

# Analisi e Visualizzazione di Reti Complesse

**DV05 - Rules of Thumbs**

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DV05 - Rules of Thumbs - a.a. 2023-2024

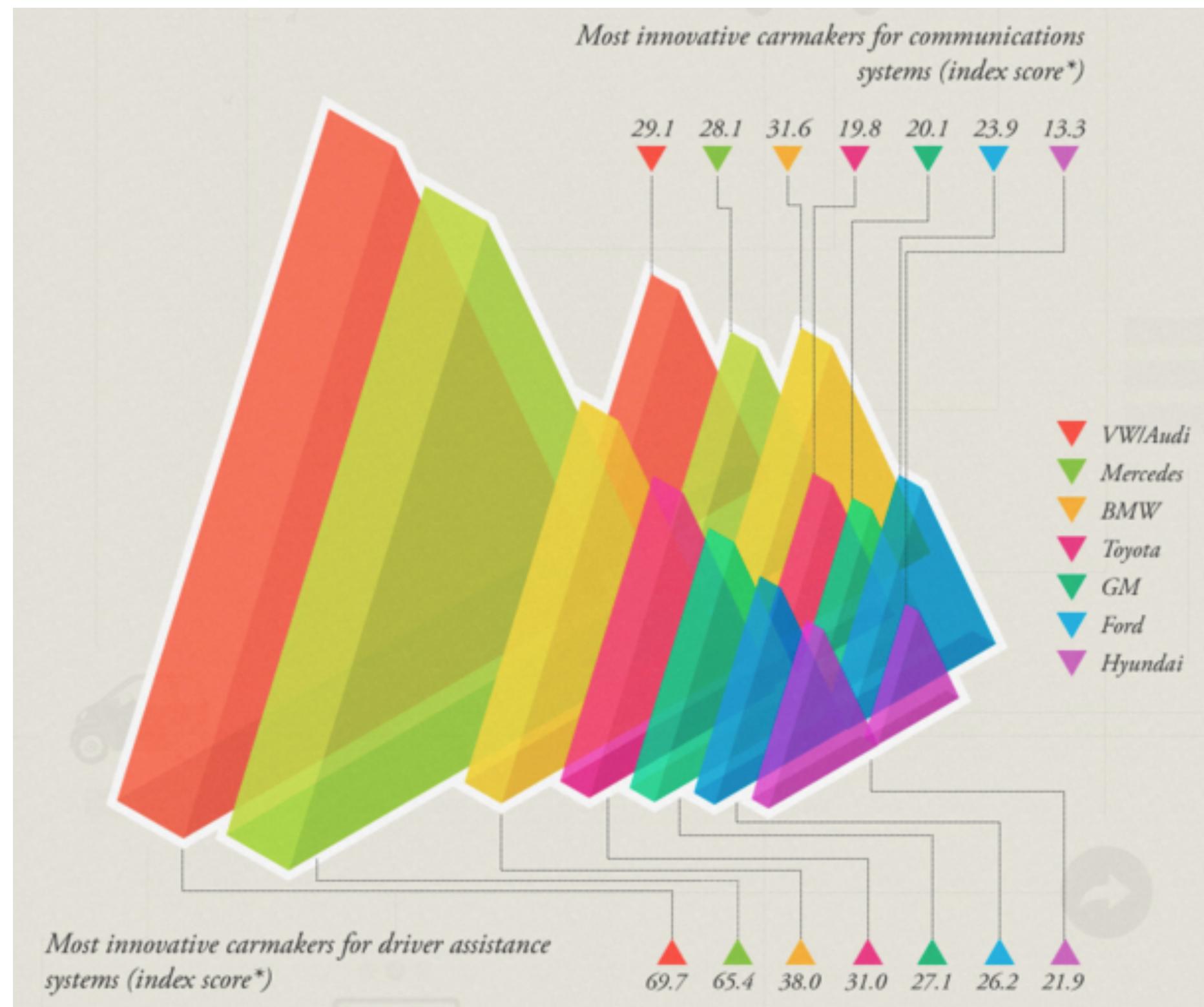


# **Rules of Thumbs**

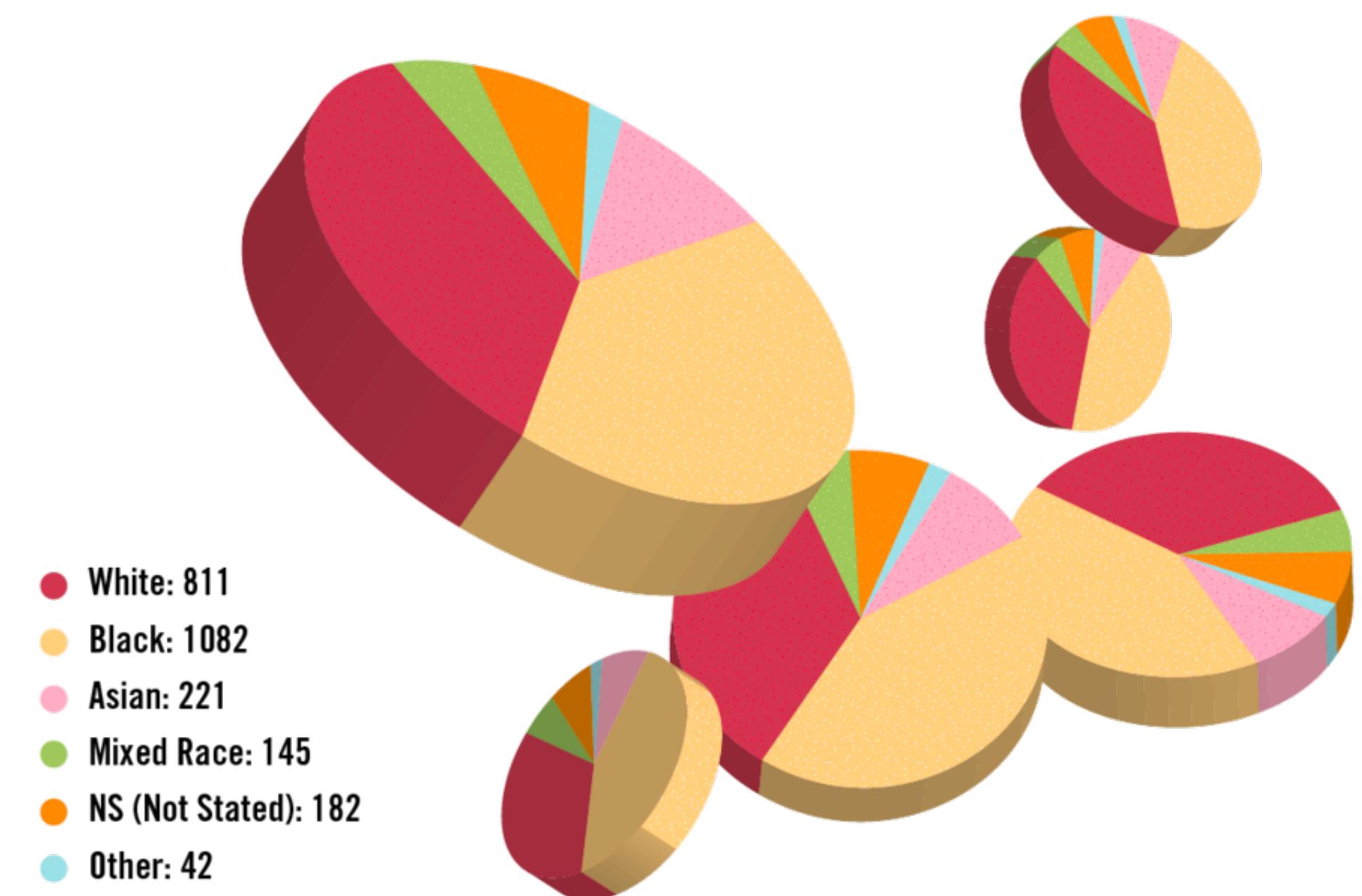
# Rules of Thumb Summary

- No unjustified 3D
- No unjustified 2D
- Eyes beat memory
- Resolution over immersion
- Overview first, zoom and filter, details on demand
- Responsiveness is required
- Function first, form next

# Unjustified 3D all too common, in the news and elsewhere

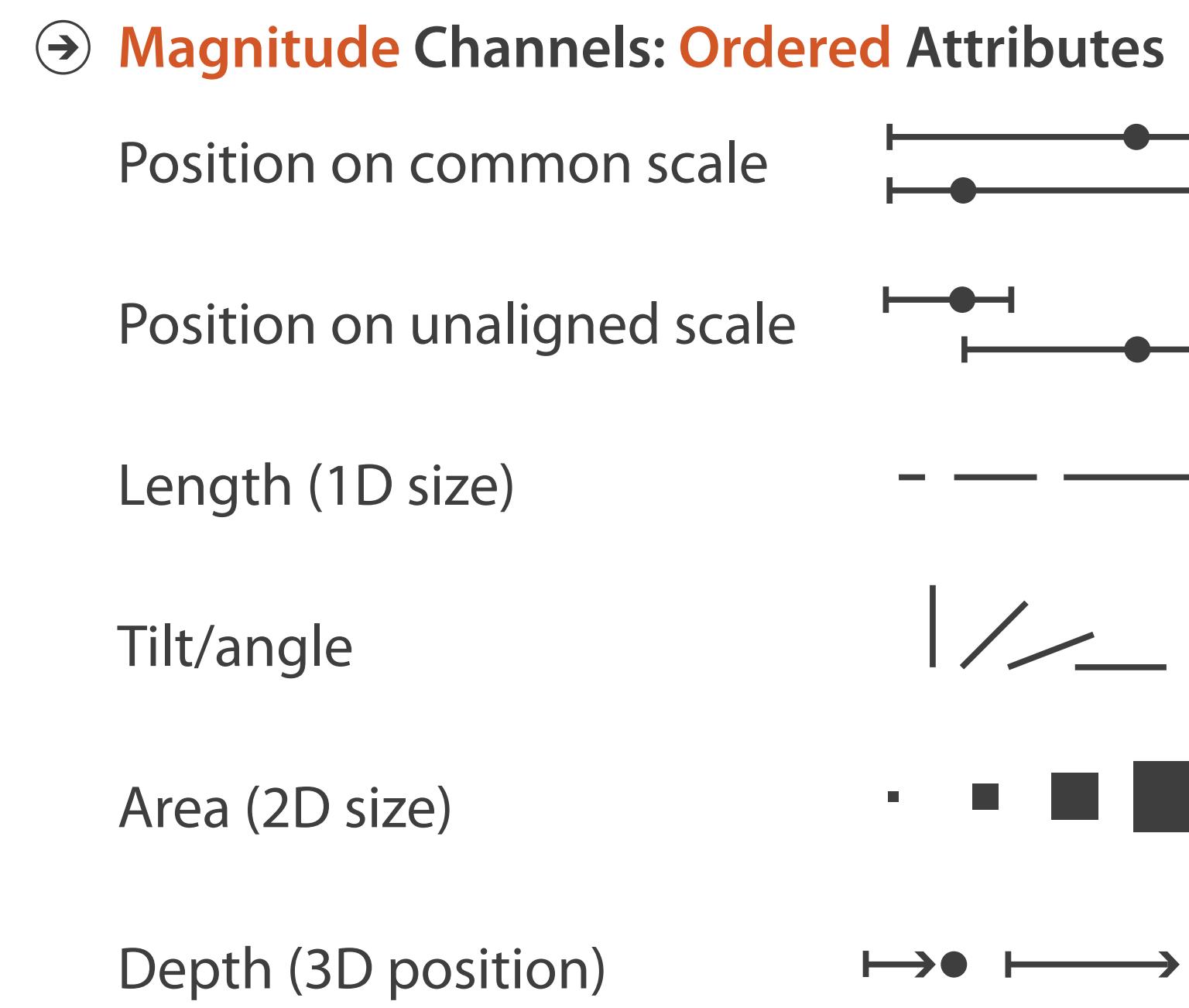


**Convictions in London for class A drug supply.**

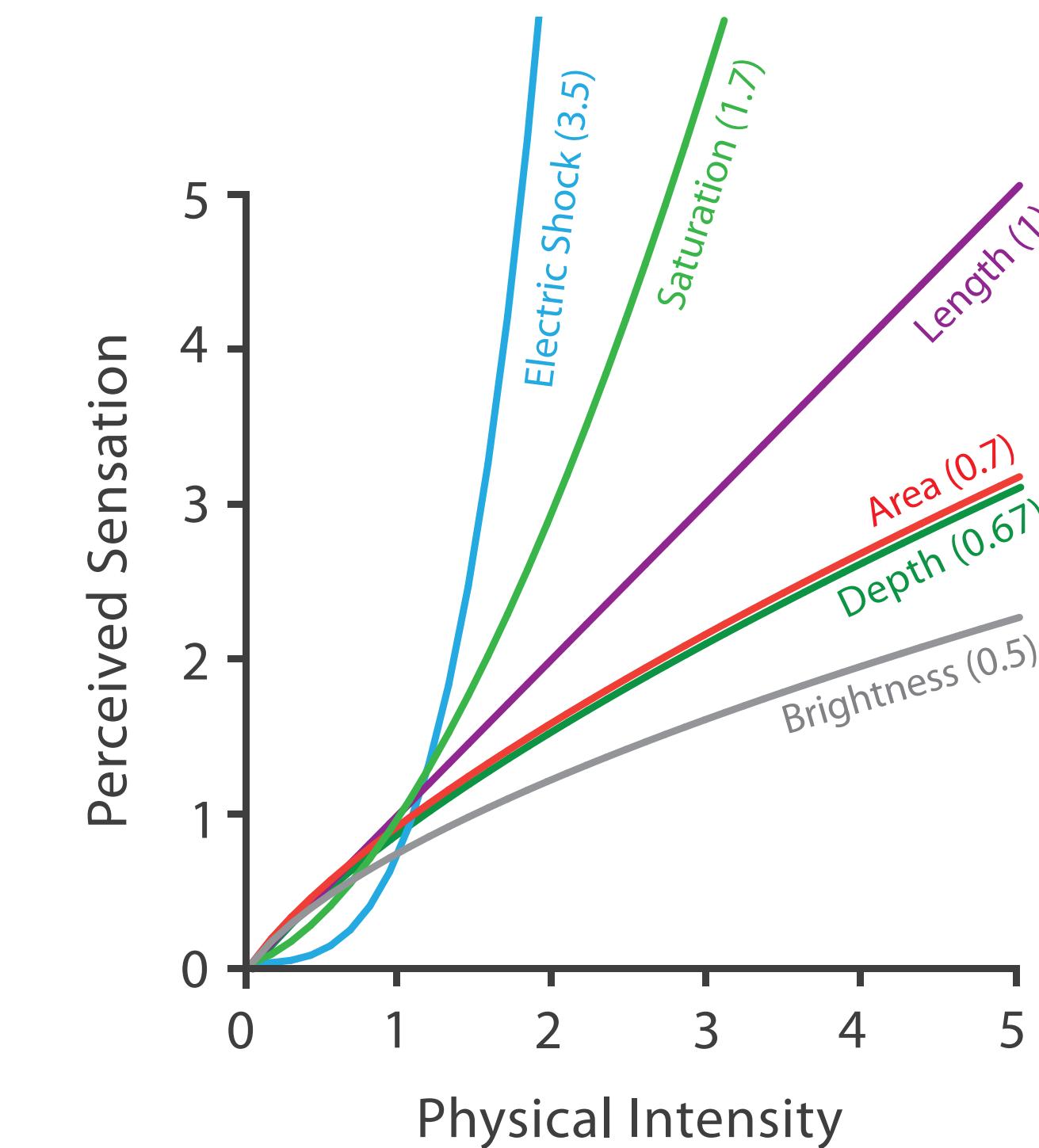


# Depth vs power of the plane

- high-ranked spatial position channels: planar spatial position
  - not depth!

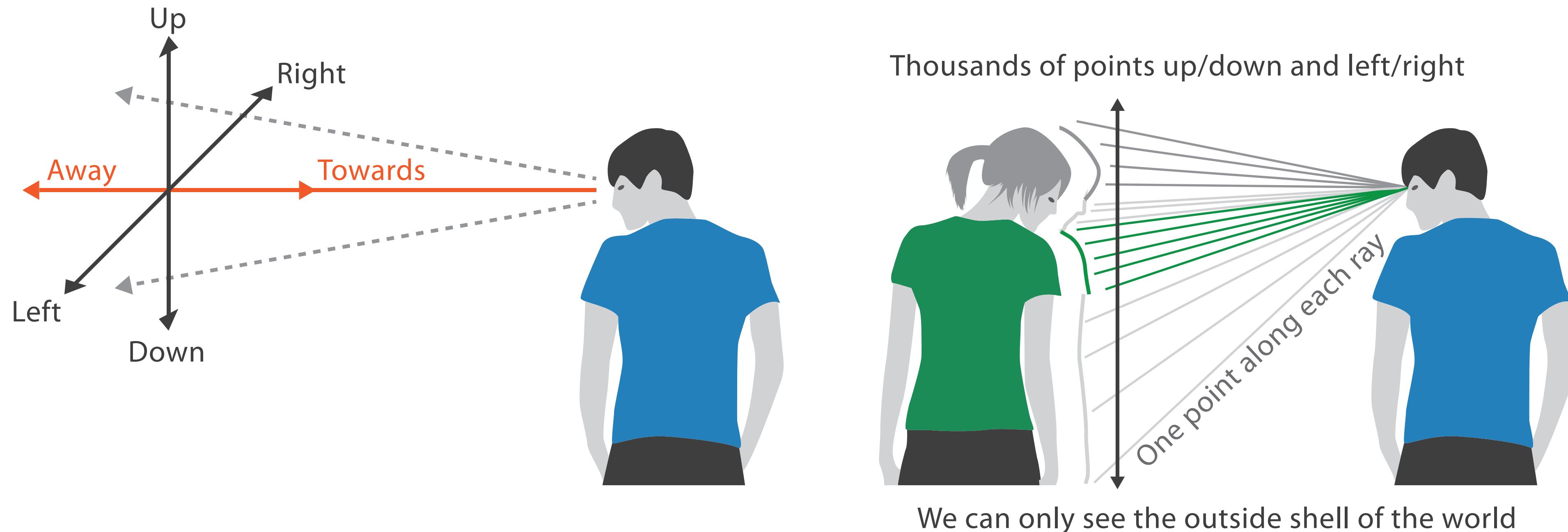


Steven's Psychophysical Power Law:  $S = I^n$



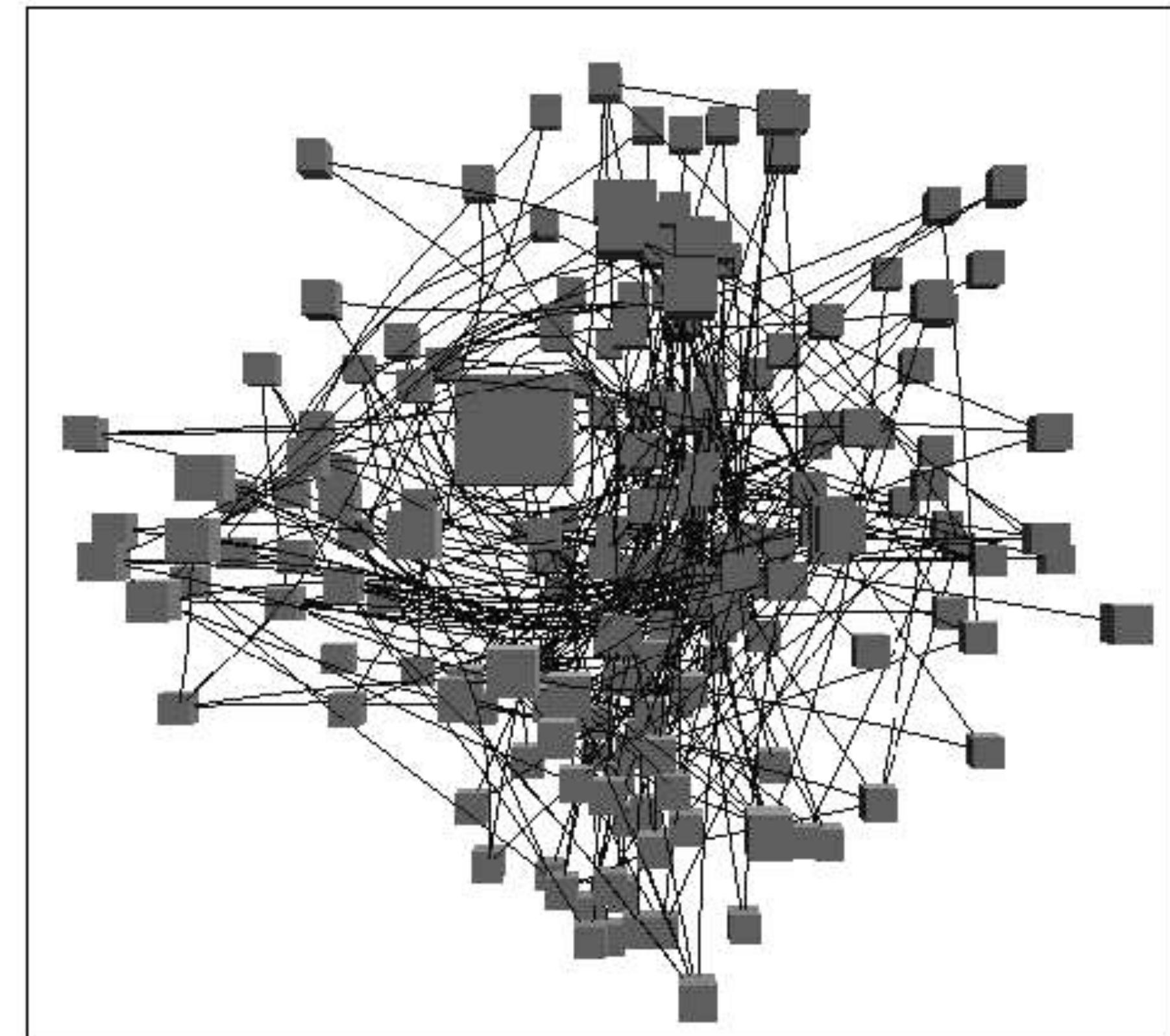
# No unjustified 3D: Danger of depth

- we don't really live in 3D: we see in 2.05D
  - acquire more info on image plane quickly from eye movements
  - acquire more info for depth slower, from head/body motion



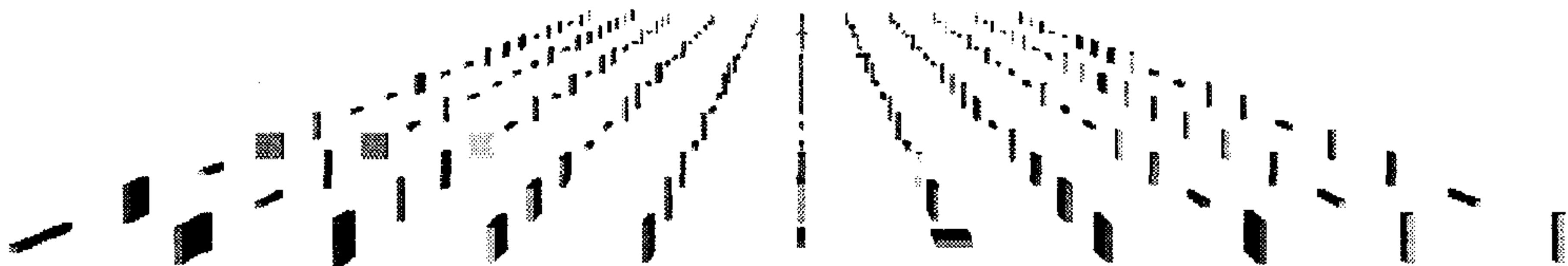
# Occlusion hides information

- occlusion
- interaction can resolve, but at cost of time and cognitive load



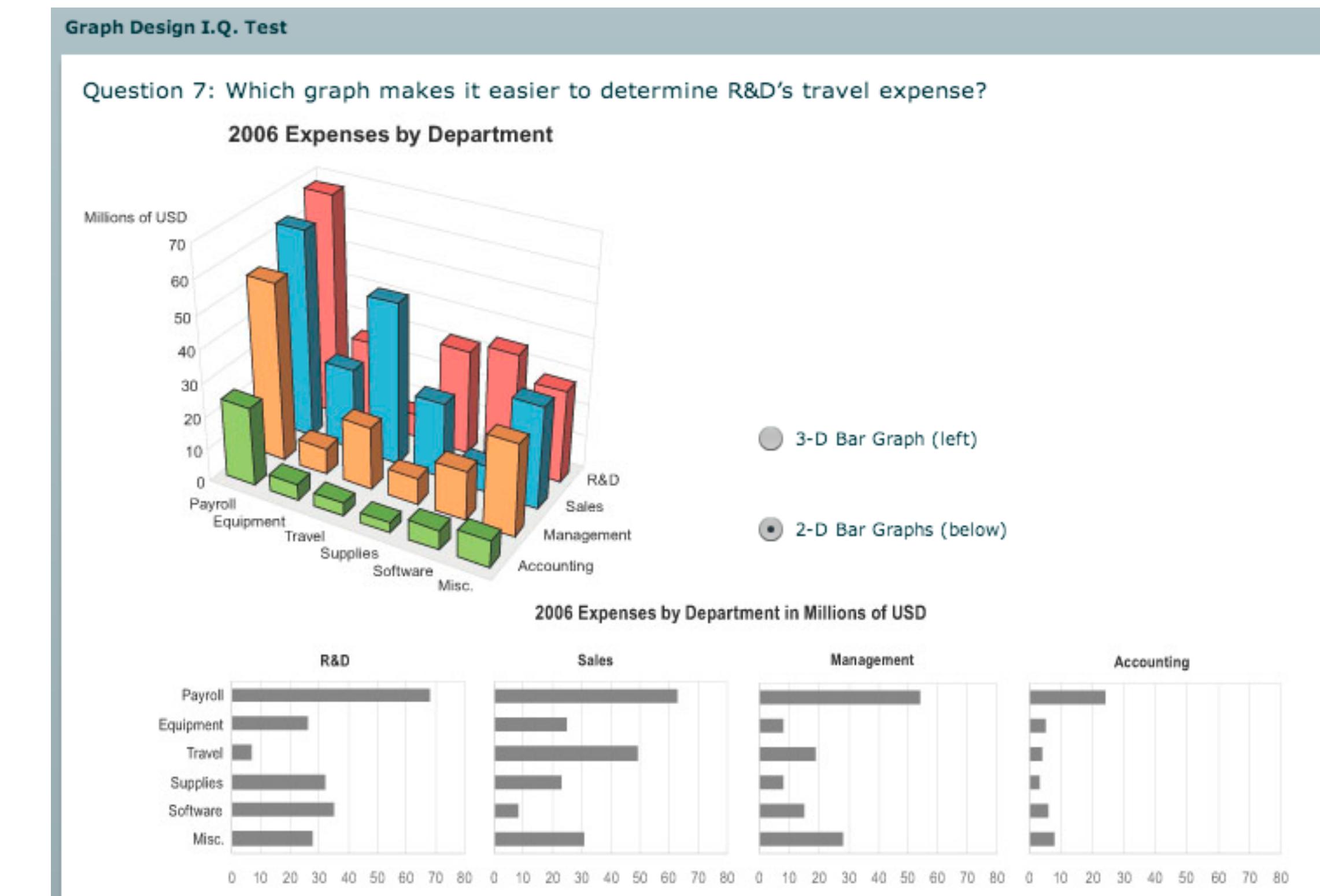
# Perspective distortion loses information

- perspective distortion
  - interferes with all size channel encodings
  - power of the plane is lost!



# 3D vs 2D bar charts

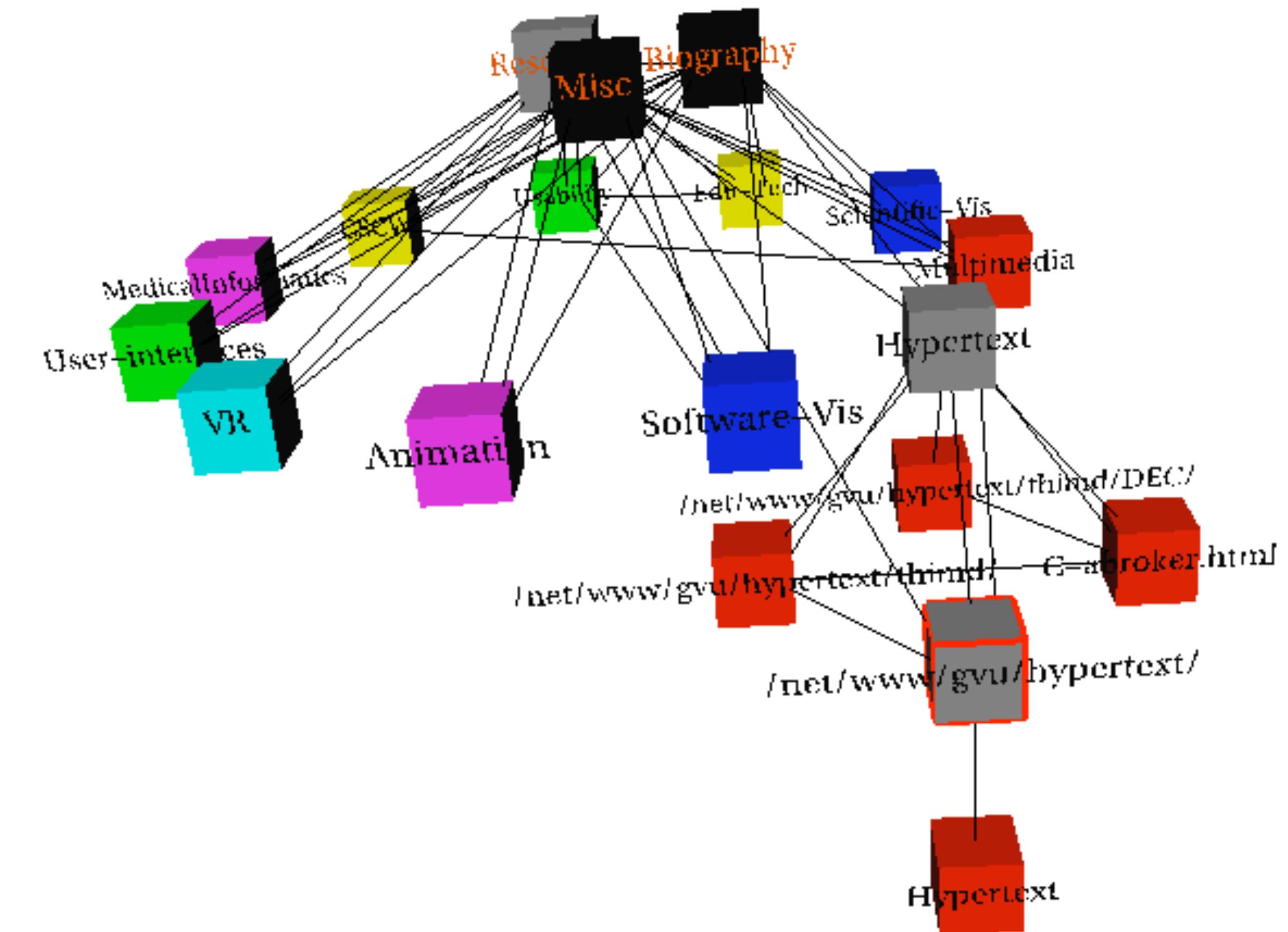
- 3D bars very difficult to justify!
  - perspective distortion
  - occlusion
- faceting into 2D almost always better choice



[<http://perceptualedge.com/files/GraphDesignIQ.html>]

# Tilted text isn't legible

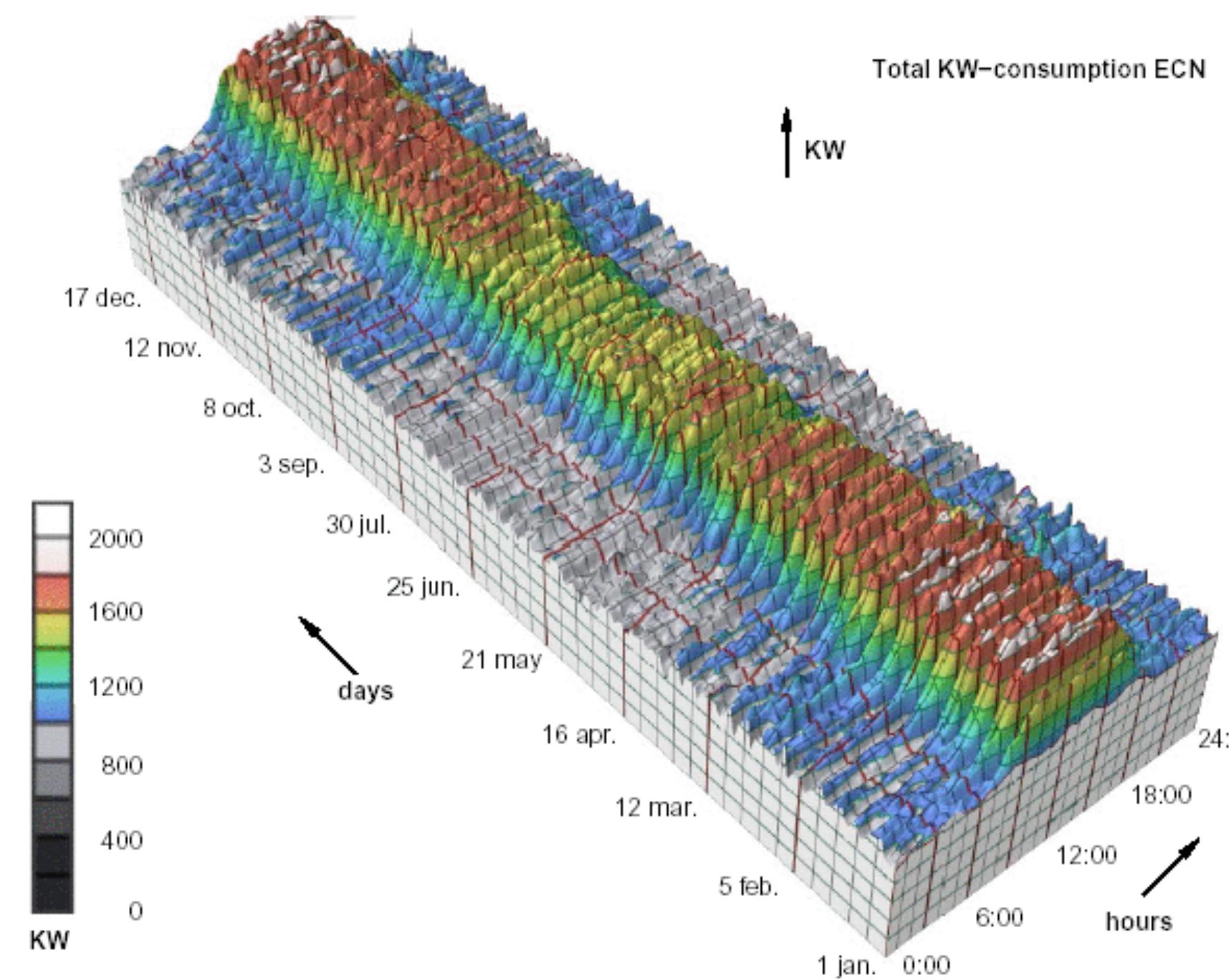
- text legibility
  - far worse when tilted from the image plane



[Visualizing the World-Wide Web with the Navigational View Builder. Mukherjea and Foley. Computer Networks and ISDN Systems, 1995.]

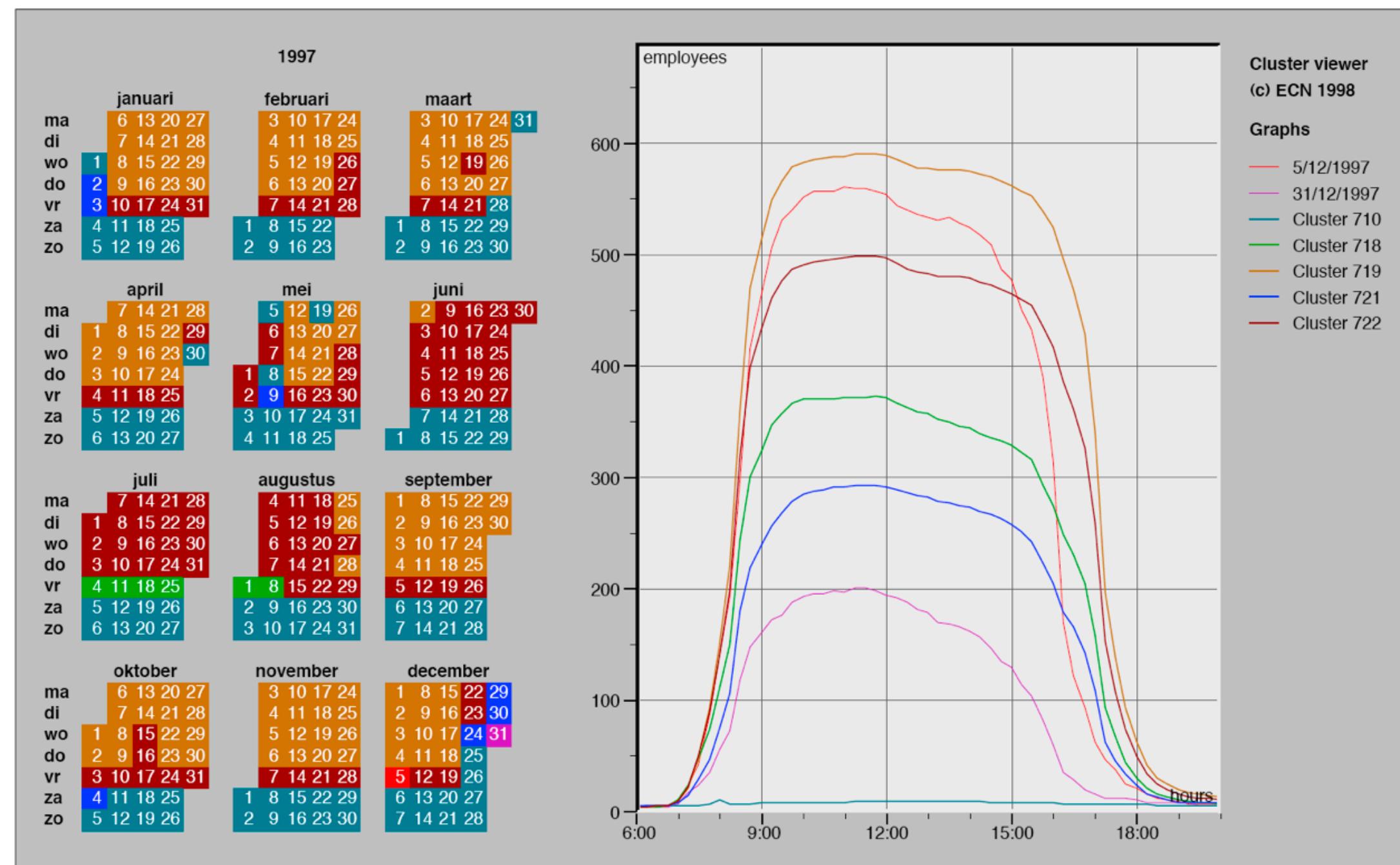
# No unjustified 3D example: Time-series data

- extruded curves: detailed comparisons impossible



# No unjustified 3D example: Transform for new data abstraction

- derived data: cluster hierarchy
- juxtapose multiple views: calendar, superimposed 2D curves



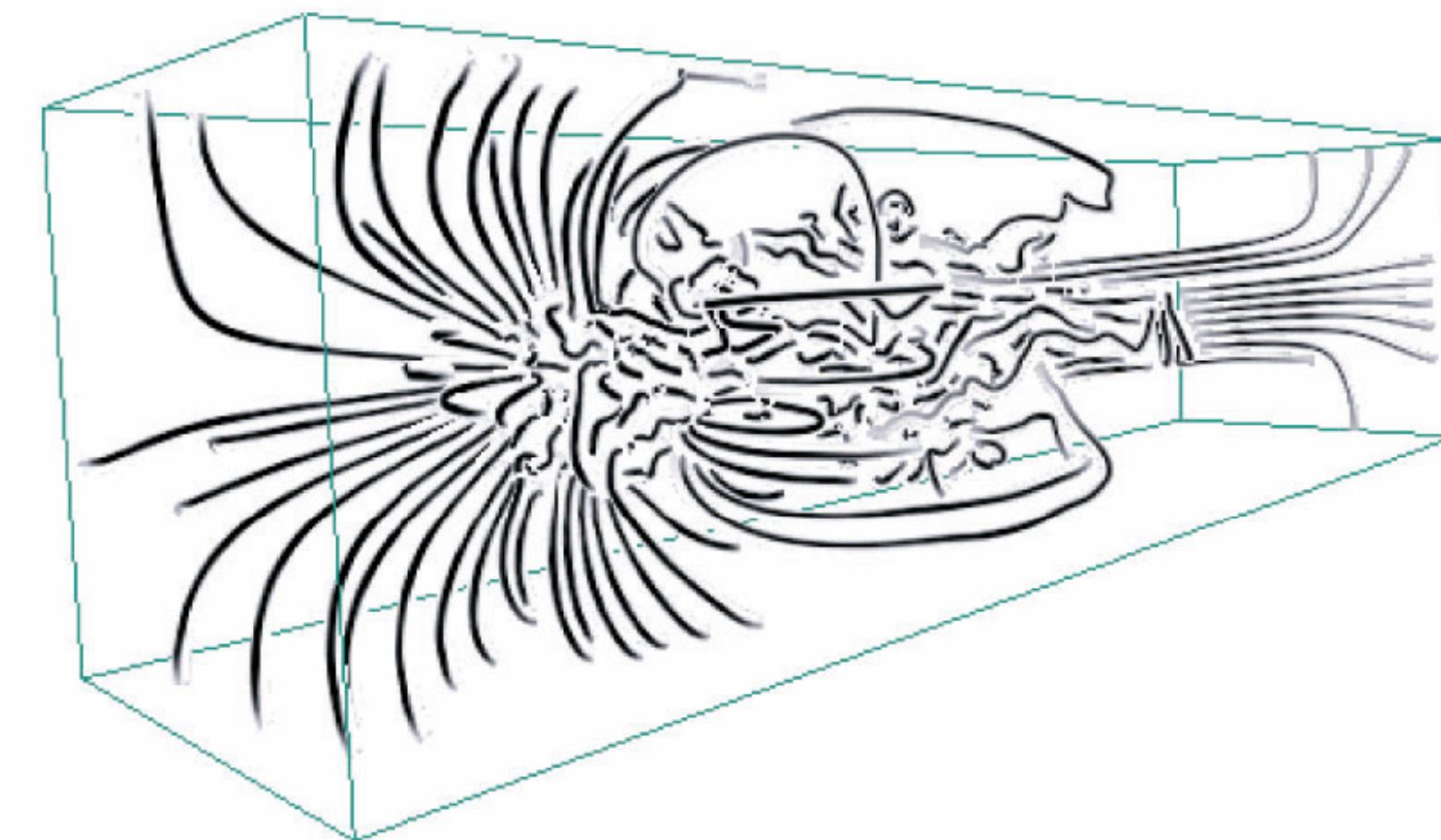
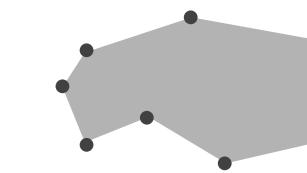
# Justified 3D: shape perception

- benefits outweigh costs when task is shape perception for 3D spatial data
- interactive navigation supports synthesis across many viewpoints

Targets

→ Spatial Data

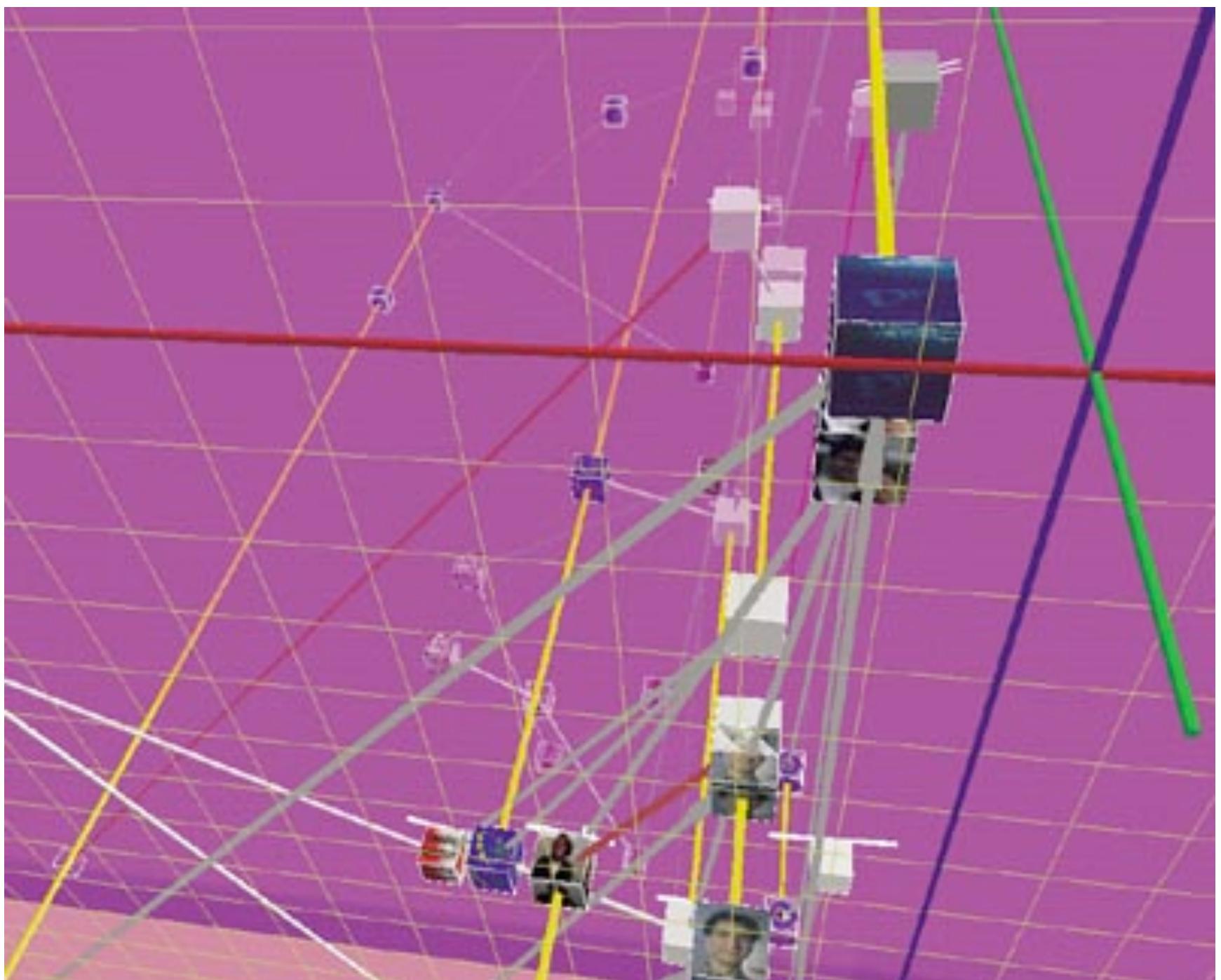
→ Shape



[Image-Based Streamline Generation and Rendering. Li and Shen. IEEE Trans. Visualization and Computer Graphics (TVCG) 13:3 (2007), 630–640.]

# No unjustified 3D

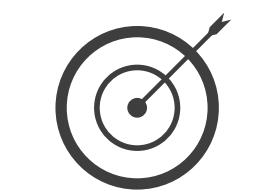
- 3D legitimate for true 3D spatial data
- 3D needs very careful justification for abstract data
  - enthusiasm in 1990s, but now skepticism
  - be especially careful with 3D for point clouds or networks



[WEBPATH-a three dimensional Web history. Frecon and Smith. Proc. InfoVis 1999]

# No unjustified 2D

- consider whether network data requires 2D spatial layout
  - especially if reading text is central to task!
  - arranging as network means lower information density and harder label lookup compared to text lists
- benefits outweigh costs when topological structure/context important for task
  - be especially careful for search results, document collections, ontologies

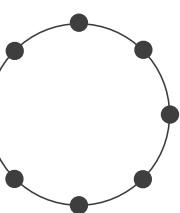
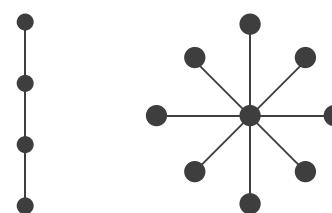
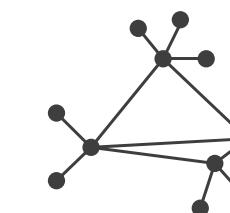


Targets

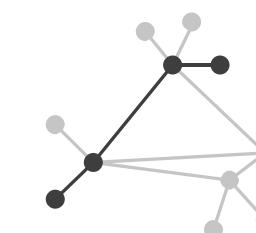


Network Data

→ Topology



→ Paths



# Eyes beat memory

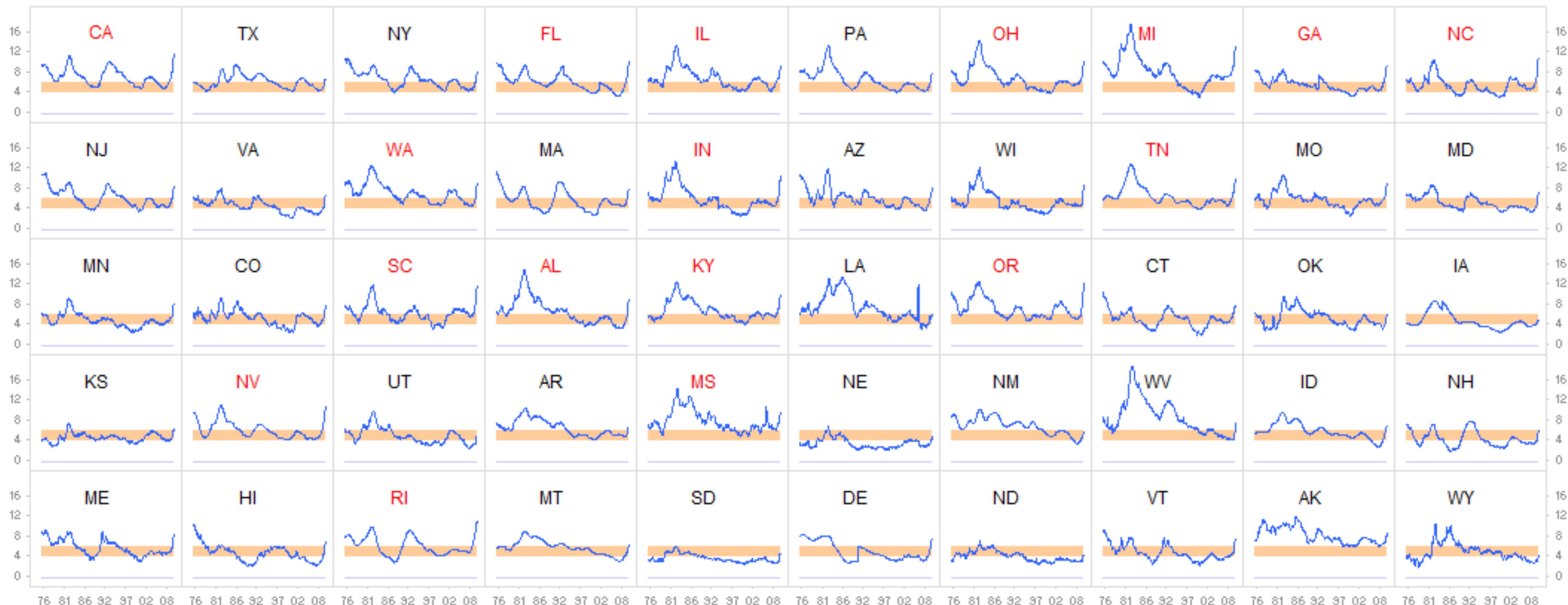
- principle: external cognition vs. internal memory
  - easy to compare by moving eyes between side-by-side views
  - harder to compare visible item to memory of what you saw
- implications for animation
  - great for choreographed storytelling
  - great for transitions between two states
  - poor for many states with changes everywhere
    - consider small multiples instead



# Eyes beat memory example: Cerebral

- small multiples: one graph instance per experimental condition
  - same spatial layout
  - color differently, by condition

## Monthly Unemployment Rates by State, Jan 1976 - Apr 2009



Source: Bureau of Labor Statistics

Notes: The orange band denotes a "normal" unemployment rate (4%-6%);

State code in red: unemployment rate in April 2009 is higher than the US average

# Kepler's Tally of Planets

NASA's Kepler mission has discovered more than 1,000 confirmed planets orbiting distant stars. Planets with known sizes and orbits are shown below, including Kepler 452b, a planet in the habitable zone of its star. [Related Article »](#)

Relative size of planets

• Earth • Neptune • Jupiter

Relative size of Mercury's orbit

• Sun

Stars and planets are enlarged for visibility.

Relative size of stars

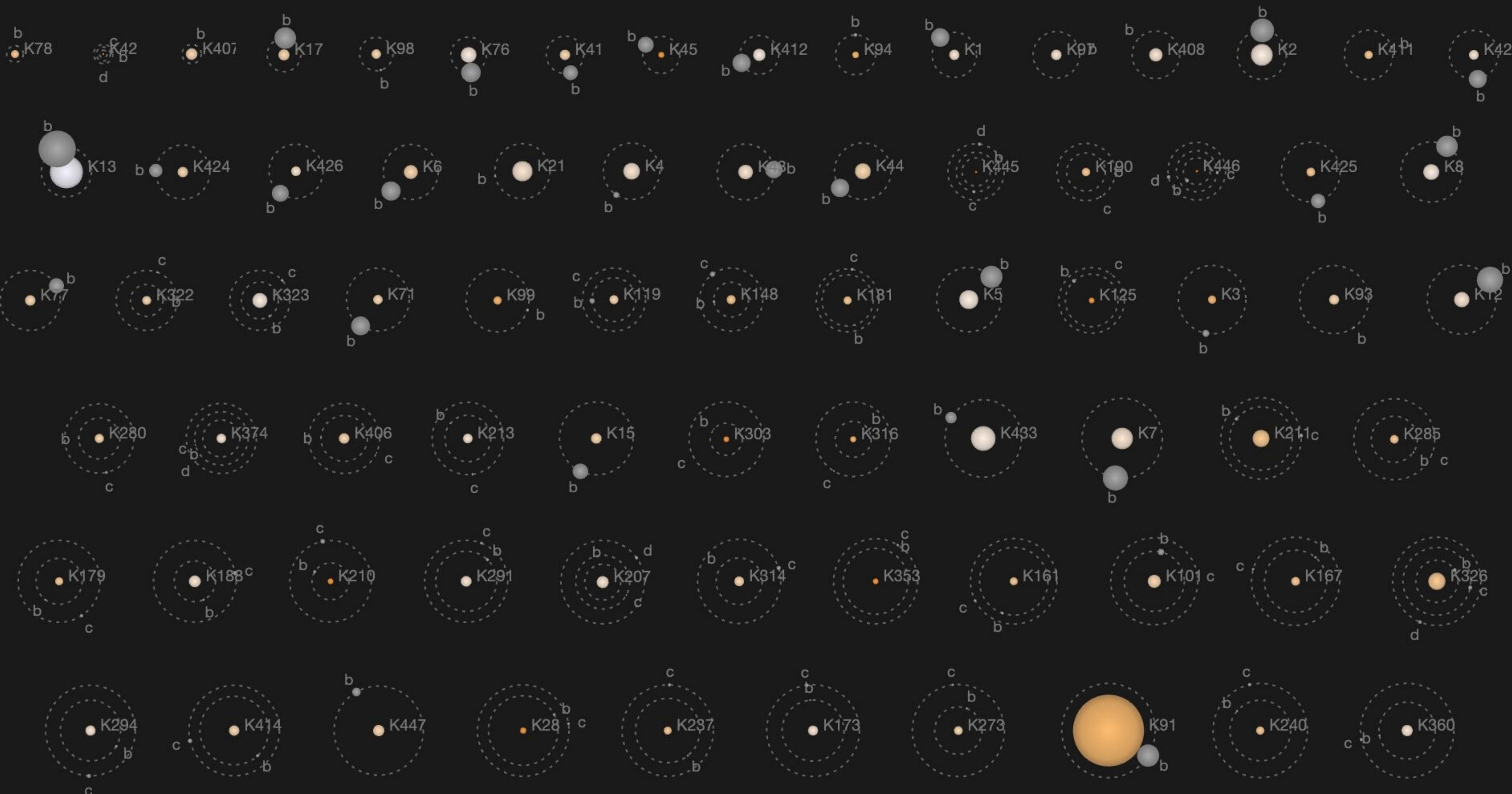
• Sun • 2 times • 3 times as wide

Star temperature

6,500° • 16,000° F

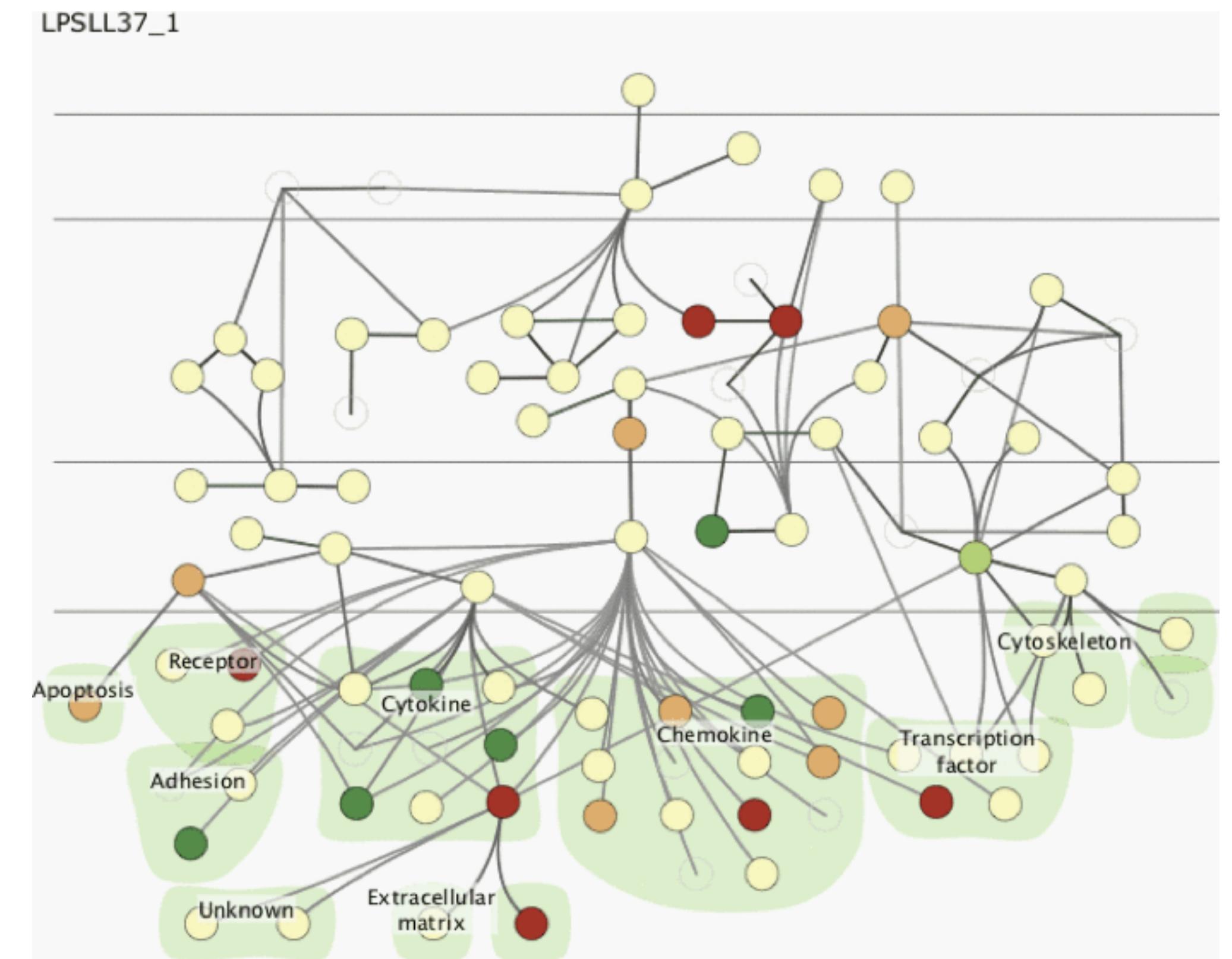
Sort by system size

Sort by order of discovery



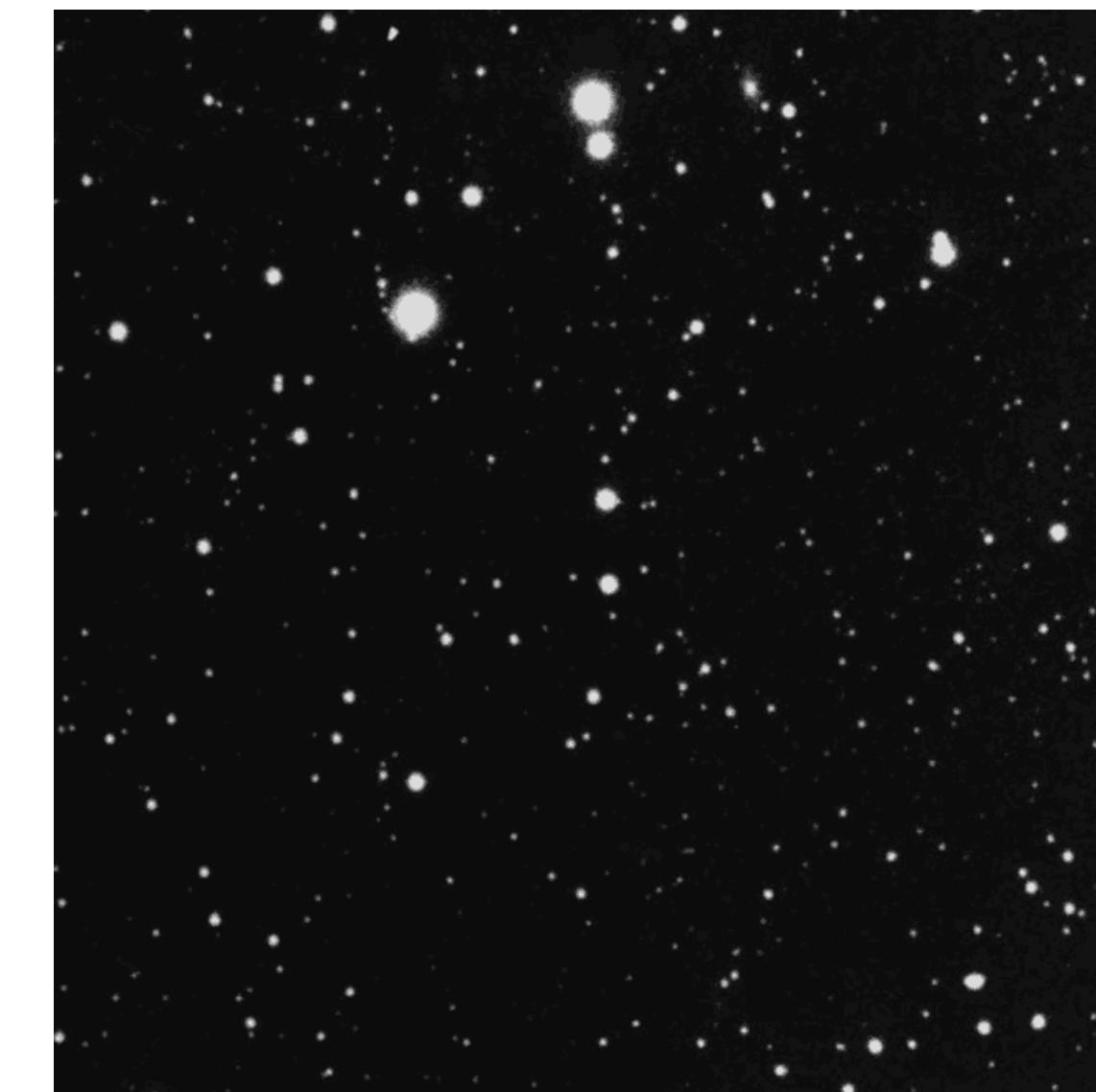
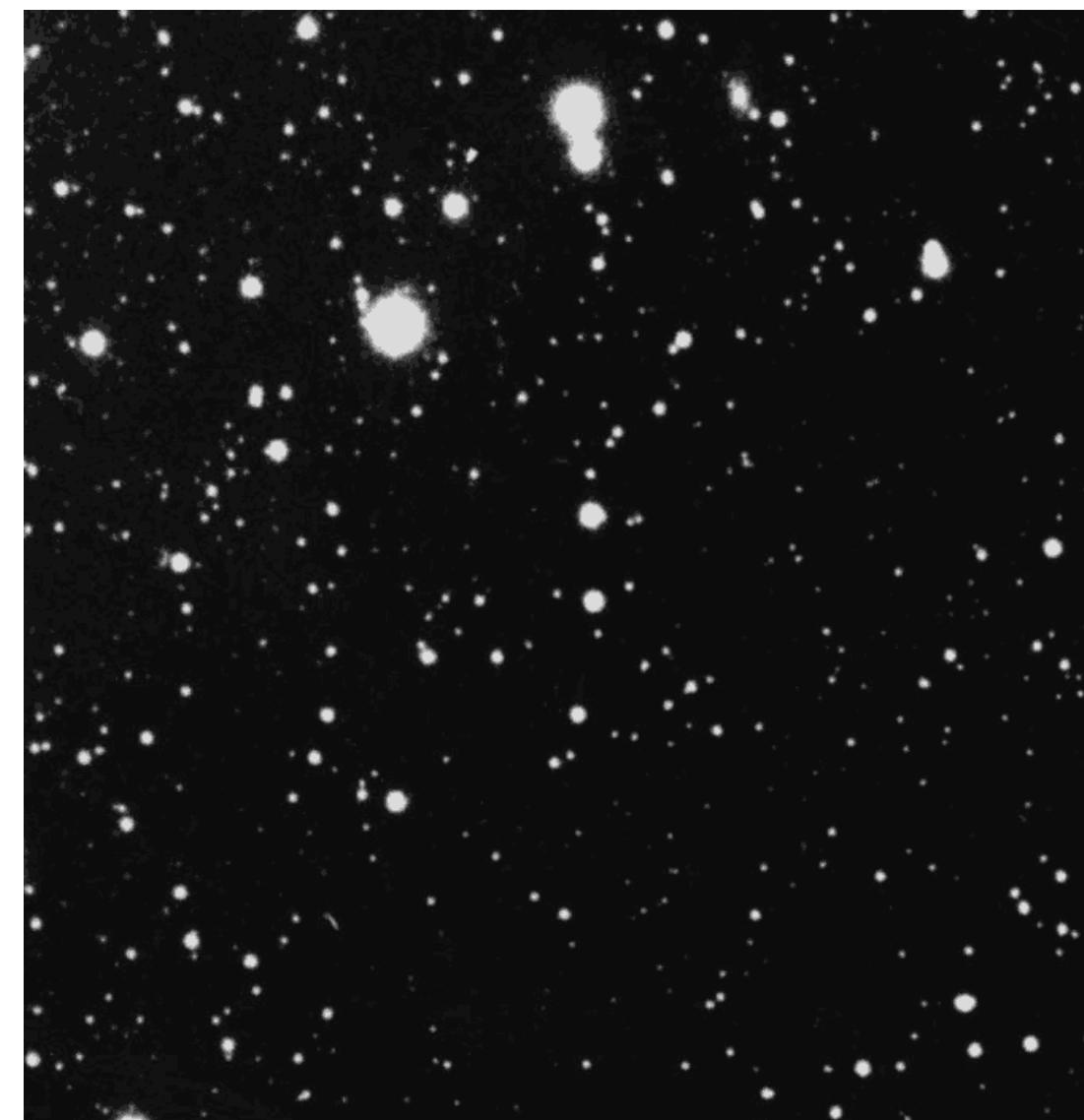
# Why not animation?

- disparate frames and regions:  
comparison difficult
  - vs contiguous frames
  - vs small region
  - vs coherent motion of group
- safe special case
  - animated transitions



# Animation: Blink comparator

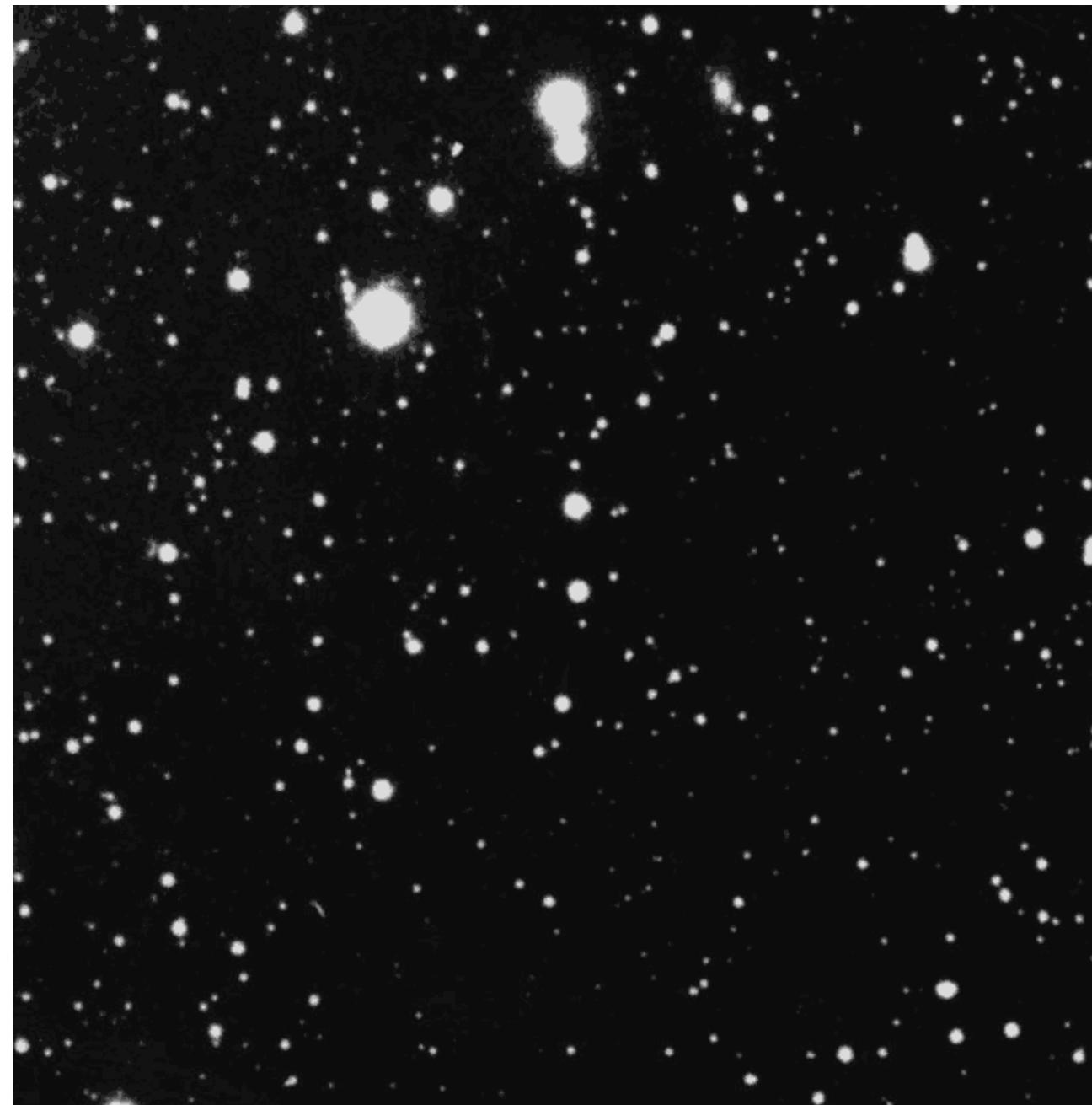
- just two contiguous frames is a special case: animation beats side by side
  - blink comparator used to discover Pluto



side by side

# Animation: Blink comparator

- just two contiguous frames is a special case: animation is great!
  - blink comparator used to discover Pluto



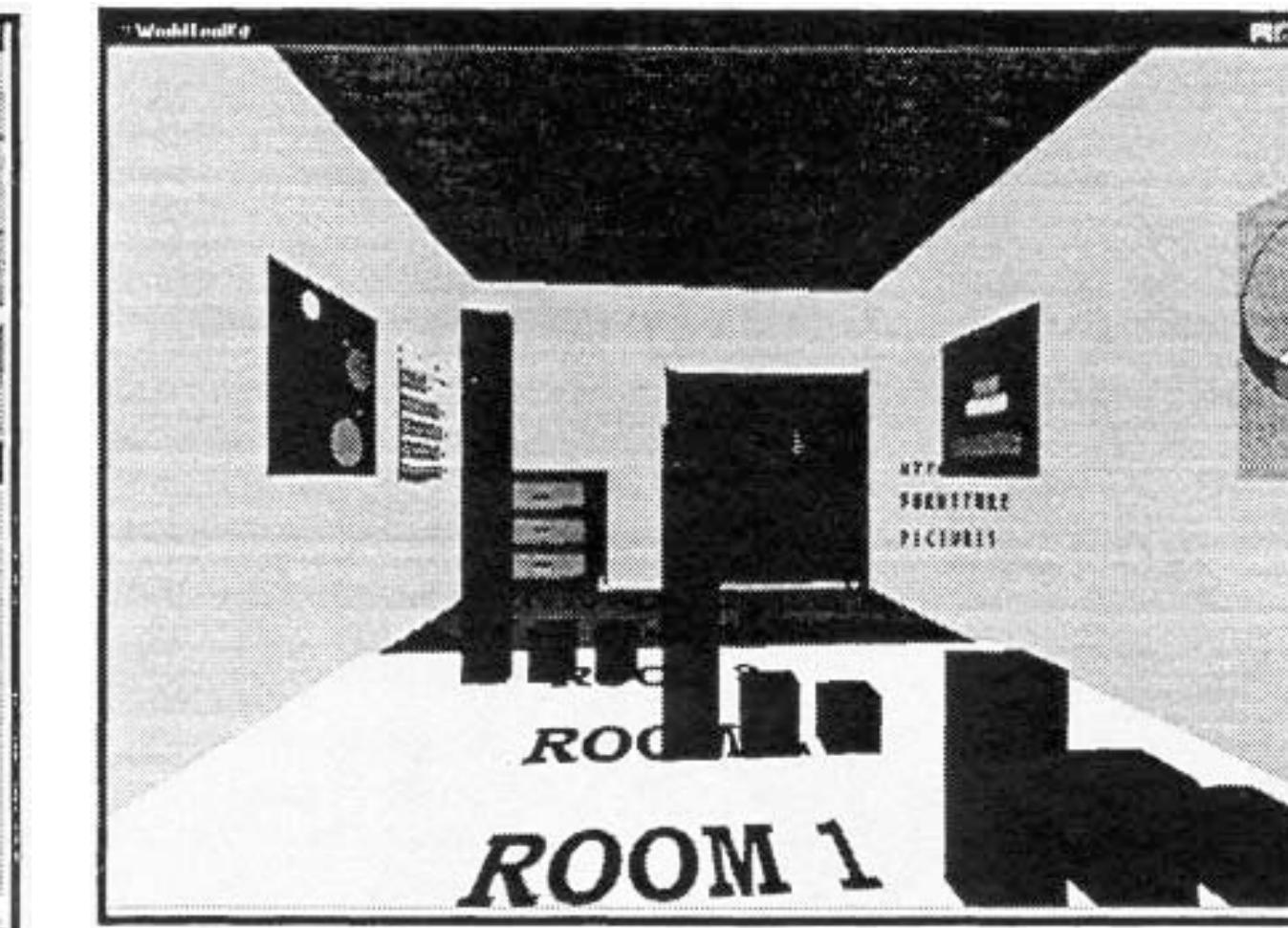
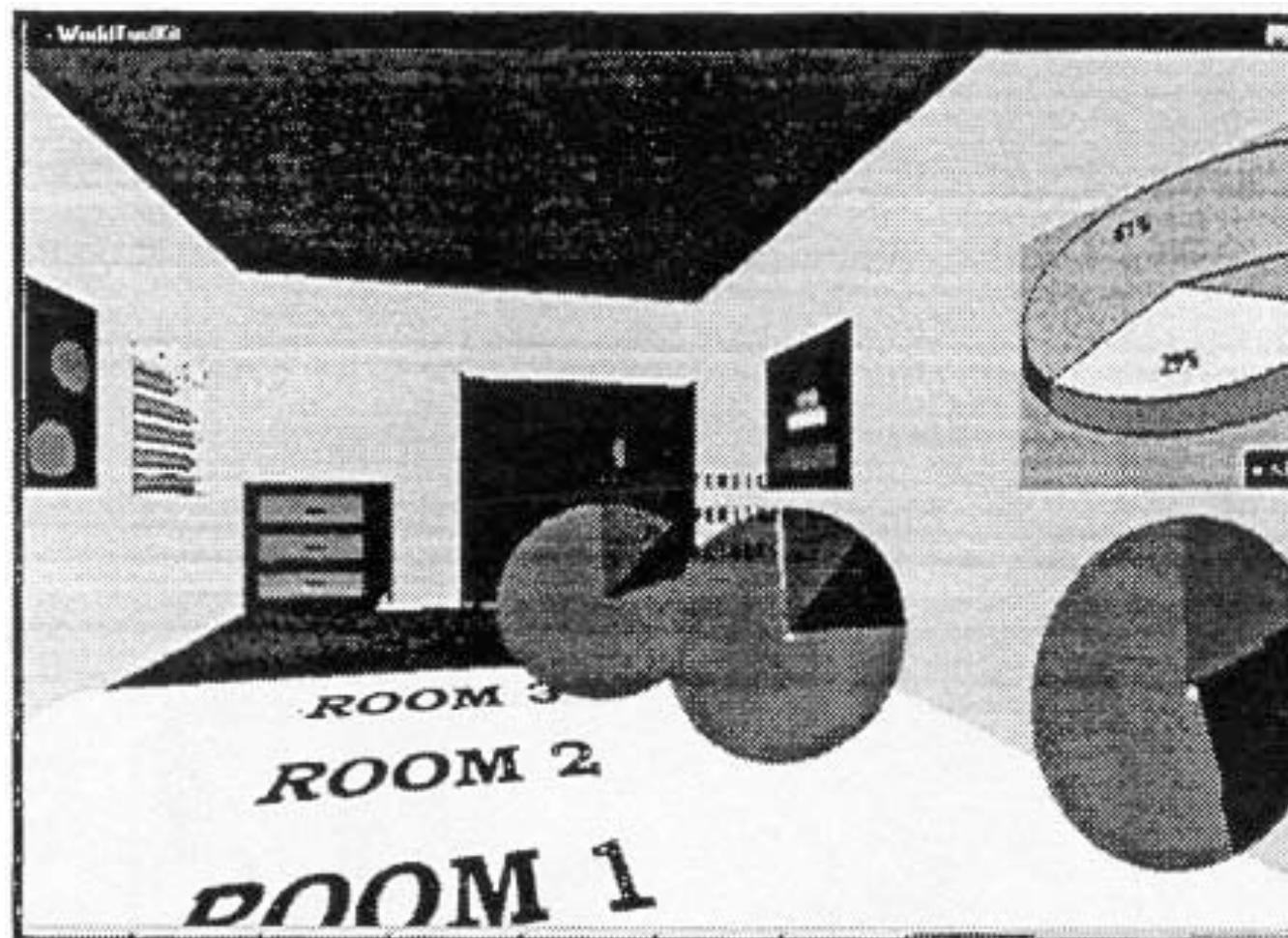
animated

# Change blindness

- if attention is directed elsewhere, even drastic changes not noticeable
  - remember door experiment?
  - change blindness demos
    - mask in between images  
[https://youtu.be/bh\\_9XFzbWV8](https://youtu.be/bh_9XFzbWV8)

# Resolution beats immersion

- immersion typically not helpful for abstract data
  - do not need sense of presence or stereoscopic 3D
  - desktop also better for workflow integration
- resolution much more important: pixels are the scarcest resource
- virtual reality for abstract data difficult to justify thus far
  - but stay tuned with second wave, AR (augmented reality) has more promise

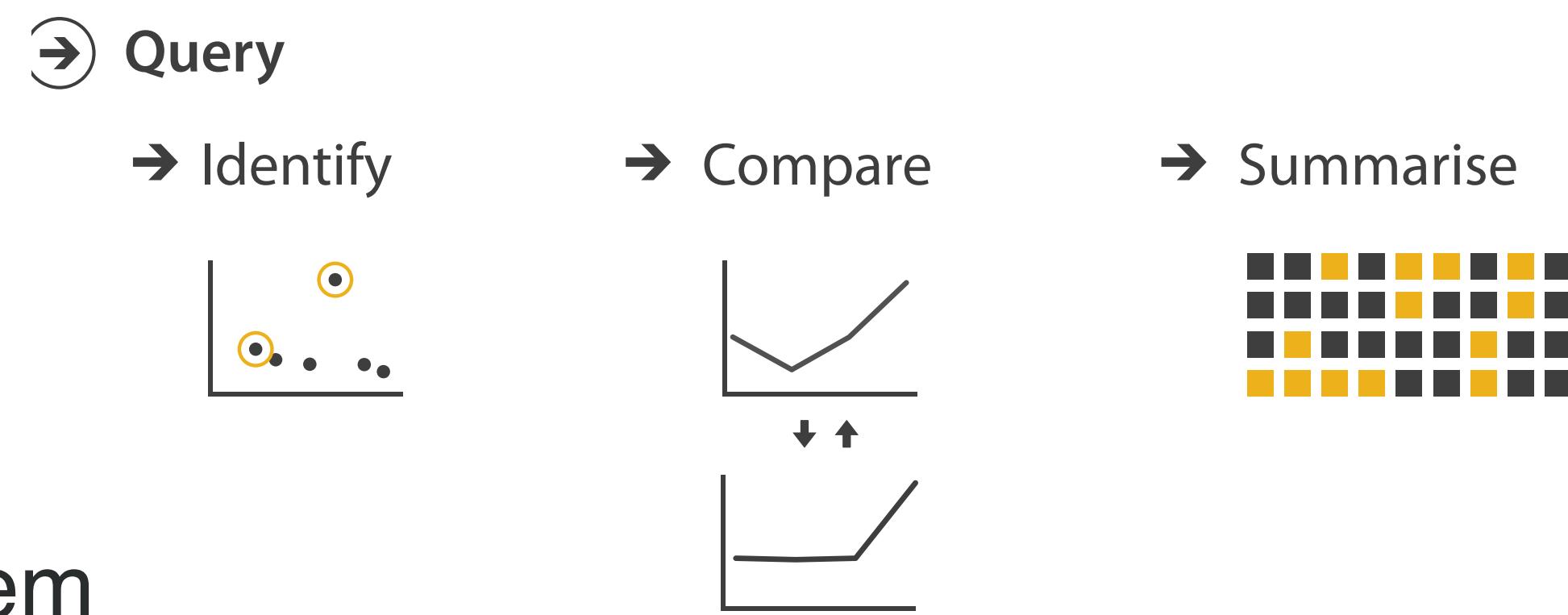


[Development of an information visualization tool using virtual reality. Kirner and Martins. Proc. Symp. Applied Computing 2000]

# Overview first, zoom and filter, details on demand

- influential mantra from Shneiderman

- overview = summary
  - microcosm of full vis design problem



# Rule of thumb: Responsiveness is required

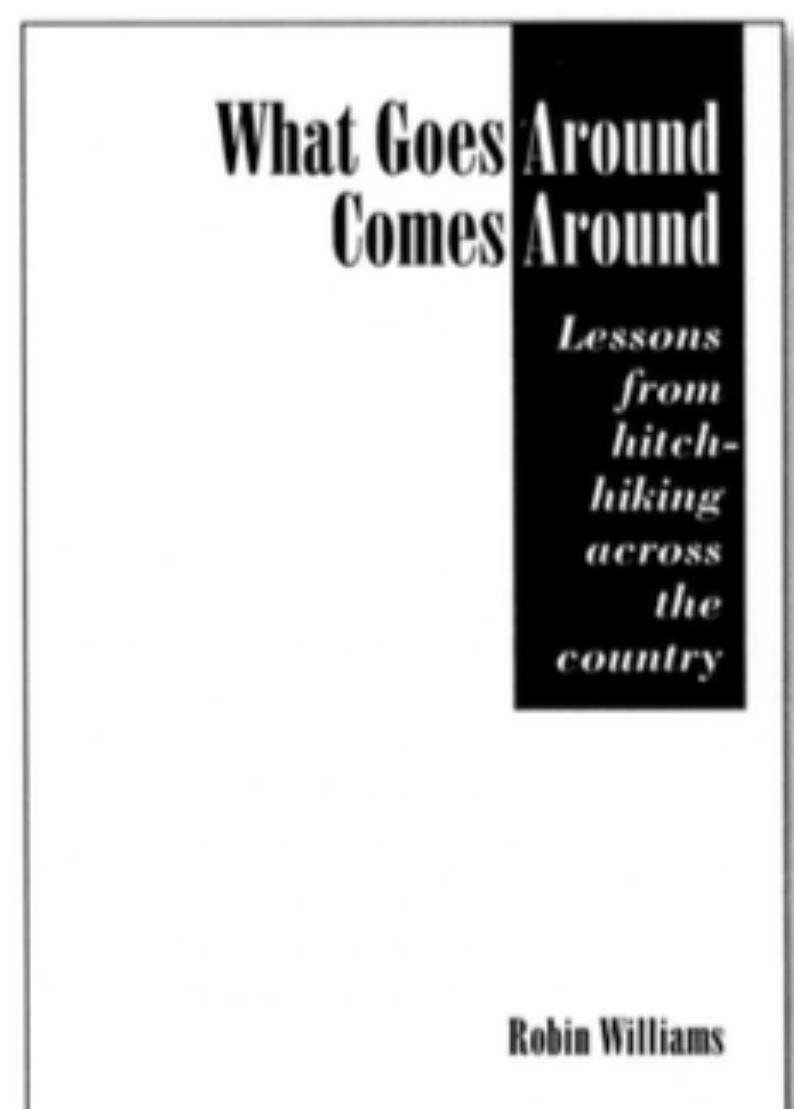
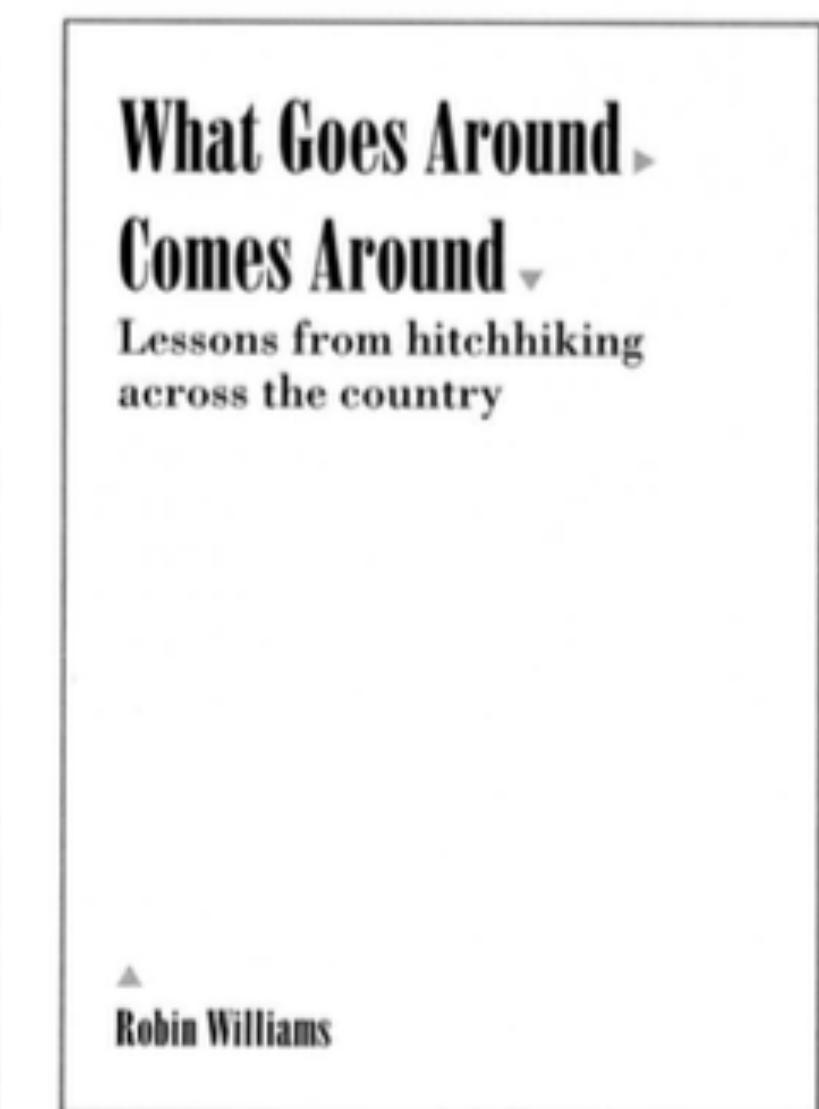
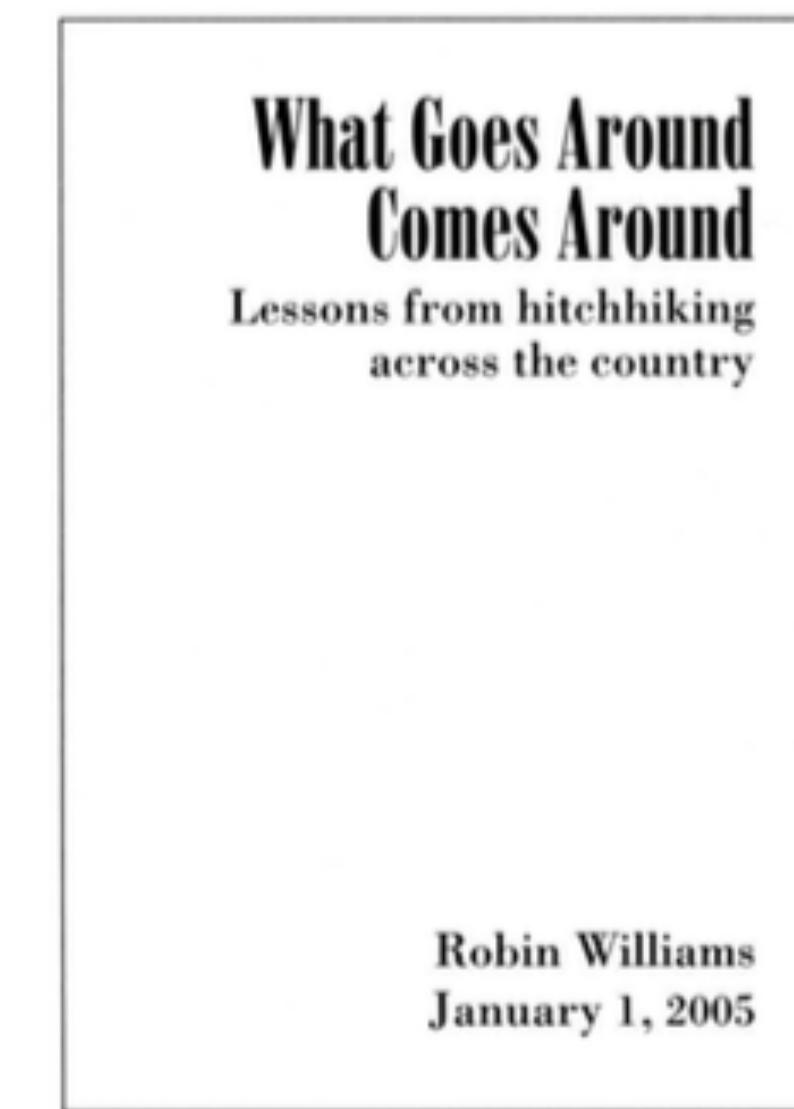
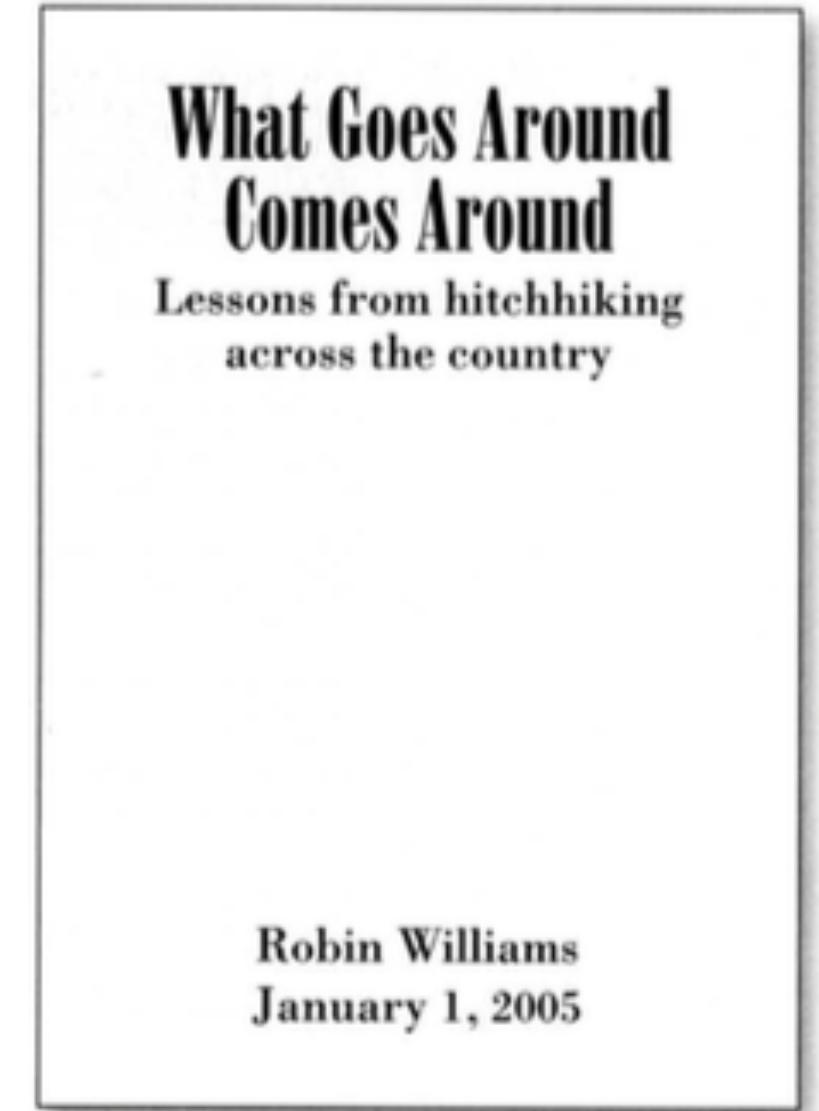
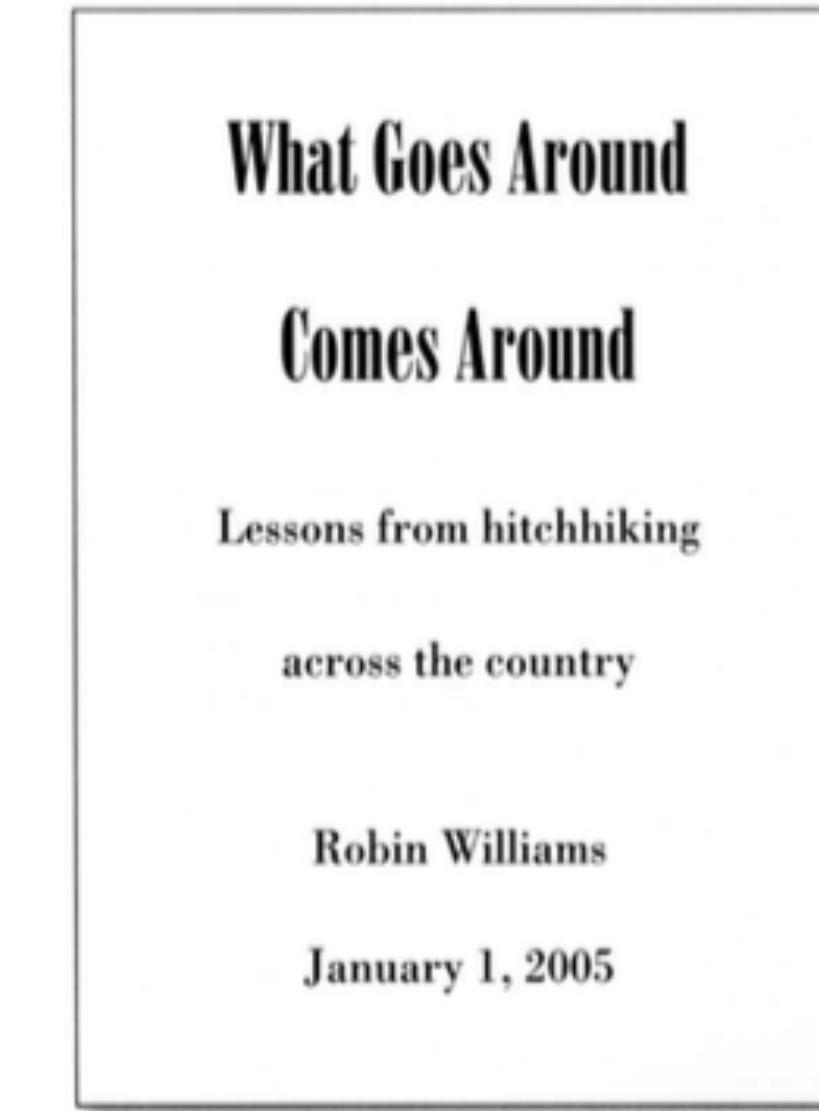
- visual feedback: three rough categories
  - 0.1 seconds: perceptual processing
    - subsecond response for mouseover highlighting - ballistic motion
  - 1 second: immediate response
    - fast response after mouseclick, button press - Fitts' Law limits on motor control
  - 10 seconds: brief tasks
    - bounded response after dialog box - mental model of heavyweight operation (file load)
- scalability considerations
  - highlight selection without complete redraw of view (graphics frontbuffer)
  - show hourglass for multi-second operations (check for cancel/undo)
  - show progress bar for long operations (process in background thread)
  - rendering speed when item count is large (guaranteed frame rate)

# Function first, form next

- start with focus on functionality
  - possible to improve aesthetics later on, as refinement
  - if no expertise in-house, find good graphic designer to work with
  - aesthetics do matter: another level of function
    - visual hierarchy, alignment, flow
    - Gestalt principles in action
      - (not covered in this class)
- dangerous to start with aesthetics
  - usually impossible to add function retroactively

# Form: Basic graphic design ideas

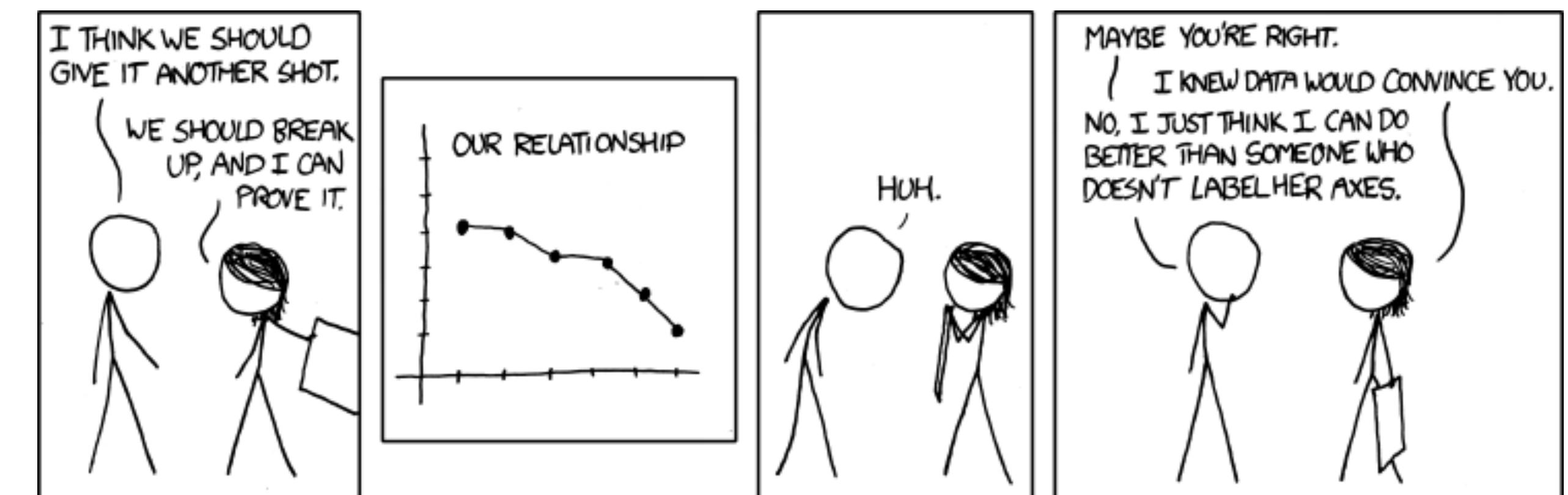
- proximity
  - do group related items together
  - avoid equal whitespace between unrelated
- alignment
  - do find/make strong line, stick to it
  - avoid automatic centering
- repetition
  - do unify by pushing existing consistencies
- contrast
  - if not identical, then very different
  - avoid not quite the same



# Best practices: Labelling

- make visualizations as self-documenting as possible
  - meaningful & useful title, labels, legends
    - axes and panes/subwindows should have labels
      - and axes should have good min/max boundary tick marks
    - everything that's plotted should have a legend
      - and own header/labels if not redundant with main title
    - use reasonable numerical format
      - avoid scientific notation in most cases

[<https://xkcd.com/833/>]



# Rules of Thumb Summary

- No unjustified 3D
  - Power of the plane
  - Disparity of depth
  - Occlusion hides information
  - Perspective distortion dangers
  - Tilted text isn't legible
- No unjustified 2D
- Eyes beat memory
- Resolution over immersion
- Overview first, zoom and filter, details on demand
- Responsiveness is required
- Function first, form next

# **Reading Material**

**[dv3] Chapter 6 - Rules of Thumbs**

# Questions?

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