

Ch 6: Rules of Thumb

Paper: Artery Vis

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CPSC 547, Information Visualization

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<http://www.cs.ubc.ca/~tmm/courses/547-15>

News

- marks out for Tue (Q4)
 - avg 90, min 63, max 100
 - clear trend of improvement, nice job!
- correction on Strahler numbers
 - colored by tree traversal order, not Strahler number
 - thanks to Mike for spotting the bug!

VAD Ch 6: Rules of Thumb

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

- **(Get it right in black and white)**

No unjustified 3D: Power of the plane

- high-ranked spatial position channels: **planar** spatial position

– not depth!

➔ **Magnitude** Channels: **Ordered** Attributes

Position on common scale



Position on unaligned scale



Length (1D size)



Tilt/angle



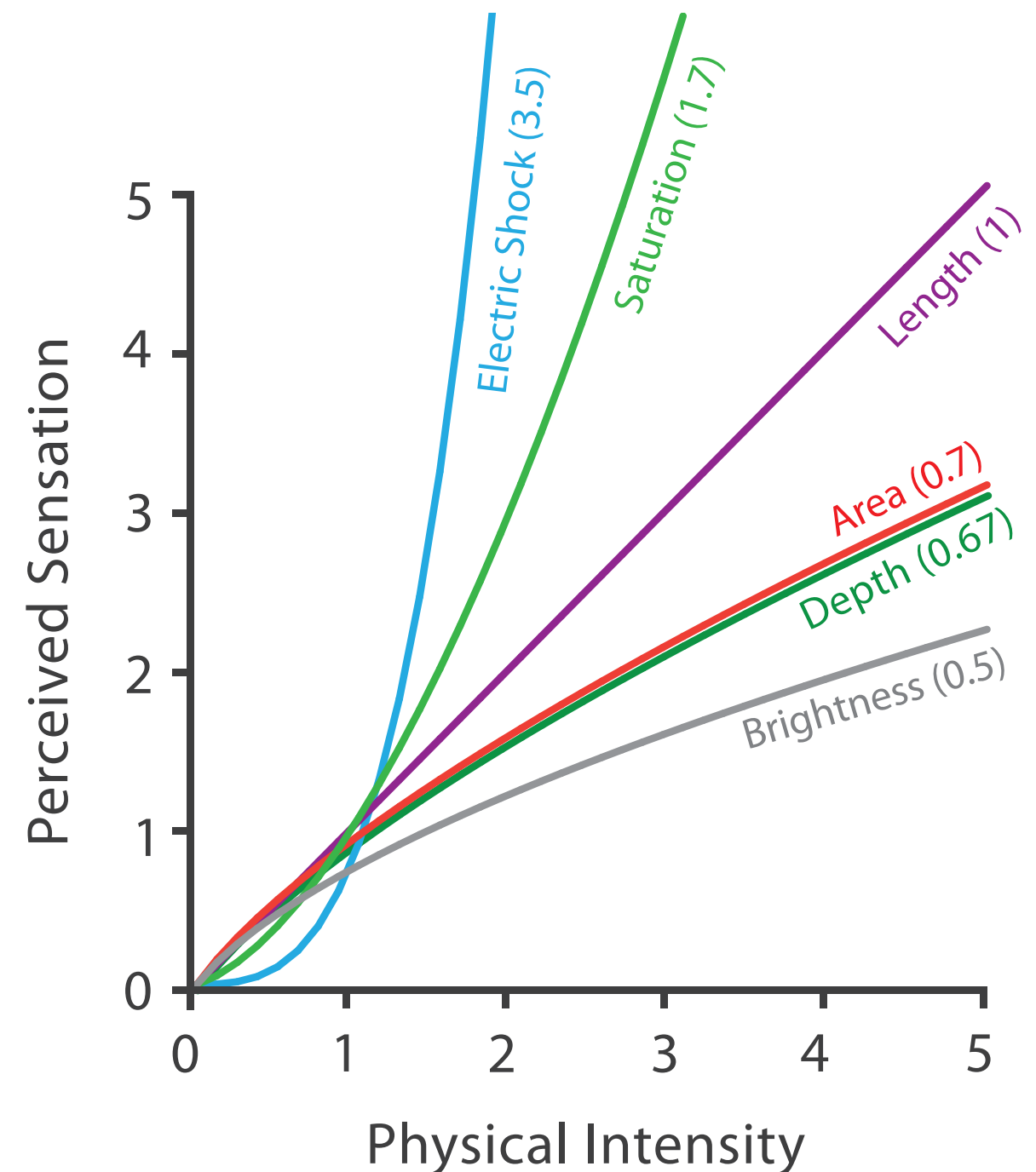
Area (2D size)



Depth (3D position)

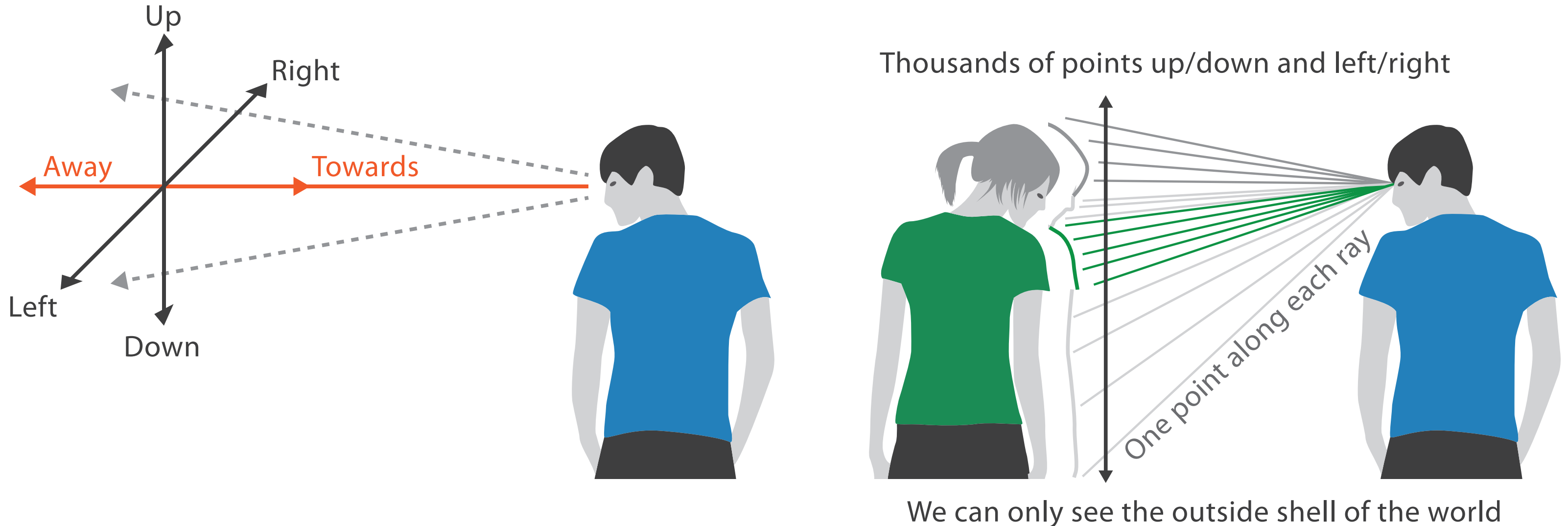


Steven's Psychophysical Power Law: $S = I^N$



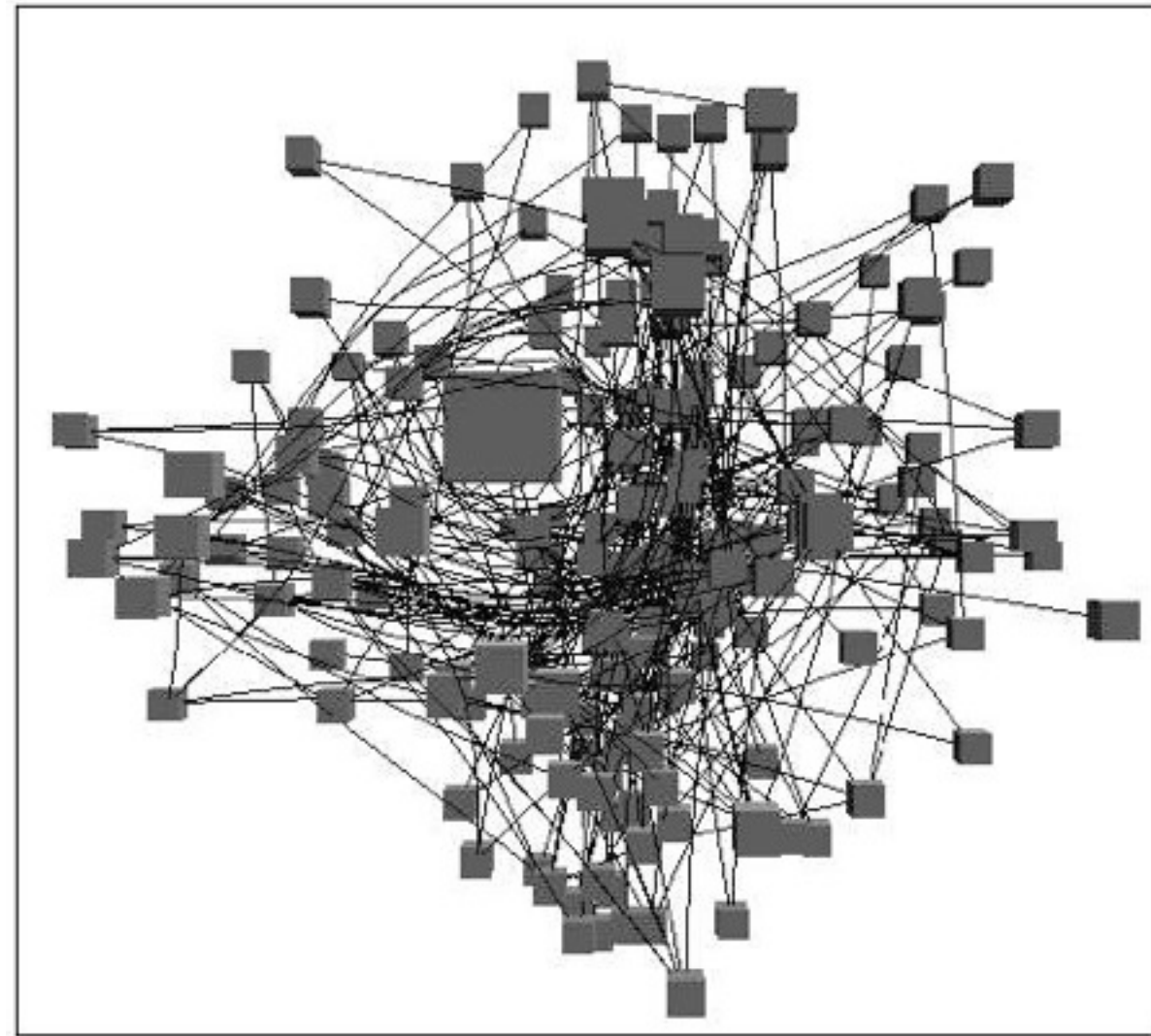
No unjustified 3D: Danger of depth

- 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

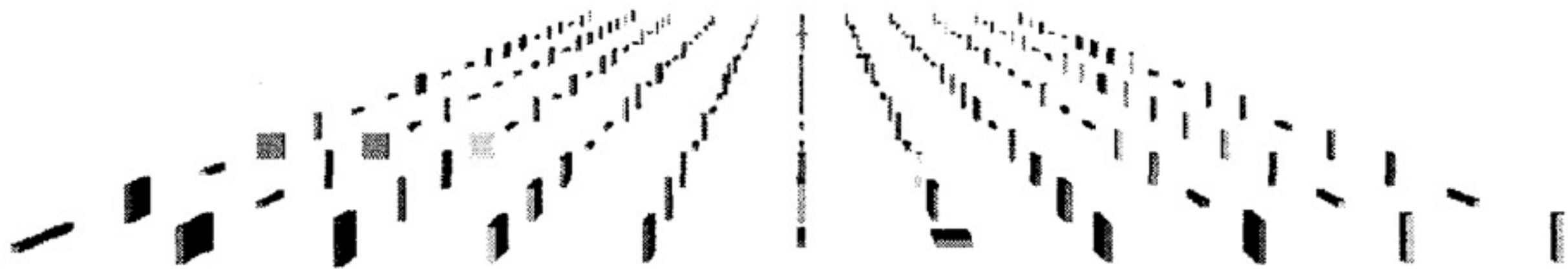
- occlusion
- interaction complexity



[Distortion Viewing Techniques for 3D Data. Carpendale et al. InfoVis 1996.]

Perspective distortion loses information

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



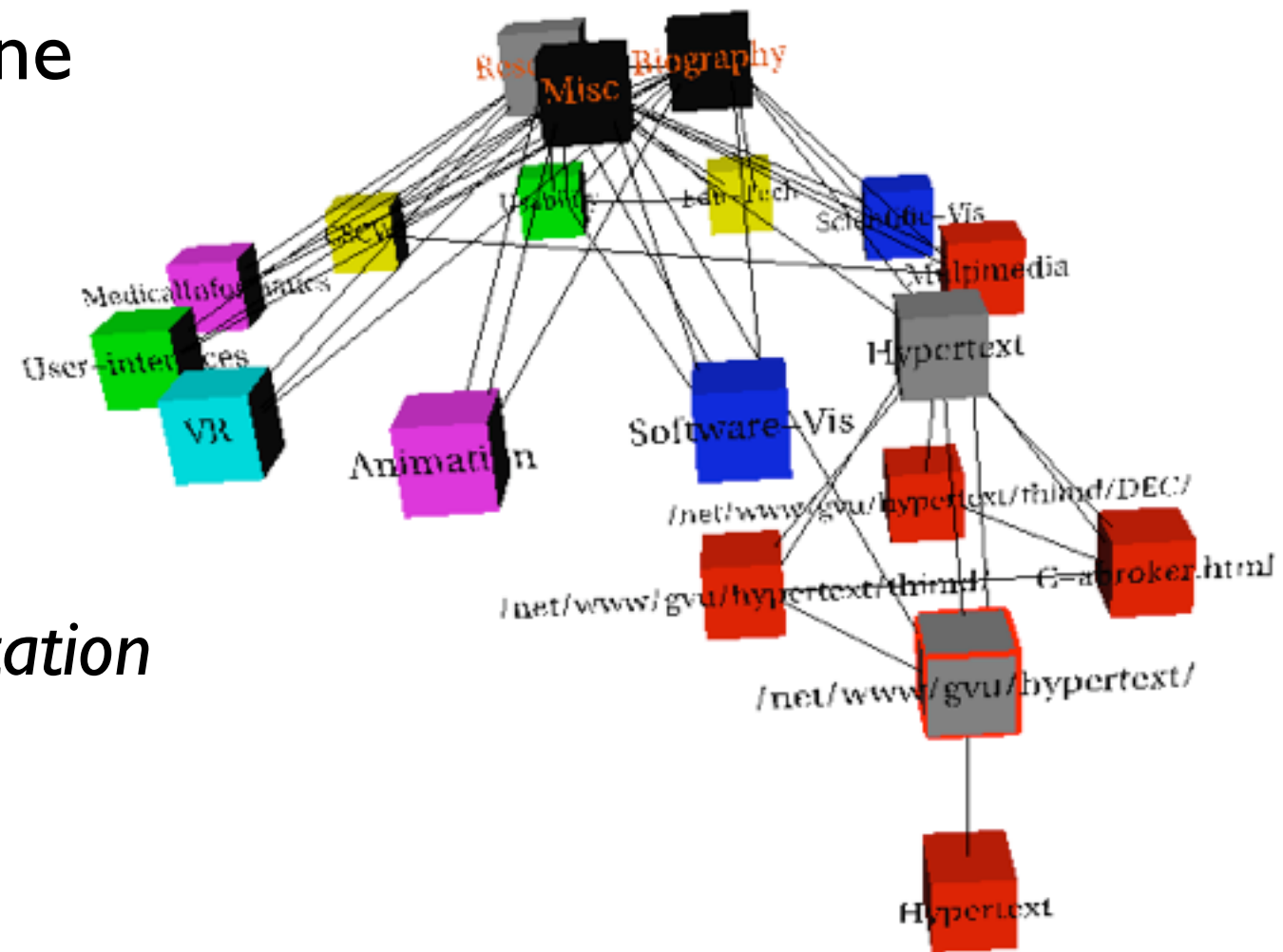
*[Visualizing the Results of Multimedia Web Search Engines.
Mukherjea, Hirata, and Hara. InfoVis 96]*

Tilted text isn't legible

- text legibility
 - far worse when tilted from image plane

- further reading

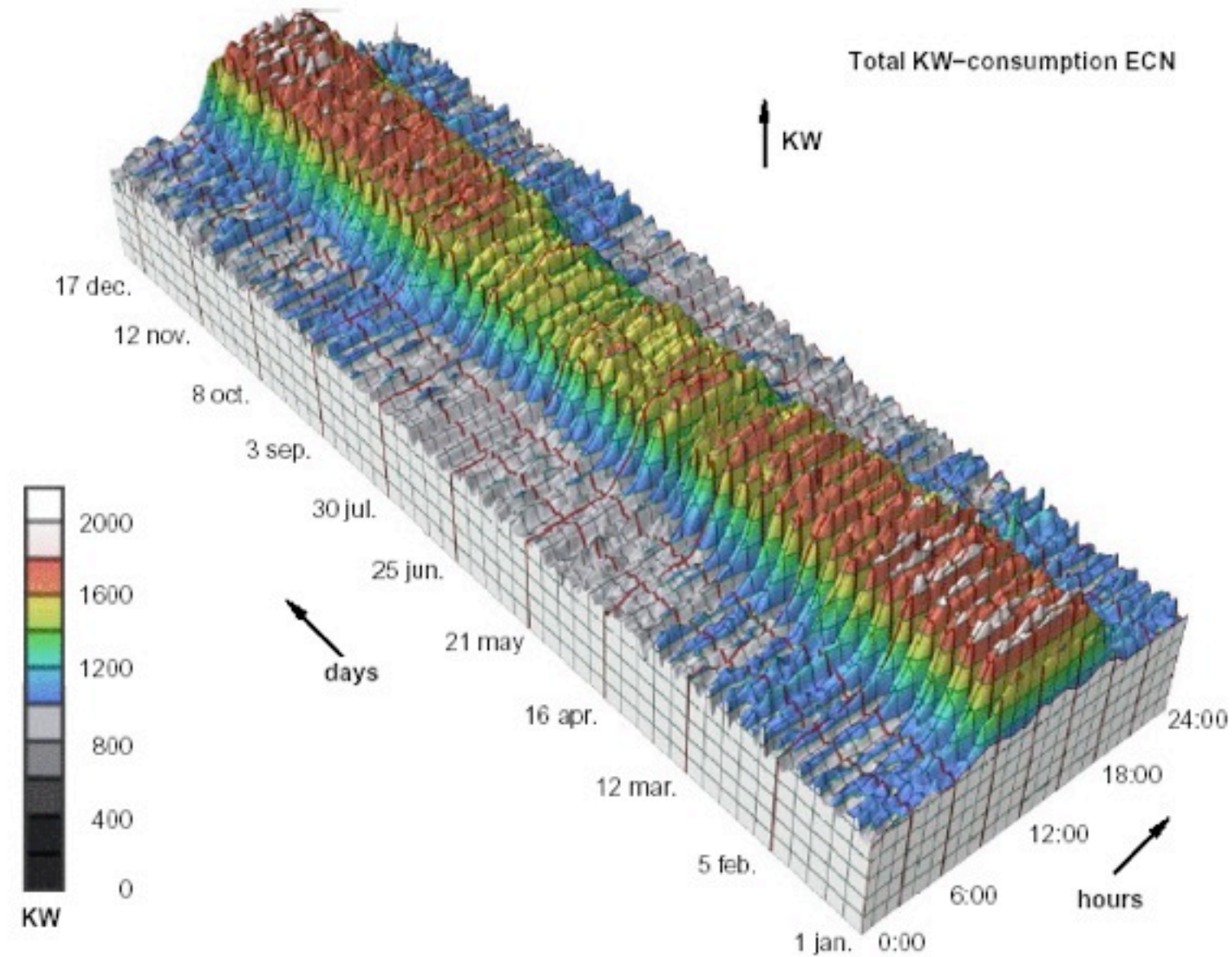
[Exploring and Reducing the Effects of Orientation on Text Readability in Volumetric Displays. Grossman et al. CHI 2007]



[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

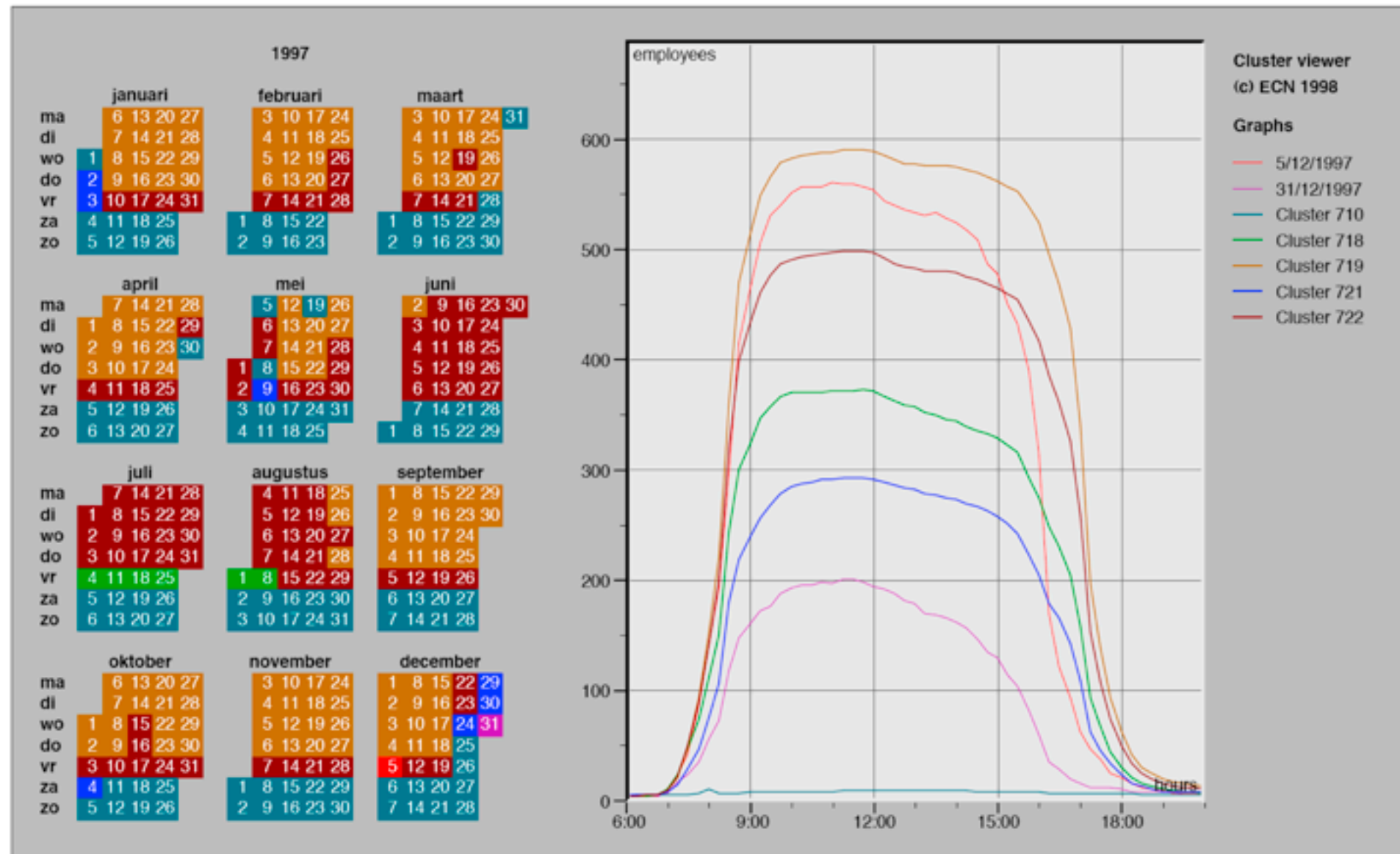
- extruded curves: detailed comparisons impossible



[Cluster and Calendar based Visualization of Time Series Data. van Wijk and van Selow, Proc. InfoVis 99.]

No unjustified 3D example: Transform for new data abstraction

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



[Cluster and Calendar based Visualization of Time Series Data. van Wijk and van Selow, Proc. InfoVis 99.]

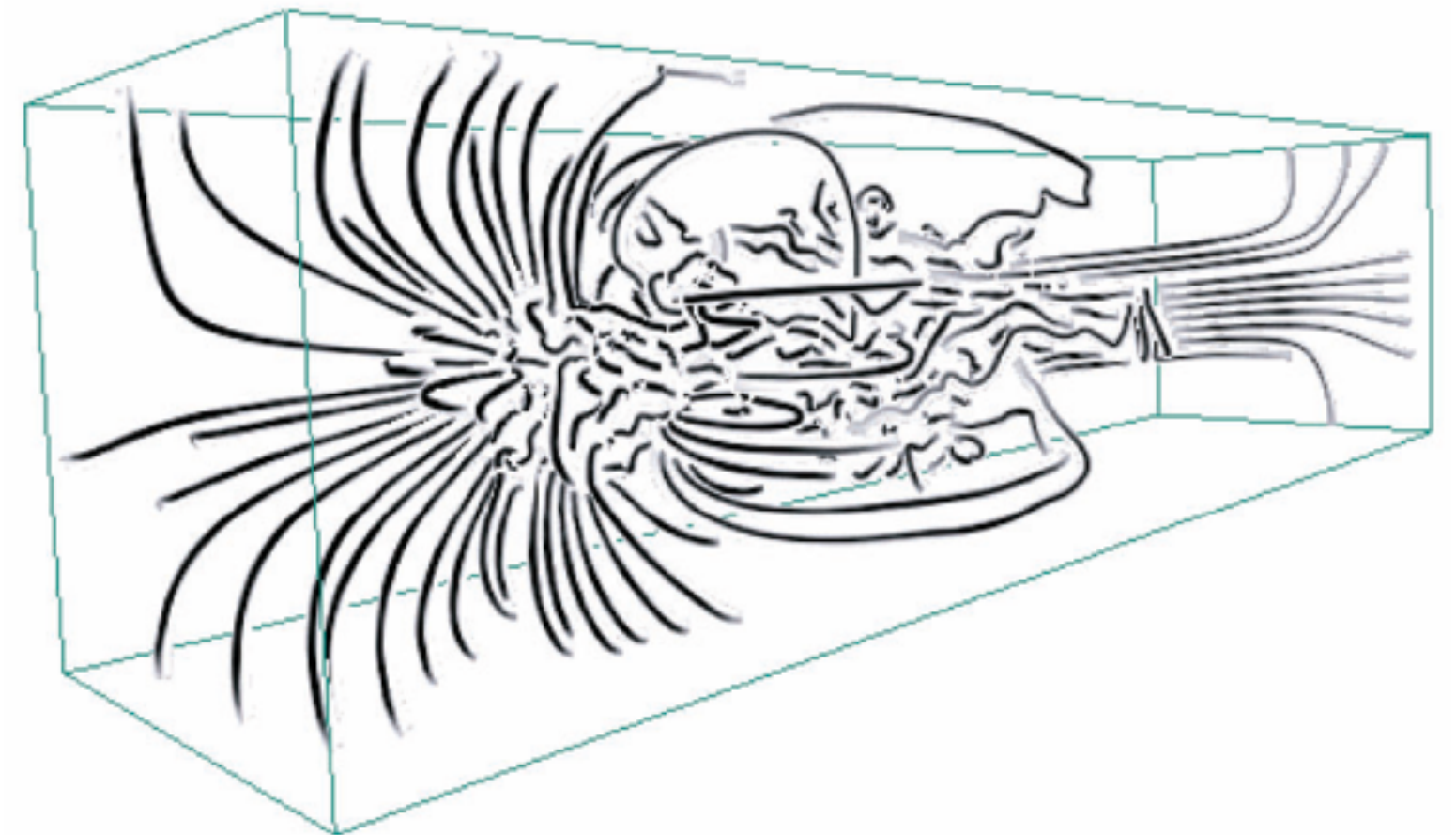
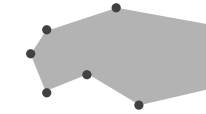
Justified 3D: shape perception

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

 Targets

 Spatial Data

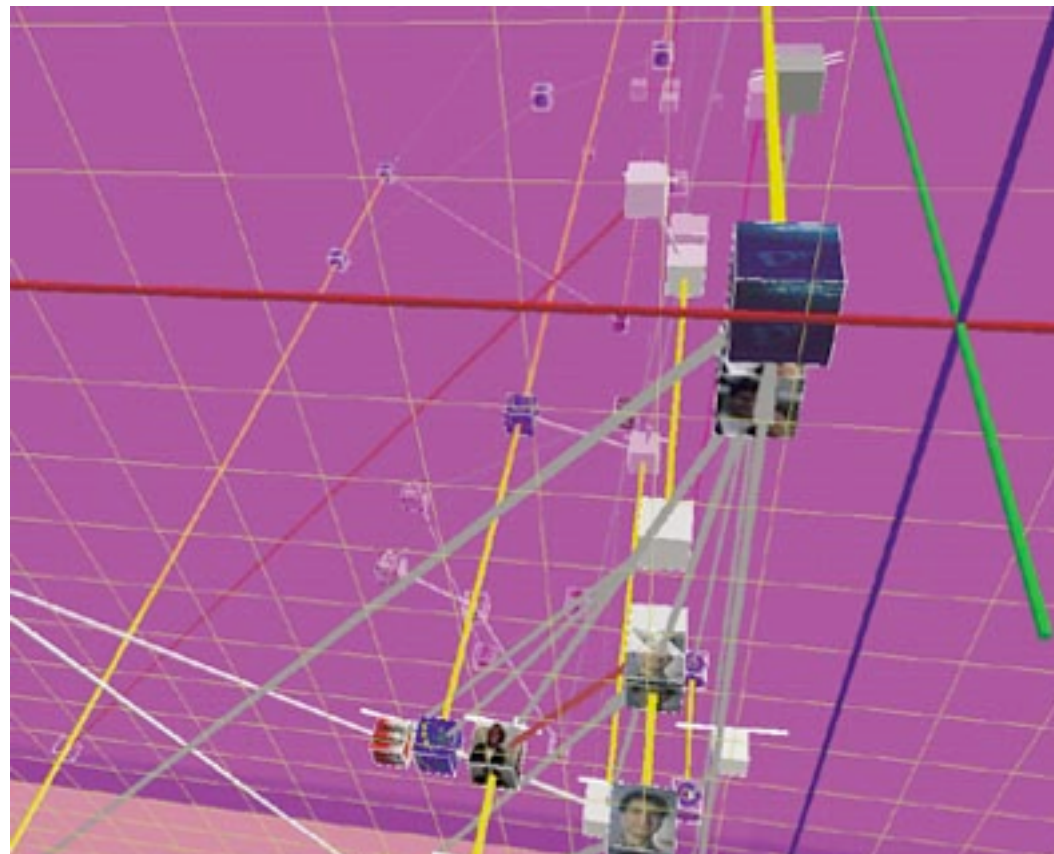
→ Shape



[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]

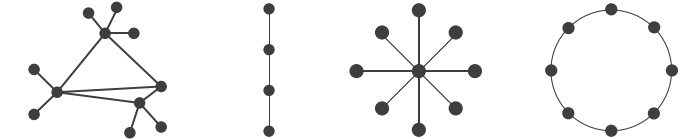
No unjustified 2D

- 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



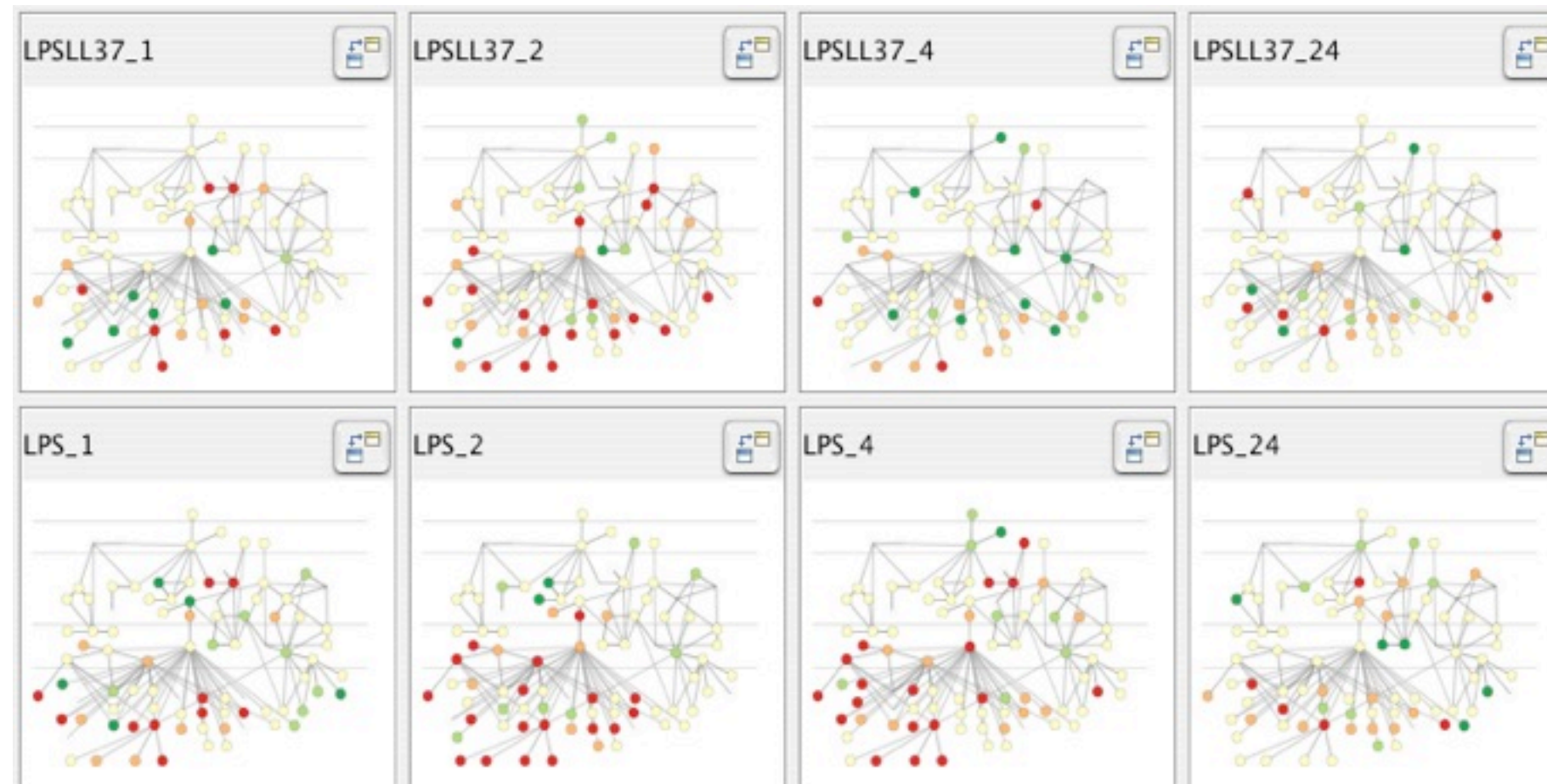
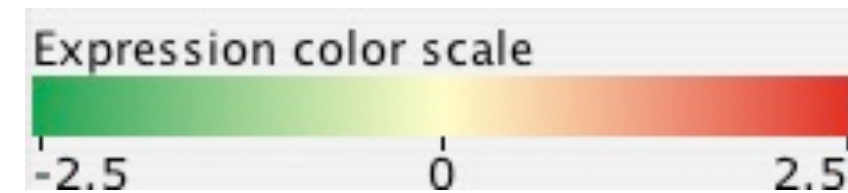
Eyes beat memory

- 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



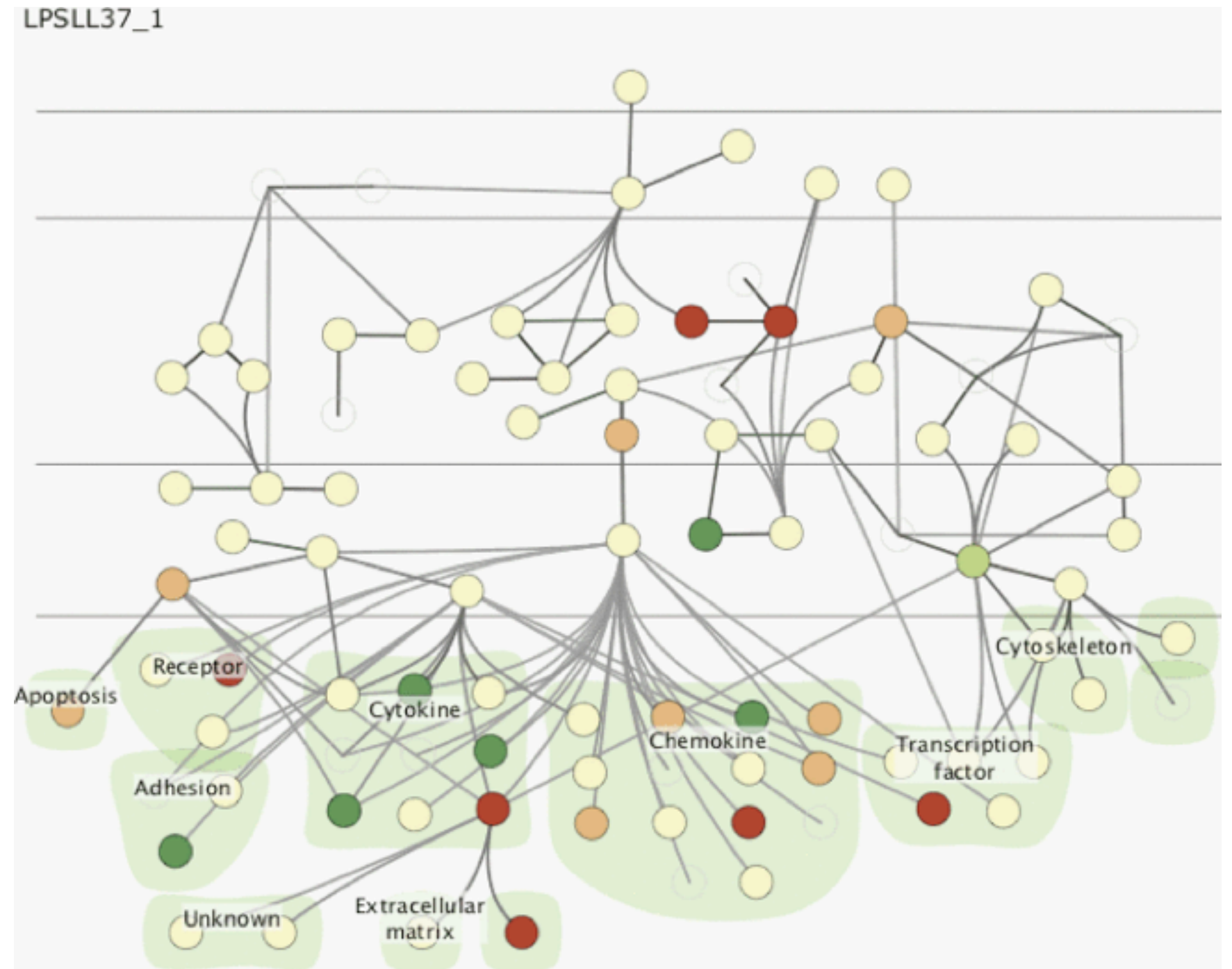
Eyes beat memory example: Cerebral

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



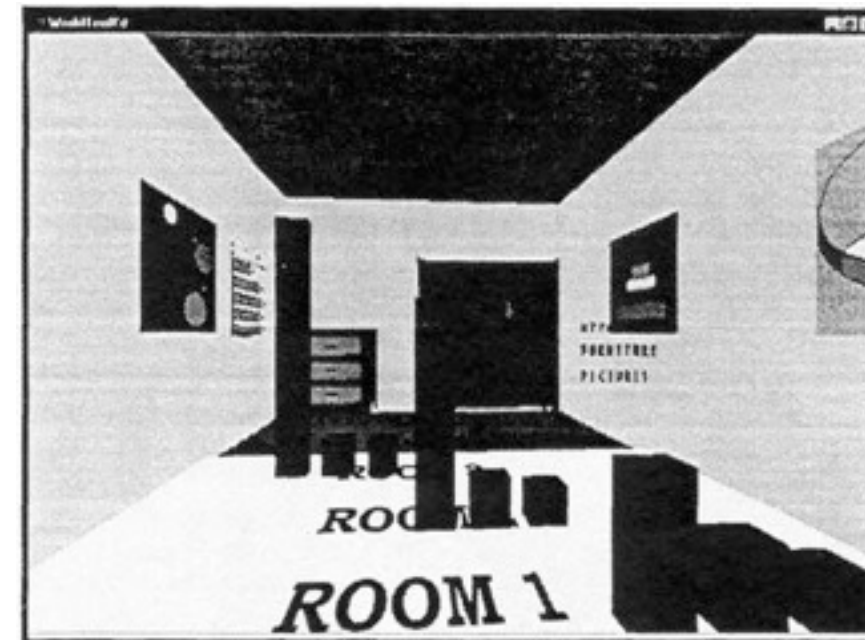
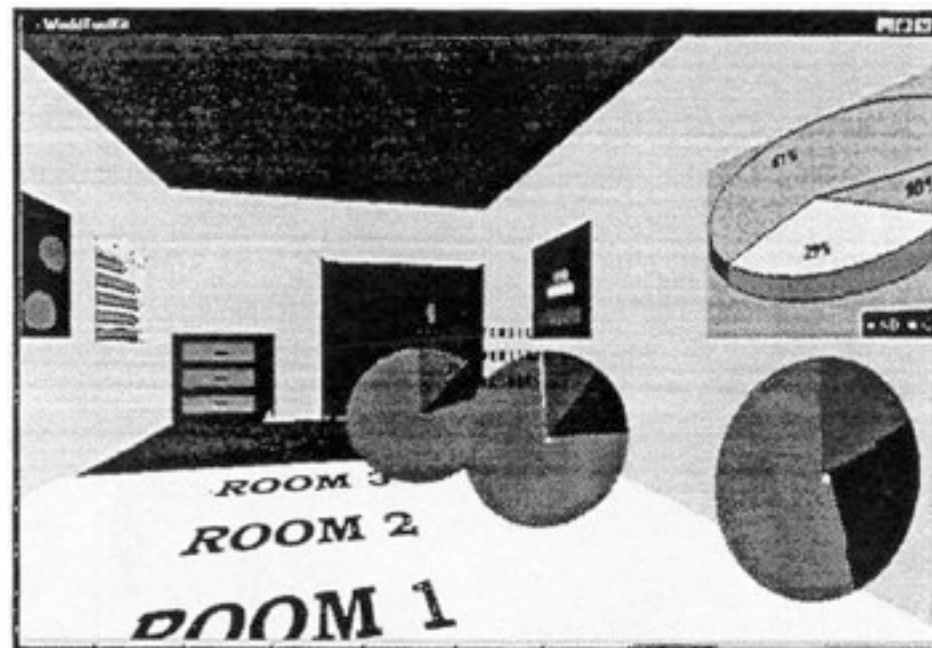
Why not animation?

- disparate frames and regions: comparison difficult
 - vs contiguous frames
 - vs small region
 - vs coherent motion of group
- change blindness
 - even major changes difficult to notice if mental buffer wiped
- safe special case
 - animated transitions



Resolution beats immersion

- immersion typically not helpful **for abstract data**
 - do not need sense of presence or stereoscopic 3D
- resolution much more important
 - pixels are the scarcest resource
 - desktop also better for workflow integration
- virtual reality for abstract data very difficult to justify



[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

[The Eyes Have It: A Task by Data Type Taxonomy for Information Visualizations. Shneiderman. Proc. IEEE Visual Languages, pp. 336–343, 1996.]

- **overview = summary**

– microcosm of full vis design problem

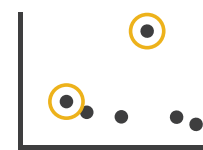
- **nuances**

– beyond just two levels: multi-scale structure

– difficult when scale huge: give up on overview and browse local neighborhoods?

→ Query

→ Identify



→ Compare



→ Summarise



[Search, Show Context, Expand on Demand: Supporting Large Graph Exploration with Degree-of-Interest. van Ham and Perer. IEEE Trans. Visualization and Computer Graphics (Proc. InfoVis 2009) 15:6 (2009), 953–960.]

Function first, form next

- start with focus on functionality
 - straightforward to improve aesthetics later on, as refinement
 - if no expertise in-house, find good graphic designer to work with
- dangerous to start with aesthetics
 - usually impossible to add function retroactively

Further reading: Books

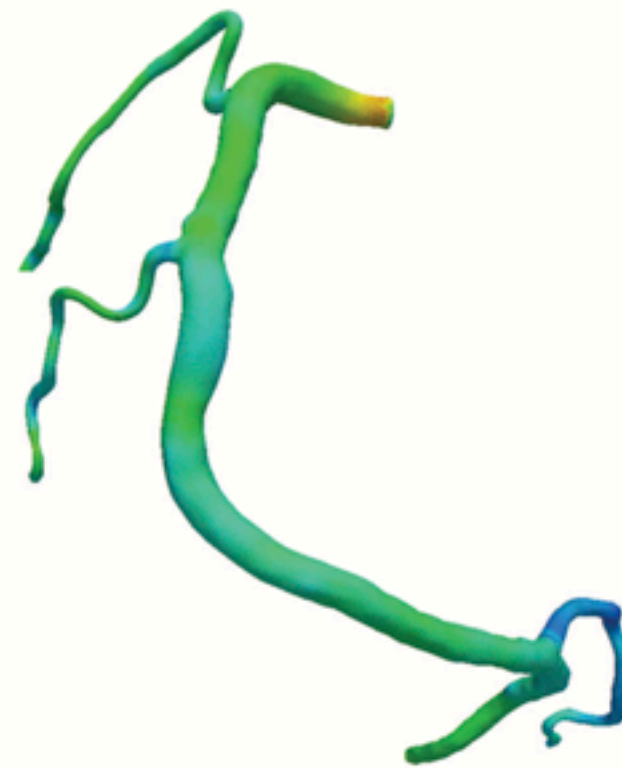
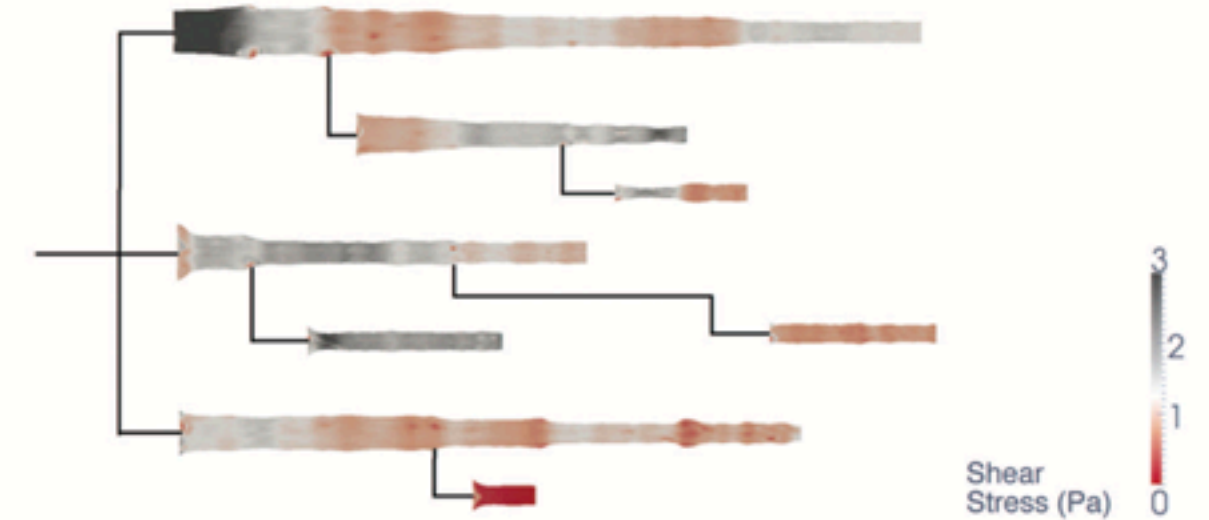
- Visualization Analysis and Design. Munzner. CRC Press, 2014.
 - Chap 6: Rules of Thumb
- The Non-Designer's Design Book. Williams. Peachpit Press, 2008.
- Visual Thinking for Design, Colin Ware, Morgan Kaufmann 2008.
- Information Visualization: Perception for Design, 3rd edition, Colin Ware, Morgan Kaufmann, 2013.

Further reading: Articles

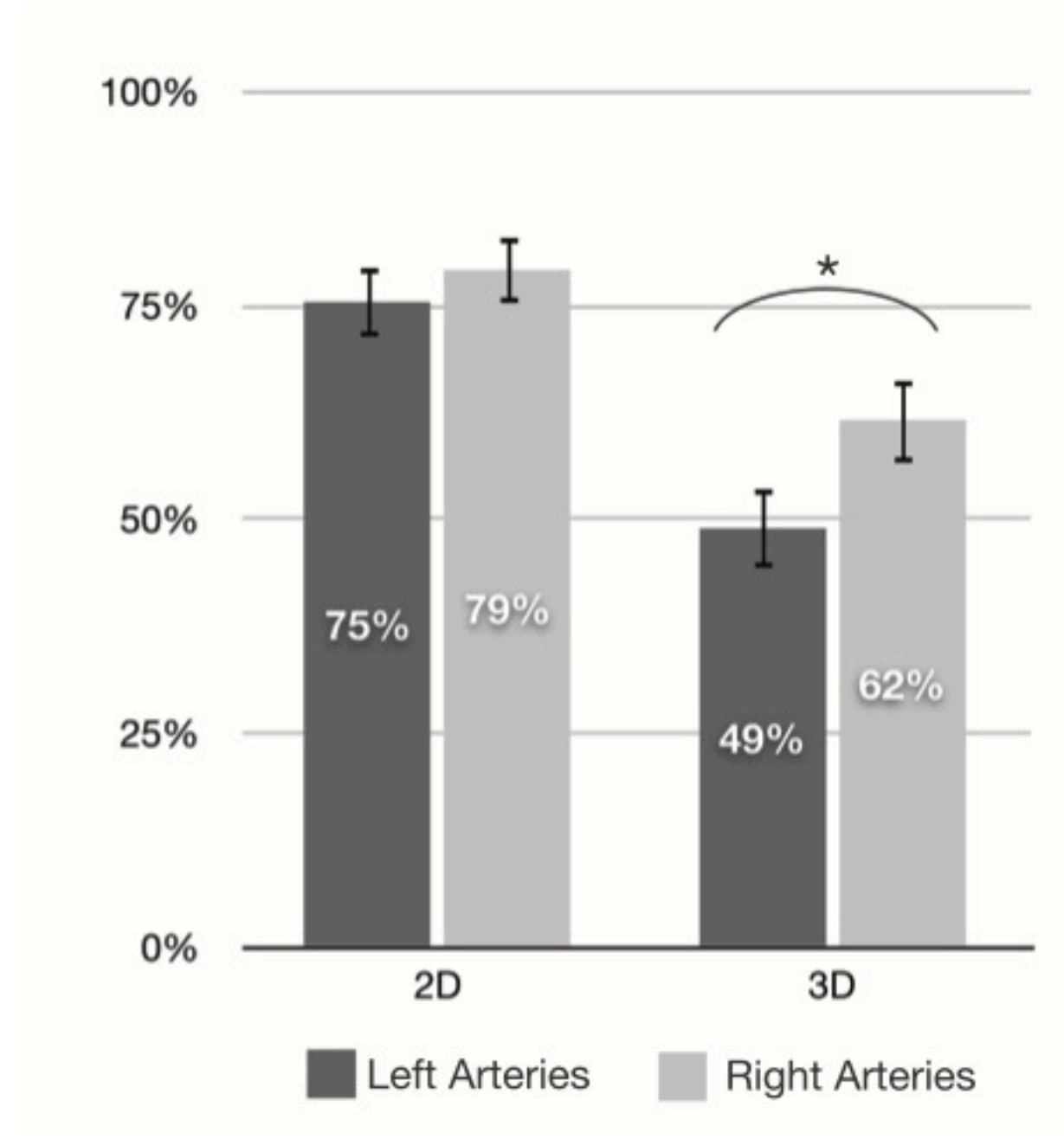
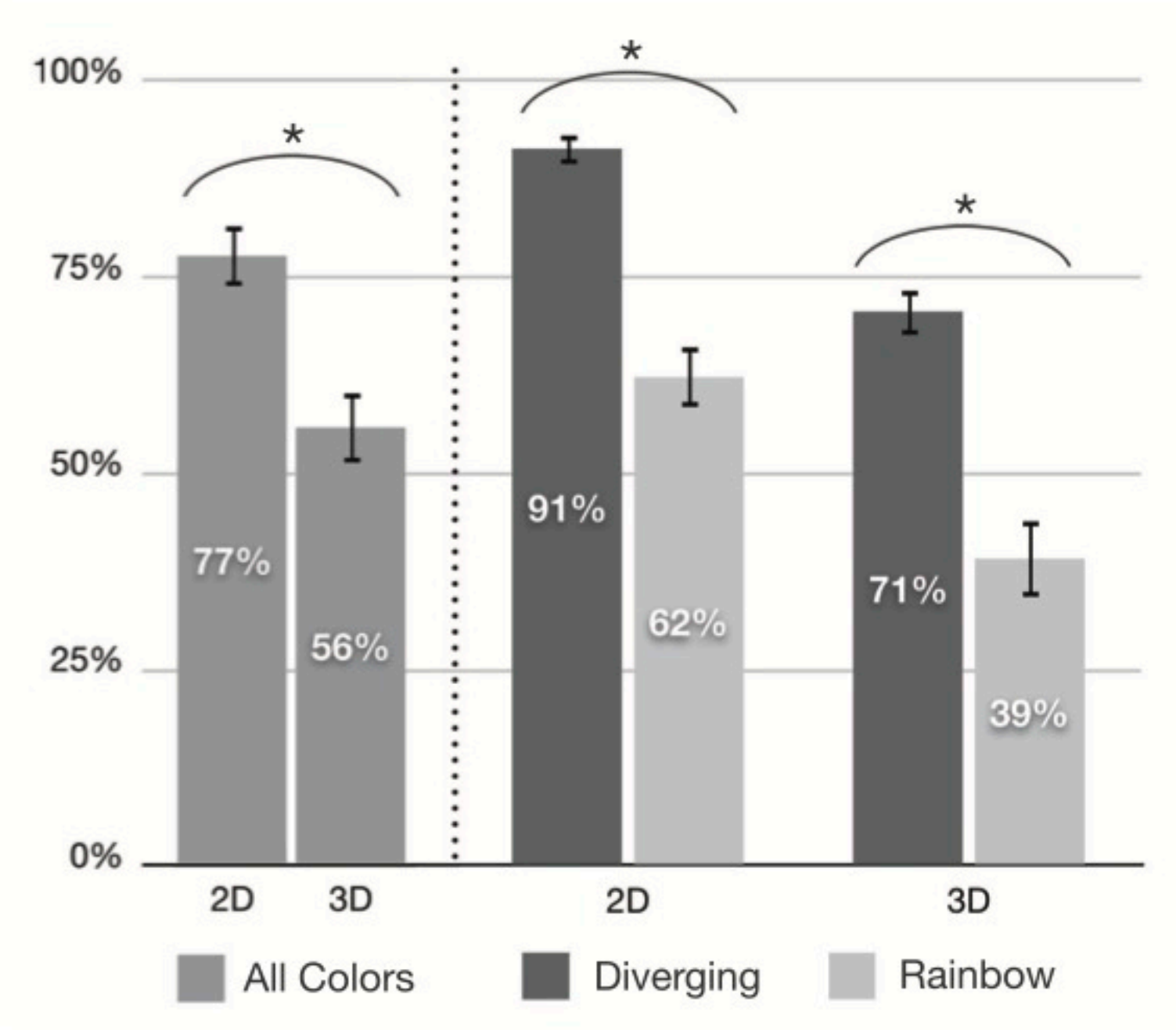
- The Use of 2-D and 3-D Displays for Shape Understanding versus Relative Position Tasks. Mark St. John, Michael B. Cowen, Harvey S. Smallman, and Heather M. Oonk. Human Factors 43:1 (2001), 79-98.
- An Evaluation of Cone Trees. Andy Cockburn and Bruce McKenzie. In People and Computers XIV: Usability or Else. British Computer Society Conference on Human Computer Interaction, pp. 425-436. Springer, 2000.
- 3D or Not 3D? Evaluating the Effect of the Third Dimension in a Document Management System. Andy Cockburn and Bruce McKenzie. Proc. CHI 2003, p 434-441.
- Evaluating Spatial Memory in Two and Three Dimensions. Andy Cockburn and Bruce McKenzie. International Journal of Human-Computer Studies. 61(30):359-373.
- Supporting and Exploiting Spatial Memory in User Interfaces. Joey Scarr, Andy Cockburn, and Carl Gutwin. Foundations and Trends in Human-Computer Interaction. 2013. 6:1 1-84.
- Principles of Traditional Animation Applied to Computer Animation John Lasseter, Proceedings of SIGGRAPH 87, Computer Graphics, 21(4), pp. 35-44, July 1987.
- Animation: Can It Facilitate? Barbara Tversky, Julie Morrison, Mireille Betrancourt. International Journal of Human Computer Studies 57:4, pp 247-262, 2002.
- Structuring information interfaces for procedural learning. Jeffrey M. Zacks and Barbara Tversky. Journal of Experimental Psychology: Applied, Vol 9(2), Jun 2003, 88-100.
- Effectiveness of Animation in Trend Visualization. George Robertson and Roland Fernandez and Danyel Fisher and Bongshin Lee and John Stasko. IEEE Trans. on Visualization and Computer Graphics 14(6):1325-1332, 2008 (Proc. InfoVis08).
- Current Approaches to Change Blindness. Daniel J. Simons. Visual Cognition 7:1/2/3 (2000), 1-15.
- The eyes have it: A task by data type taxonomy for information visualizations. Ben Shneiderman. Proc. Conf. Visual Languages 1996, p 336-343.
- The Notion of Overview in Information Visualization. Kaspar Hornbaek and Morten Hertzum. International Journal of Human-Computer Studies 69:7-8 (2011), 509-525.
- The Information Visualizer, an Information Workspace. Stuart Card, George Robertson, and Jock Mackinlay. Proc. CHI 1991, p 181-186.
- Designing with the Mind in Mind: Simple Guide to Understanding User Interface Design Rules. Jeff Johnson. Morgan Kaufmann, 2010.
- A Framework of Interaction Costs in Information Visualization. IEEE Transactions on Visualization and Computer Graphics (Proc. InfoVis 08) 14:6 (2008), 1149-1156.
- Toward a Deeper Understanding of the Role of Interaction in Information Visualization. Ji Soo Yi, Youn Ah Kang, John T. Stasko, and Julie A. Jacko. TVCG (Proc. InfoVis 07) 13:6 (2007), 1224-1231.
- Get It Right in Black and White. Maureen Stone. Functional Color, 2010.

HemoViz: Design study + evaluation

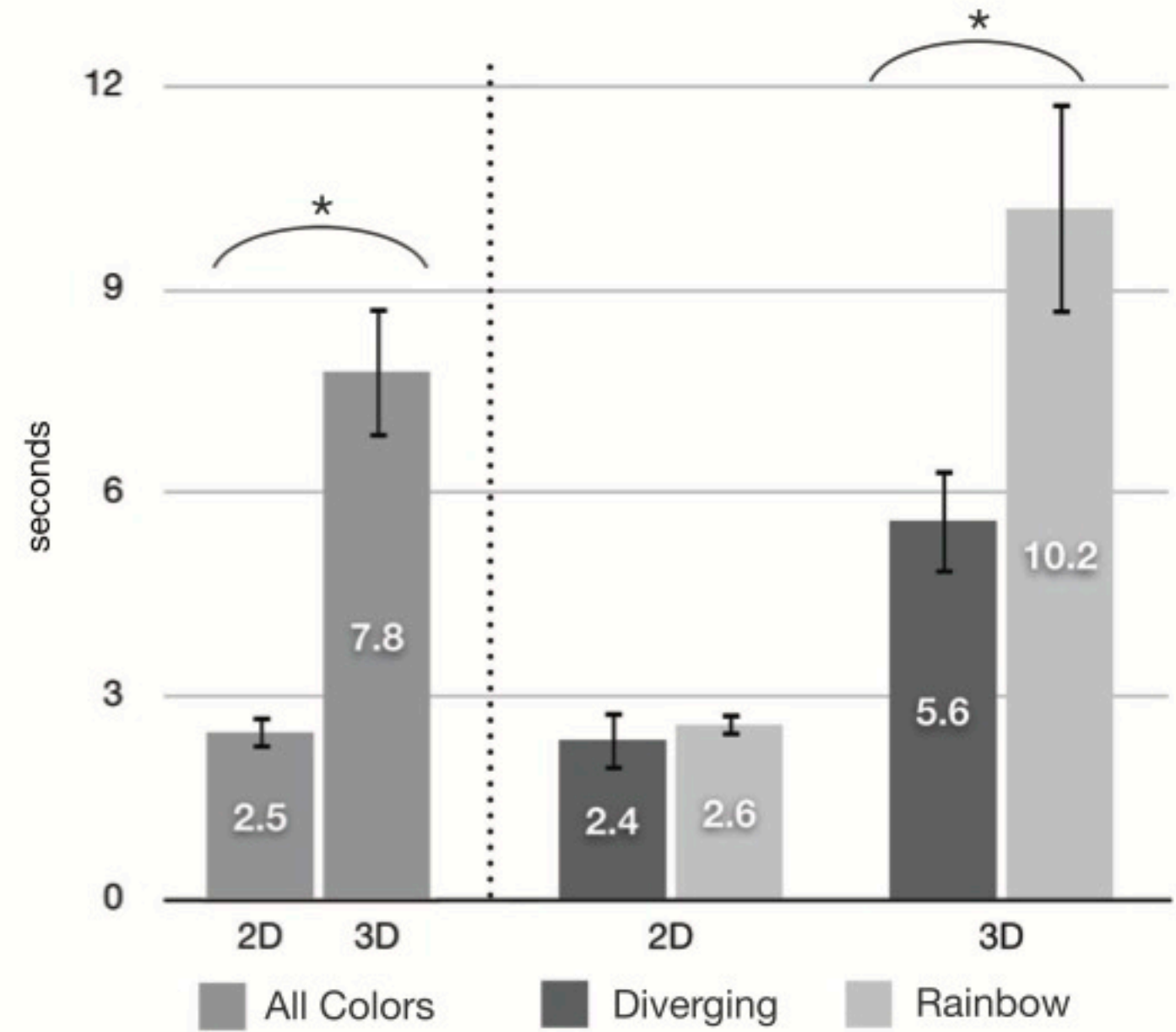
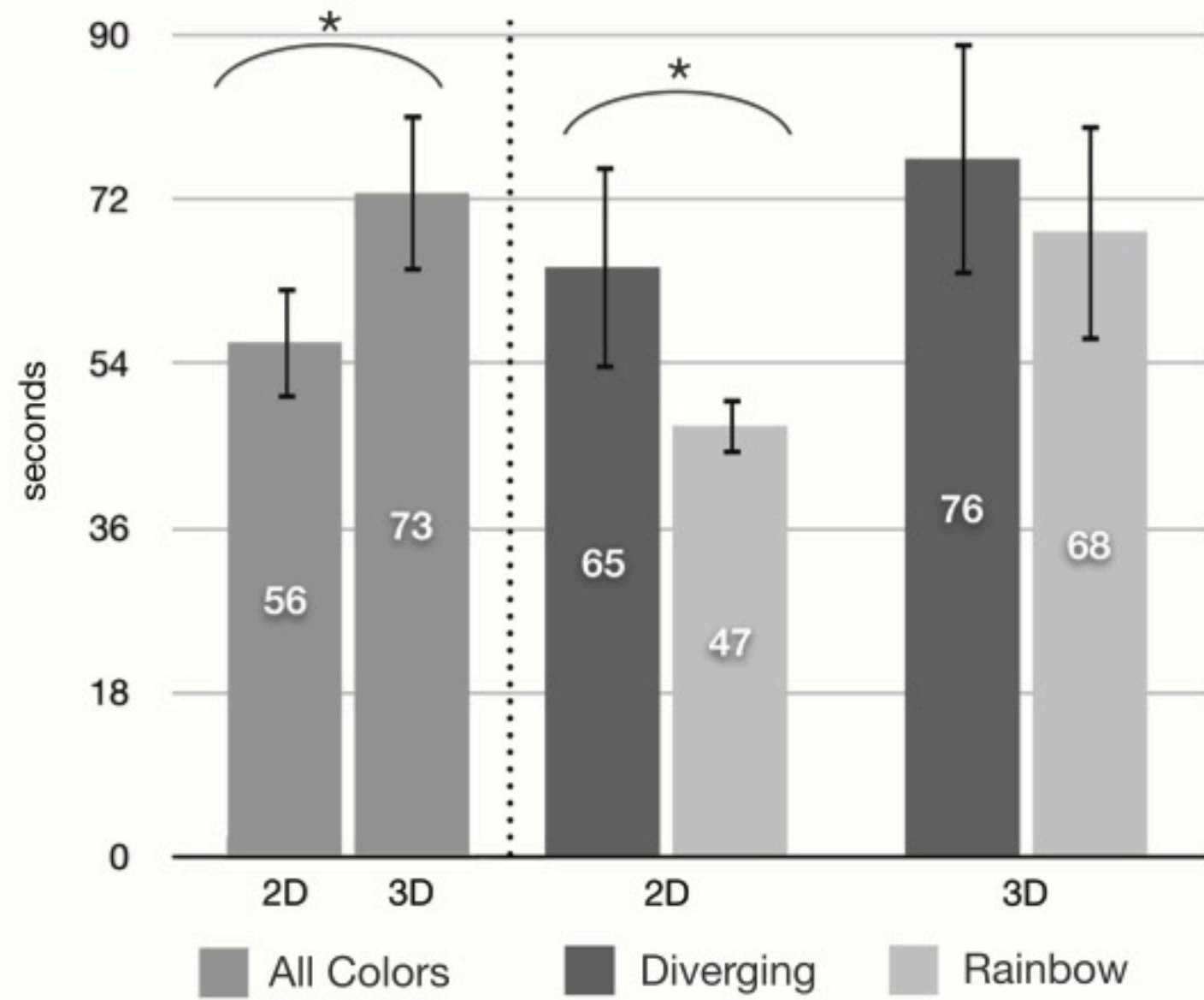
- formative study with experts
 - task taxonomy
- HemoViz design
- deploy attempt fails
 - experts balk: demand 3D and rainbows
- quantitative user study
 - med students, real data
 - 91% with 2D/diverging vs 39% with 3D/rainbows
 - experts willing to use



Study results: Error



Study results: Time



Next Time

- to read
 - VAD Ch. 4: Validation
 - D3: Data-Driven Documents. Michael Bostock, Vadim Ogievetsky, Jeffrey Heer. IEEE Trans. Visualization & Comp. Graphics (Proc. InfoVis), 2011.
 - paper type: system
 - guest lecture/demos: Matt Borkin, project resources