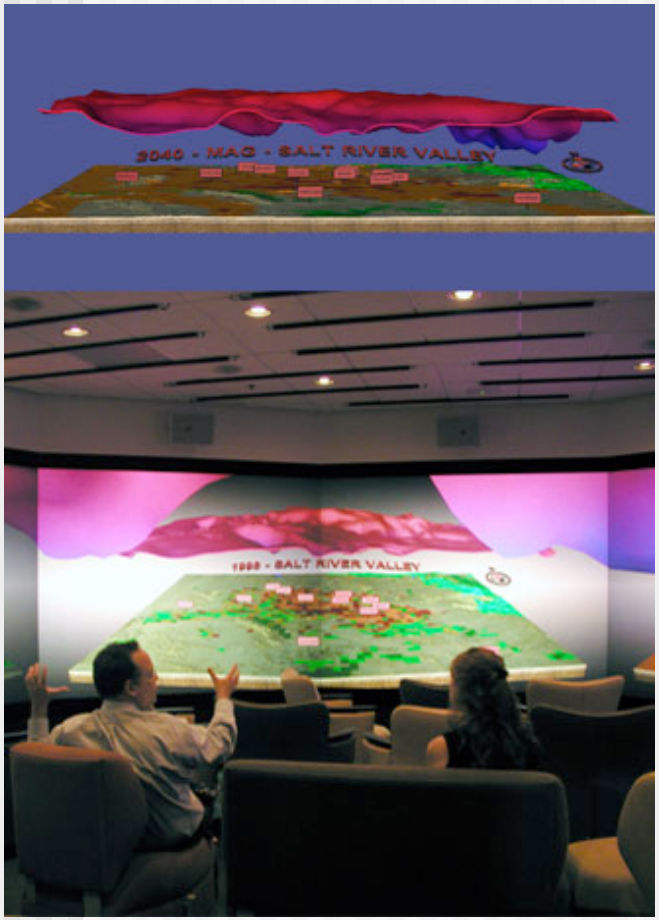
typical uses of geovisualization

exploration (not communication)

deliberation (not speed)

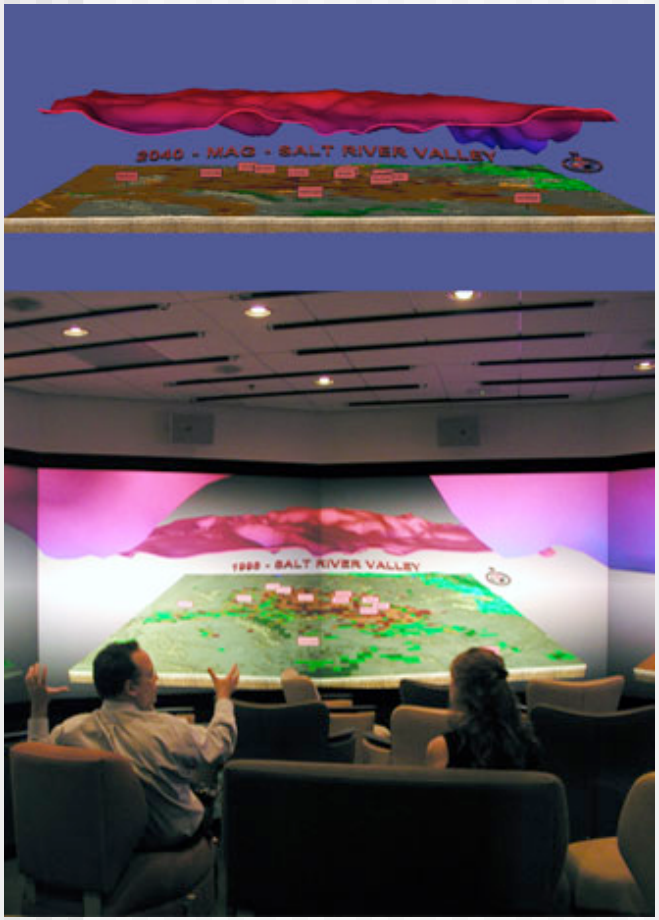
creative (not conventional or conformal) thinking

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:

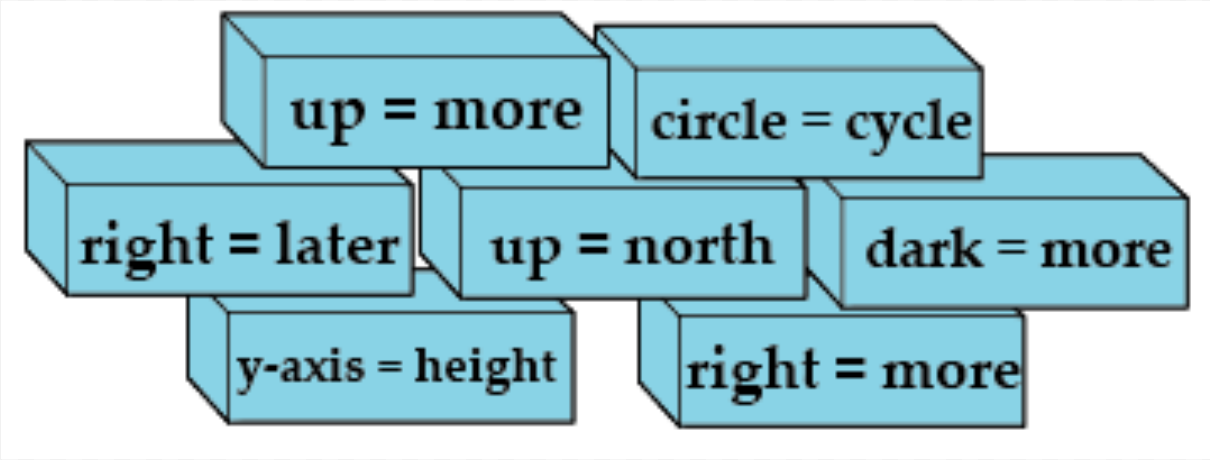
Graphic (map): top = farther away

Verbal: top = closer

Cartographic implications

Work with L. Sidney, *Research in Geographic Education* (2005)

- conventions of Western maps

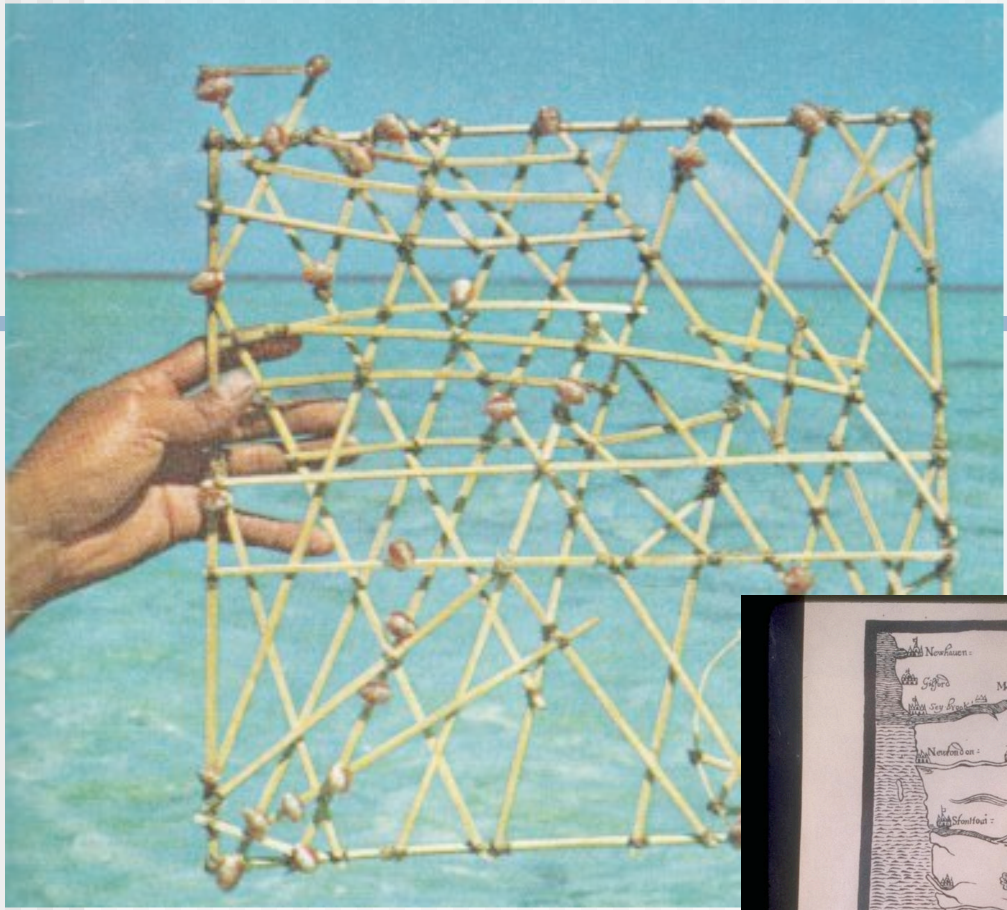


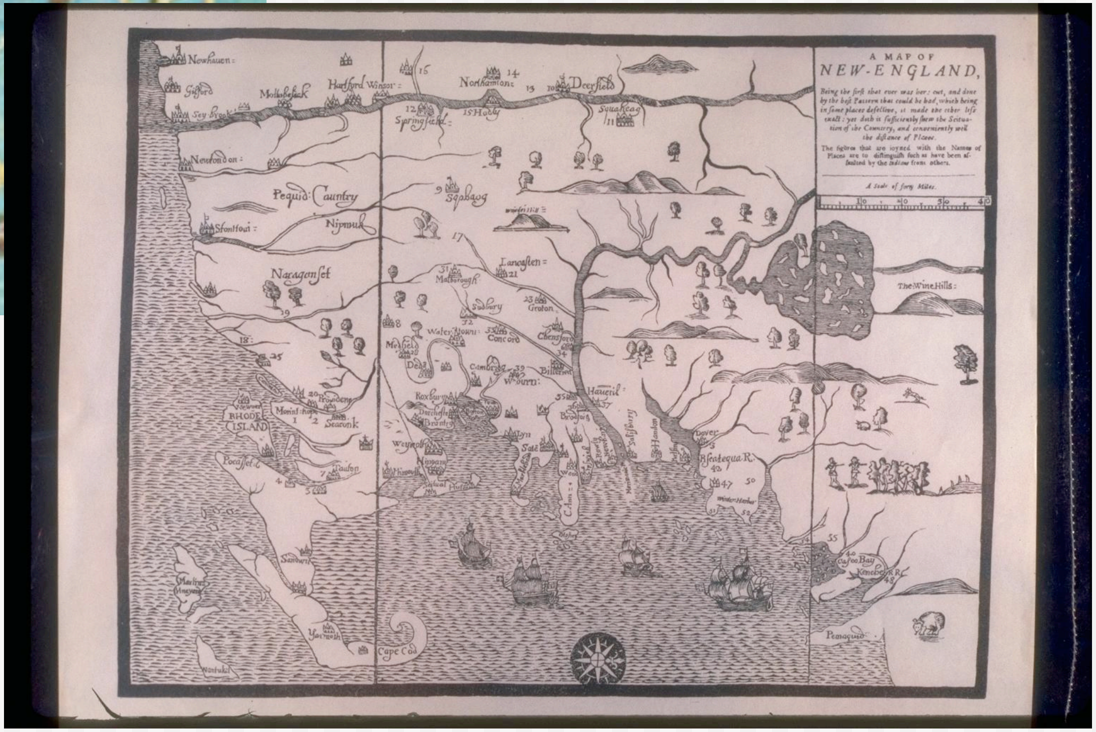
- how committed should we be to these for
  - designing for diverse **users** ?
  - designing for diverse **uses** ?

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

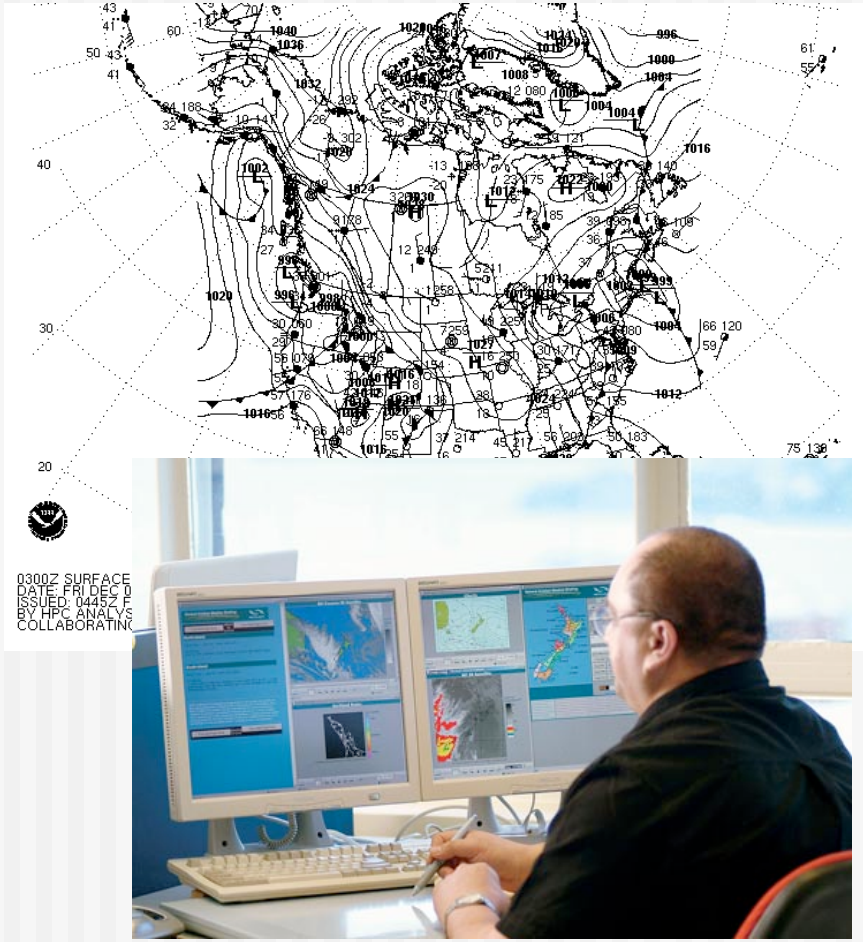



A MAP OF
NEW-ENGLAND,
Pequid Countrey
Naragenset
Cape Cod
The Wine Hills
Northampton
Deerfield
Lancaster

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

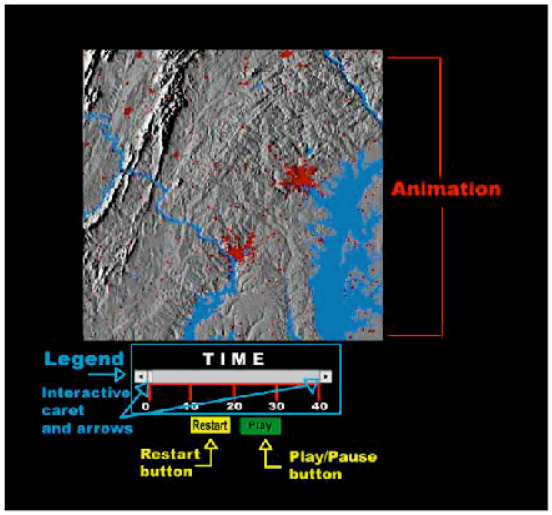
(McGuinness 1994)



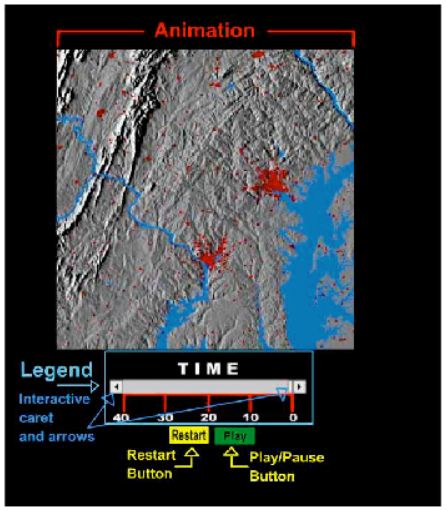
Interface metaphors: "blinkering" users and designers?

- 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

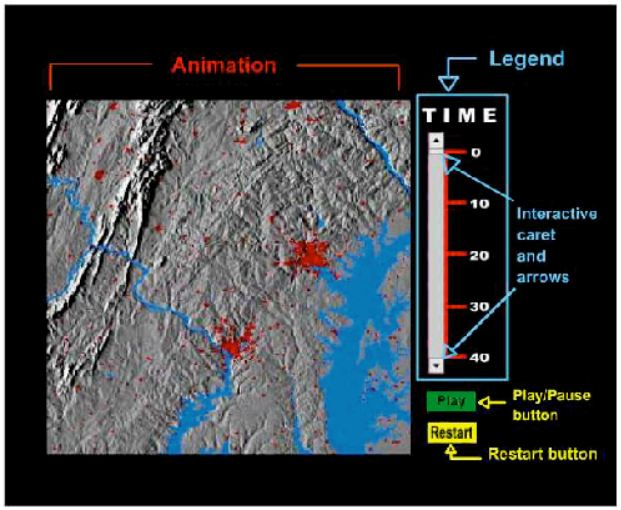
(Nelson 1990; Preece, Rogers and Sharp, 2003)



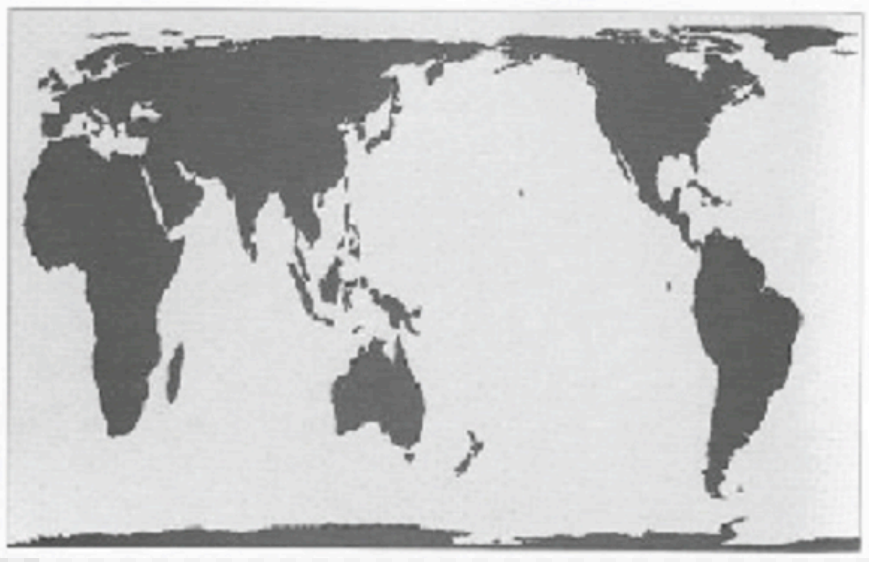
left-to-right motion

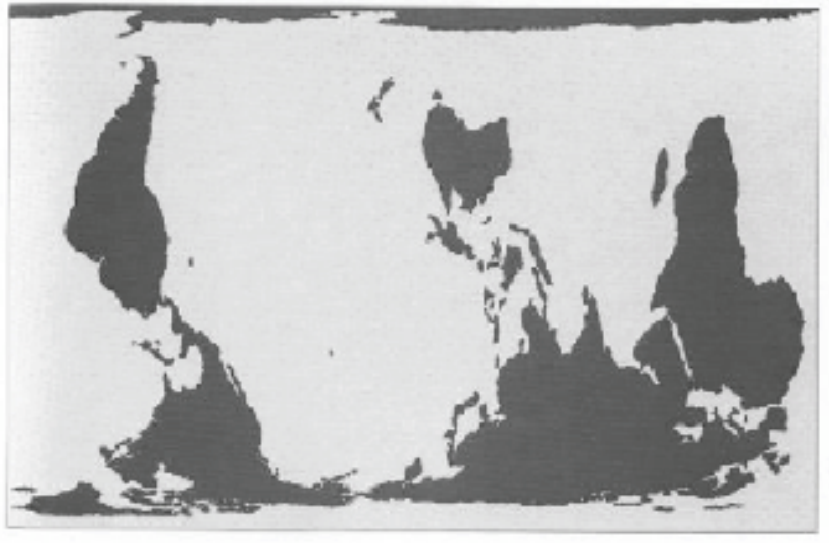


right-to-left motion



top-to-bottom motion





Maps: necessary biases, indispensable deficiencies

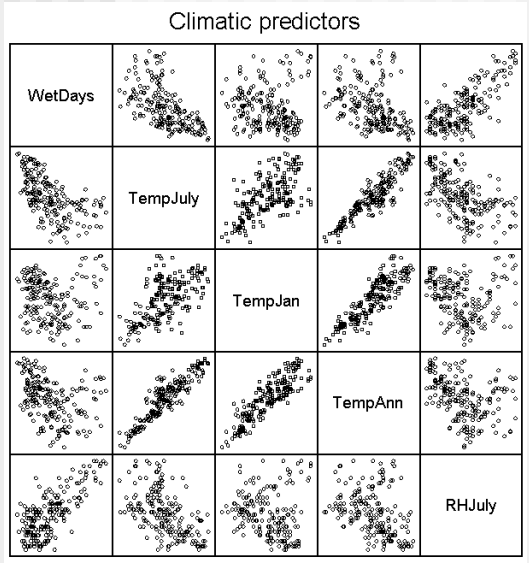
- representation: a series of choices
  - selection, generalization, aggregation, classification, description… modes of abstraction
  - limited space, limited visibility (resolution), invisible themes (e.g., density), adherence to convention
  - geovisualization can alleviate some of these biases: user interaction

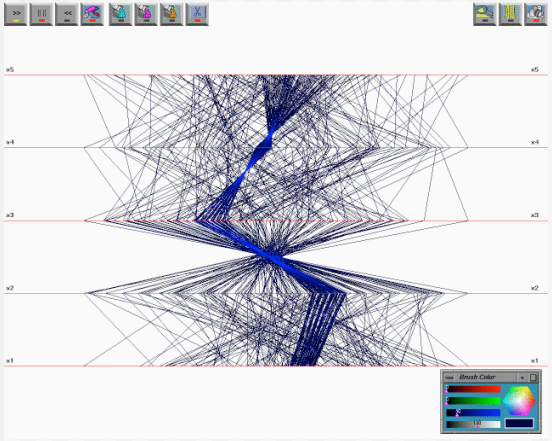
Increasing user interaction:
enabling multiple perspectives

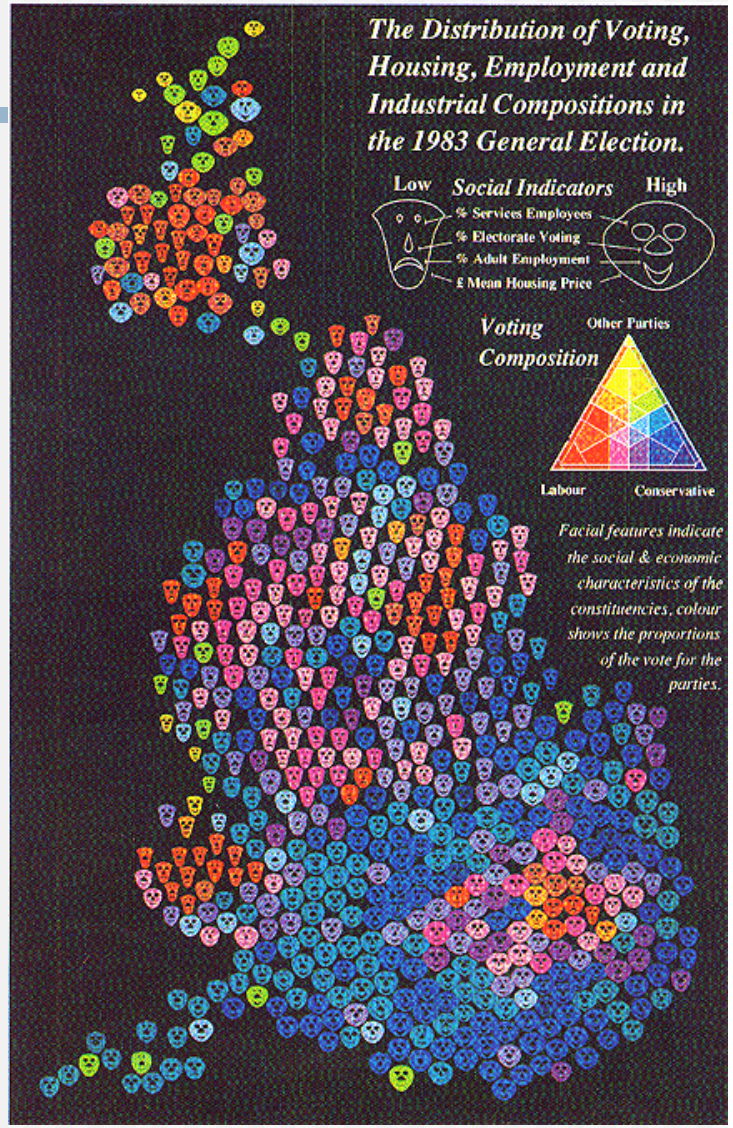
- interaction plays multiple roles in visualization:
  - overcomes inherent deficiencies in the display
    - dynamic reclassification, filtering, highlighting, zooming, linking displays
  - help to discover non-obvious patterns in data
    - data transformations, color scheme manipulation, rotation 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

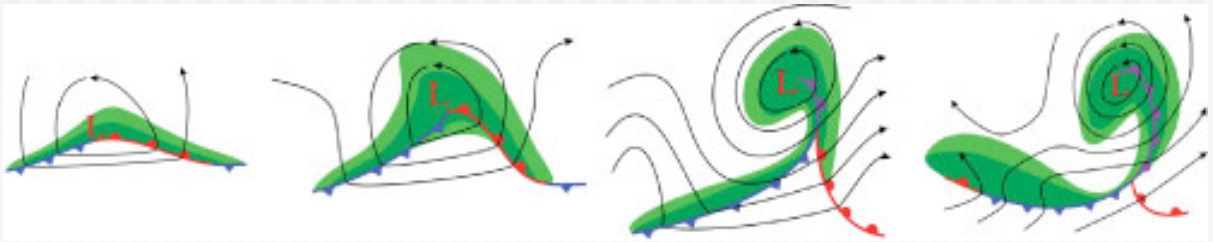


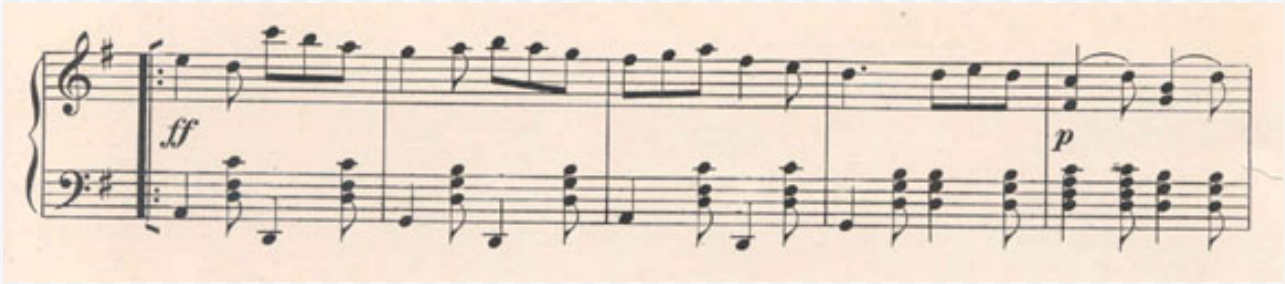




Expanding the mental models: music and animation

- 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?

Proposal for DHS or NEA, Spring 2006

Geographic **experienc**ation

- 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 **experienc**ation

- 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)