CS-5630 / CS-6630 Visualization Interaction

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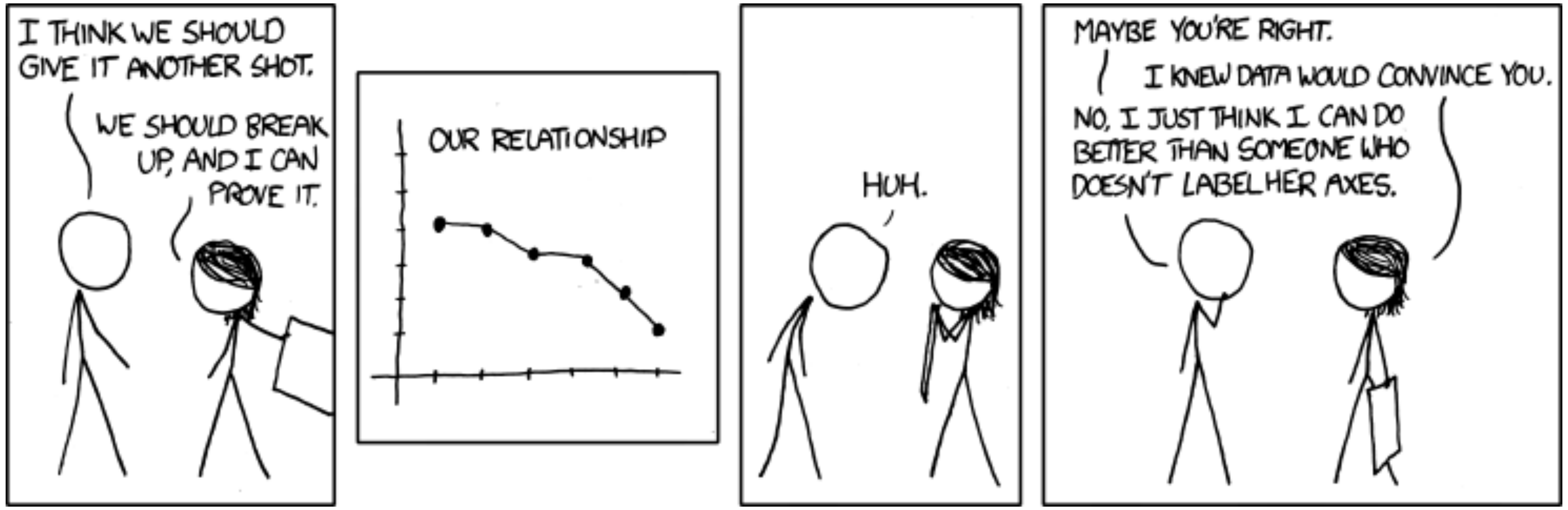
THE UNIVERSITY OF UTAH



[xkcd]

Administrativa

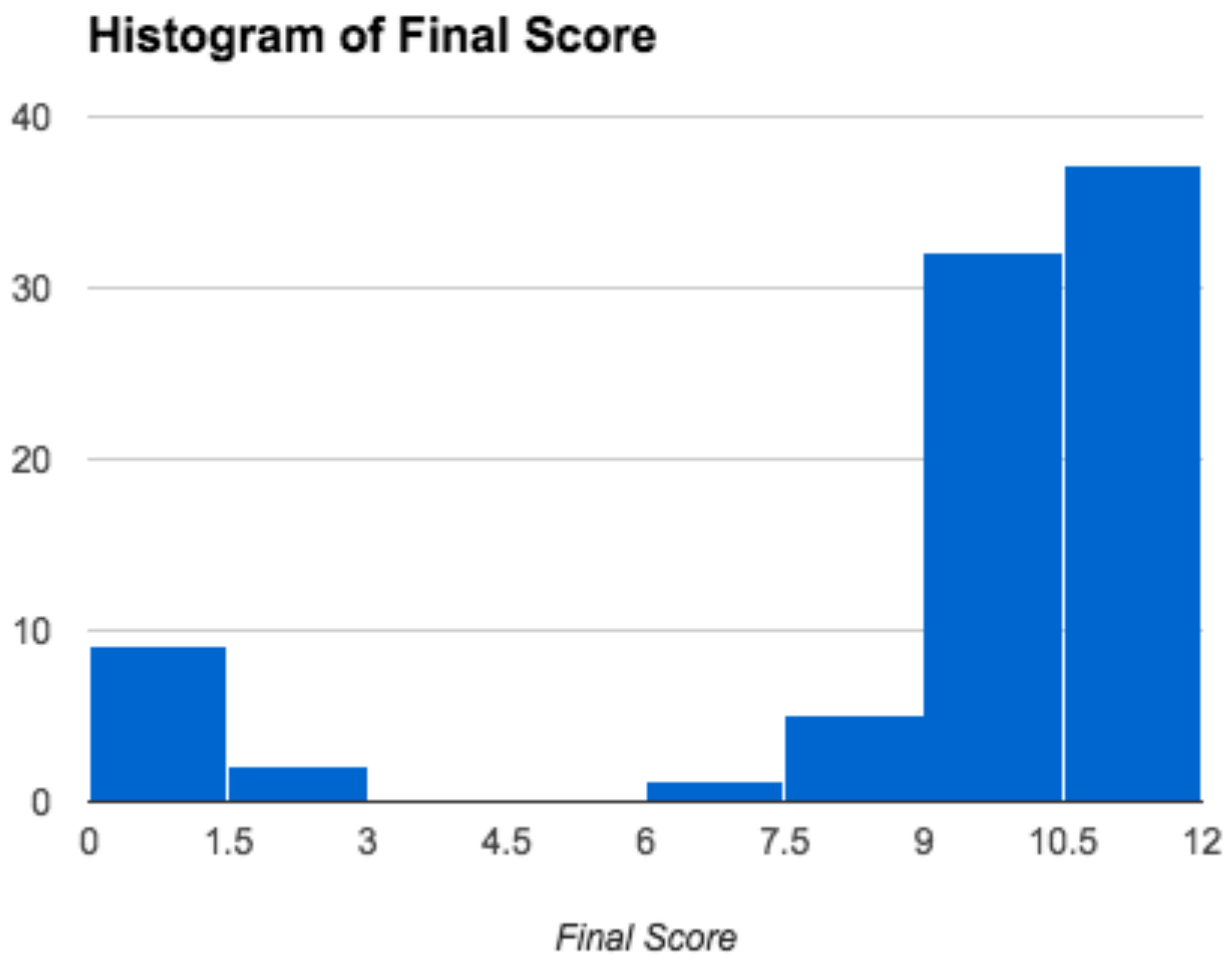
Homeworks 2 & 3

Homework 2

- Average score: 8.88
- Late Days used: 15

Homework 3

- Graded by Fall Break

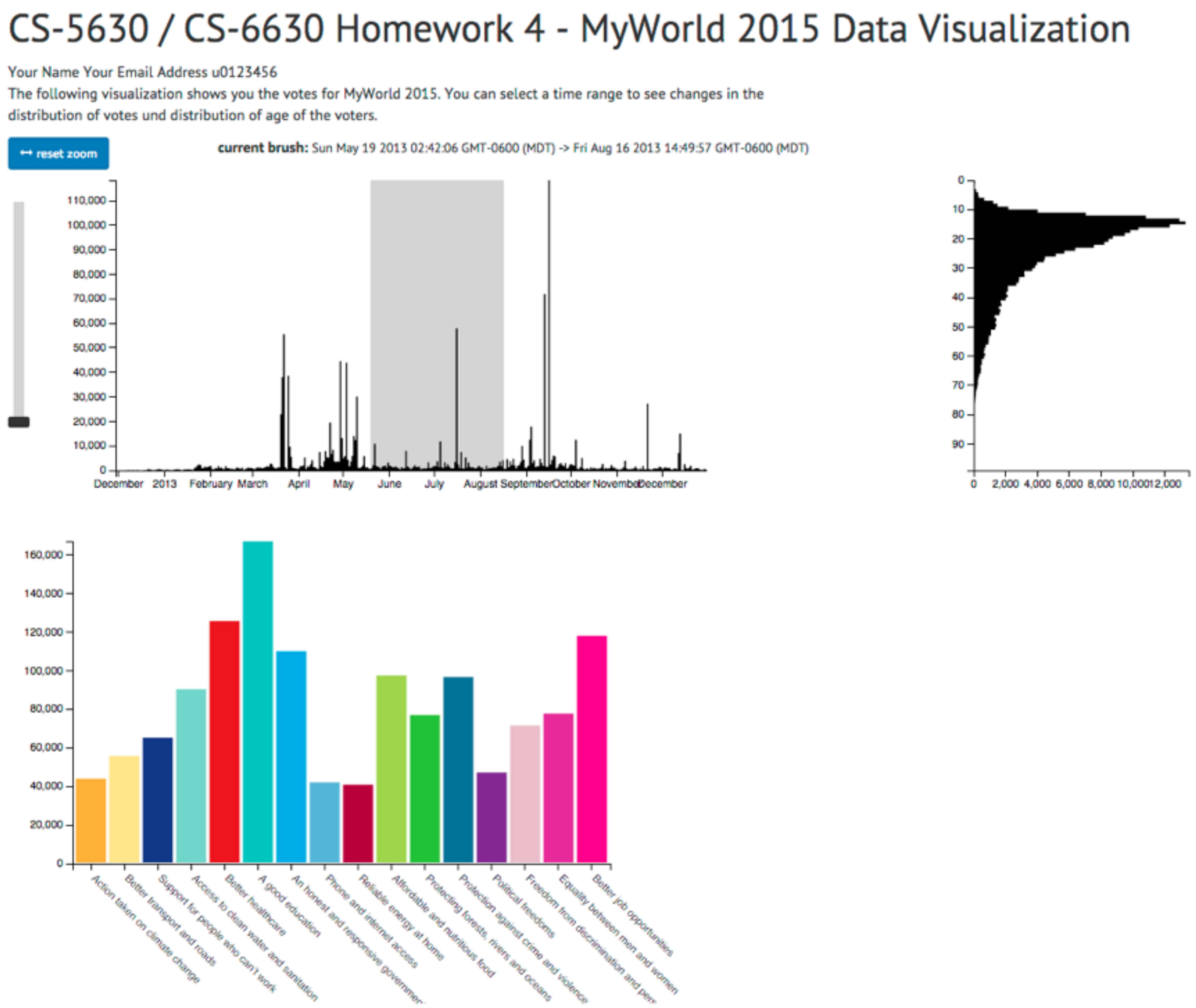


Homework 4

Reading and understanding

Use structure for your projects

Design your own solution for comparison task



Project

It’s time to start thinking about your project.

HW5: your project proposal, due Oct 23

- 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/2015/resources/#data-sources

http://dataviscourse.net/2015/project/

Project Requirements

Scope as agreed upon with TAs

Be ambitious! Define your goals and categorize them:

- must have, nice to have, etc.

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

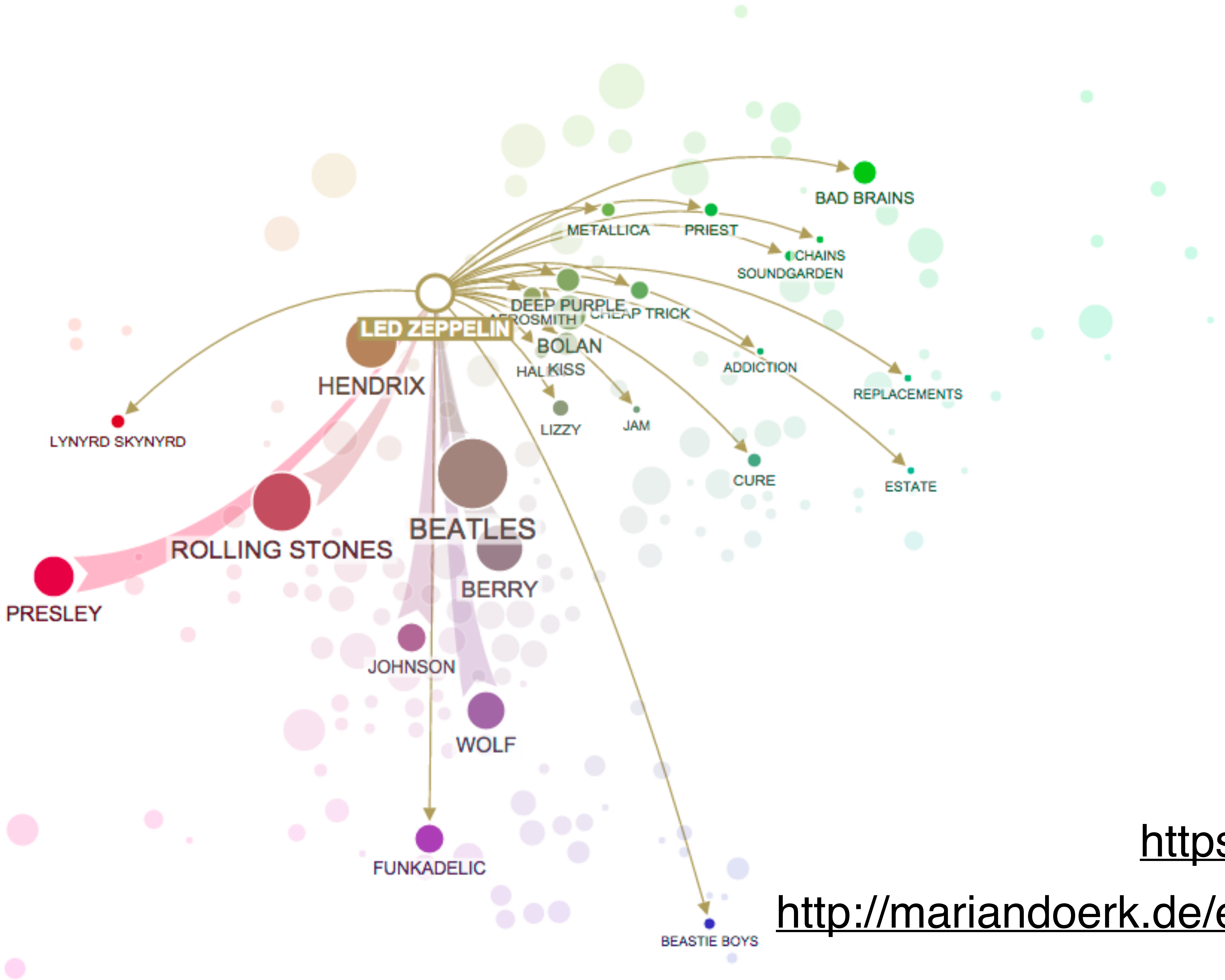
- Given a vis, analyze what's good/bad and redesign.

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.

Design Critique

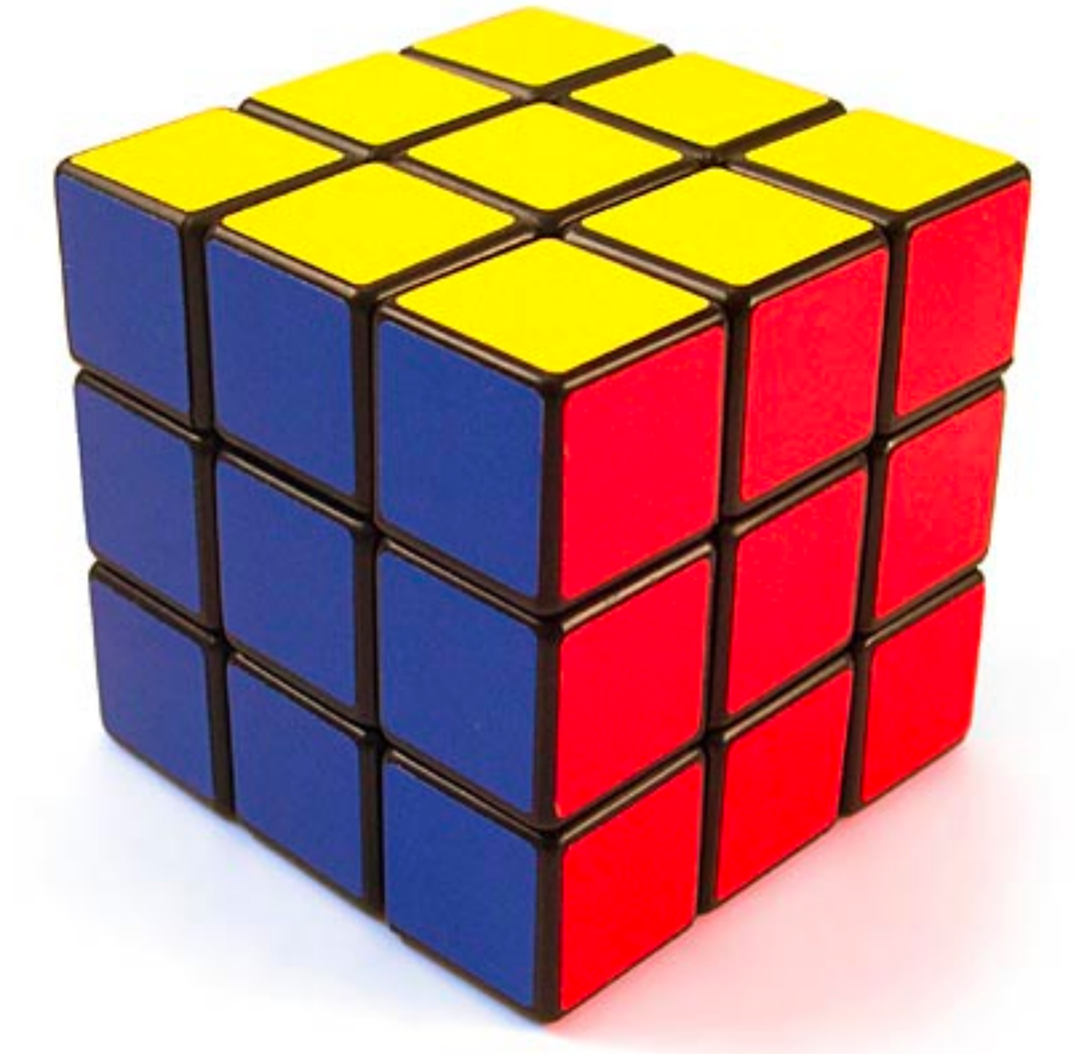


https://goo.gl/IDRXDI

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

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

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

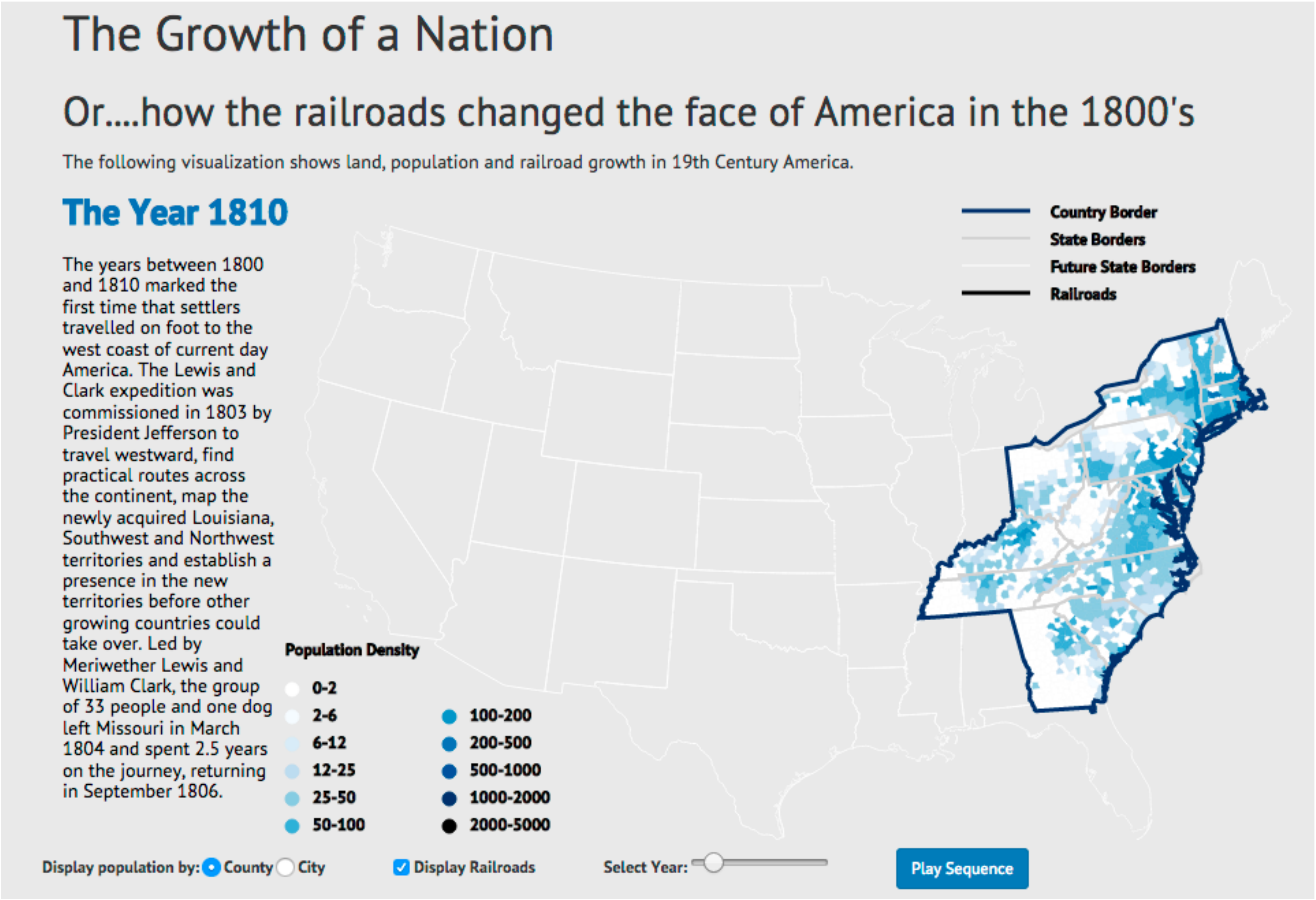
Next Lecture

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

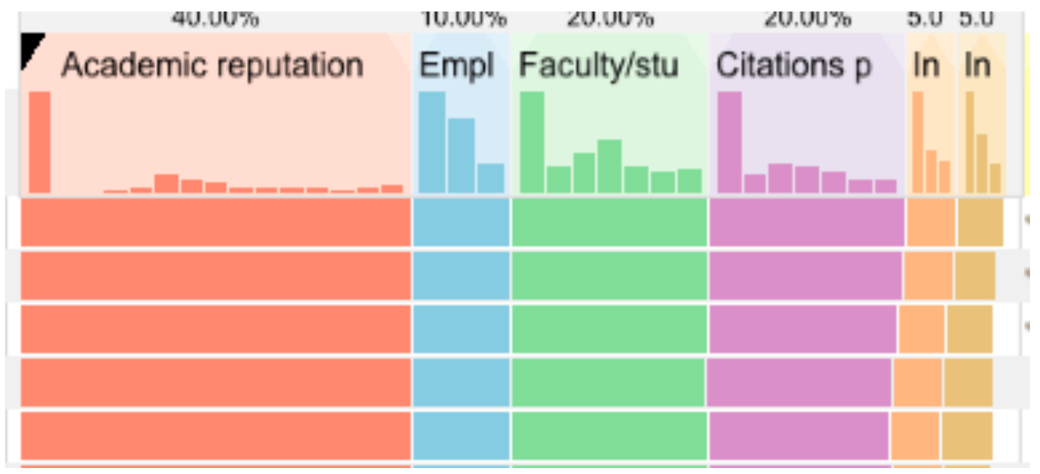


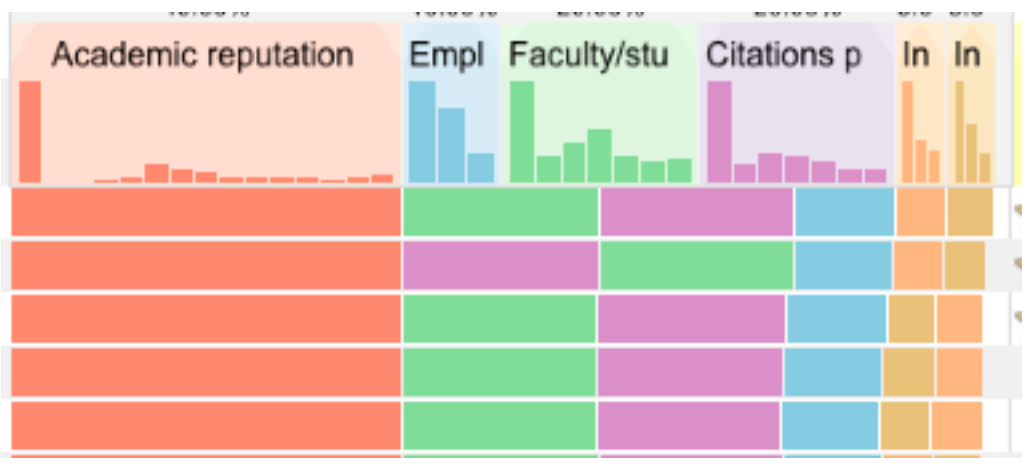
[Lauren Wood]

Change over Time

Doesn't have to be literal time:

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





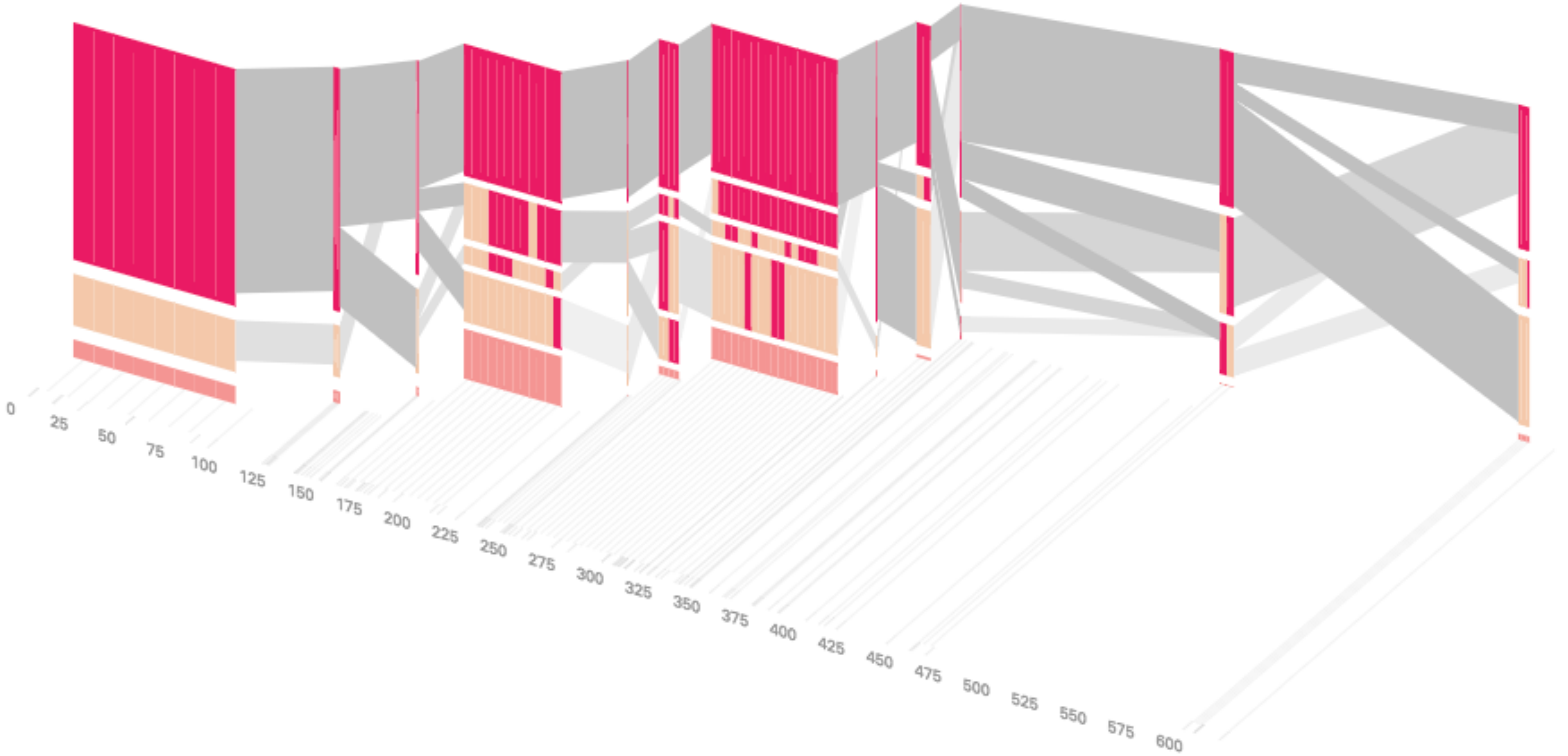
Why Transition?

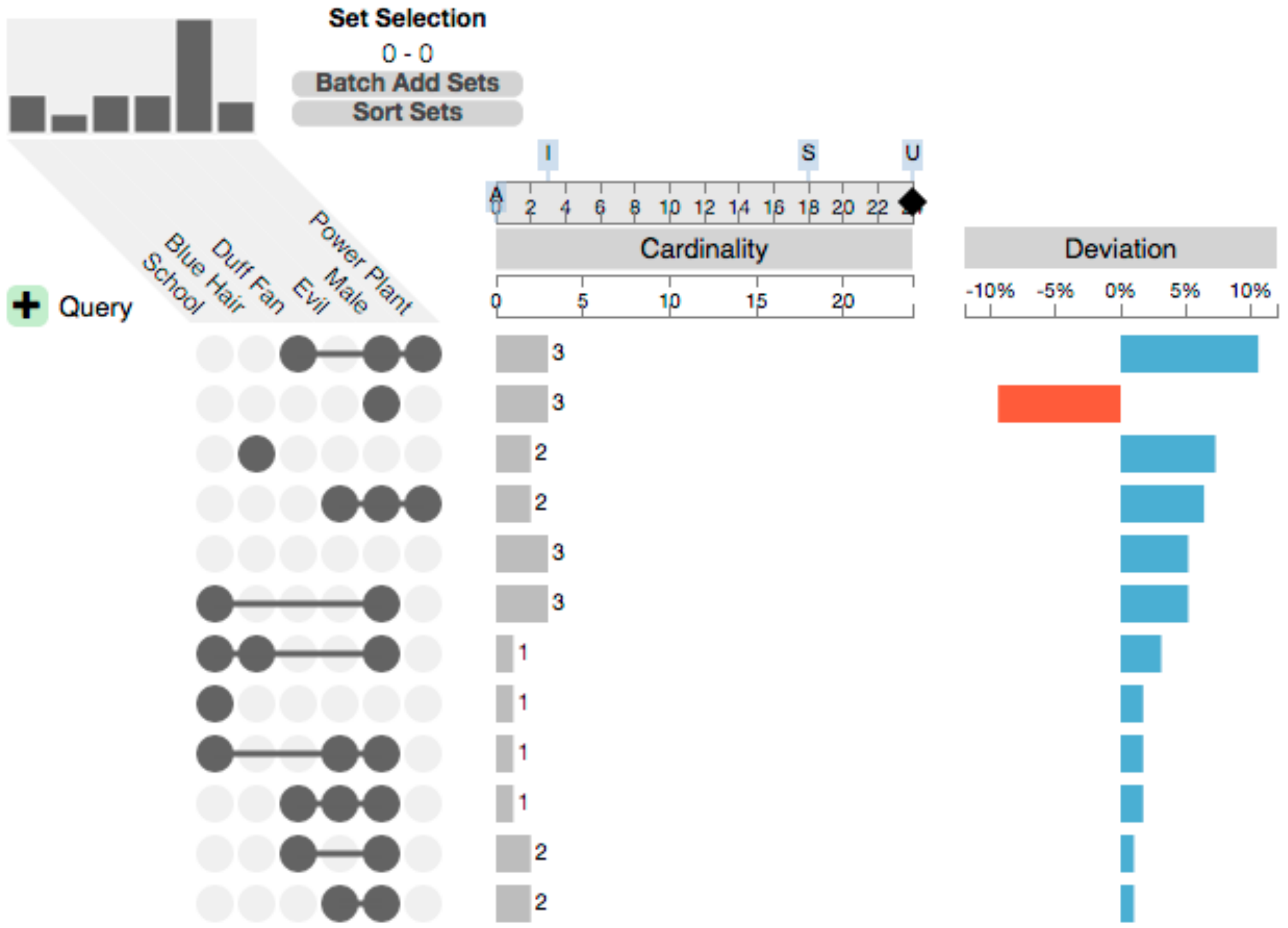
Different representations support different tasks

bar chart, vs stacked bar chart

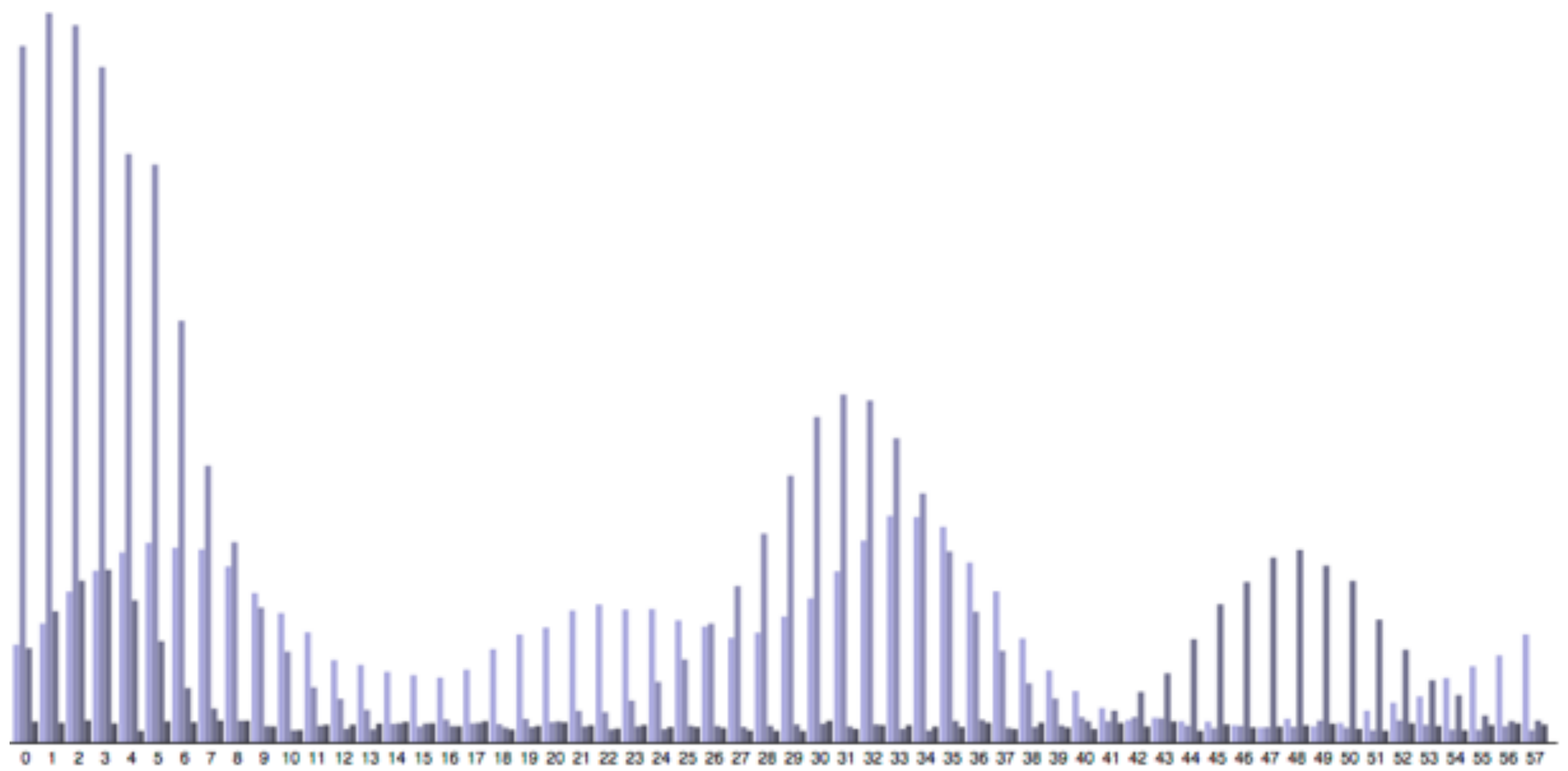
Change Ordering

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





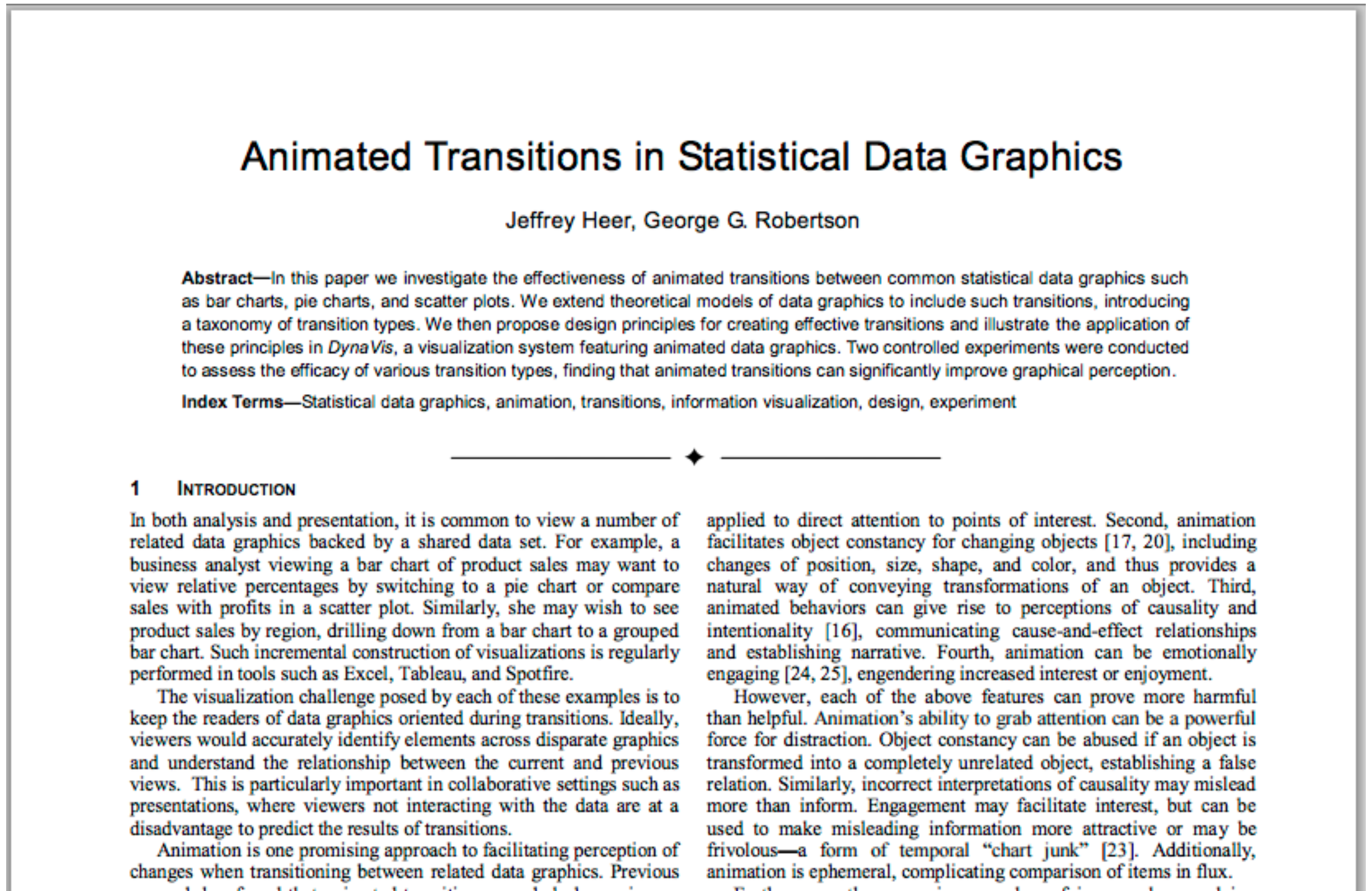
Animated Transitions



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

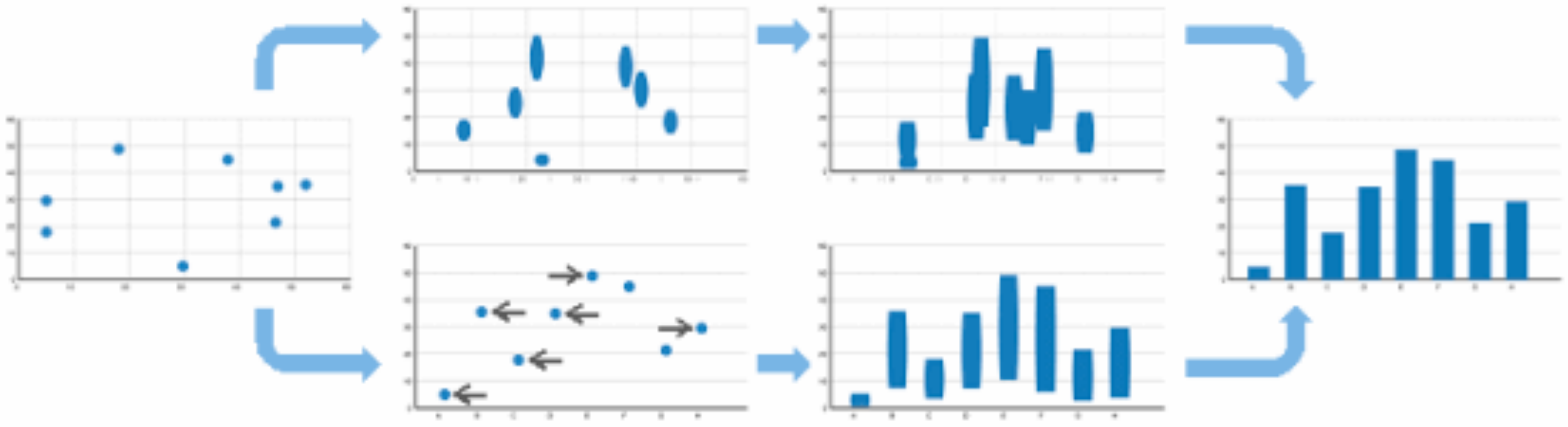
In both analysis and presentation, it is common to view a number of related data graphics backed by a shared data set. For example, a business analyst viewing a bar chart of product sales may want to view relative percentages by switching to a pie chart or compare sales with profits in a scatter plot. 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.



Navigation

Navigation

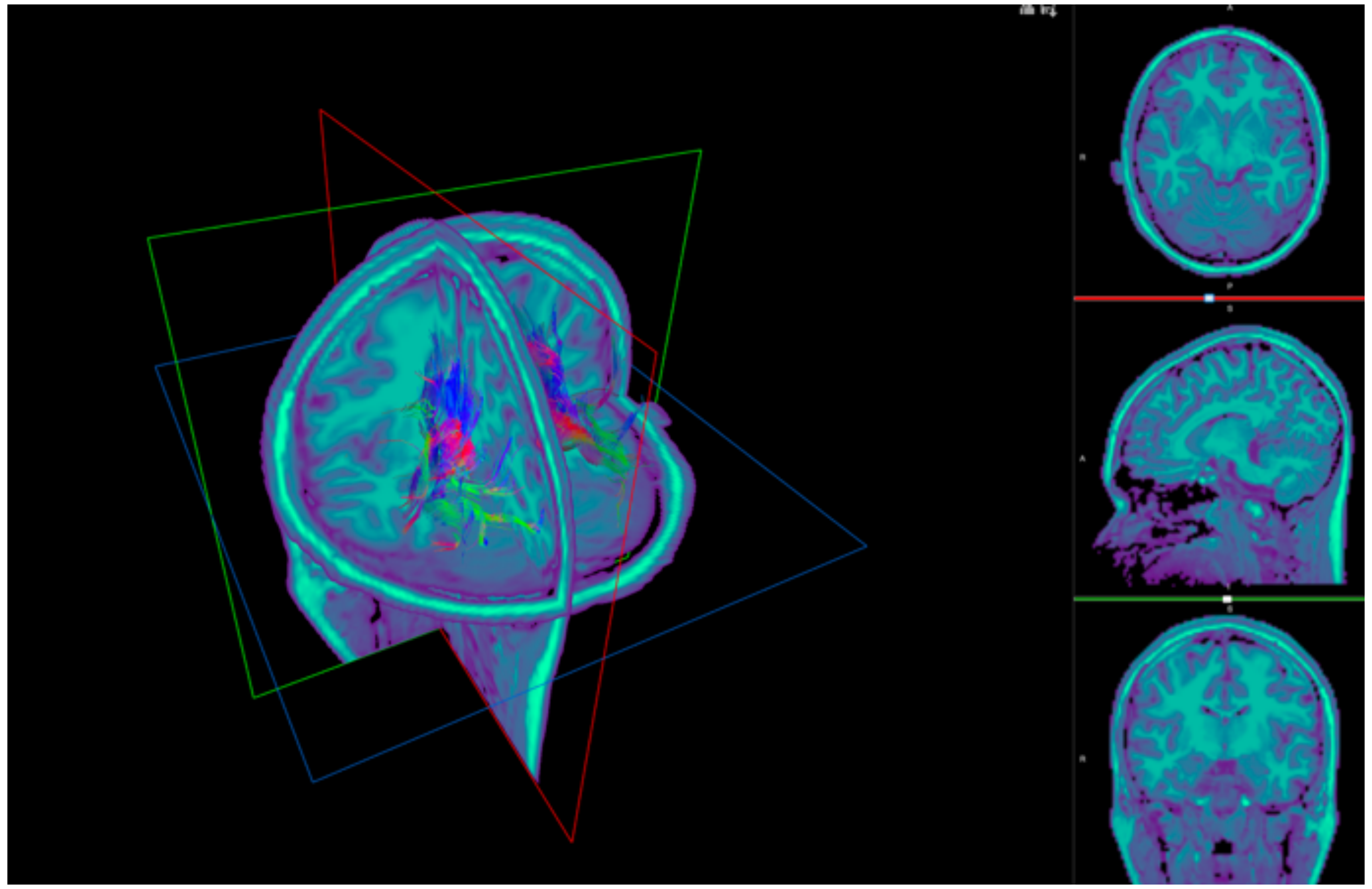
Pan

- move around

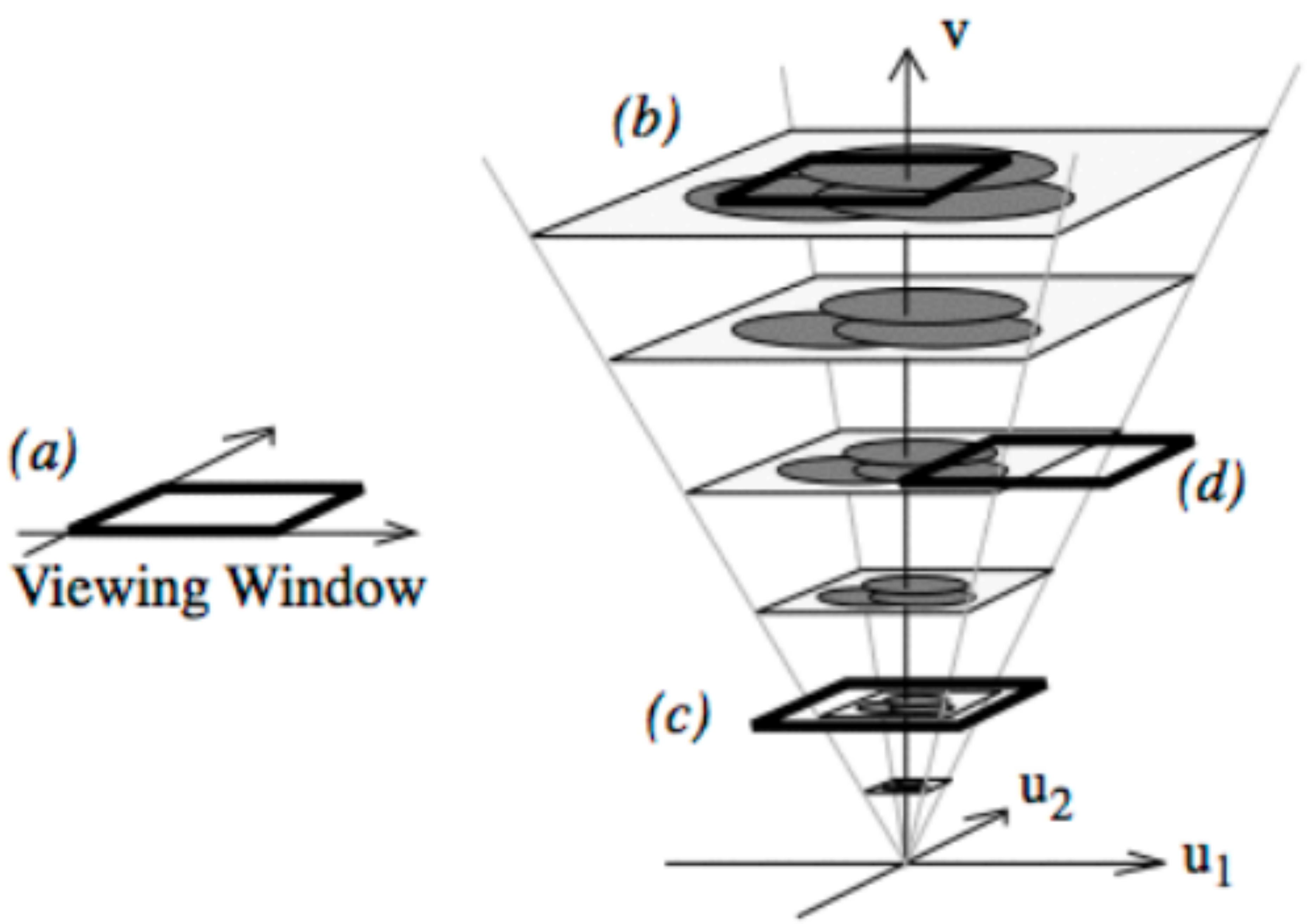
Zoom

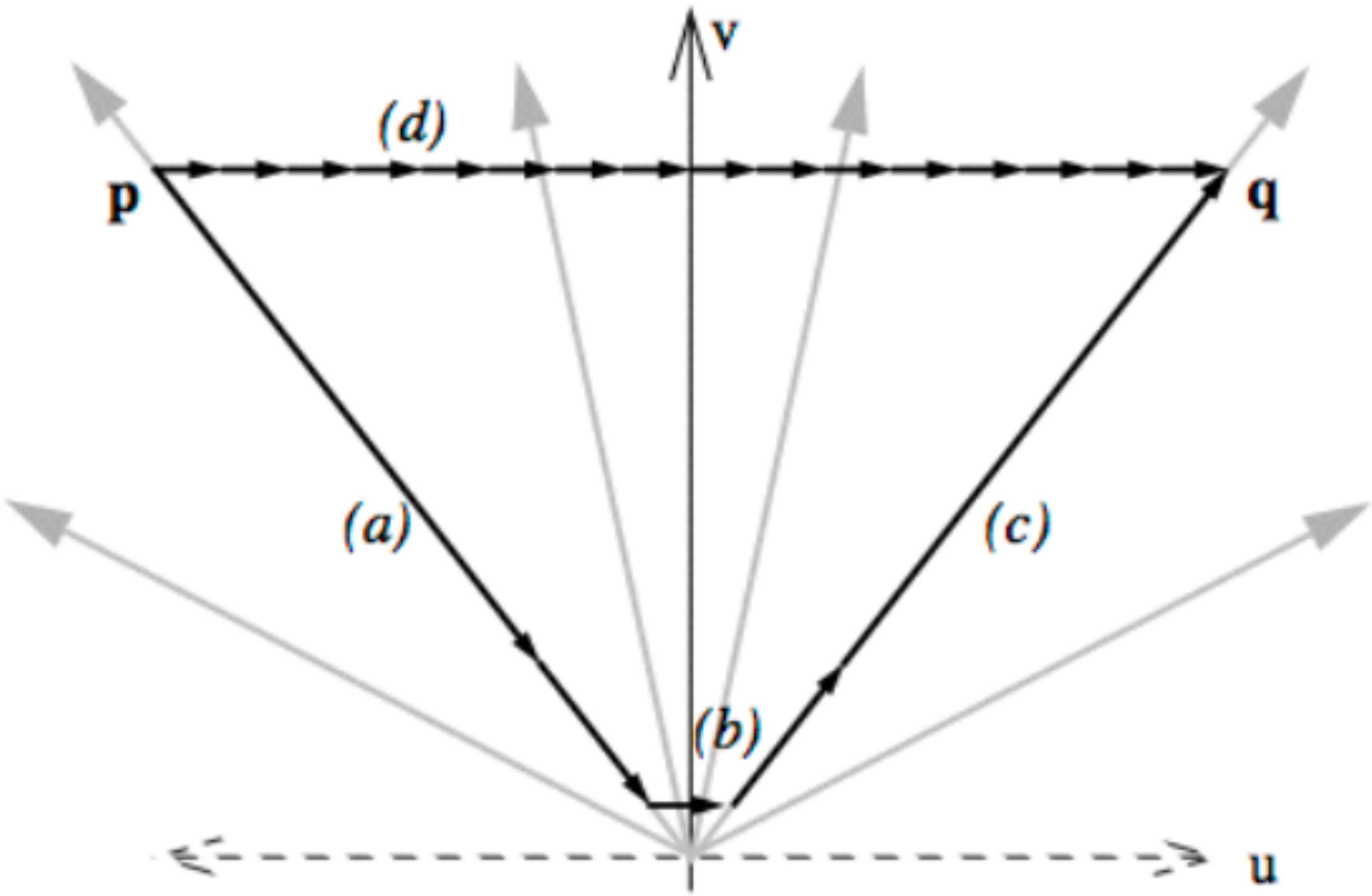
- enlarge/ make smaller (move camera)

Rotate

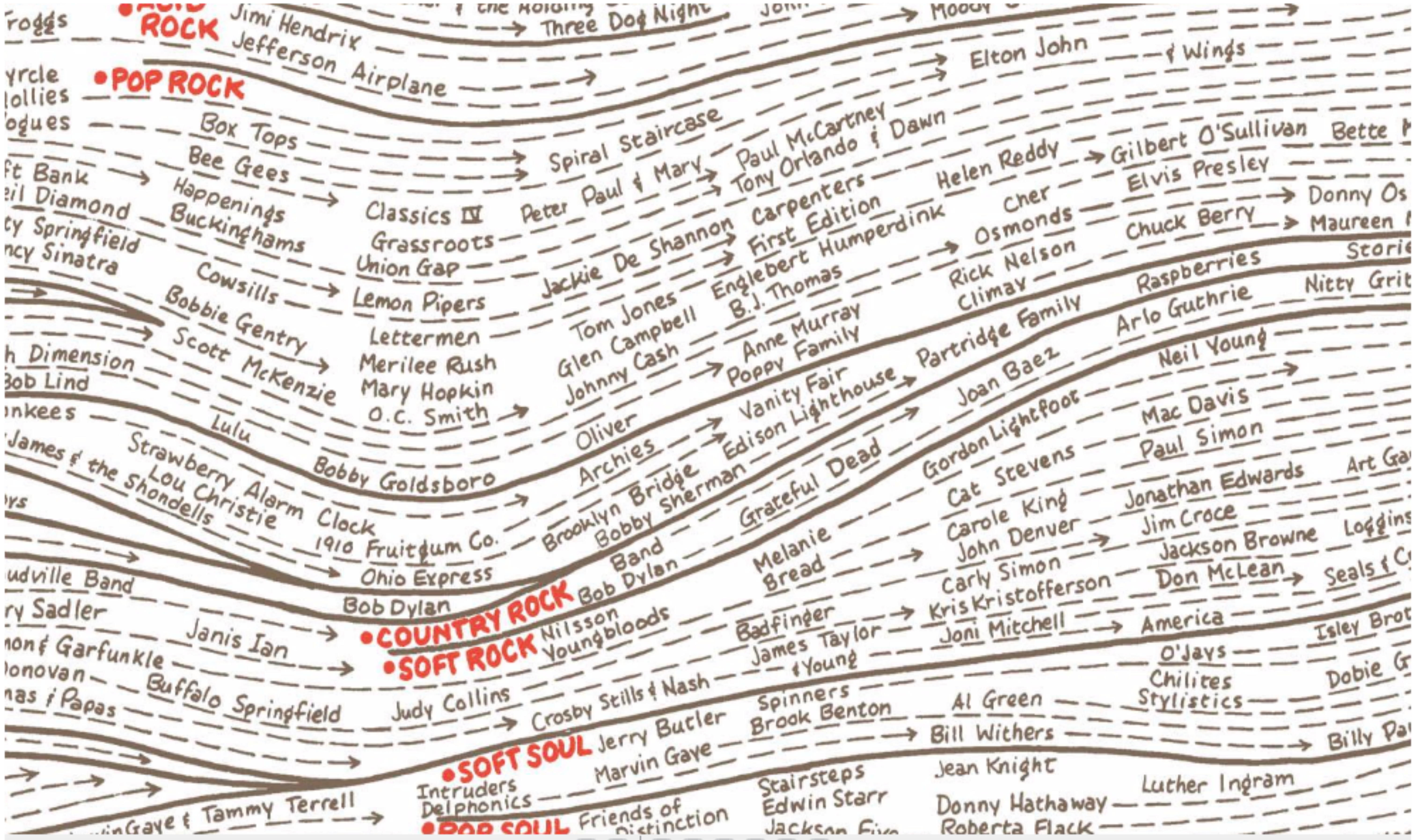


Space-Scale Diagrams





[Furnas & Bederson 1995]


ROCK
Jimi Hendrix
Three Dog Night
Jefferson Airplane
Elton John
¢ Wings
POP ROCK
Box Tops
Bee Gees
Spiral Staircase
Paul McCartney
Tony Orlando ¢ Dawn
Happenings
Buckinghams
Classics IV
Peter Paul ¢ Mary
Helen Reddy
Gilbert O'Sullivan
Bette
Grassroots
Union Gap
Carpenters
First Edition
Cher
Elvis Presley
Donny Os
Cowsills
Lemon Pipers
Jackie De Shannon
Englebert Humperdink
Osmonds
Chuck Berry
Maureen
Bobbie Gentry
Lettermen
Tom Jones
B.J. Thomas
Rick Nelson
Climax
Raspberries
Nitty Grit
Scott McKenzie
Merilee Rush
Mary Hopkin
O.C. Smith
Glen Campbell
Johnny Cash
Anne Murray
Poppy Family
Partridge Family
Arlo Guthrie
Neil Young
Lulu
Oliver
Vanity Fair
Edison Lighthouse
Joan Baez
Mac Davis
Paul Simon
Strawberry Alarm Clock
Lou Christie
Bobby Goldsboro
Archies
Brooklyn Bridge
Bobby Sherman
Grateful Dead
Gordon Lightfoot
Cat Stevens
Jonathan Edwards
Art Ga
1910 Fruitgum Co.
Ohio Express
Band
Bob Dylan
Melanie
Bread
Carole King
John Denver
Jim Croce
Jackson Browne
Loggins
Carly Simon
Kris Kristofferson
Don McLean
Seals ¢ C
Bob Dylan
COUNTRY ROCK
SOFT ROCK
Nilsson
Youngbloods
Badfinger
James Taylor
¢ Young
Joni Mitchell
America
Isley Brot
Janis Ian
O'Jays
Chilites
Stylistics
Dobie G
Buffalo Springfield
Judy Collins
Crosby Stills ¢ Nash
Spinners
Brook Benton
Al Green
Bill Withers
Billy Pa
SOFT SOUL
Jerry Butler
Marvin Gaye
Jean Knight
Luther Ingram
Intruders
Delphonics
Stairsteps
Edwin Starr
Donny Hathaway
Roberta Flack
Tammy Terrell
Friends of Distinction

Semantic Zooming

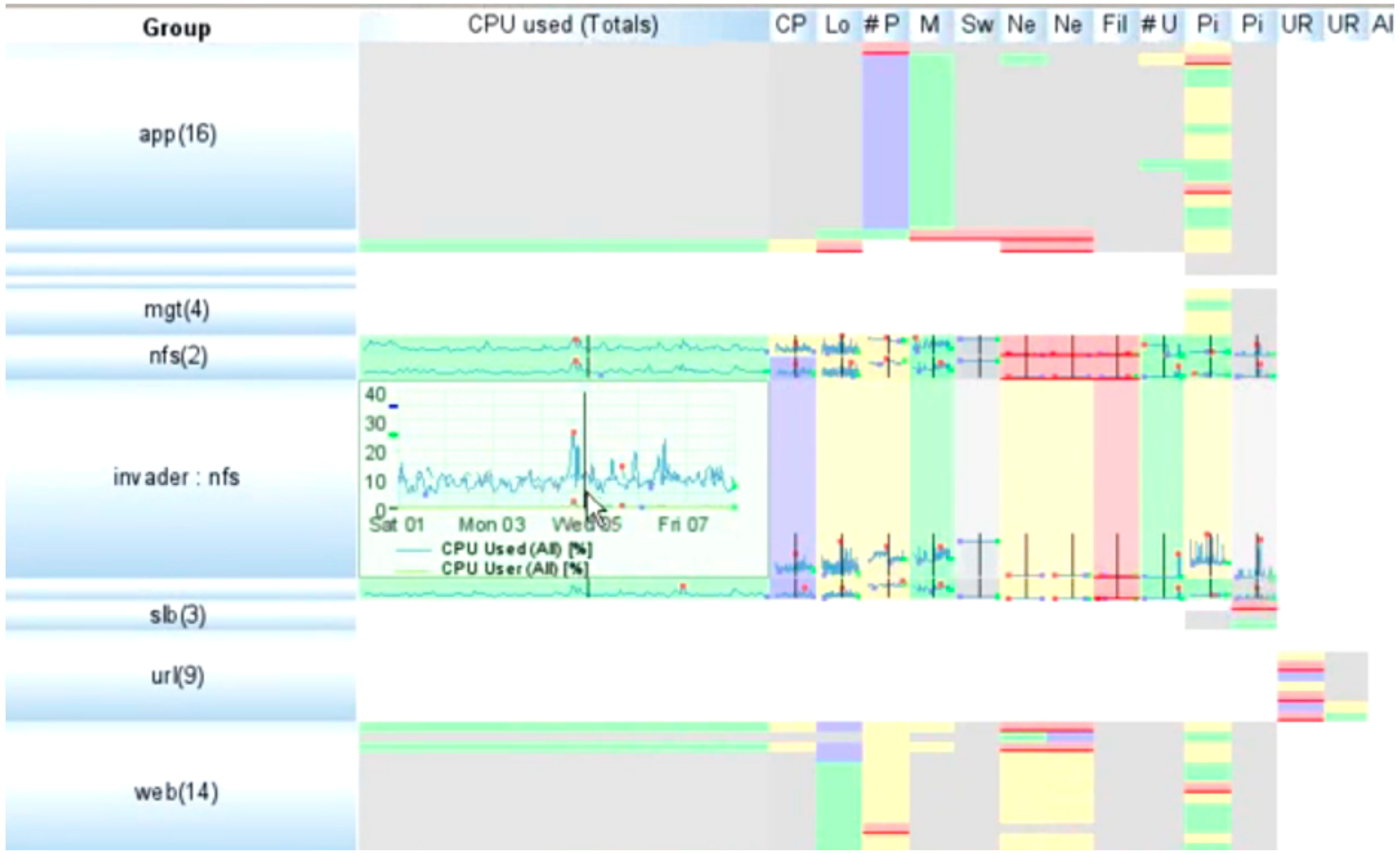
Semantic Zoom

Semantic Zooming

As you zoom in, content is updated

More detail as more space becomes available

Ideally readable at multiple resolutions



[McLachlan 2008]

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

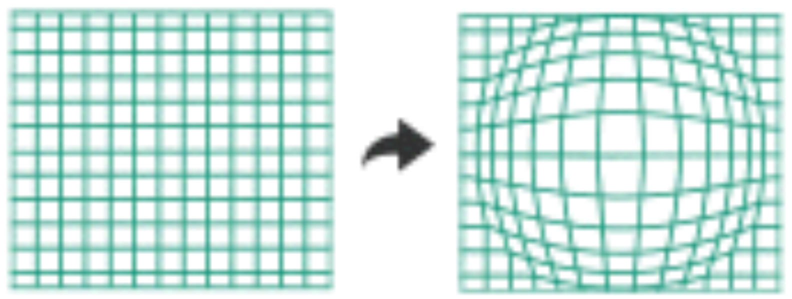
- aggregation
- reduction
- layering

Embed

→ Elide Data

→ Superimpose Layer

→ Distort Geometry



Elision

focus items shown in detail,

other items summarized for context

e·li·sion

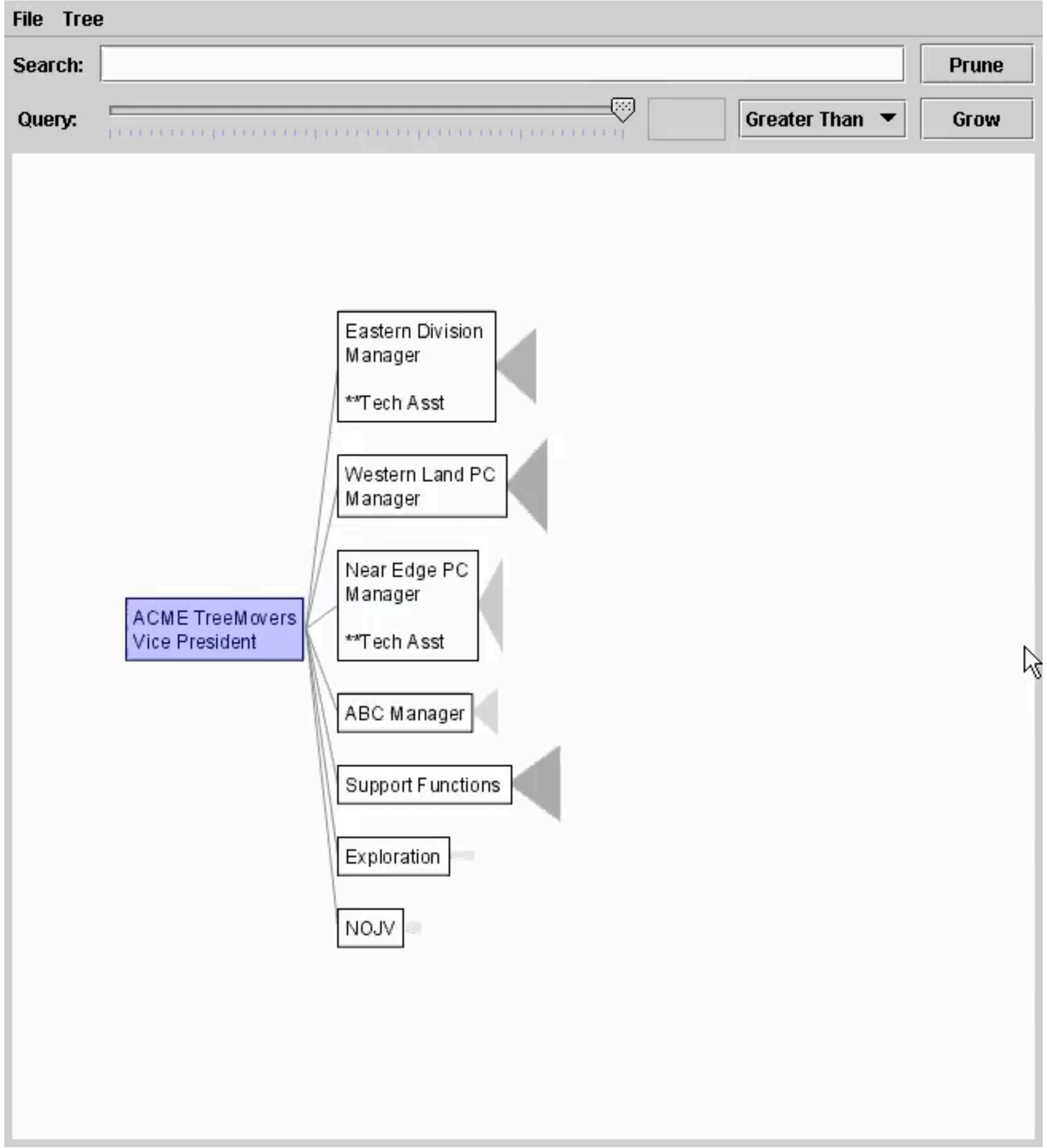
/iˈliZHən/

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

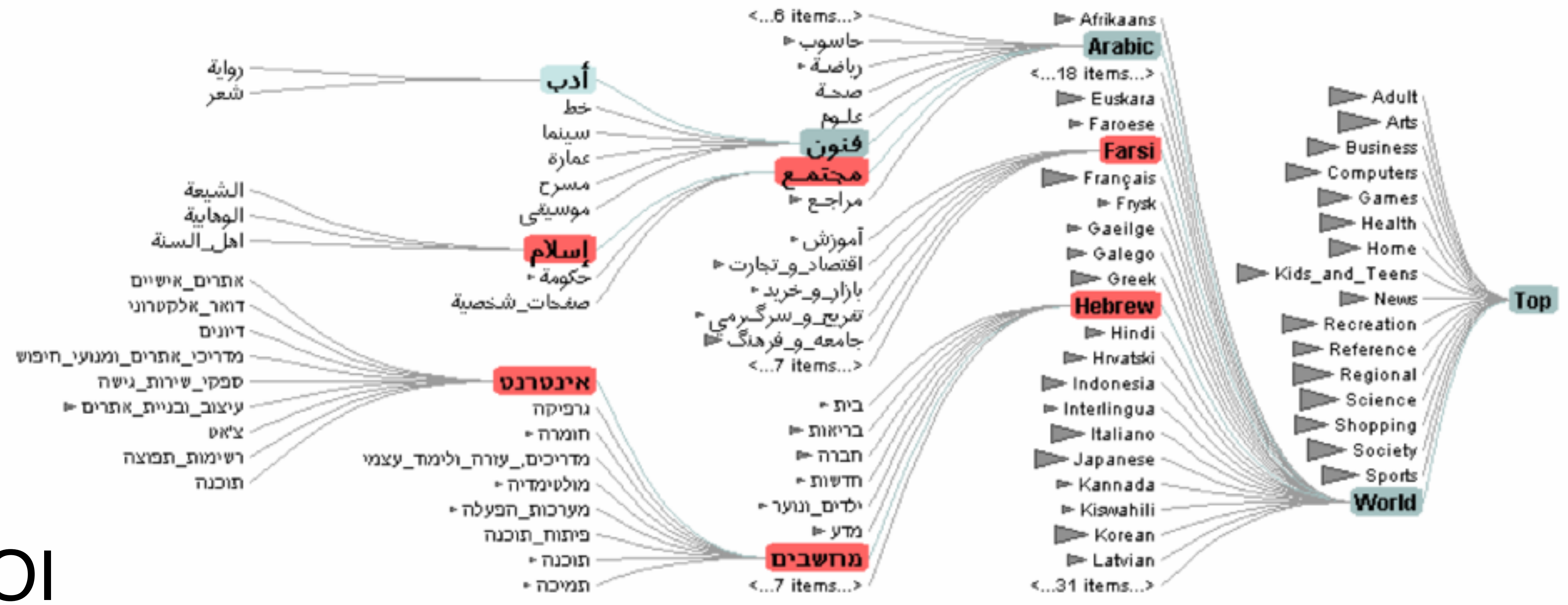
DOI Tree

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

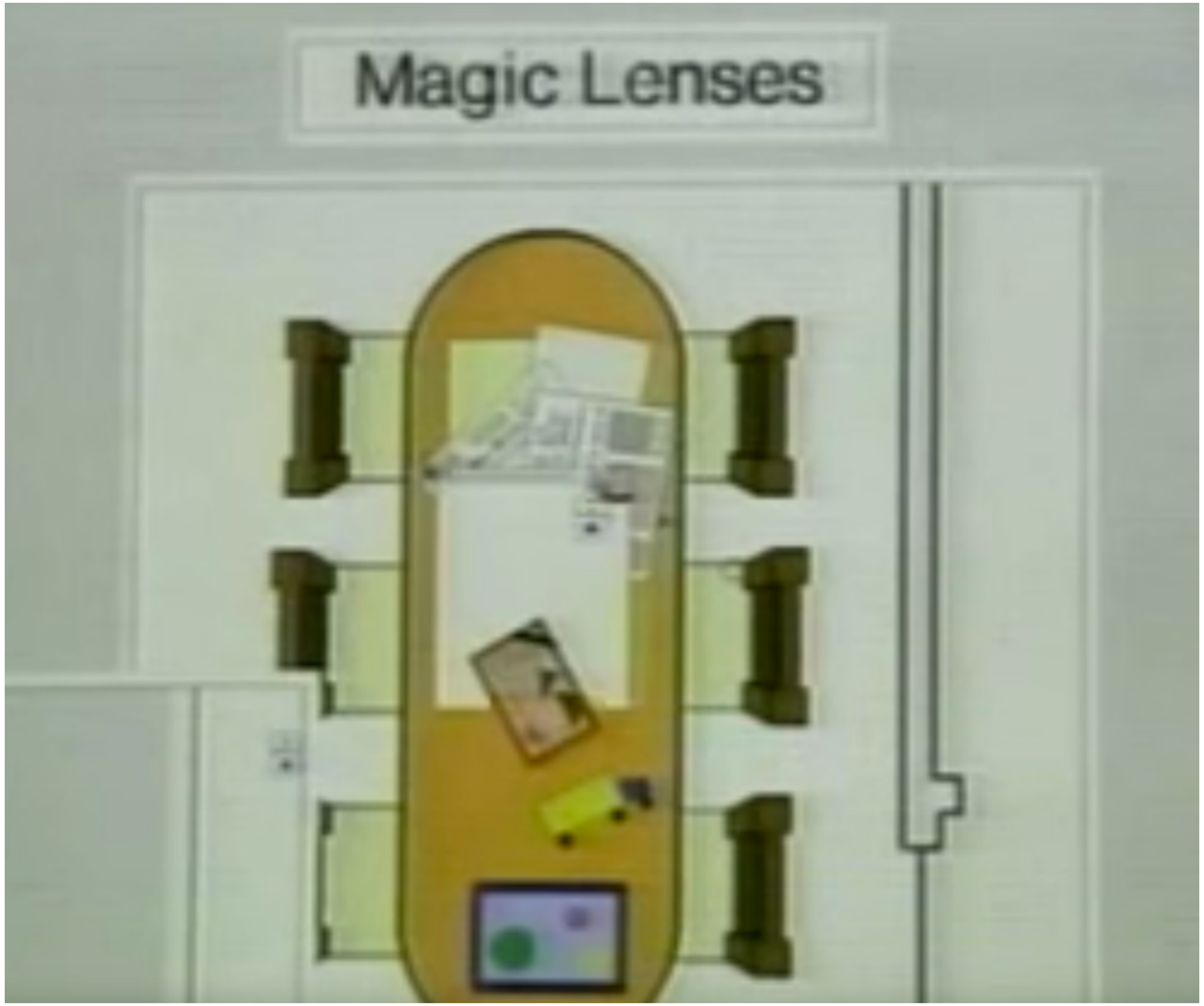
focus layer limited to a local region of view,
instead of stretching across the entire view

Toolglass & Magic Lenses

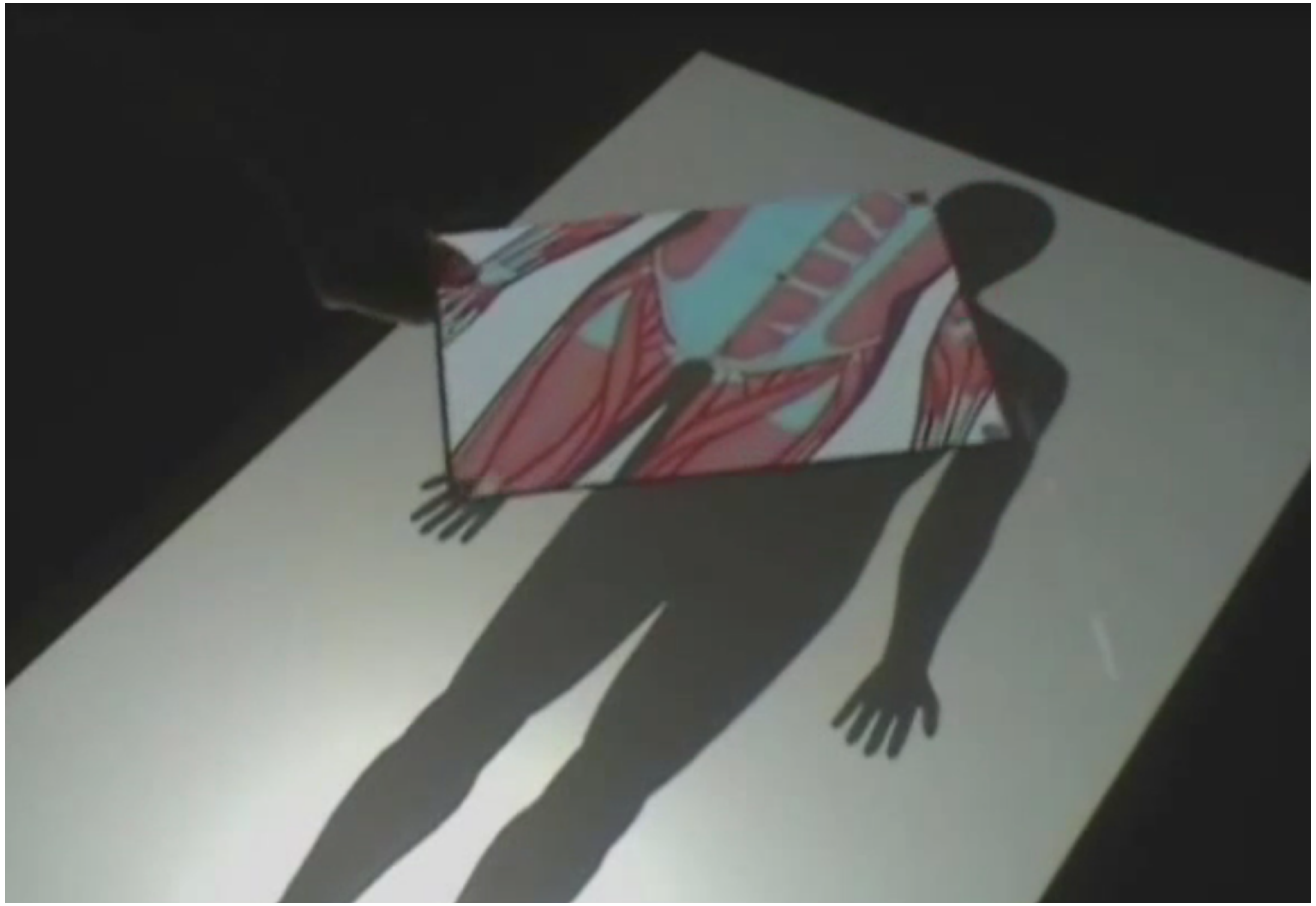
Magic Lense:

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

[Bier, Siggraph 1993]

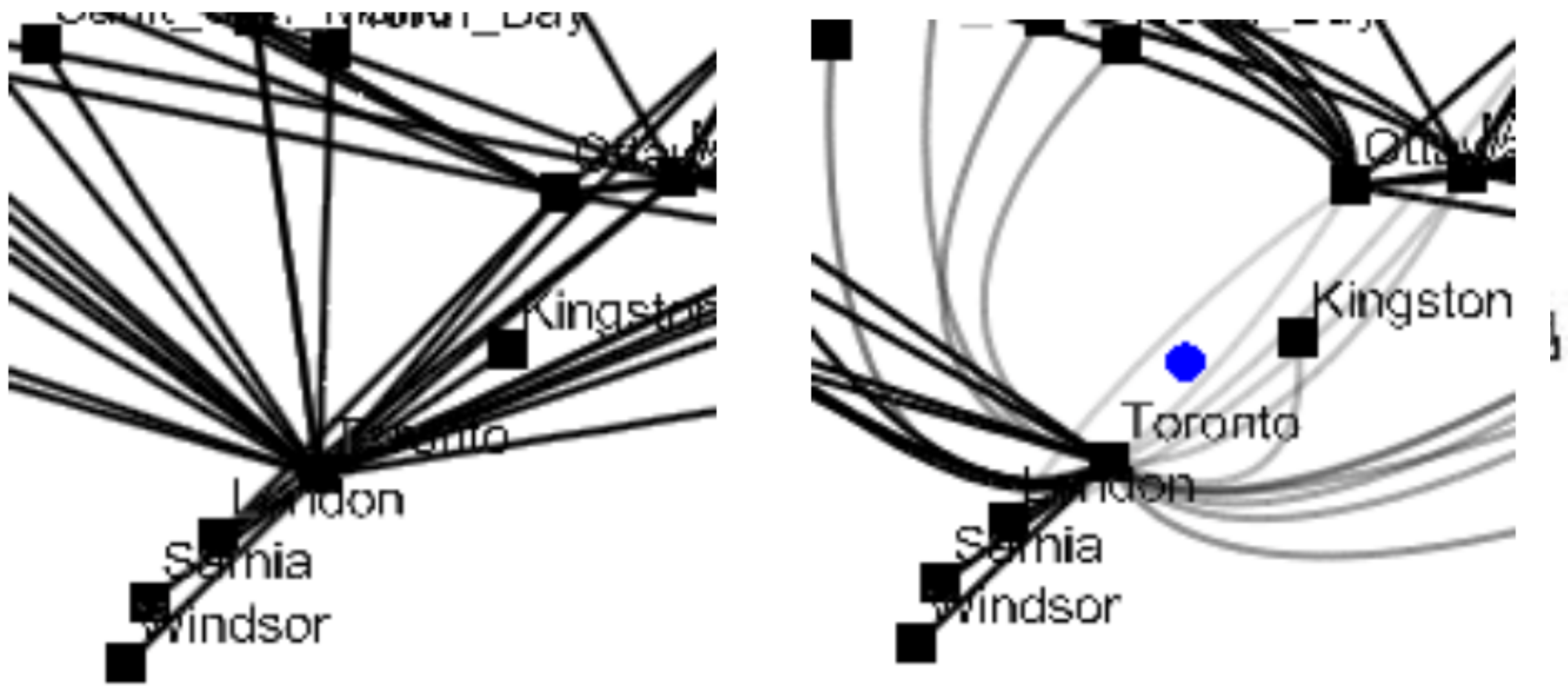


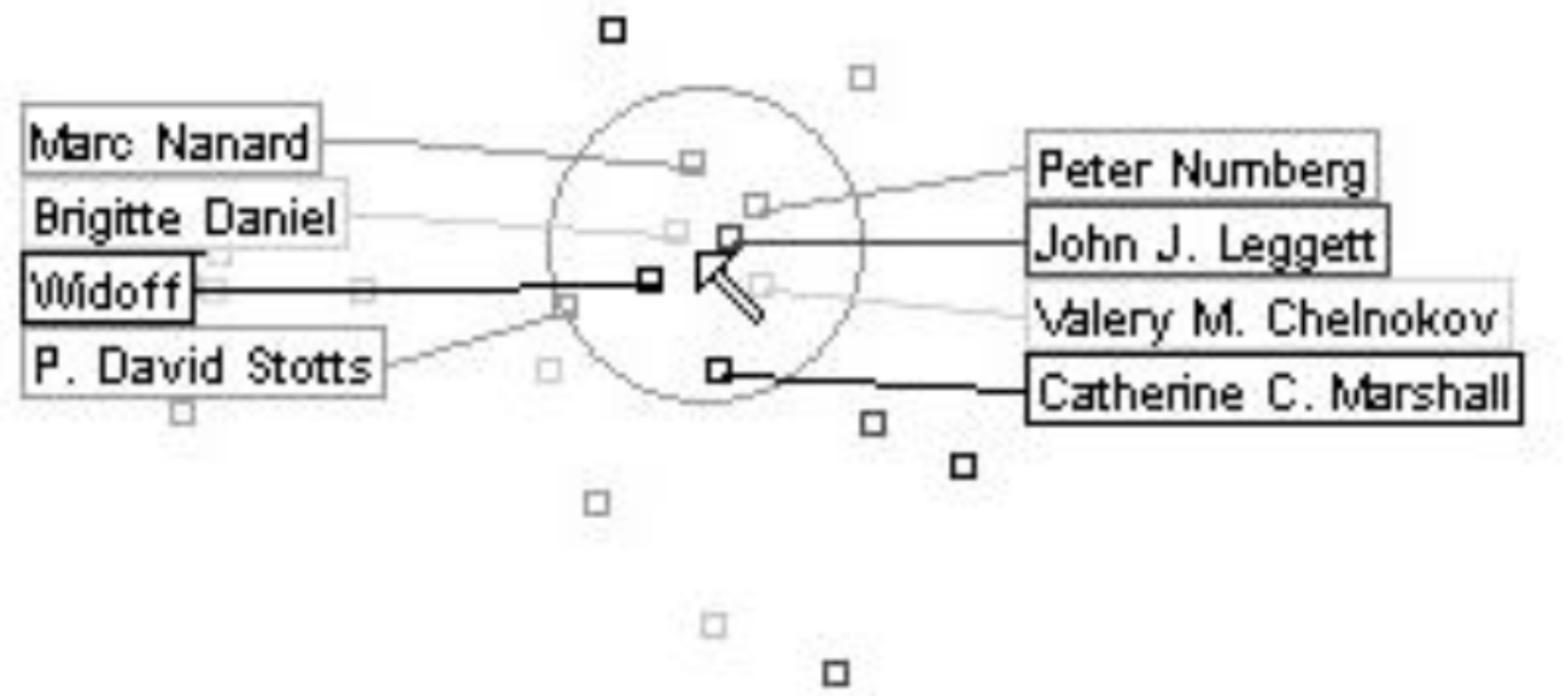
Magic Lense with Tangible Interface



[Spindler, CHI 2010]

Magic Lense: Edges & Labeling



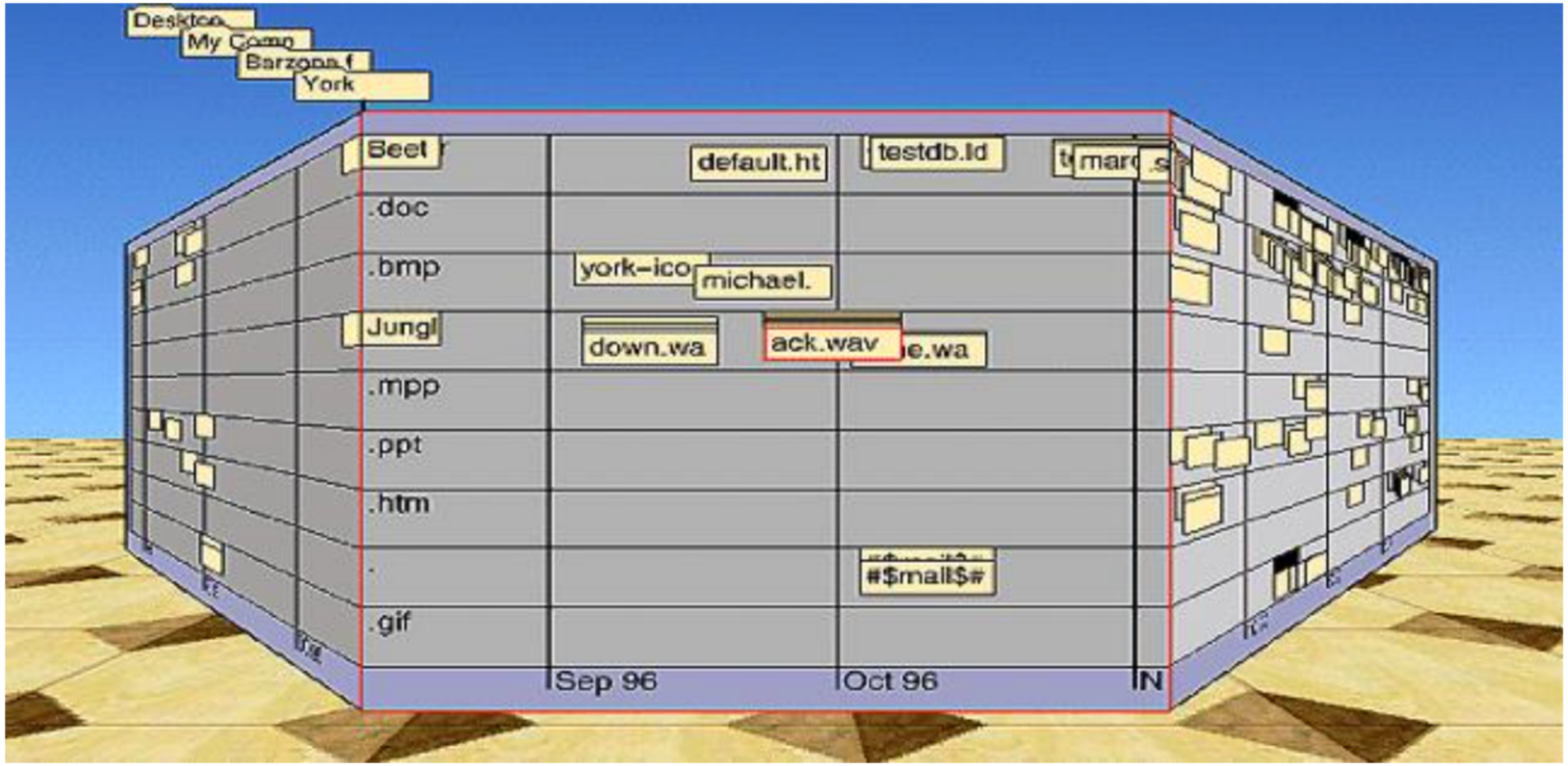


[Fekete and Plaisant, 1999]

Distortion

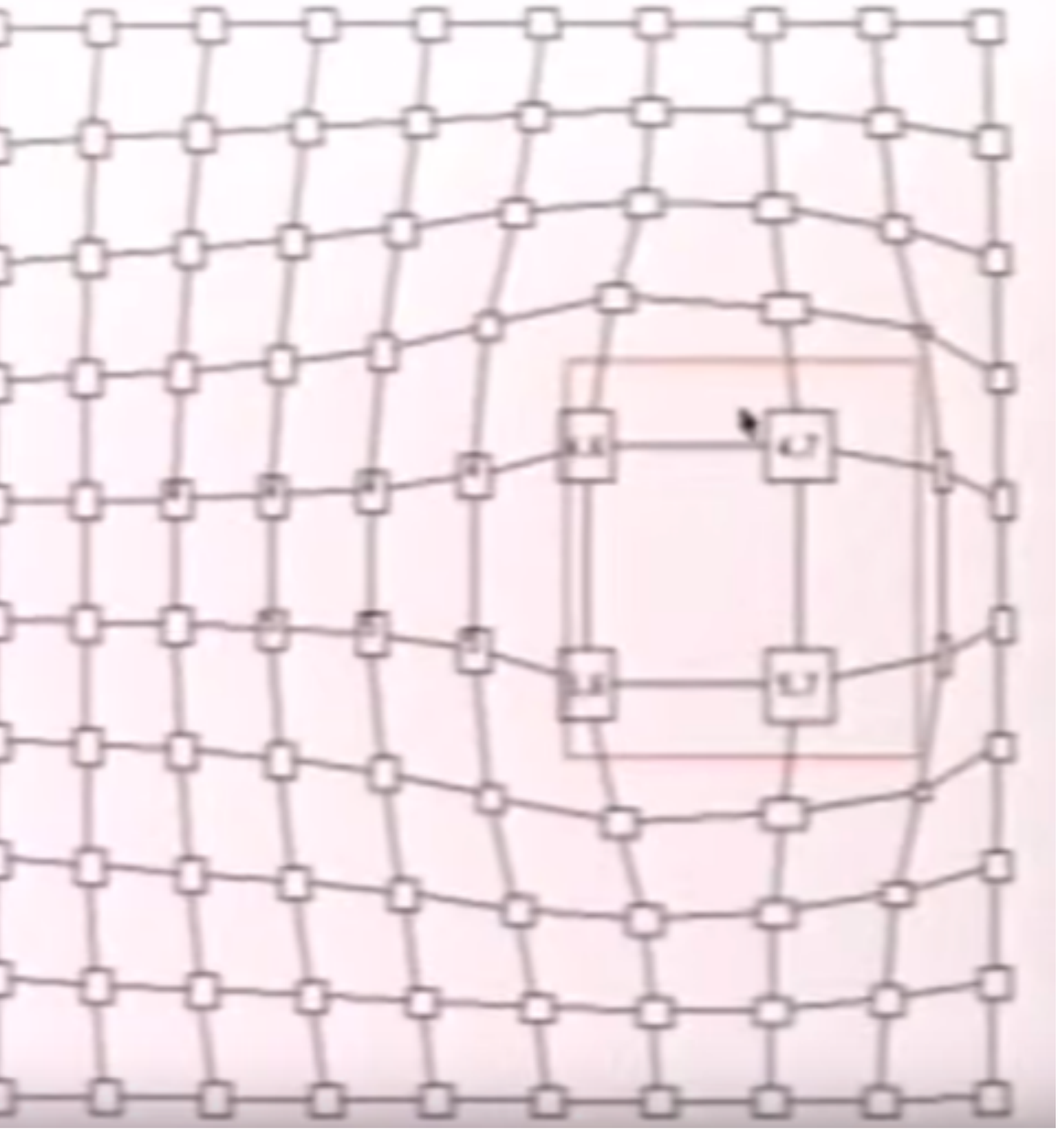
use geometric distortion of the contextual regions to make room for the details in the focus region(s)

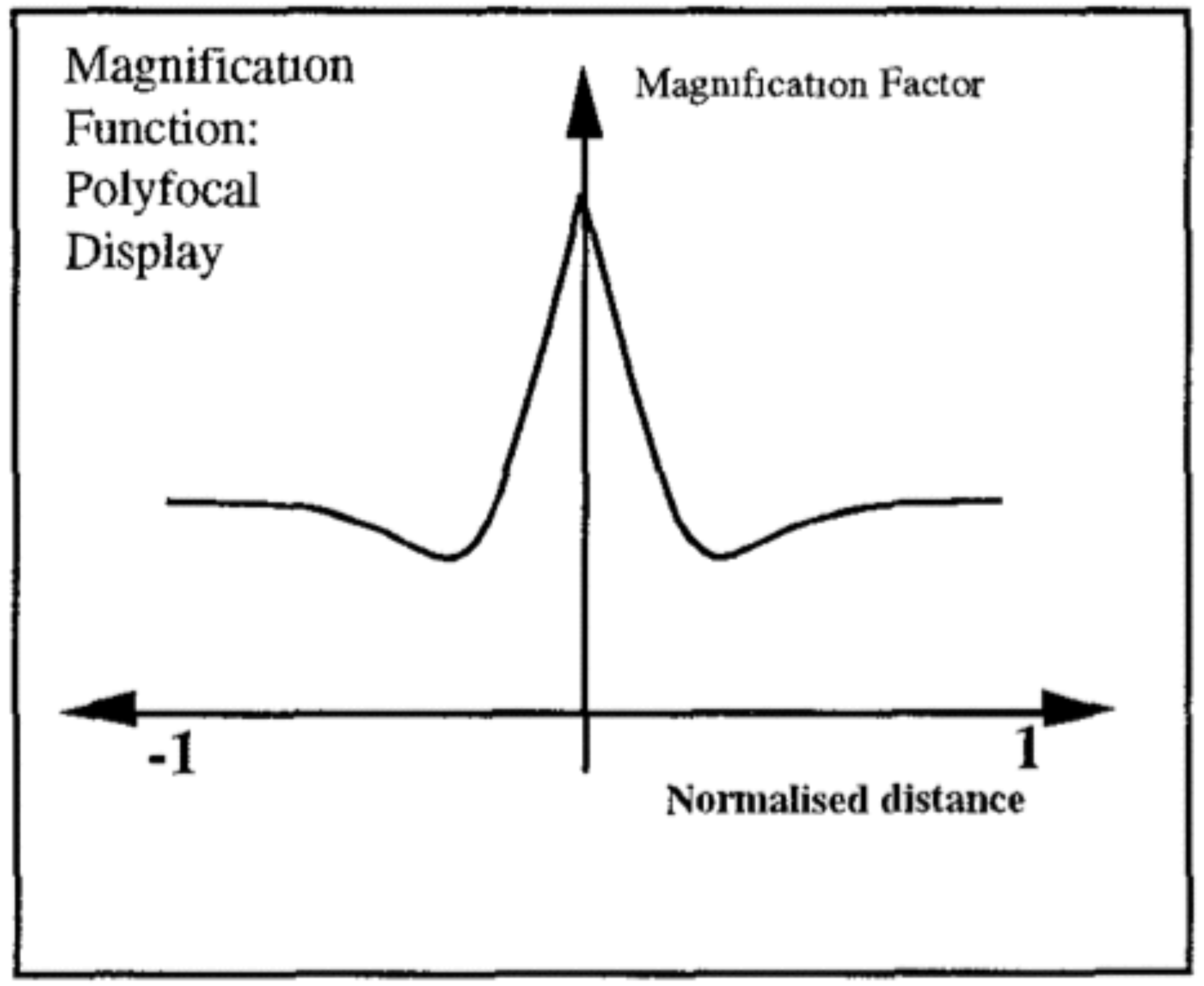
Perspective Wall

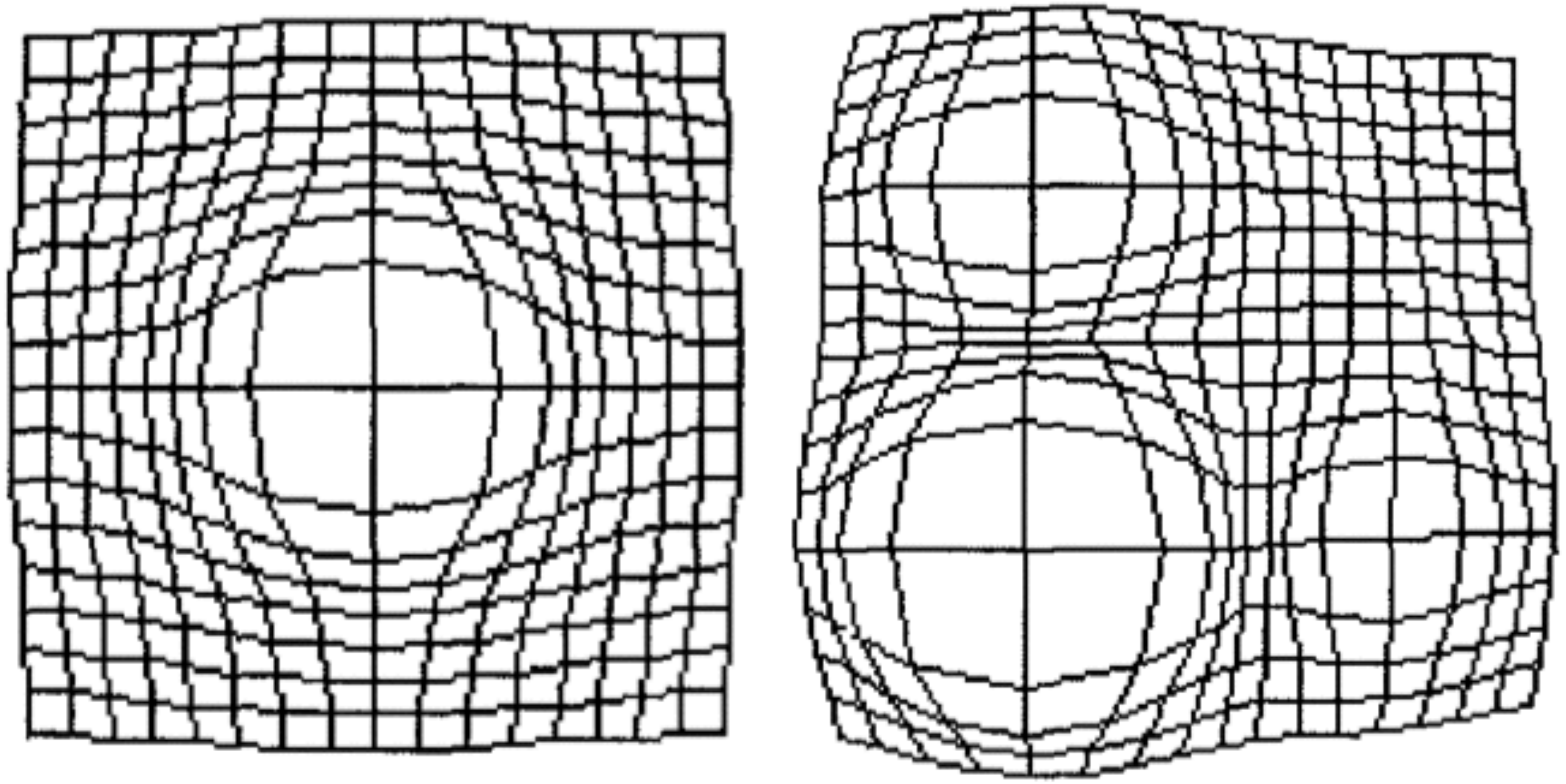


[Mackinlay, 1991]

Fisheye



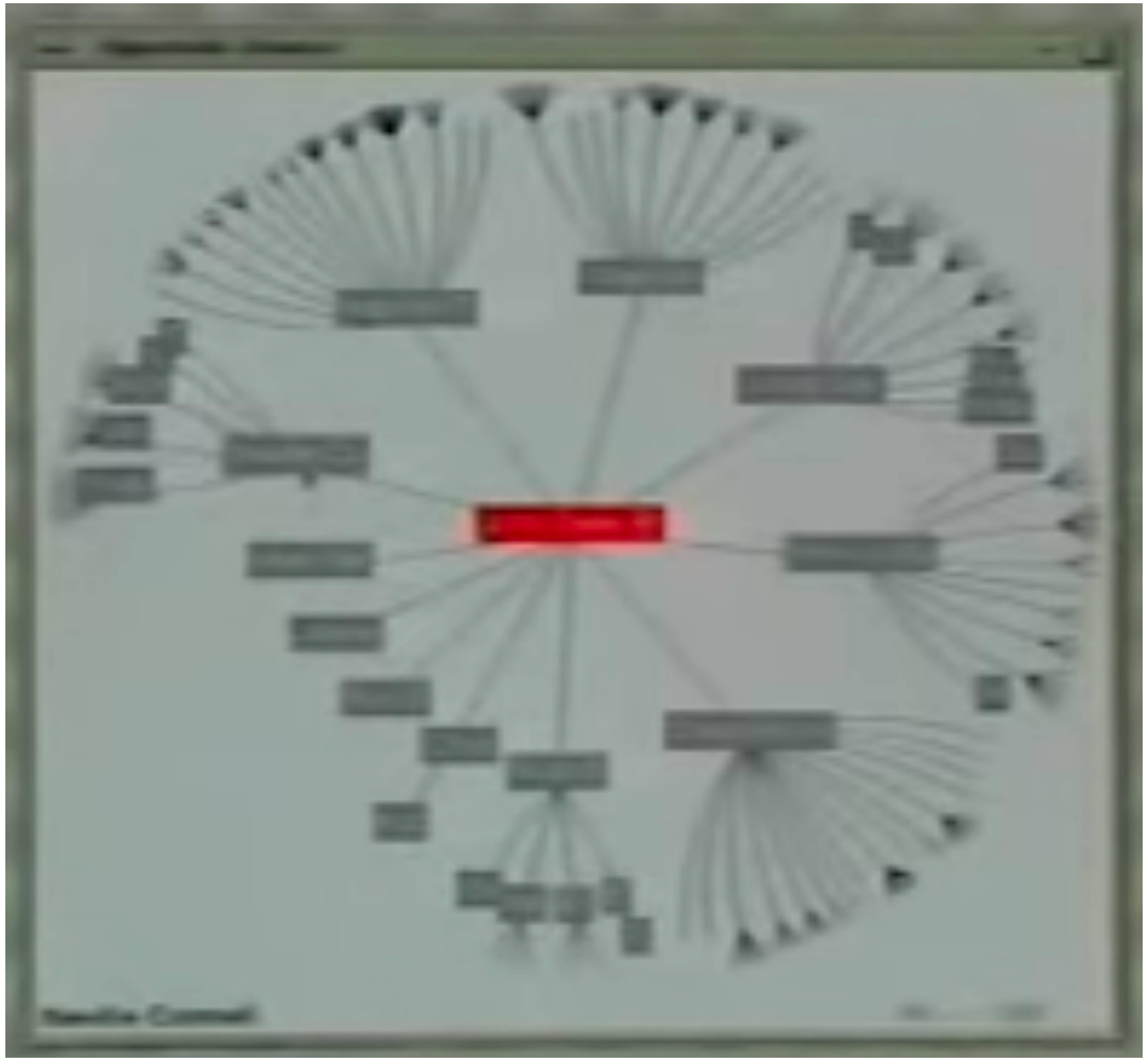




[Sarkar, 1993]

Leung 1994

Hyperbolic Geometry



[Lamping, 1995]

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Edmonton
Calgary
Ontario
Quebec
Winnipeg
Vancouver
Seattle
Spokane
Washington
Portland
Oregon
Montana
North Dakota
Minnesota
Minneapolis
Wisconsin
South Dakota
Idaho
Wyoming
Michigan
Toronto
Ottawa
Montreal
Quebec
Maine
Buffalo
New York
Cleveland
Pennsylvania
Philadelphia
Madison
Chicago
Toledo
Iowa
Nebraska
Omaha
Lincoln
Illinois
Salt Lake City
Nevada
Utah
United States
Colorado
Kansas
Kansas City
St. Louis
Missouri
Indiana
Ohio
Columbus
West Virginia
Kentucky
Virginia
Sacramento
Stockton
California
Las Vegas
Bakersfield
Wichita
Tulsa
Oklahoma
Albuquerque
New Mexico
Arizona
Phoenix
Riverside
Los Angeles
Tucson
Arkansas
Tennessee
Memphis
North Carolina
Connecticut
New Jersey
Delaware
Maryland
District of Columbia
Rhode
Dallas
Mississippi
Atlanta
South Carolina
Texas
San Antonio
Alabama
Georgia
Houston
Louisiana
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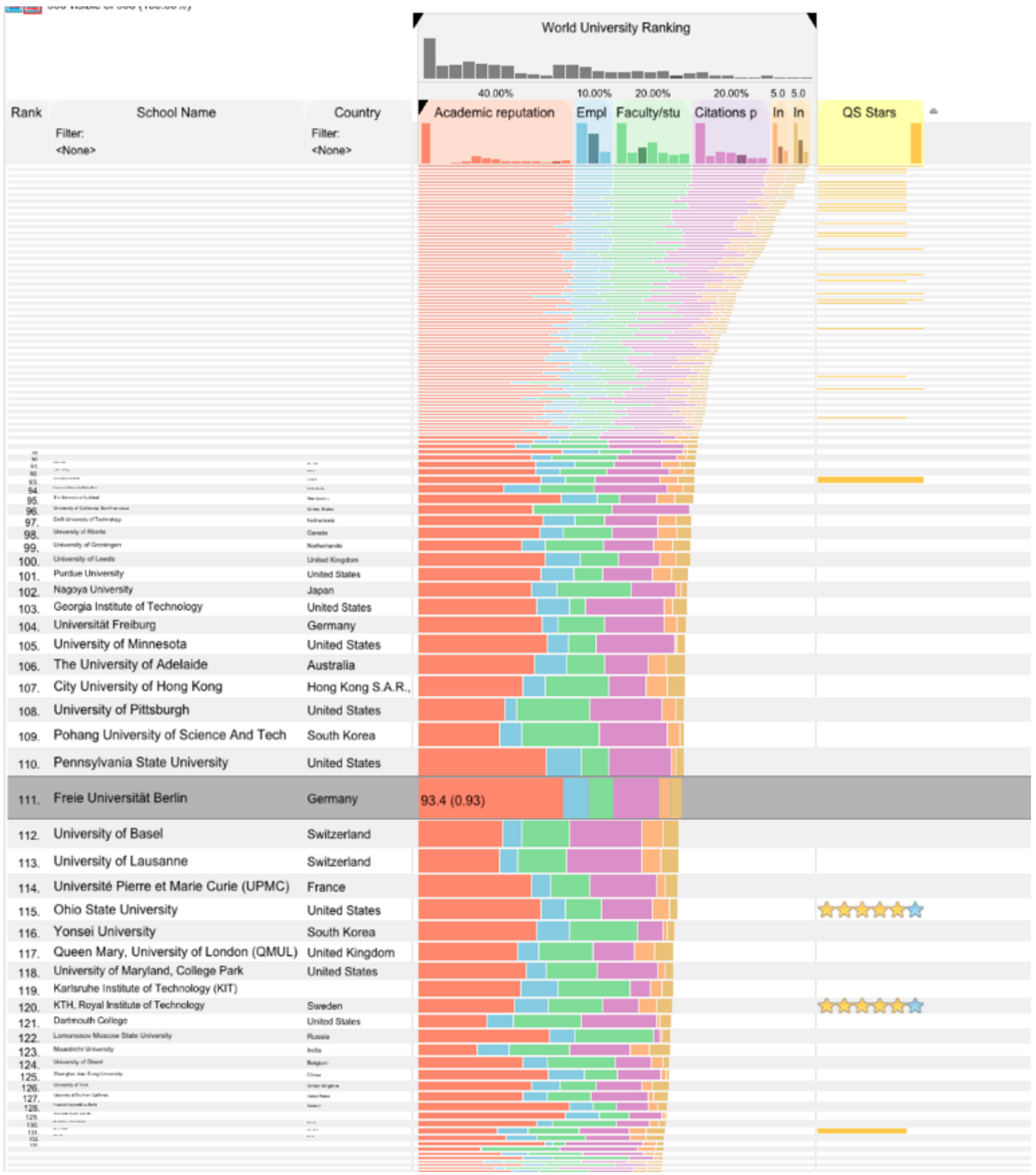
Jacksonville
Orlando
Florida
Miami
Hermosillo
Chihuahua
Ciudad Juarez
Gulf of California
Nuevo Laredo
Corpus Christi
Monclova
Matamoros
Monterrey
México
Gulf of Mexico
Ensenada
La Paz
Culiacán
Mazatlán
Aguascalientes
San Luis

http://pmcruz.com/information-visualization/data-lenses


World University Ranking
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School Name
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Academic reputation
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101. Purdue University United States
102. Nagoya University Japan
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108. University of Pittsburgh United States
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111. Freie Universität Berlin Germany 93.4 (0.93)
112. University of Basel Switzerland
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115. Ohio State University United States
116. Yonsei University South Korea
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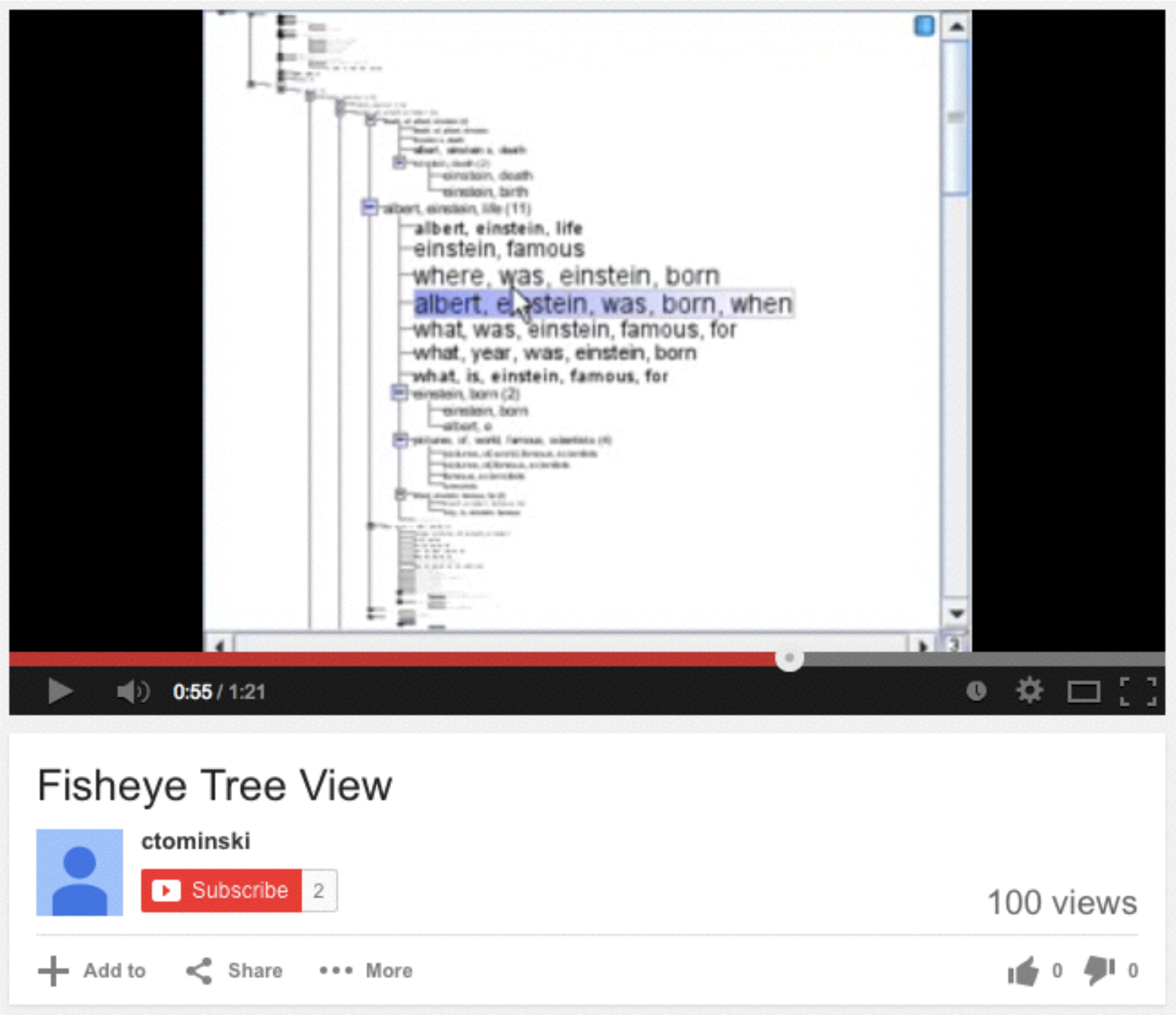
118. University of Maryland, College Park United States
119. Karlsruhe Institute of Technology (KIT)
120. KTH, Royal Institute of Technology Sweden


albert, einstein, life
einstein, famous
where, was, einstein, born
albert, einstein, was, born, when
what, was, einstein, famous, for
what, year, was, einstein, born
what, is, einstein, famous, for
0:55 / 1:21
Fisheye Tree View
ctominski
Subscribe
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100 views
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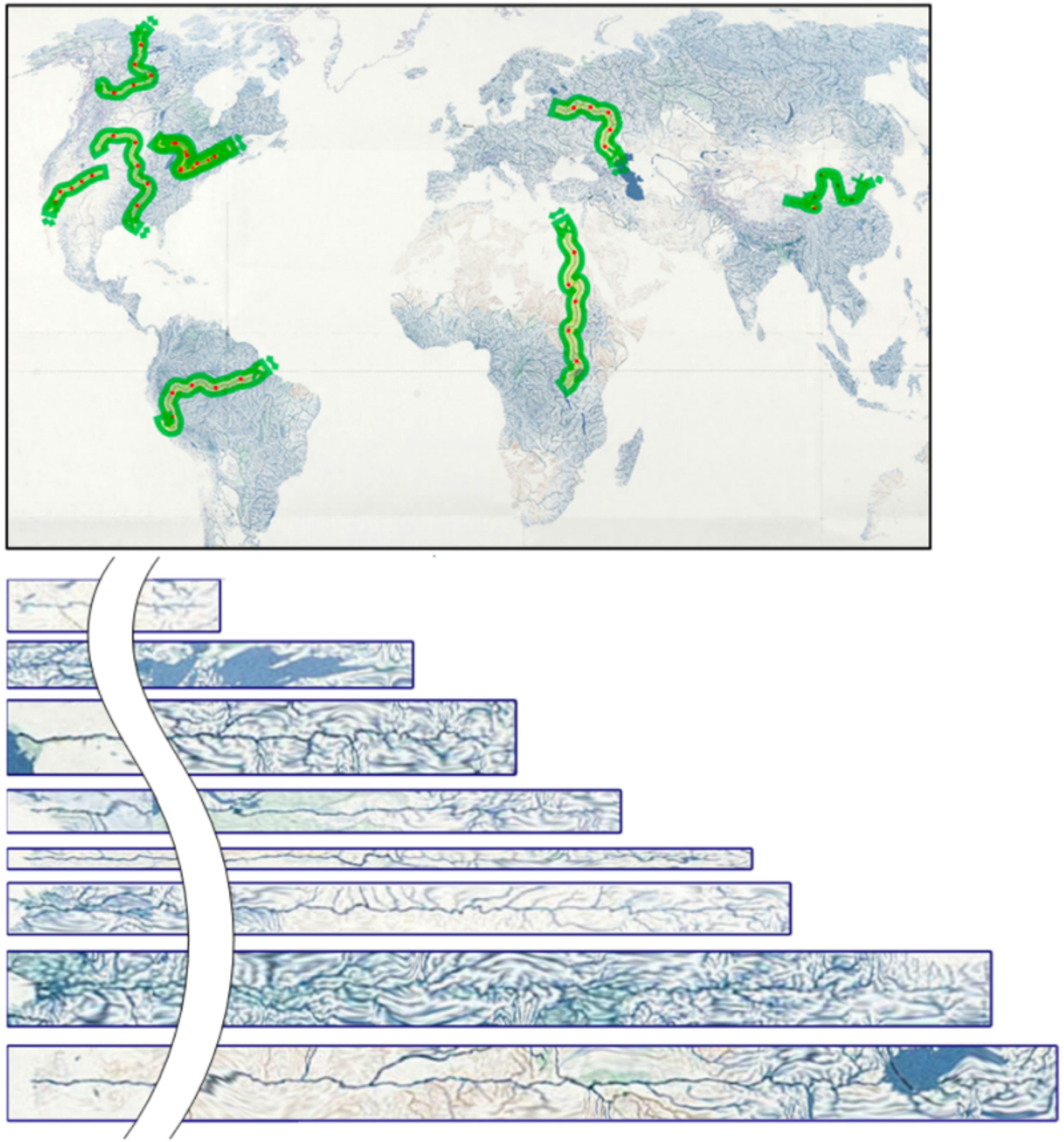
Transmorgification

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

fisheye follow-up: concern with enthusiasm over distortion

- what is being shown: selective filtering
- how it is being shown: distortion as one possibility

Filtering

aka brushing, aka selecting

& dynamic querying

The MANTRA

Visual Information Seeking Mantra (Shneiderman, 1996)

Overview first,

zoom and filter,

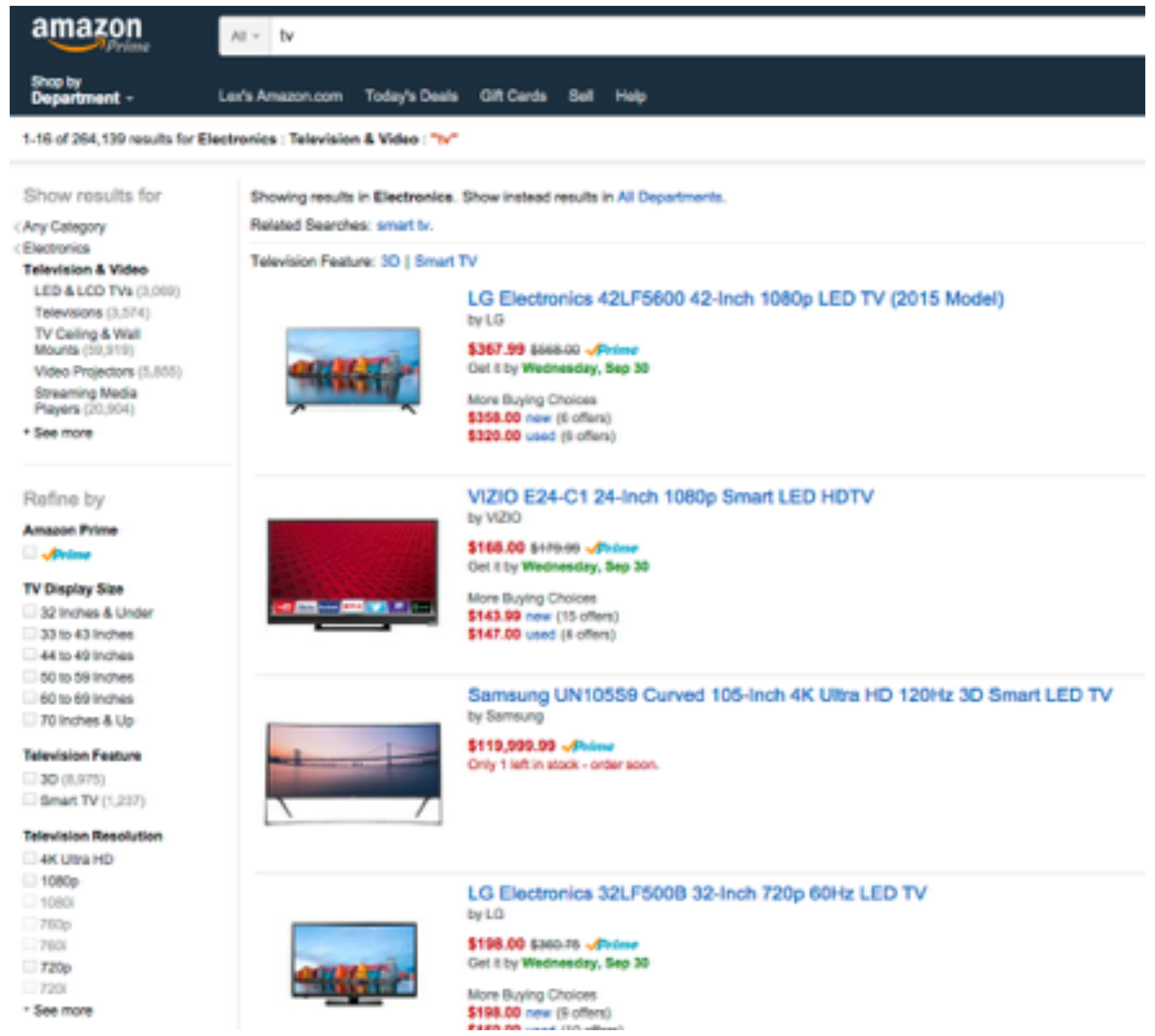
then details on demand

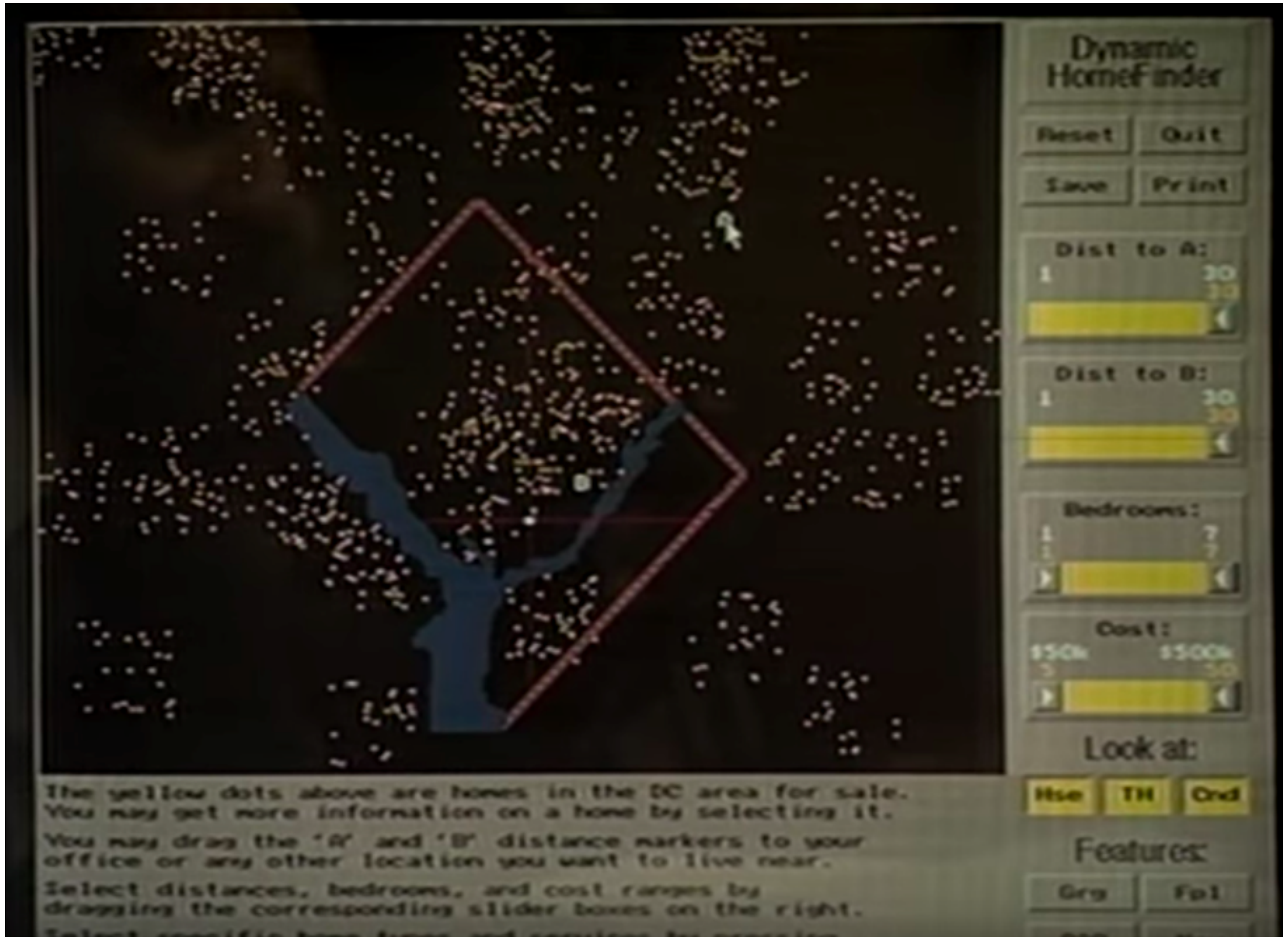
relate, history, extract

Dynamic Queries

Define criteria for inclusion/ exclusion

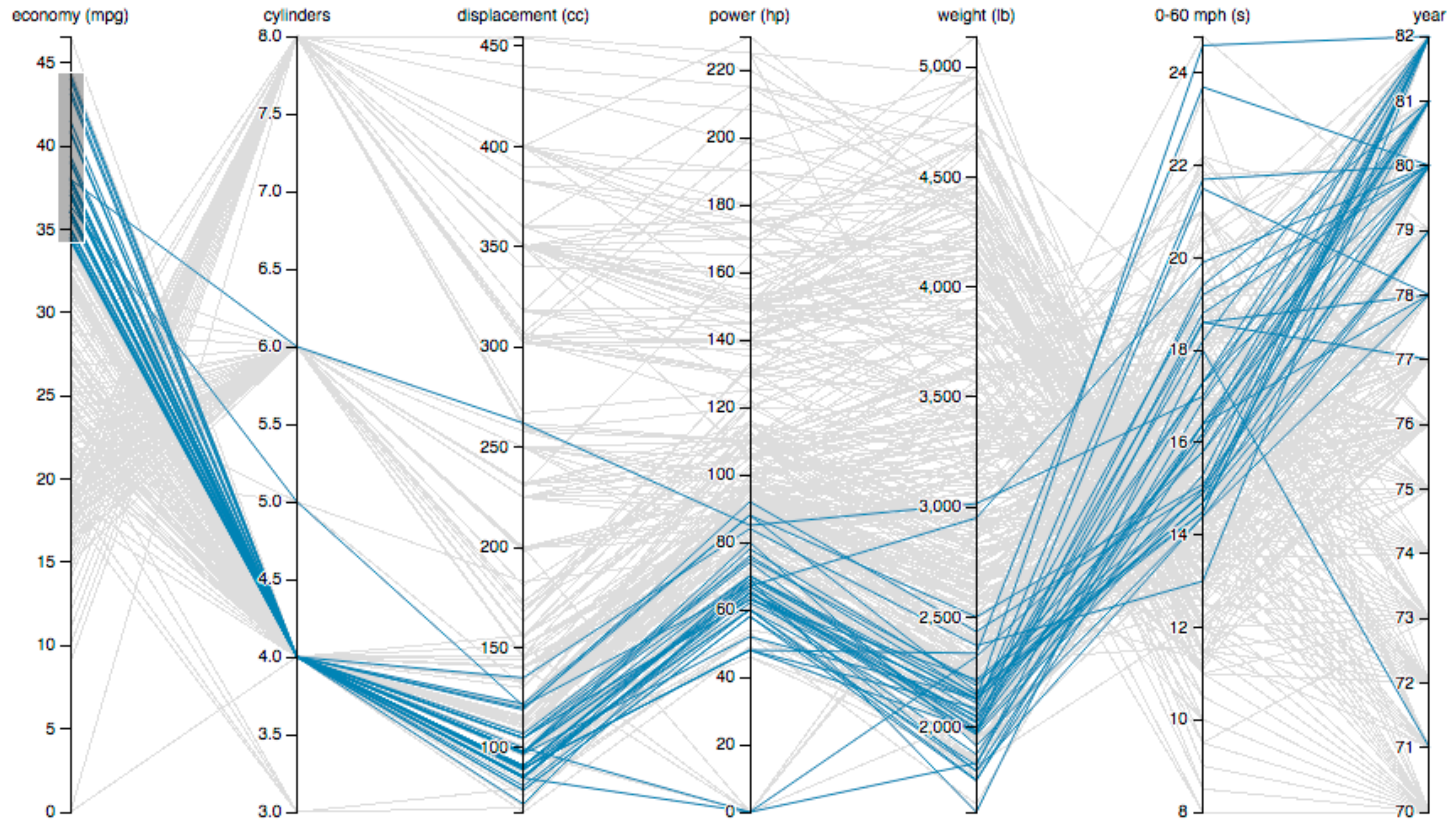
“Faceted Search”



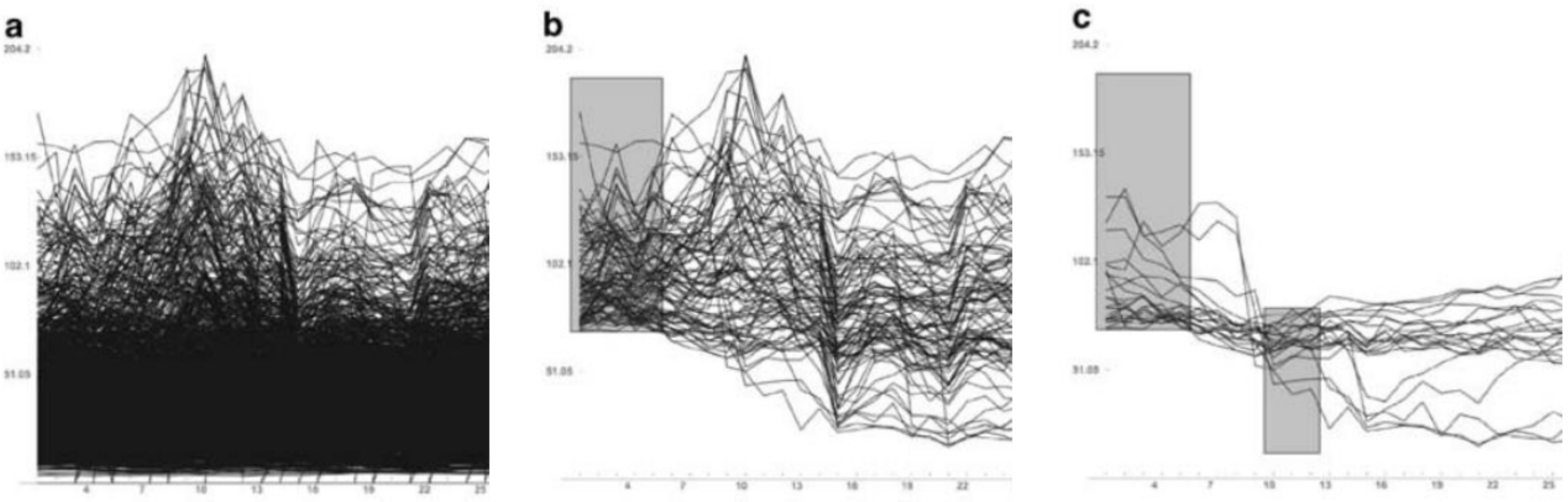


[Ahlberg & Shneiderman, 1994]

Visual Queries

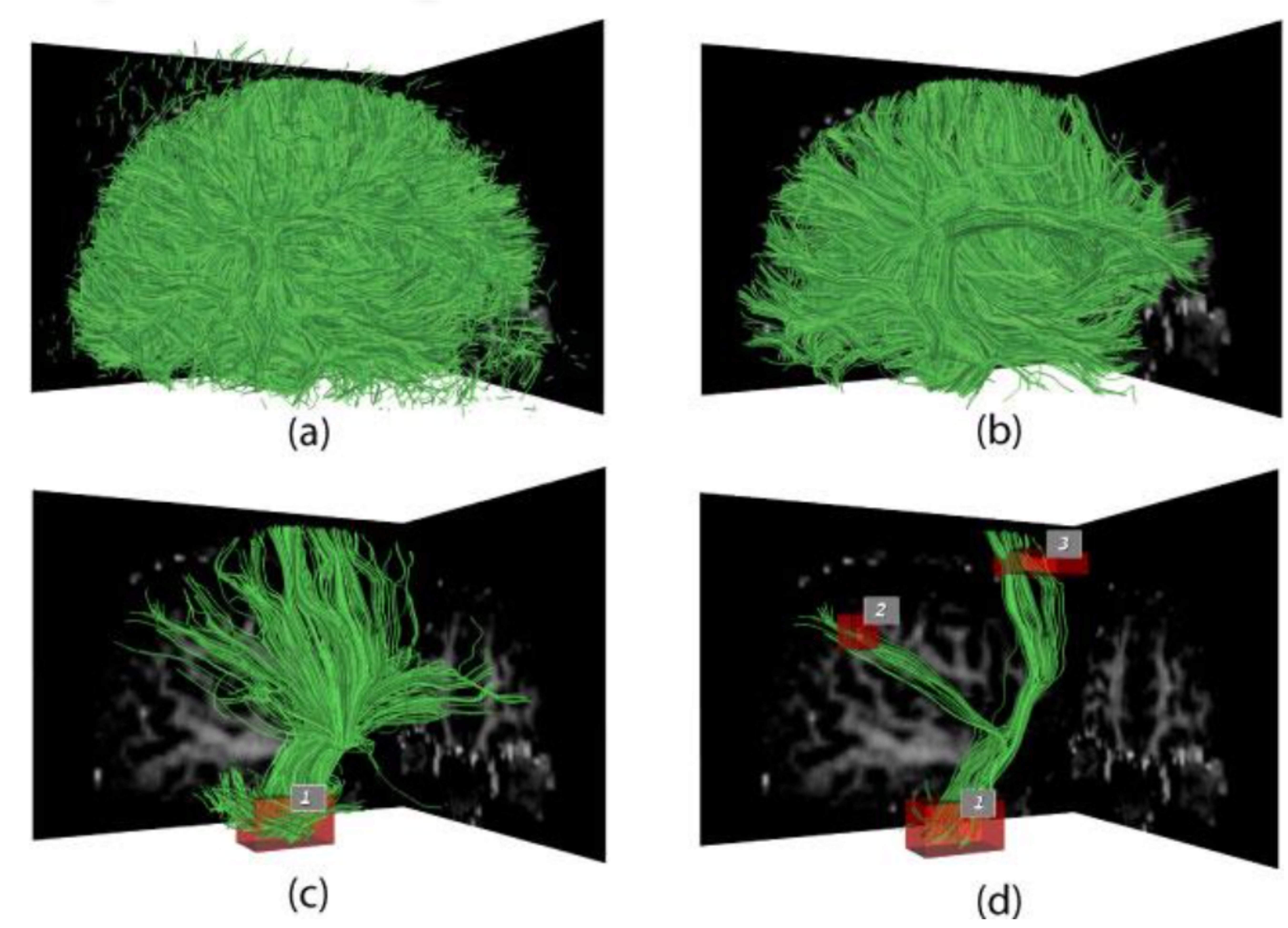


Visual Queries



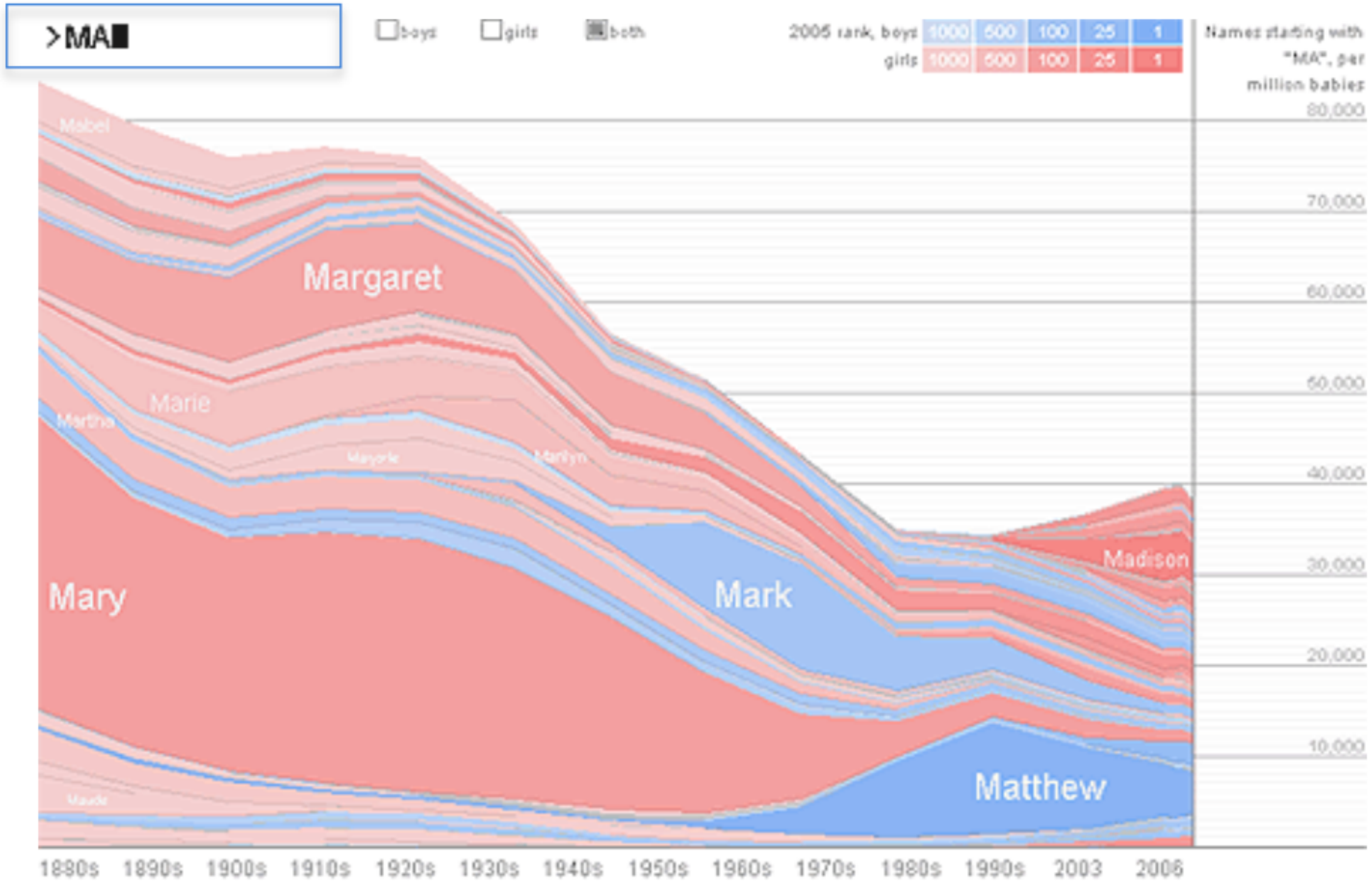
Time Searcher (Hocheiser, 2003)

Dynamic Querise for Volumetric Data

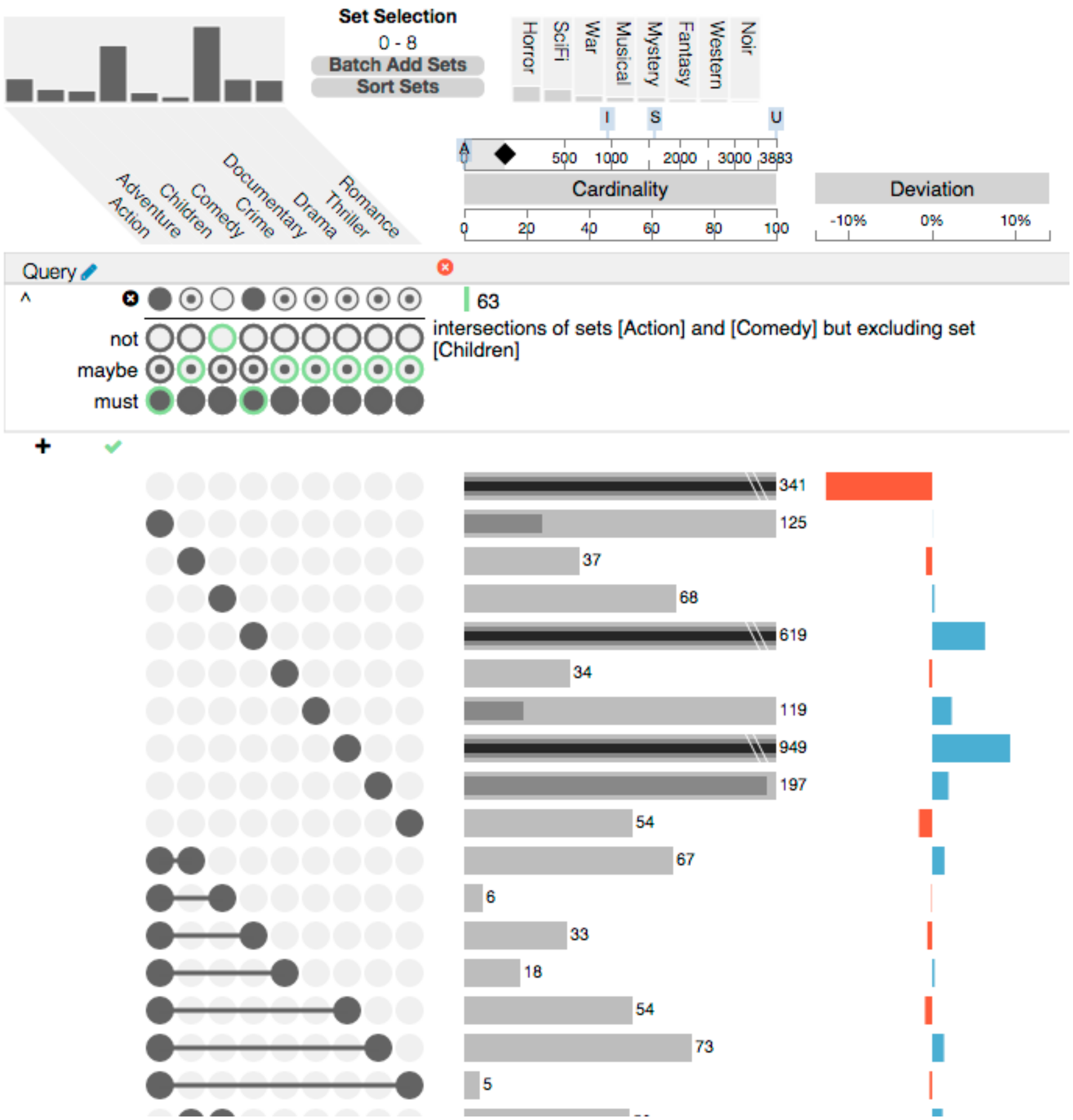


[Sherbondy 2004]

Incremental Text Search



Query Interfaces



More on Filters after the Fall Break!