CS-5630 / CS-6630 Visualization Interaction

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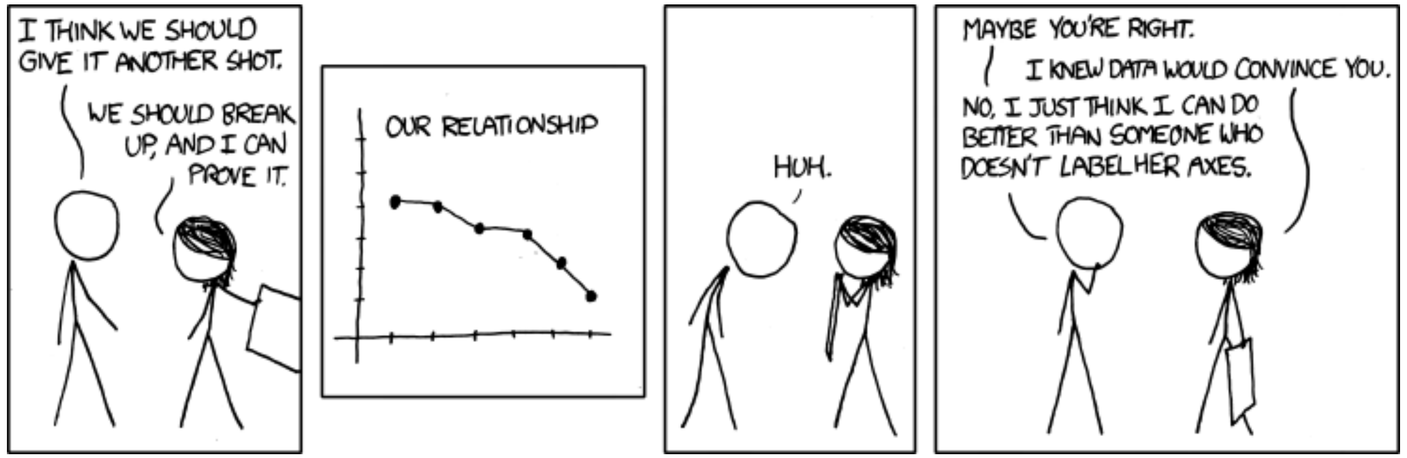
THE UNIVERSITY OF UTAH



[xkcd]

Project

It’s time to start thinking about your project.

Your project proposal, due Oct 21

- Use fall break to get started!
- Come to my office hours!

What you need:

- A team
- An idea
- A dataset (that you actually can get!) http://dataviscourse.net/2016/resources/

More Info: http://dataviscourse.net/2016/project/

Project Requirements

Scope as agreed upon with TAs

Be ambitious! Define your goals and categorize them:

- must have, nice to have, etc.
- check out the hall of fame!

Minimum:

- original idea of dataset/vis combo
- interactive
- at least two coordinated views

Exam

Theory Questions

- What's bad about a rainbow color scale?
- What are common spatial datasets?

Design Critique

- Given a vis, analyze what's good/bad and redesign.

Conceptual questions about D3/JavaScript

- How does data binding work? How do you access data? Where is the bound data stored in the DOM? What is the DOM?

Find the bug question.

Interaction

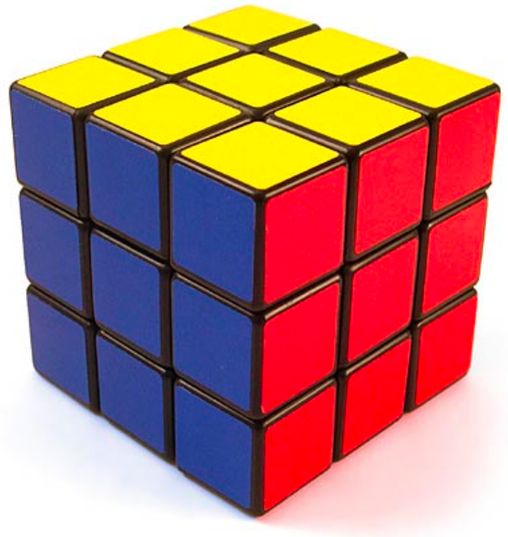
Why Interact with Visualization?

Explore data that is big / complex

- to big to show everything at once
- explore data with different representations

Interaction amplifies cognition

- We understand things better if we can touch them
- If we can observe cause and effect



Interaction Methods

What do you design for?

- Mouse, keyboard?
- Touch interaction / mobile?
- Gestures?
- Eye Movement?

https://www.youtube.com/watch?v=QXLfT9sFcbc

Types of Interaction

Single View

Change over time

Navigation

Semantic zooming

Filtering and Querying

Focus + Context

Multiple Views

Selection (Details on Demand)

Linking & Brushing

Adapting Representations

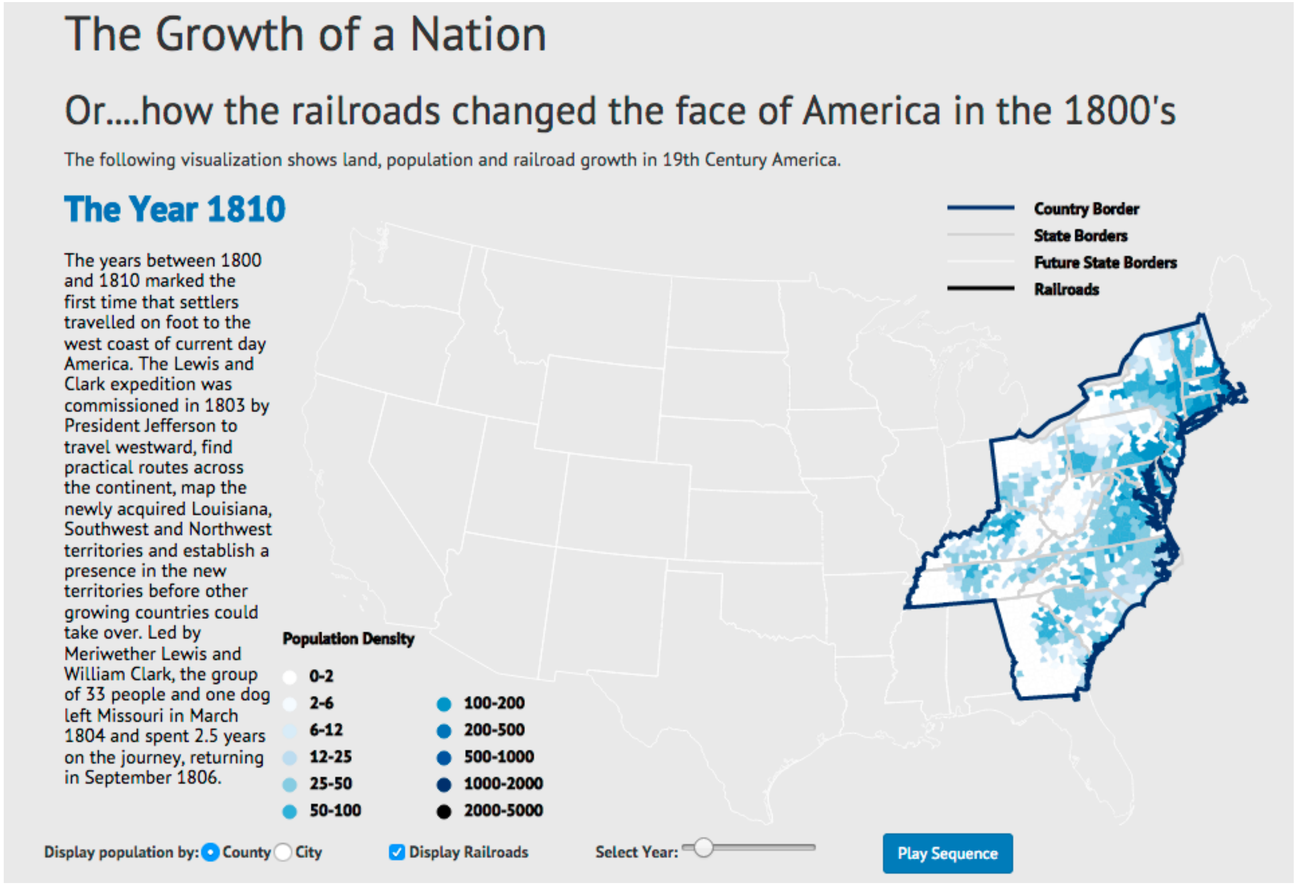
Next Lecture

Change over Time / Transitions

Change over Time

Use, e.g., slider to see view with data at different times

Sometimes better to show difference explicitly

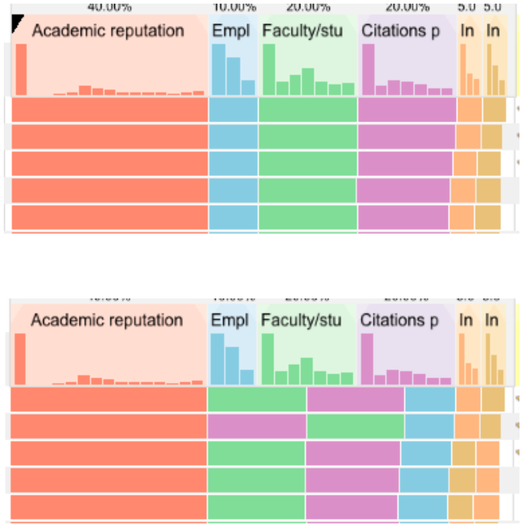


[Lauren Wood]

Change over Time

Doesn’t have to be literal time:

- change as you go
- as part of an analysis process



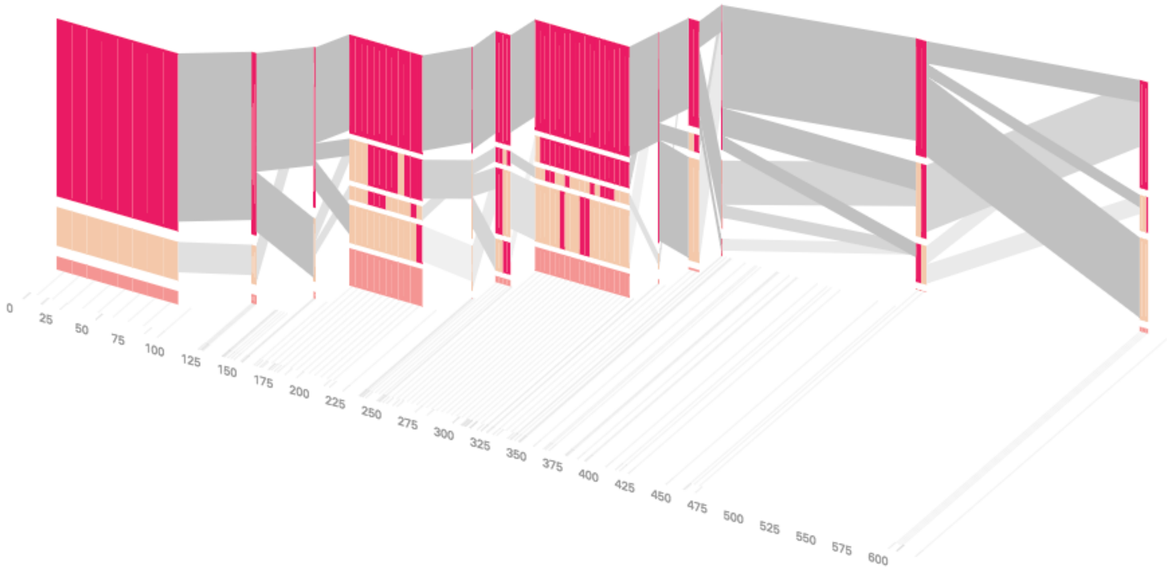
Why Transition?

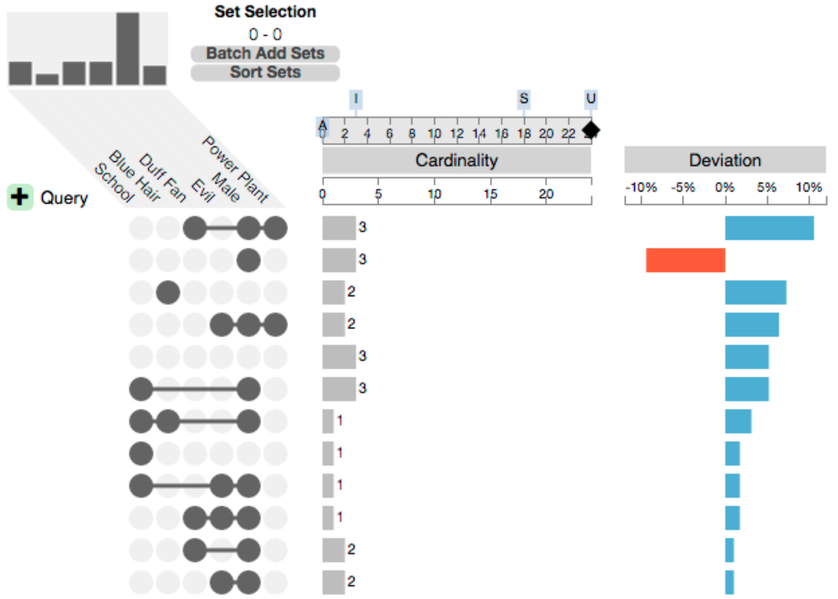
Different representations support different tasks

bar chart, vs stacked bar chart

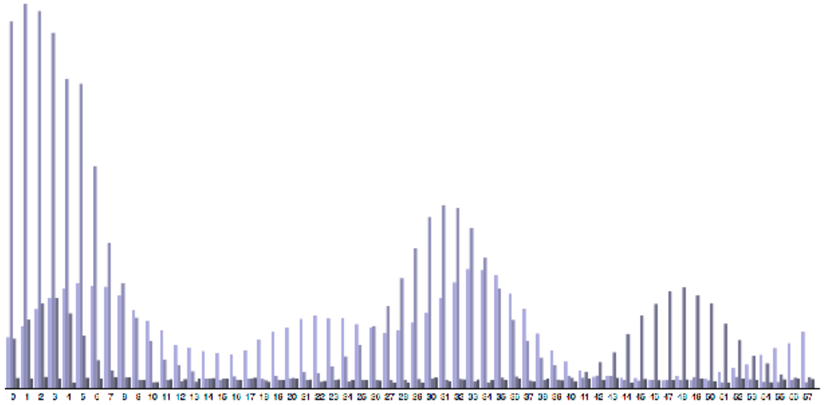
Change Ordering

Transition make it possible for users to track what is going on





Animated Transitions



Smooth interpolation between states or visualization techniques

[Sunburst by John Stasko, Implementation in Caleydo by Christian Partl]

Why Animated Transition?

Animated Transitions in Statistical Data Graphics

Jeffrey Heer, George G. Robertson

Abstract—In this paper we investigate the effectiveness of animated transitions between common statistical data graphics such as bar charts, pie charts, and scatter plots. We extend theoretical models of data graphics to include such transitions, introducing a taxonomy of transition types. We then propose design principles for creating effective transitions and illustrate the application of these principles in *DynaVis*, a visualization system featuring animated data graphics. Two controlled experiments were conducted to assess the efficacy of various transition types, finding that animated transitions can significantly improve graphical perception.

Index Terms—Statistical data graphics, animation, transitions, information visualization, design, experiment

1 Introduction

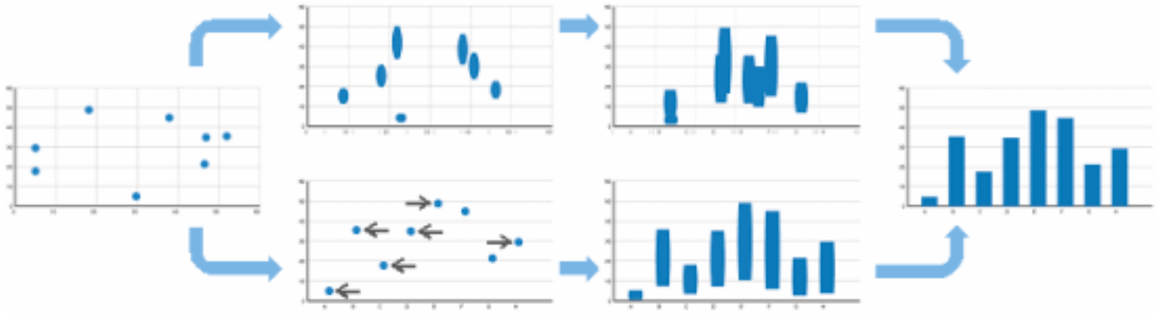
In both analysis and presentation, it is common to view a number of related data graphics backed by a shared data set. For example, a business analyst viewing a bar chart of product sales may want to view relative percentages by switching to a pie chart or compare sales with profits in a scatter plot. Similarly, she may wish to see product sales by region, drilling down from a bar chart to a grouped bar chart. Such incremental construction of visualizations is regularly performed in tools such as Excel, Tableau, and Spotfire.

The visualization challenge posed by each of these examples is to keep the readers of data graphics oriented during transitions. Ideally, viewers would accurately identify elements across disparate graphics and understand the relationship between the current and previous views. This is particularly important in collaborative settings such as presentations, where viewers not interacting with the data are at a disadvantage to predict the results of transitions.

Animation is one promising approach to facilitating perception of changes when transitioning between related data graphics. Previous

applied to direct attention to points of interest. Second, animation facilitates object constancy for changing objects [17, 20], including changes of position, size, shape, and color, and thus provides a natural way of conveying transformations of an object. Third, animated behaviors can give rise to perceptions of causality and intentionality [16], communicating cause-and-effect relationships and establishing narrative. Fourth, animation can be emotionally engaging [24, 25], engendering increased interest or enjoyment.

However, each of the above features can prove more harmful than helpful. Animation's ability to grab attention can be a powerful force for distraction. Object constancy can be abused if an object is transformed into a completely unrelated object, establishing a false relation. Similarly, incorrect interpretations of causality may mislead more than inform. Engagement may facilitate interest, but can be used to make misleading information more attractive or may be frivolous—a form of temporal "chart junk" [23]. Additionally, animation is ephemeral, complicating comparison of items in flux.



Animation Caveats

Changes can be hard to track

Eyes over memory!

- Show all states in multiple views

Navigation

Navigation

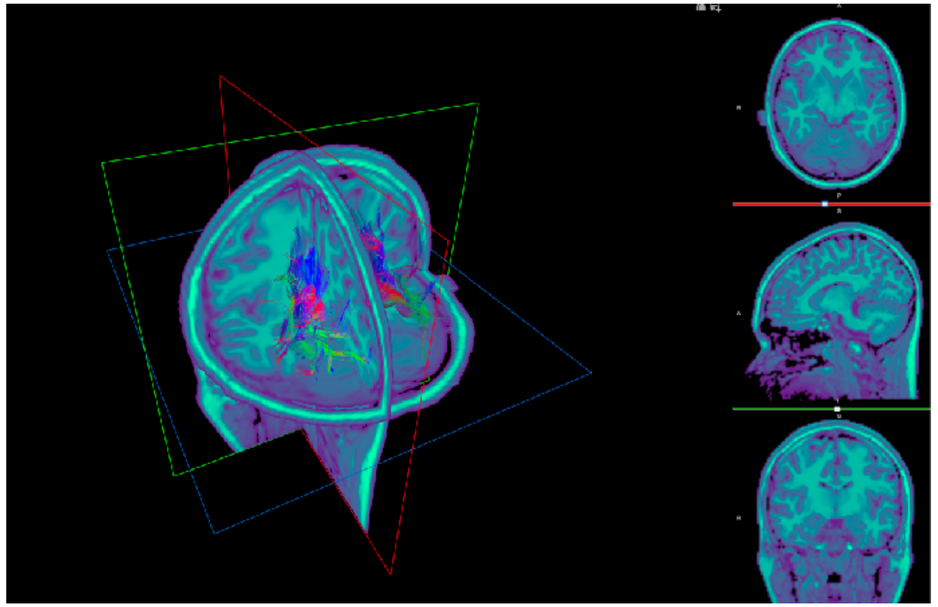
Pan

move around

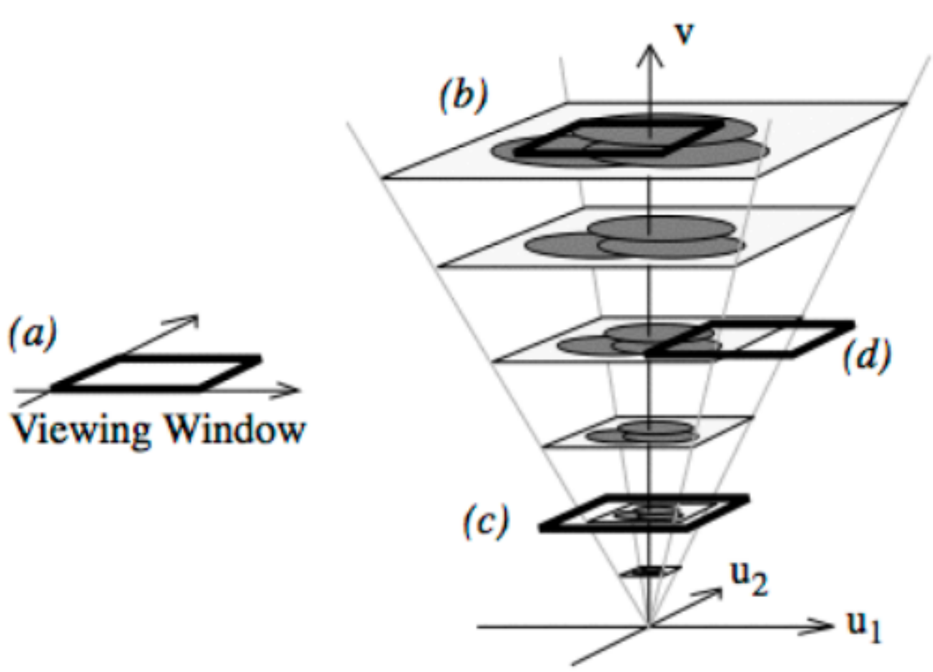
Zoom

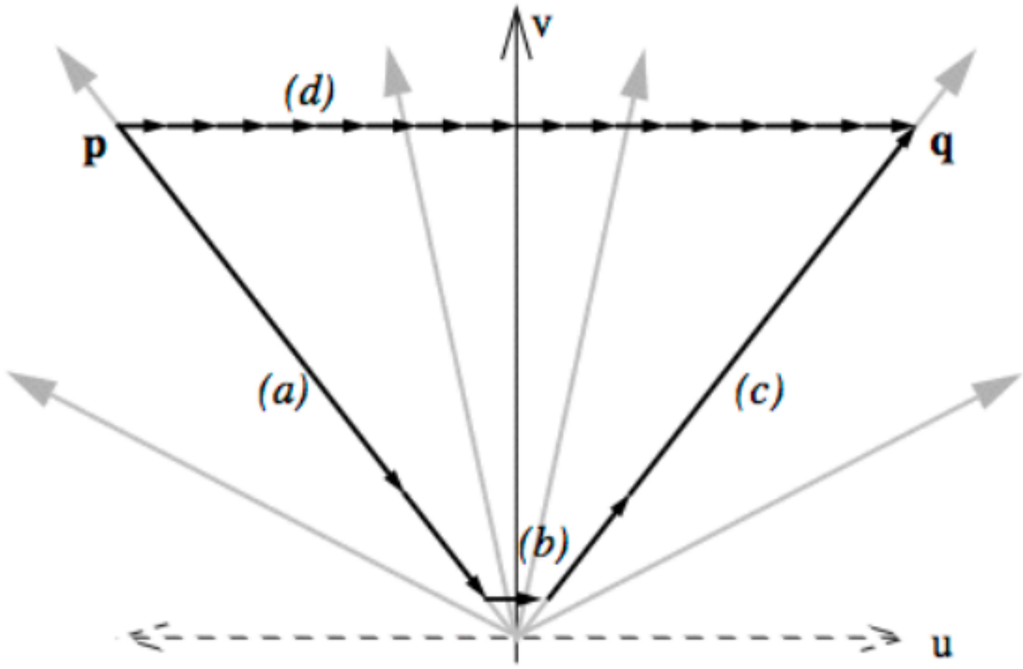
enlarge/ make smaller (move camera)

Rotate



Space-Scale Diagrams





[Furnas & Bederson 1995]

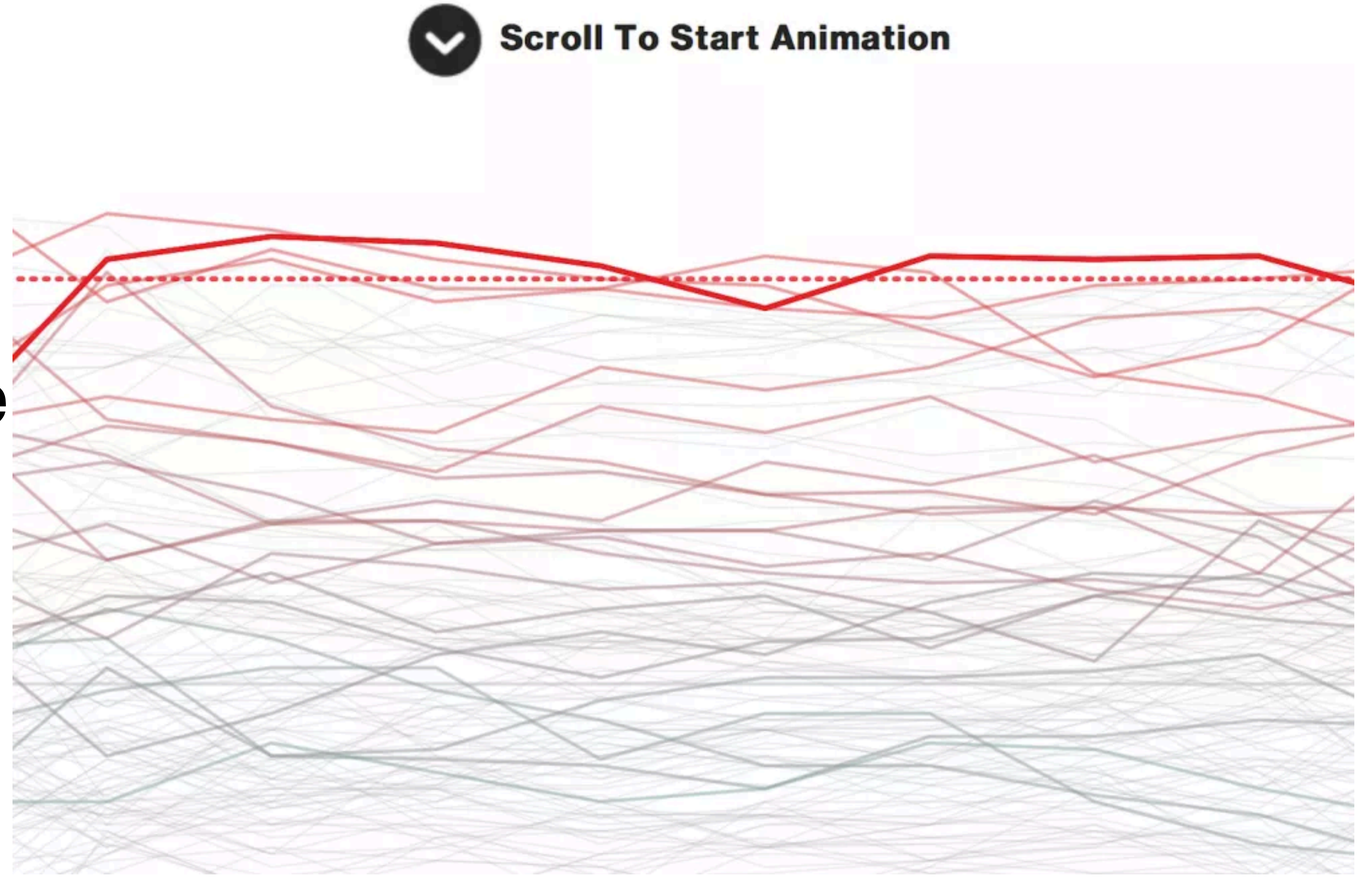
Scrollytelling

Telling an interactive story

Interaction by scrolling

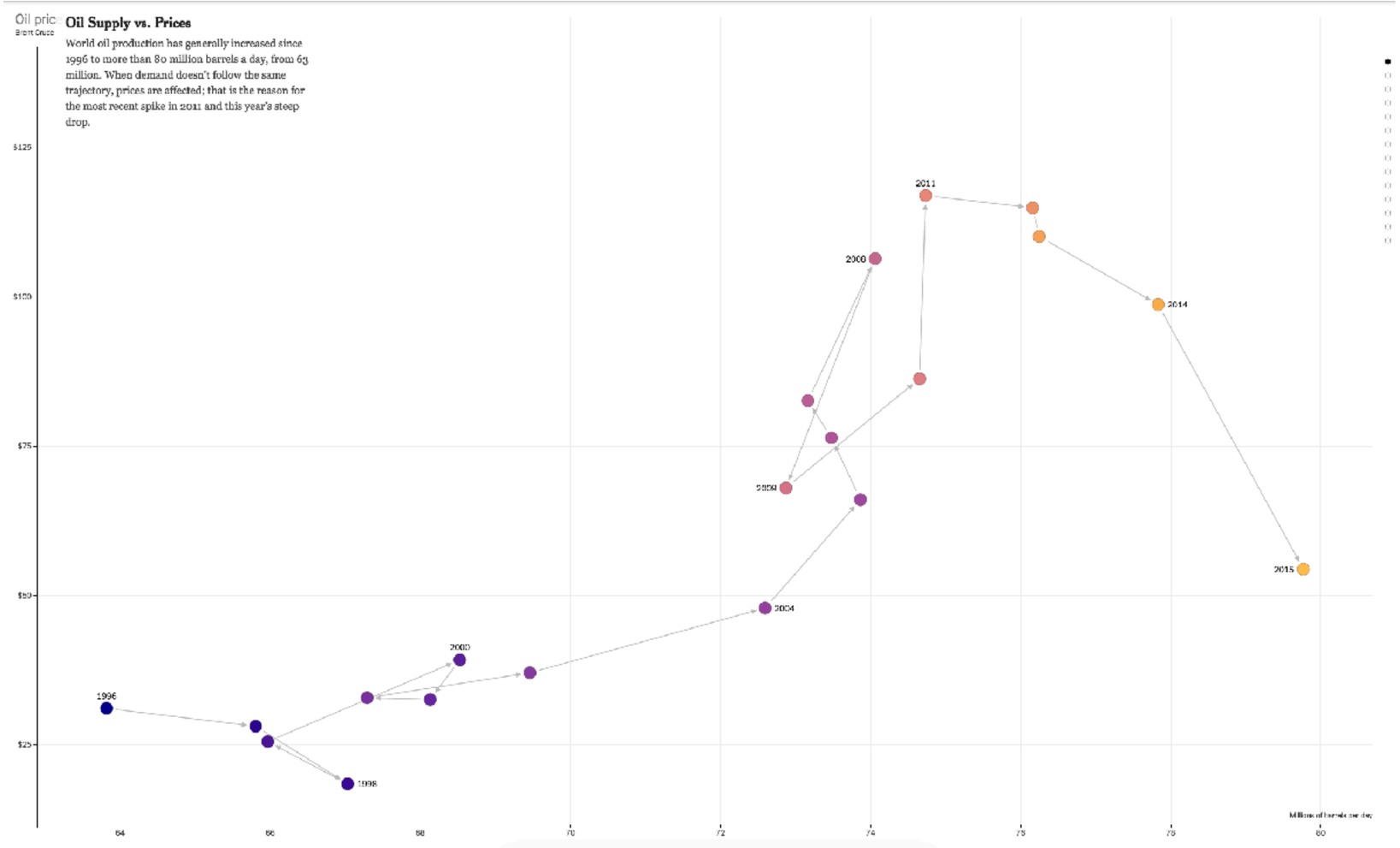
Nice but

- Continuous scrolling vs discrete states
- Direct access
- Unexpected behavior



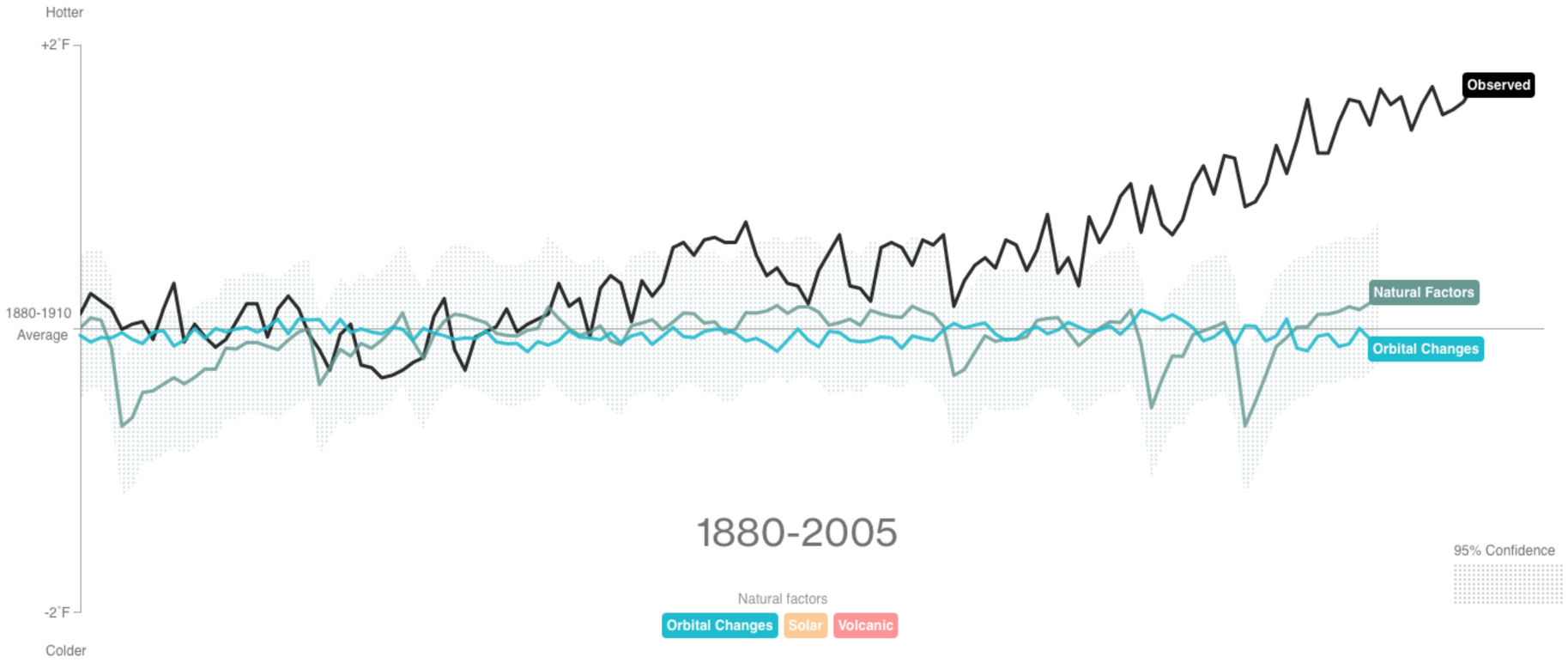
https://eagereyes.org/blog/2016/the-scrollytelling-scourge

Example: Oil Prices



http://www.nytimes.com/interactive/2015/09/30/business/how-the-us-and-opec-drive-oil-prices.html?_r=0

Example: What's Warming the World



www.bloomberg.com/graphics/2015-whats-warming-the-world/

Sent in by Siddartha Ravichandran

Semantic Zooming

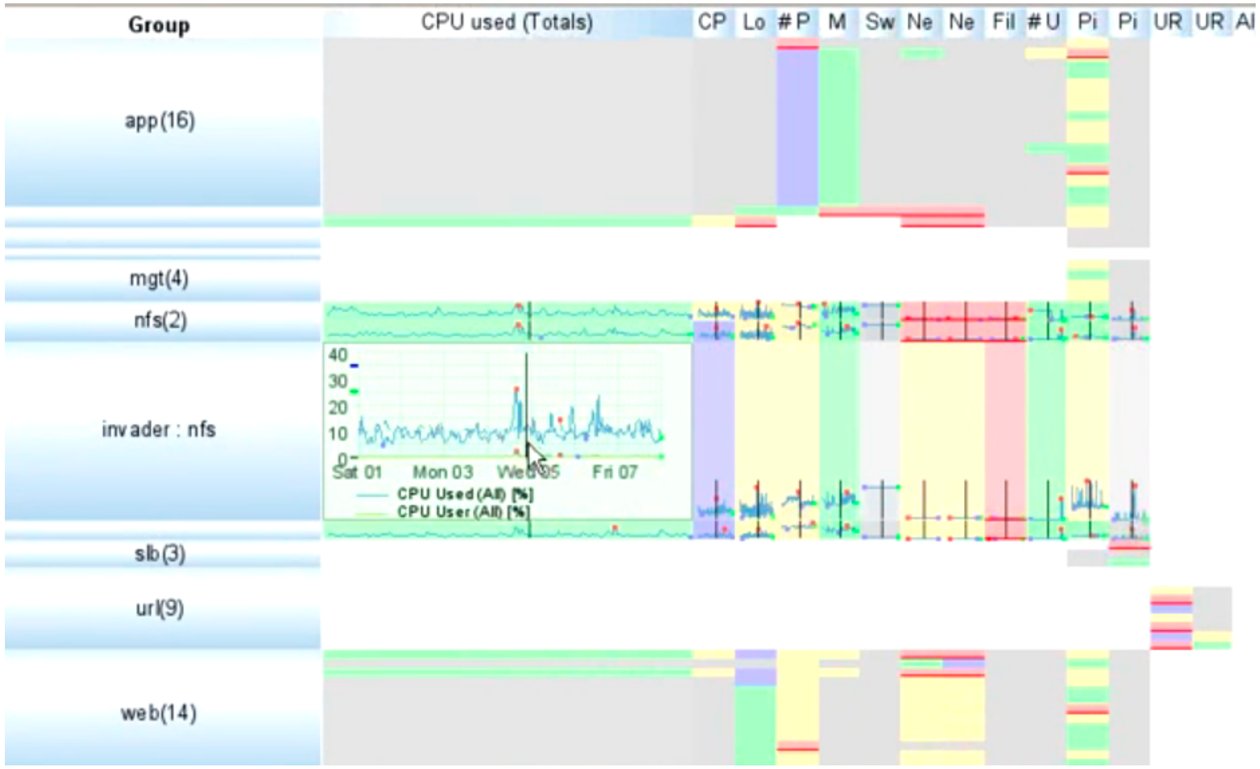
Semantic Zoom

Semantic Zooming

As you zoom in, content is updated

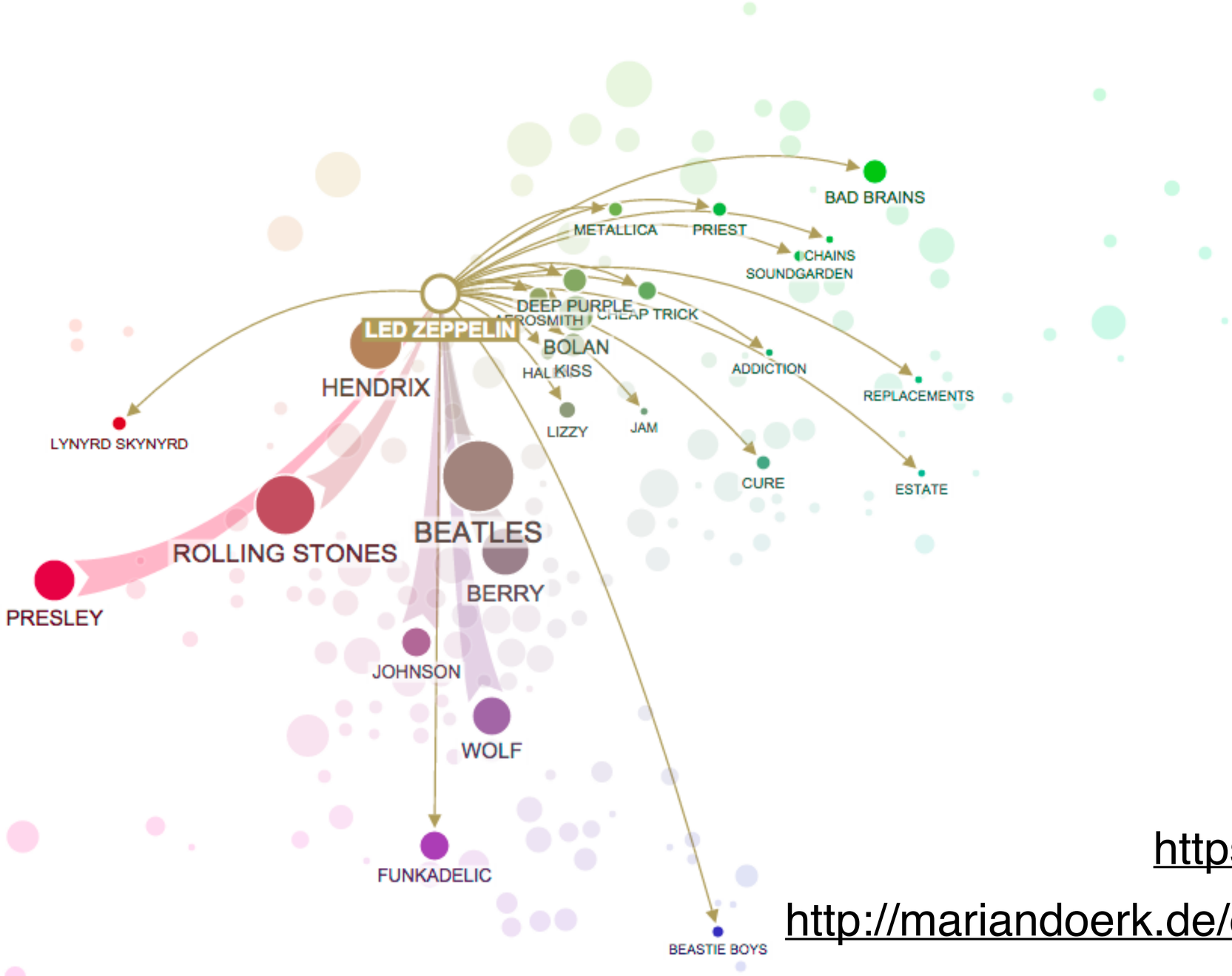
More detail as more space becomes available

Ideally readable at multiple resolutions



[McLachlan 2008]

Design Critique



https://goo.gl/IDRXDl

http://mariandoerk.de/edgemaps/demo/

Focus + Context

Focus + Context

carefully pick what to show

hint at what you are not showing

Focus + Context

synthesis of **visual encoding and interaction**

user selects region of interest (focus)
through navigation or selection

provide context through

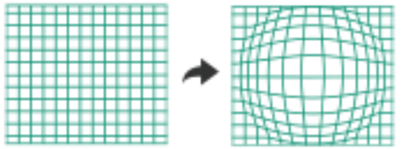
- aggregation
- reduction
- layering

Embed

- Elide Data

- Superimpose Layer

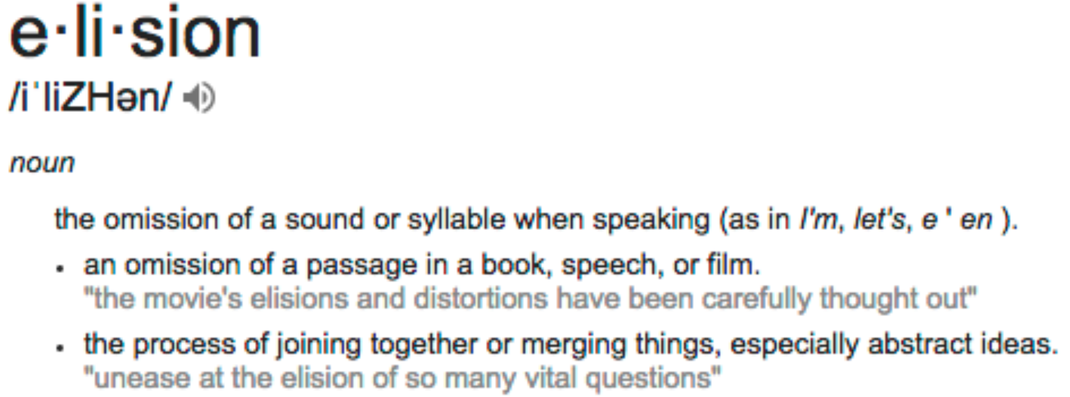
- Distort Geometry



Elision

focus items shown in detail,

other items summarized for context



e·li·sion

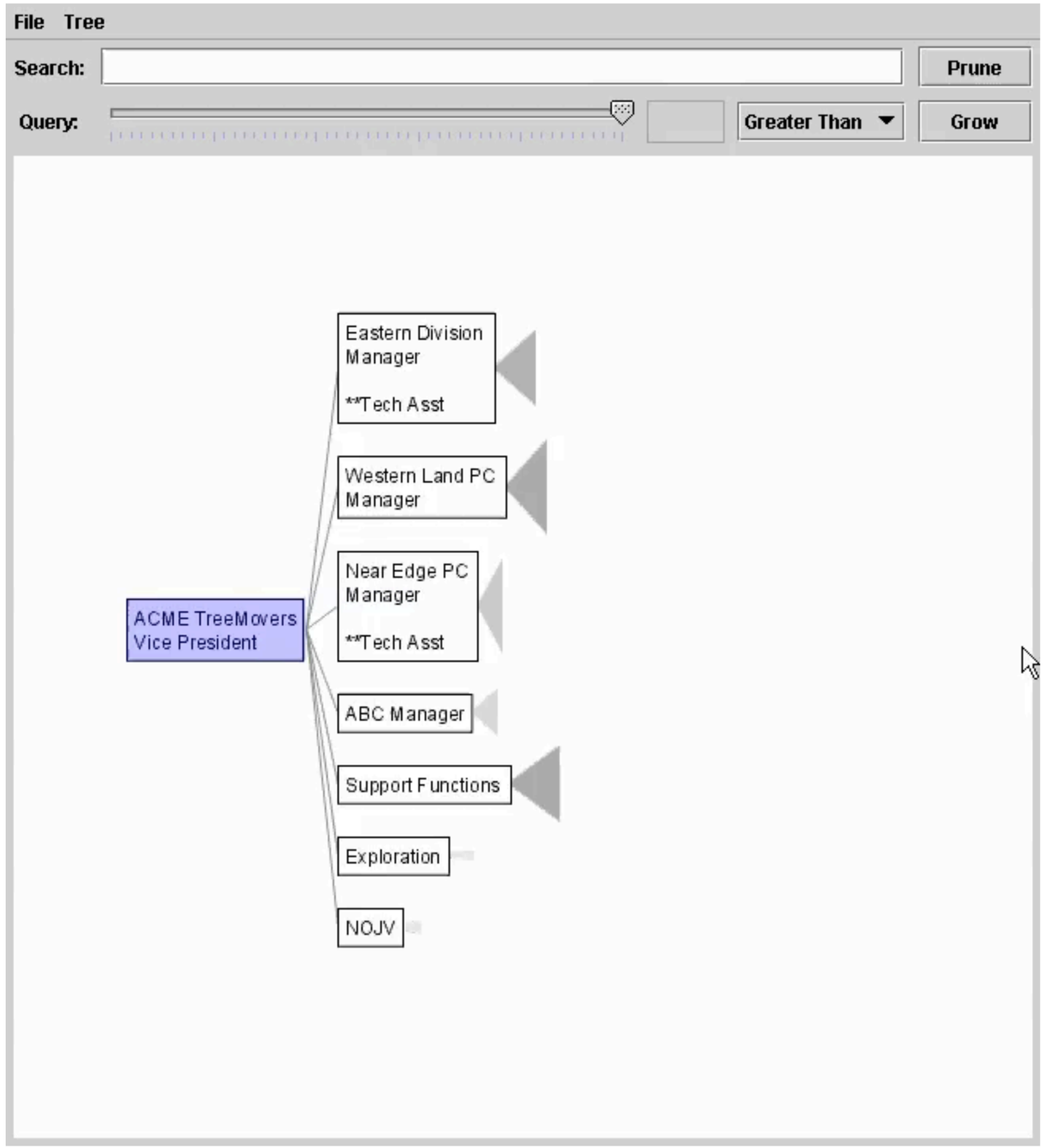
/iˈliZHən/

noun

the omission of a sound or syllable when speaking (as in *I'm*, *let's*, *e ' en*).

- an omission of a passage in a book, speech, or film.
  "the movie's elisions and distortions have been carefully thought out"
- the process of joining together or merging things, especially abstract ideas.
  "unease at the elision of so many vital questions"

SpaceTree



Grosjean 2002

Degree of Interest (DOI)

based on observation that humans often represent their own neighborhood in detail, yet only major landmarks far away

goal is balance between local detail and global context

$$DOI(x) = API(x) - D(x,y)$$

API - a priori interest
D - a distance function to the current focus
can have multiple foci

Furnas 1986

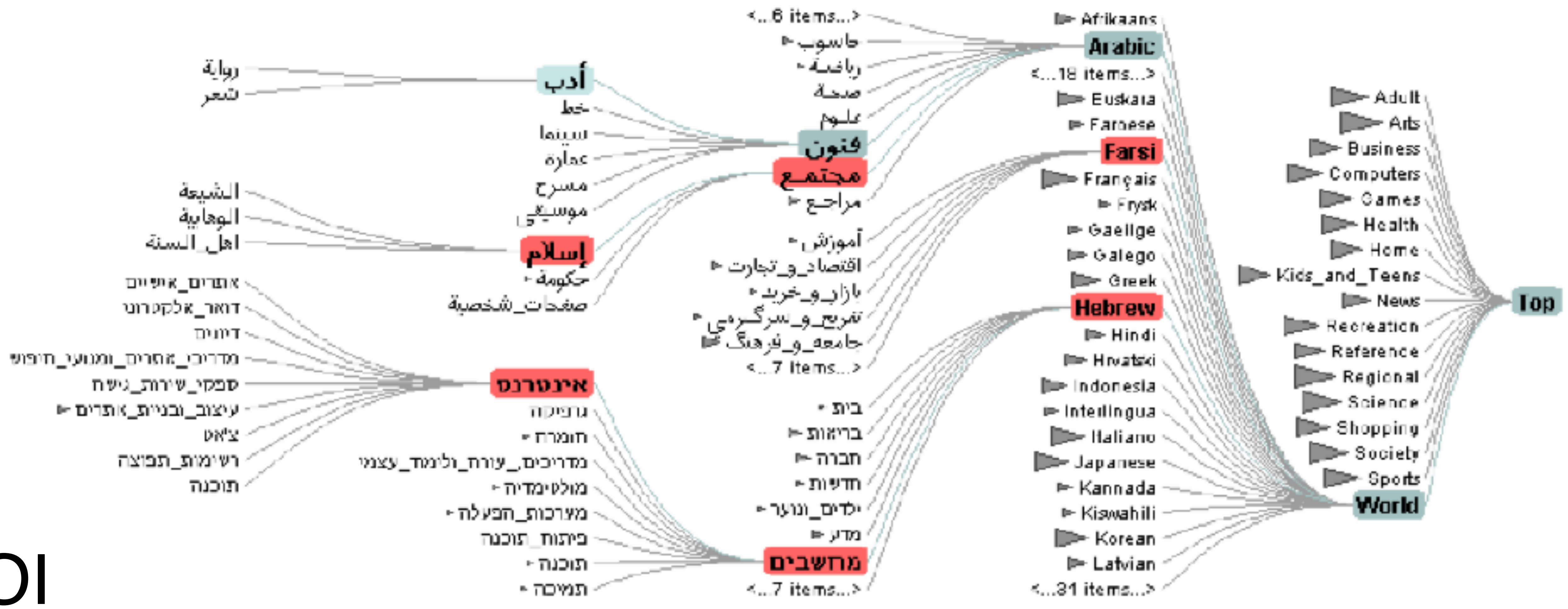
DOI Tree

interactive trees with animated transitions that fit within a bounded region of space

layout depends on the user's estimated DOI

use:

- logical filtering based on DOI
- geometric distortion of node size based on DOI
- semantic zooming on content based on node size
- aggregate representations of elided subtrees



[Heer 2004]

Superimpose

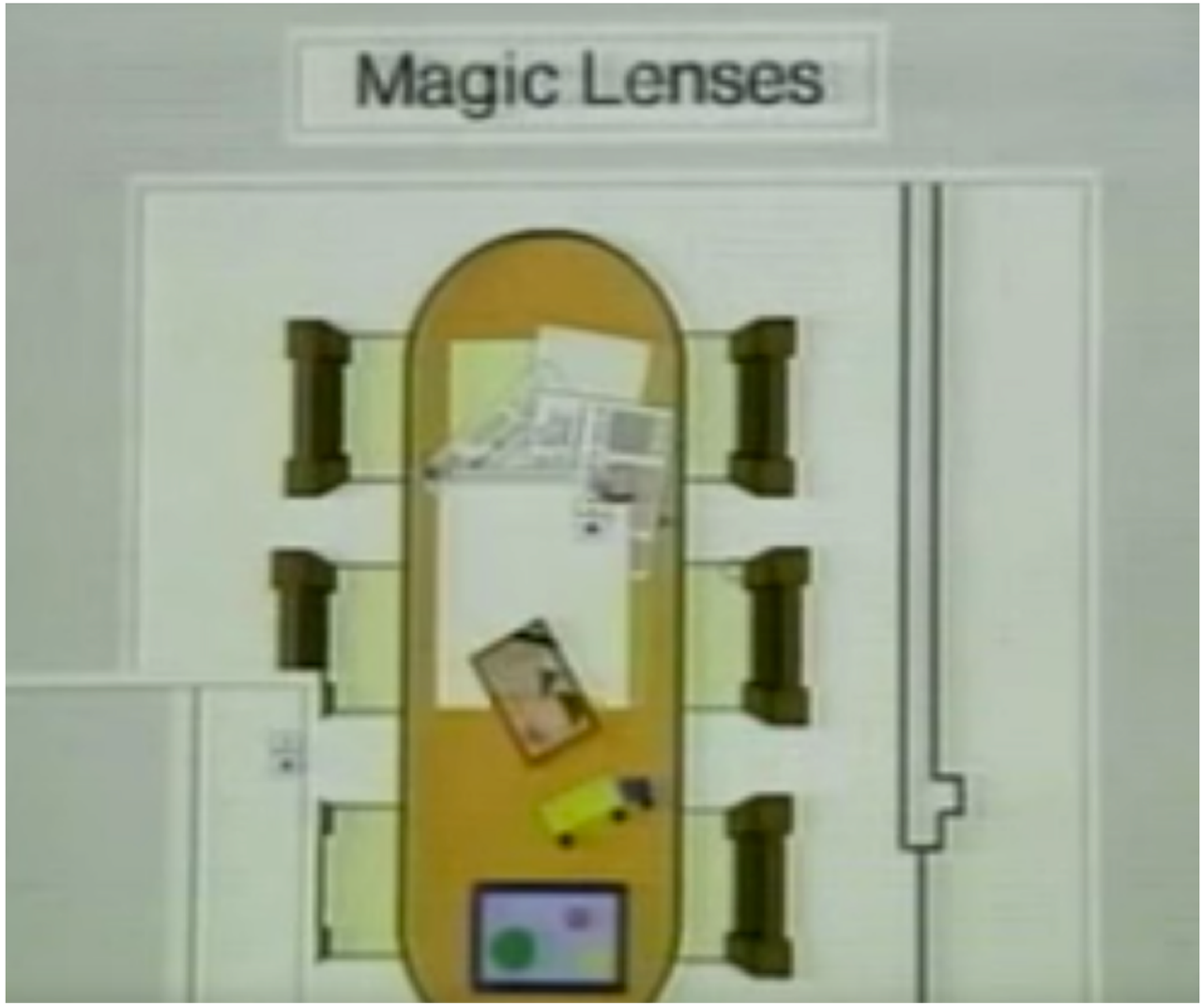
focus layer limited to a local region of view,

instead of stretching across the entire view

Toolglass & Magic Lenses

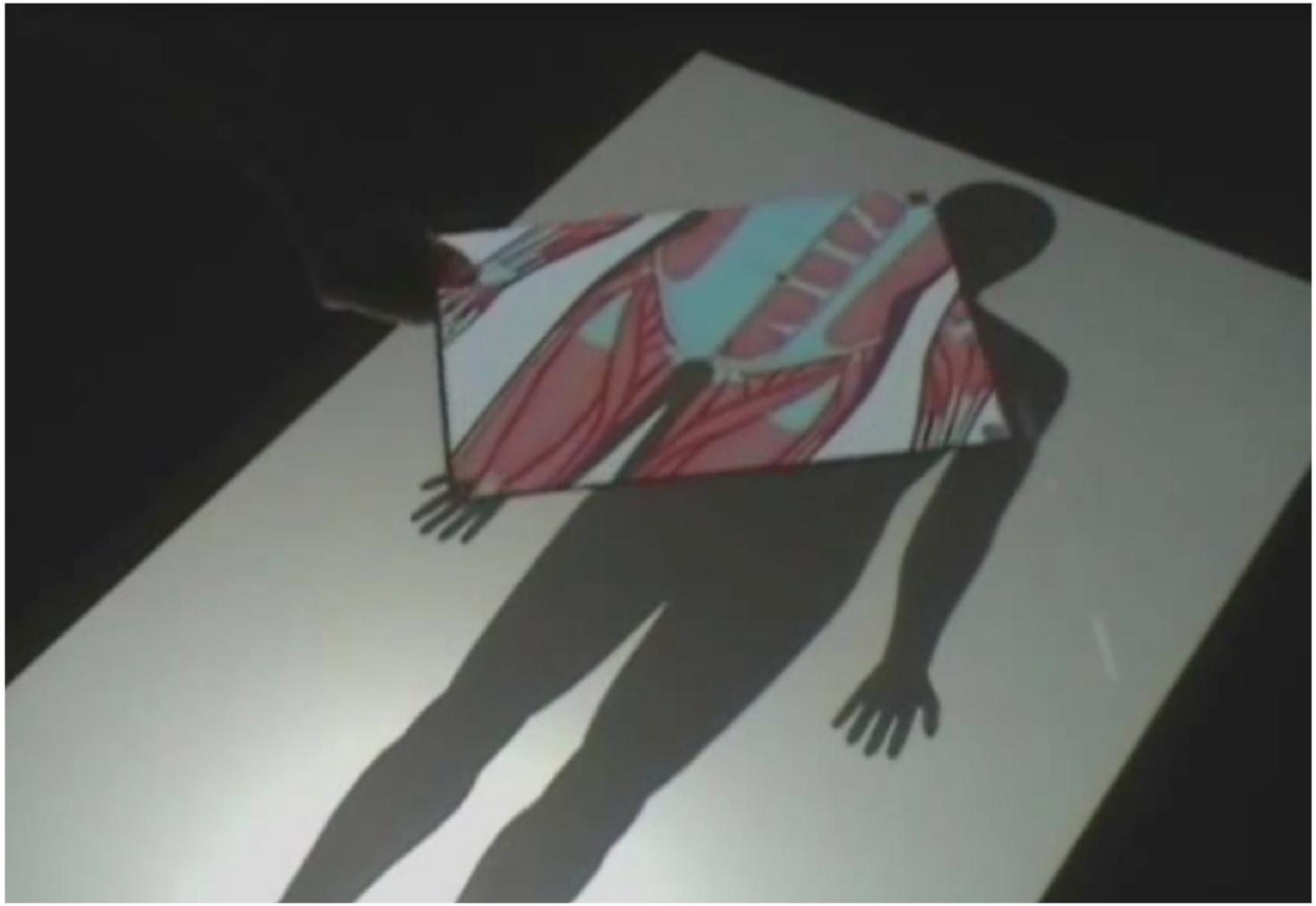
Magic Lense:

details/different data is shown
when moving a lens
over a scene



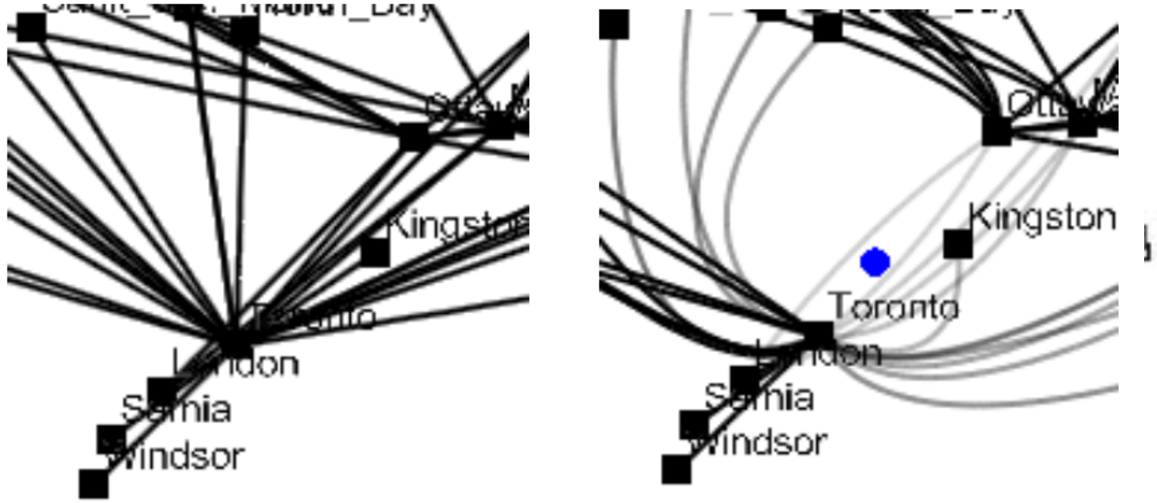
[Bier, Siggraph 1993]

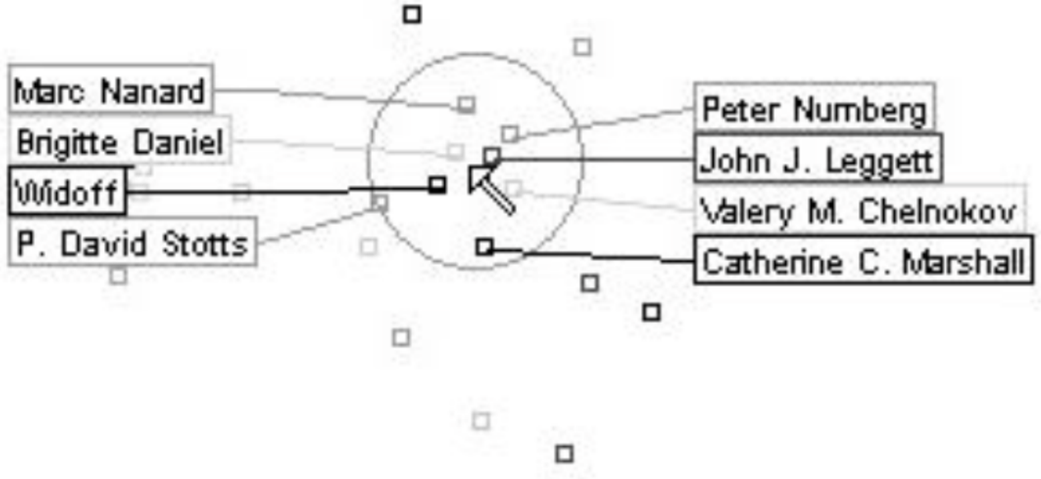
Magic Lense with Tangible Interface



[Spindler, CHI 2010]

Magic Lense: Edges & Labeling



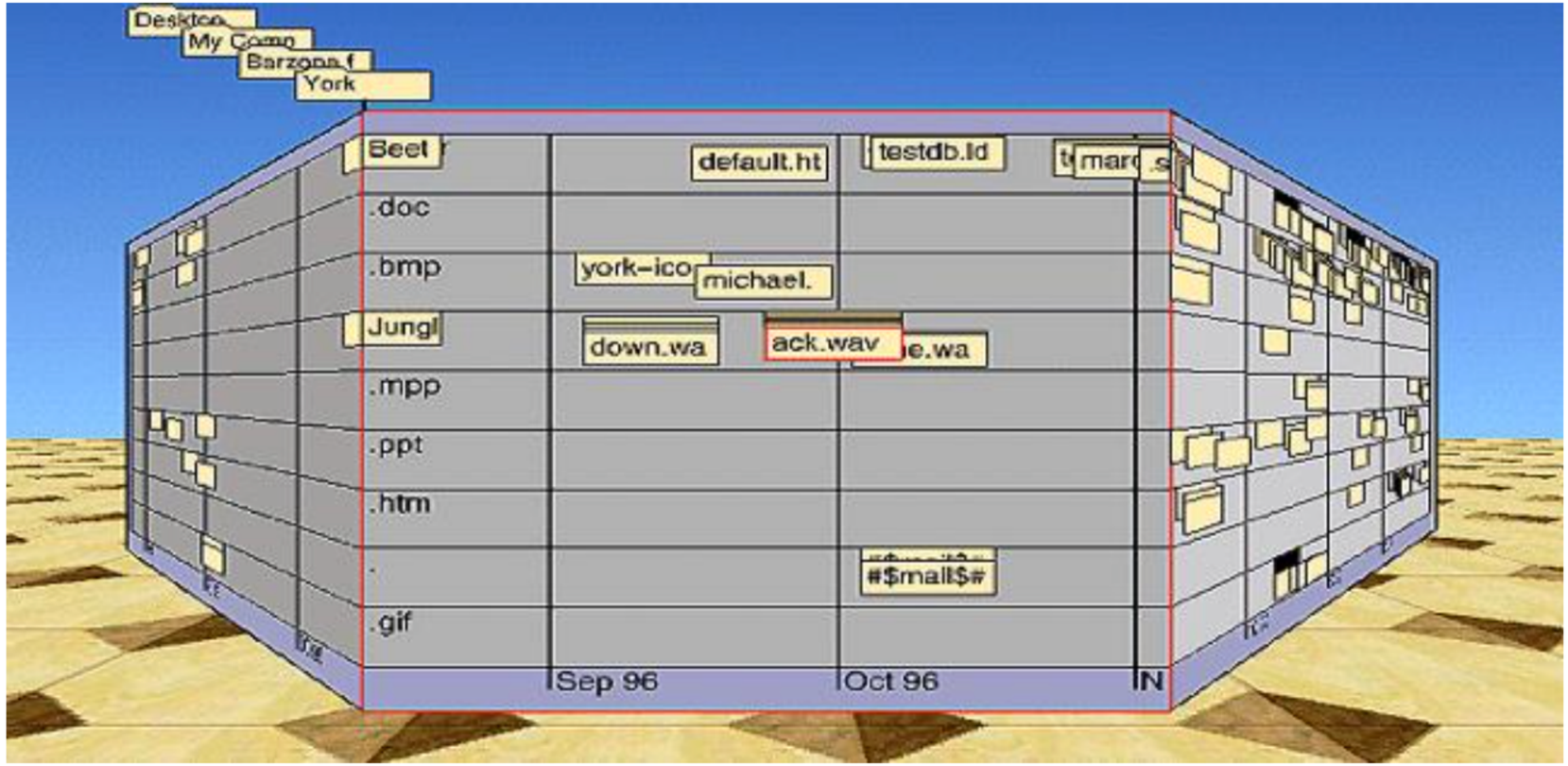


[Fekete and Plaisant, 1999]

Distortion

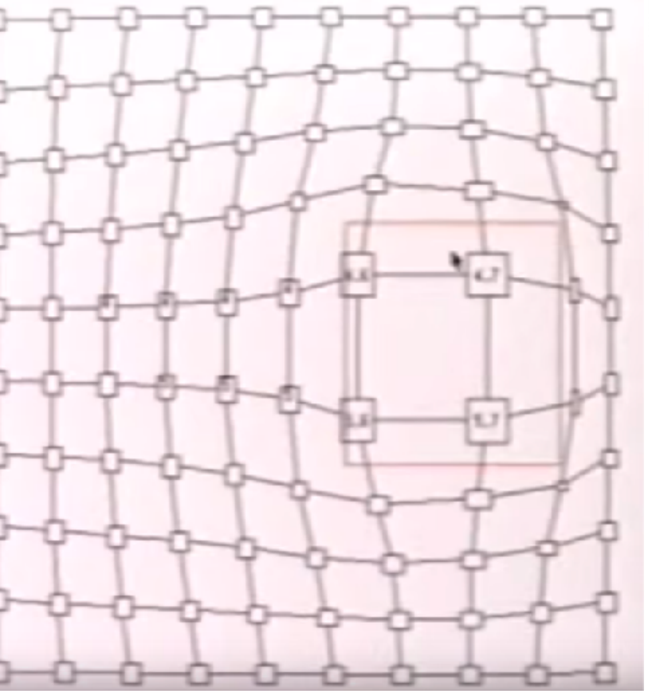
use geometric distortion of the contextual regions to make room for the details in the focus region(s)

Perspective Wall

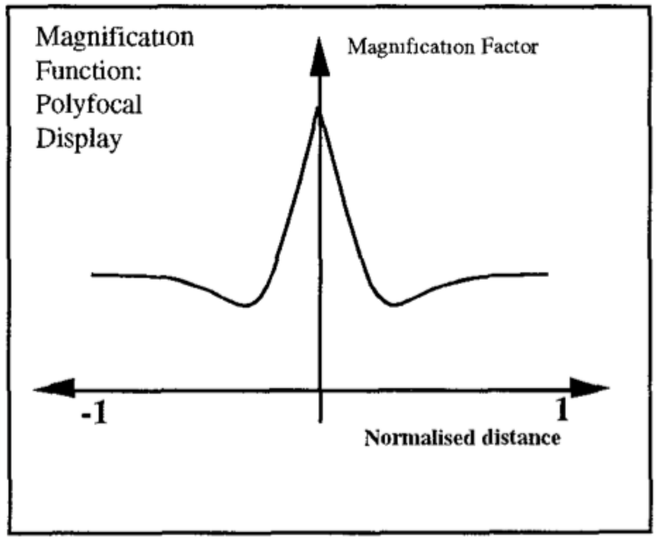


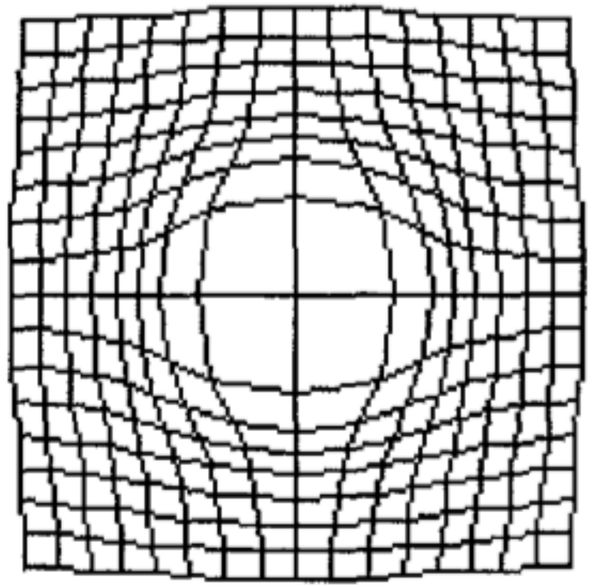
[Mackinlay, 1991]

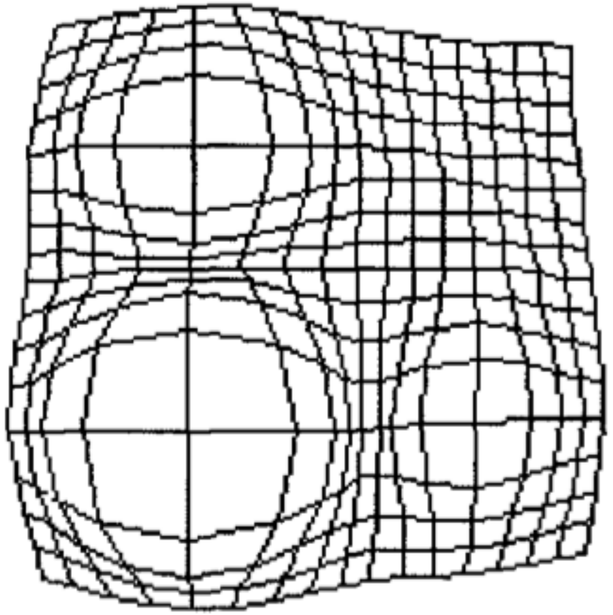
Fisheye



[Sarkar, 1993]

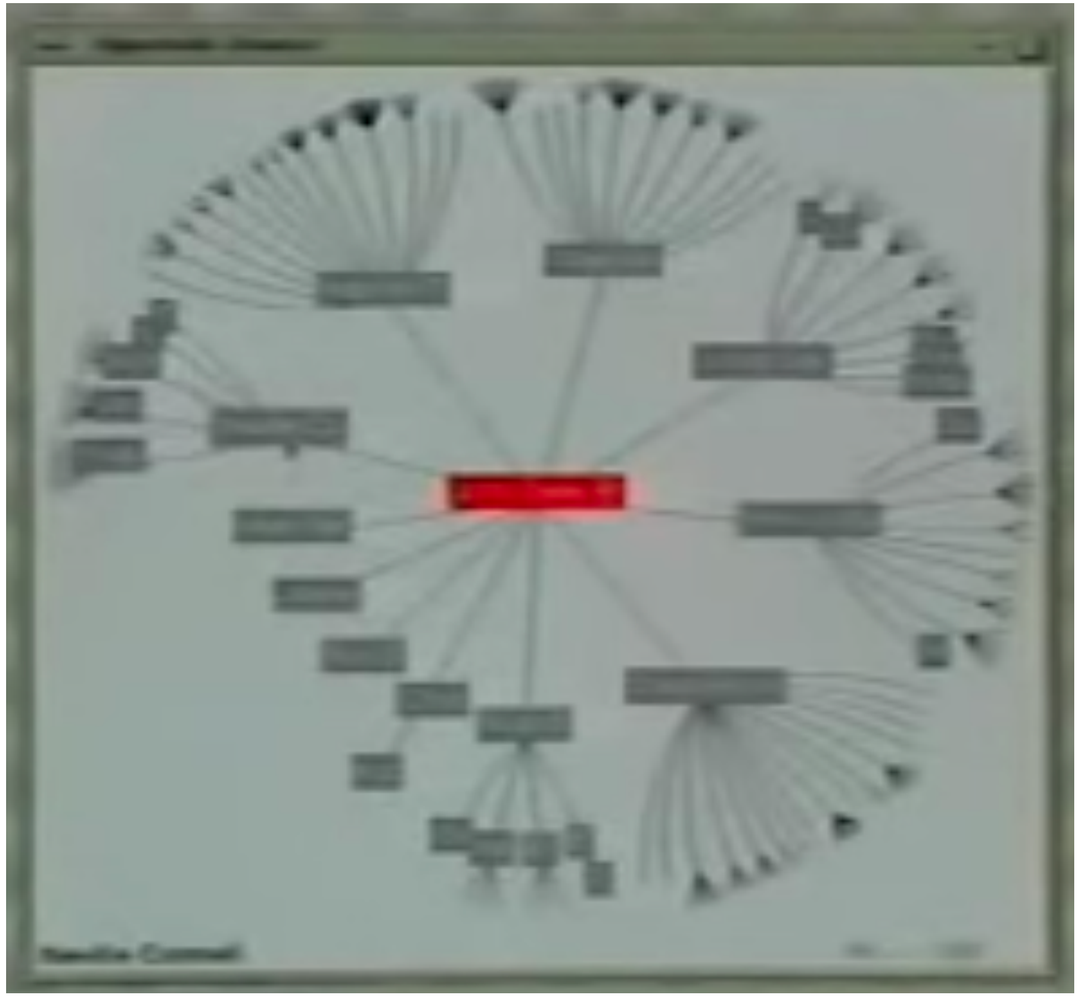






Leung 1994

Hyperbolic Geometry



[Lamping, 1995]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Vancouver
Seattle
Spokane
Washington
Montana
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Minnesota
Portland
Minneapolis
Wisconsin
Michigan
South Dakota
Oregon
Idaho
Wyoming
Madison
Milwaukee
Detroit
Toledo
Chicago
Iowa
Nebraska
Omaha
Lincoln
Illinois
Salt Lake City
Kansas City
Indiana
Ohio
Nevada
Utah
Colorado
United States
St. Louis
Missouri
Kansas
Sacramento
Stockton
California
Las Vegas
Bakersfield
Wichita
Tulsa
Oklahoma
Arkansas
Kentucky
West Virginia
Virginia
Tennessee
Albuquerque
Arizona
New Mexico
Los Angeles
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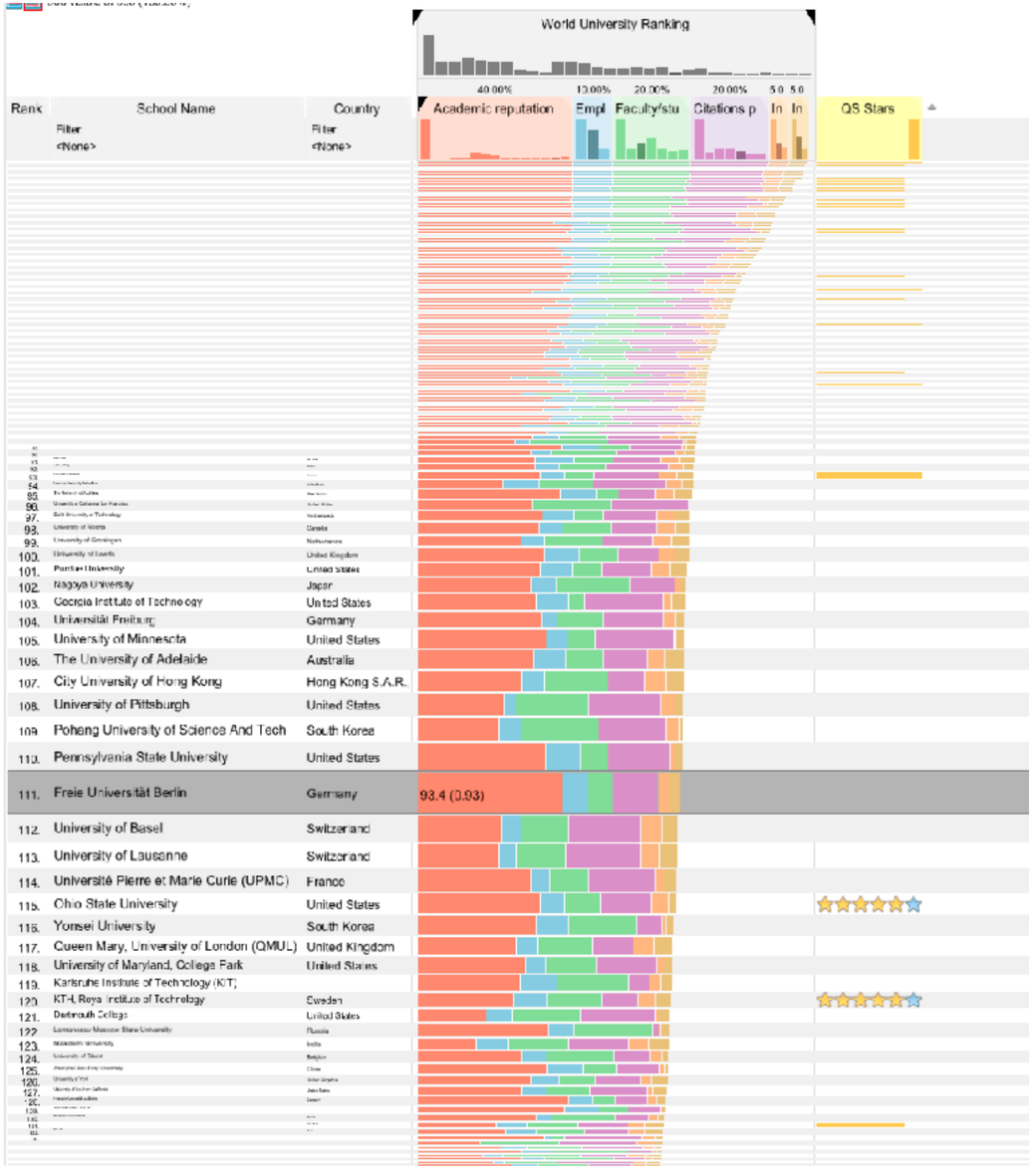
http://pmcruz.com/information-visualization/data-lenses



Fisheye Tree View

ctominski

Subscribe 2

100 views

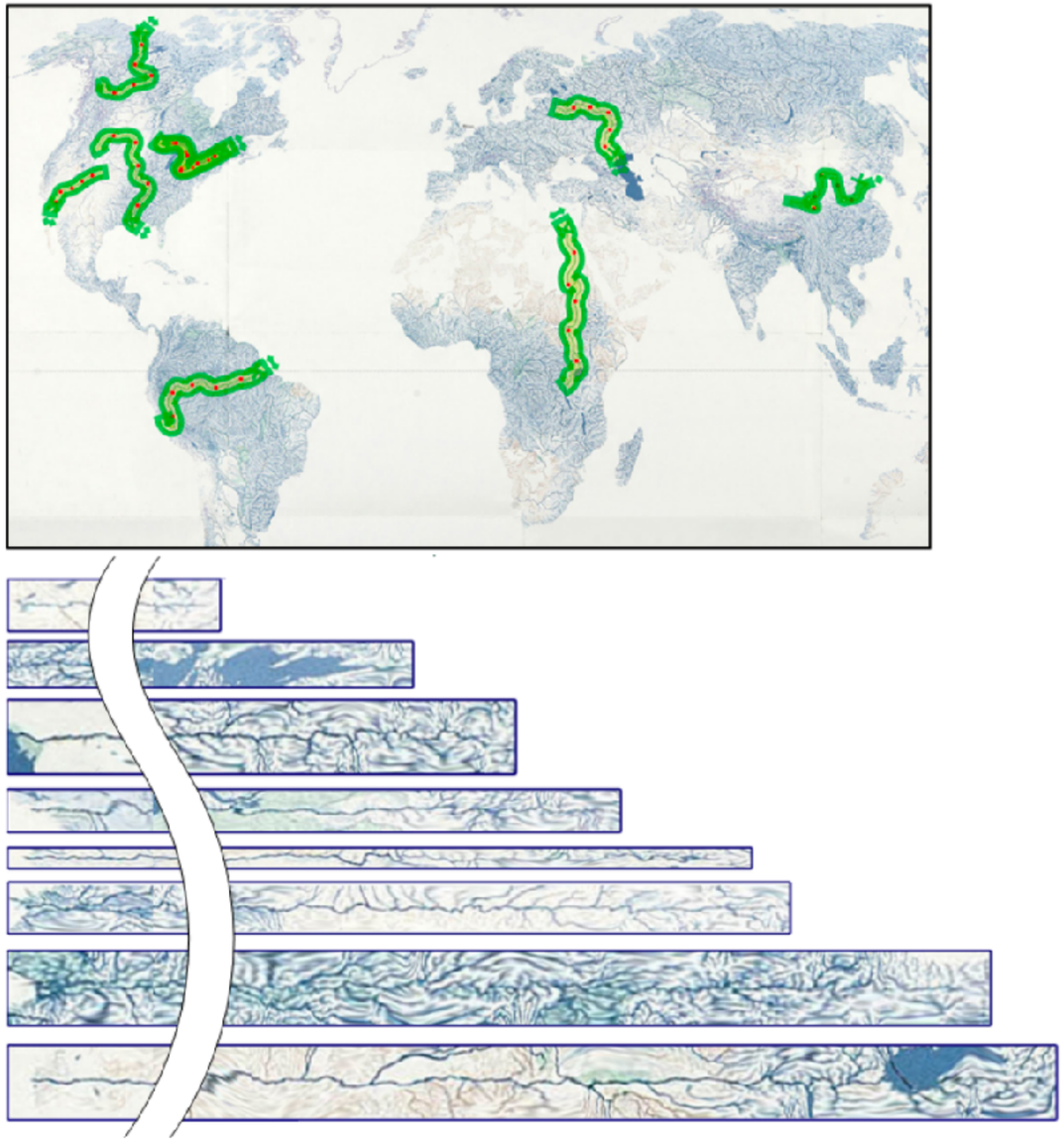
Add to Share More

0 0

Transmorgification

Idea: straighten complex shapes in image space

Can be spatial data,
but also other vis techniques



[Brosz, 13]

Distortion Concerns

unsuitable for relative spatial judgements

overhead of tracking distortion

visual communication of distortion

- gridlines, shading

target acquisition problem

- lens displacing items away from screen location

mixed results compared to separate views and temporal navigation

Filtering

aka brushing, aka selecting

& dynamic querying

The MANTRA

Visual Information Seeking Mantra (Shneiderman, 1996)

Overview first,

zoom and filter,

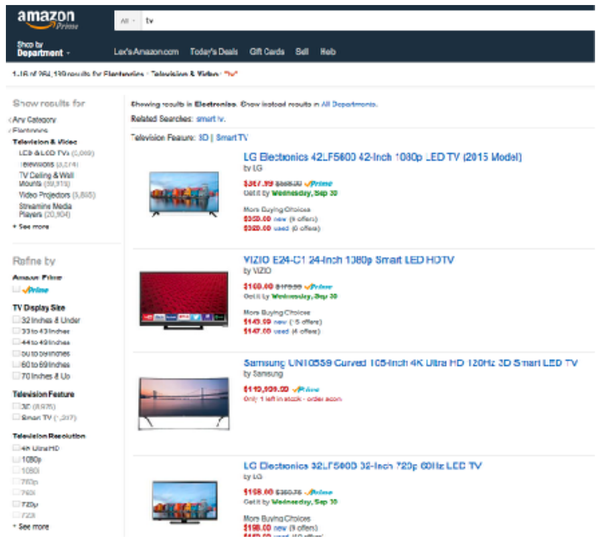
then details on demand

relate, history, extract

Dynamic Queries

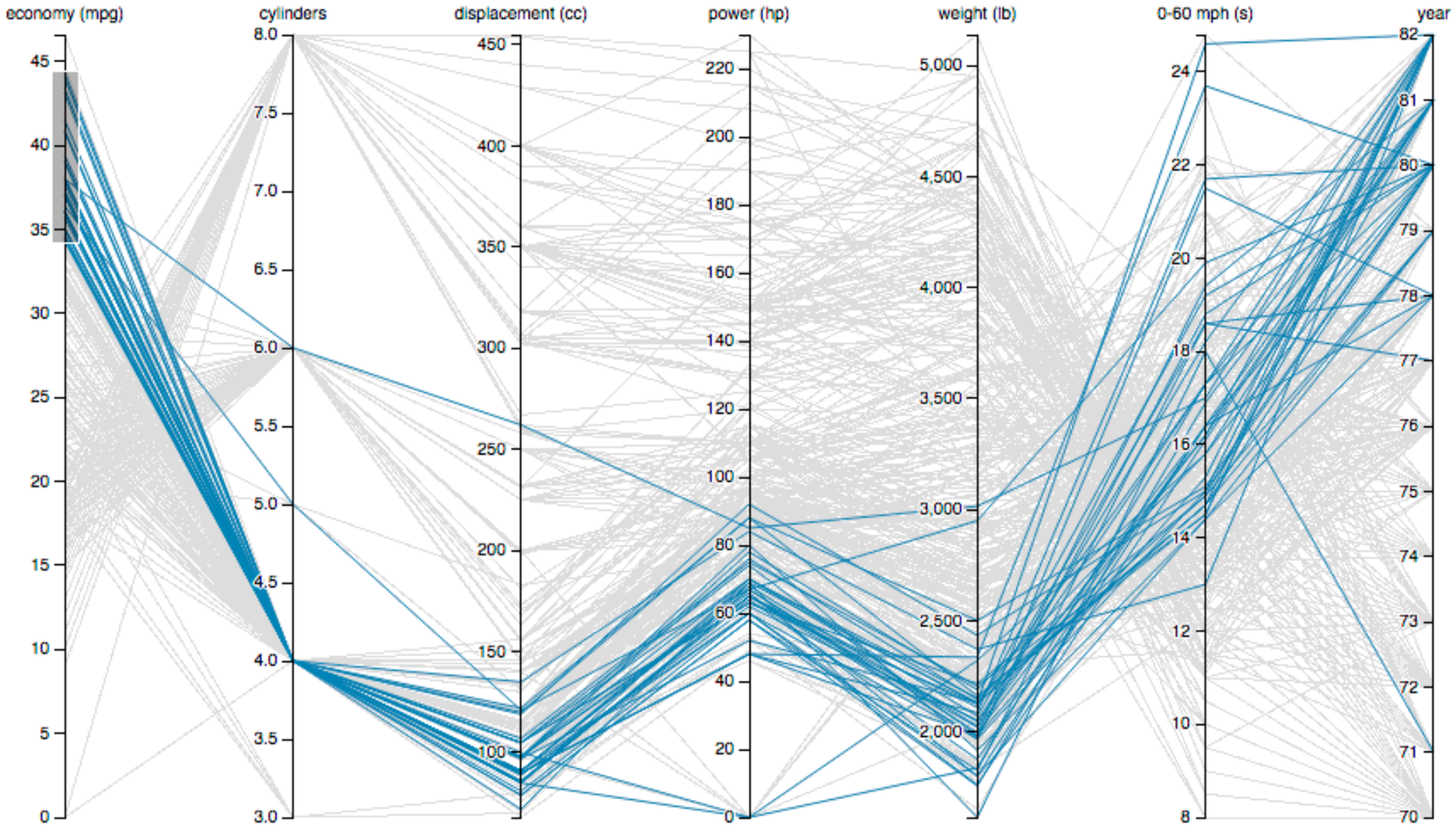
Define criteria for inclusion/ exclusion

“Faceted Search”

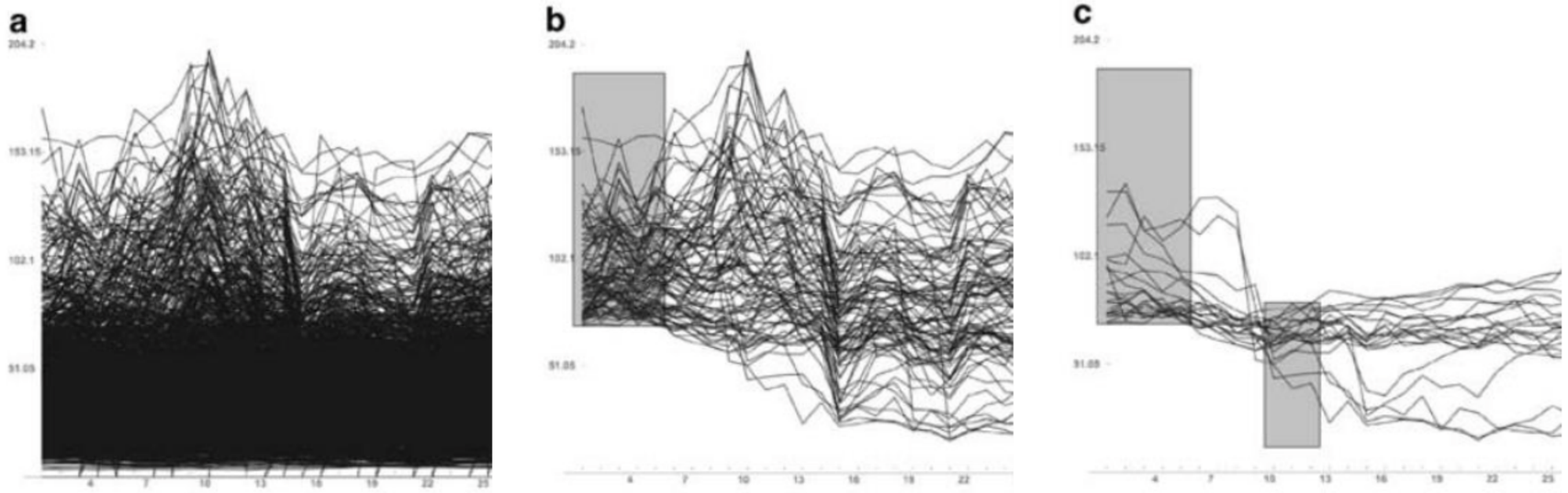


[Ahlberg & Shneiderman, 1994]

Visual Queries

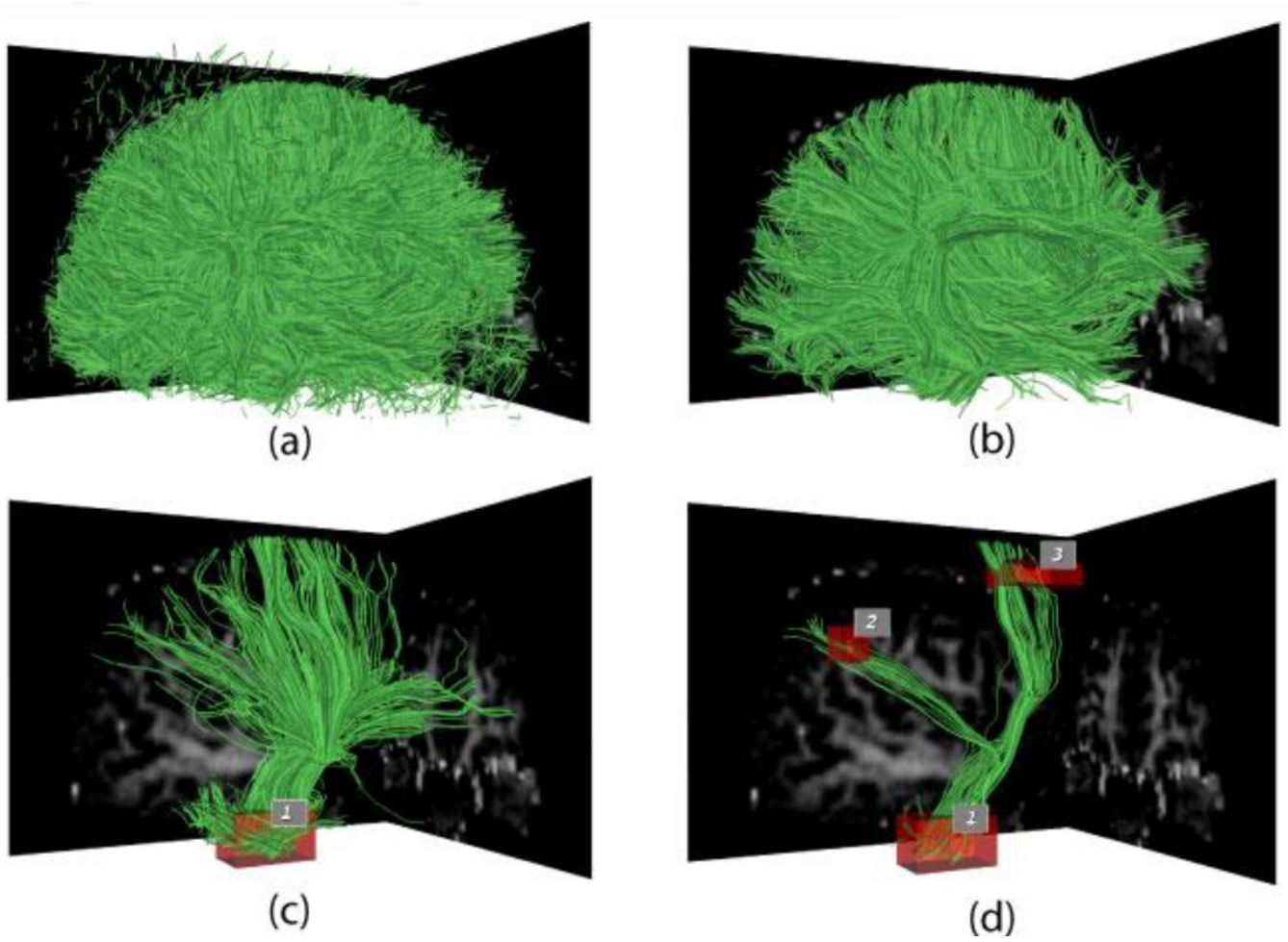


Visual Queries



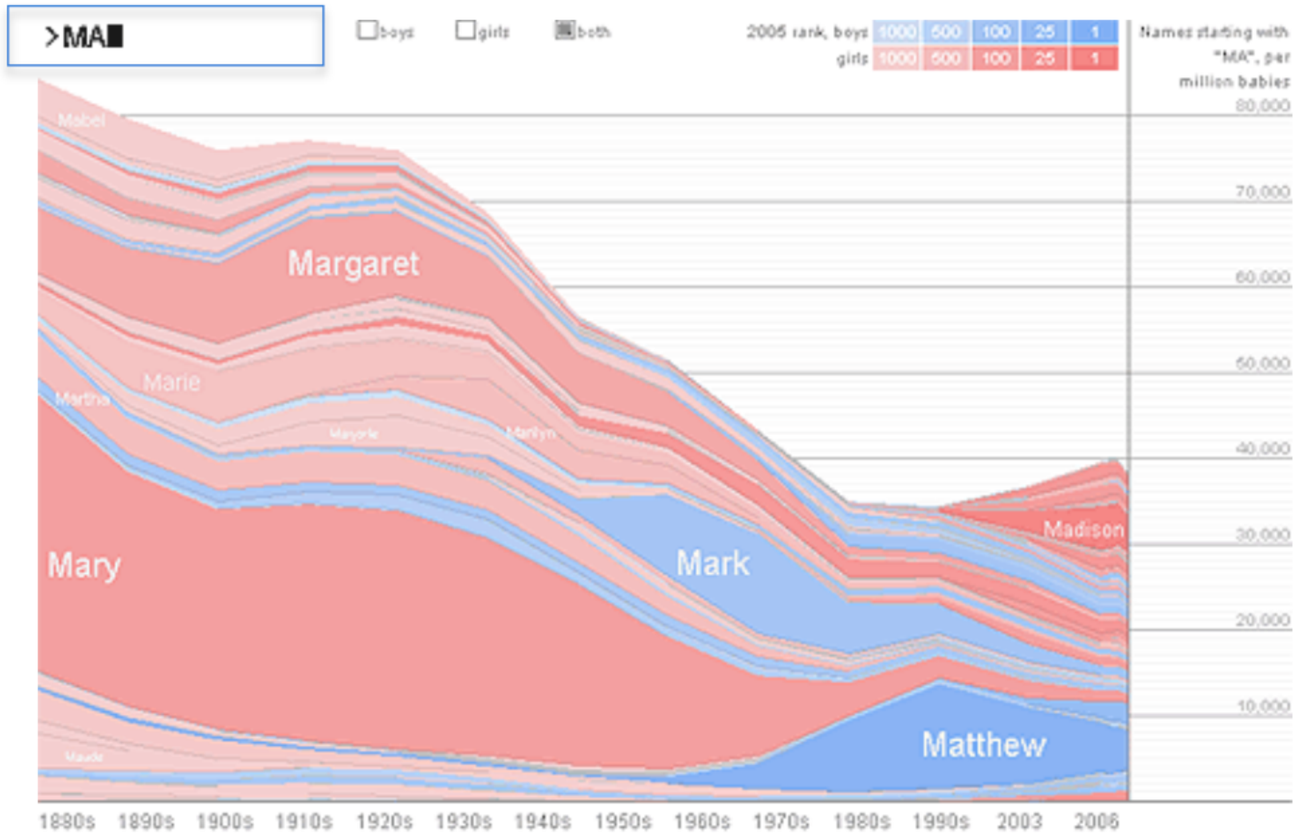
Time Searcher (Hocheiser, 2003)

Dynamic Querise for Volumetric Data

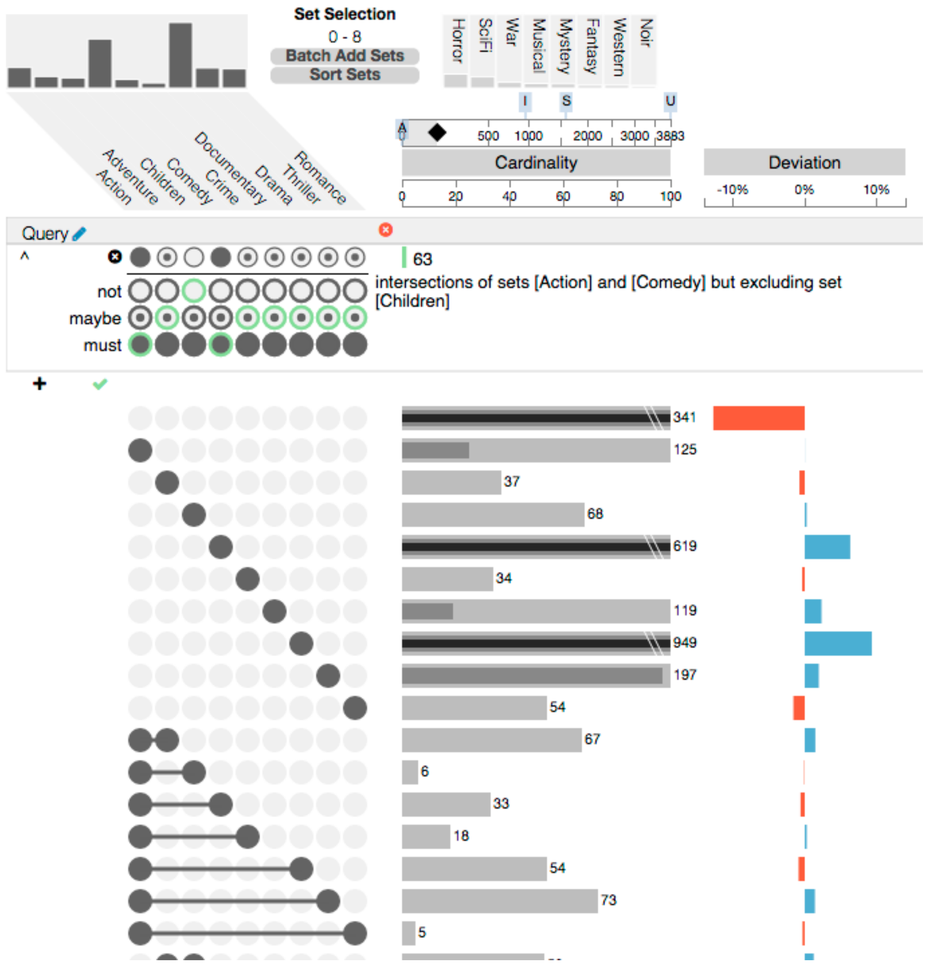


[Sherbondy 2004]

Incremental Text Search



Query Interfaces



More on Filters after the Fall Break!