CS-5630 / CS-6630 Visualization for Data Science Interaction

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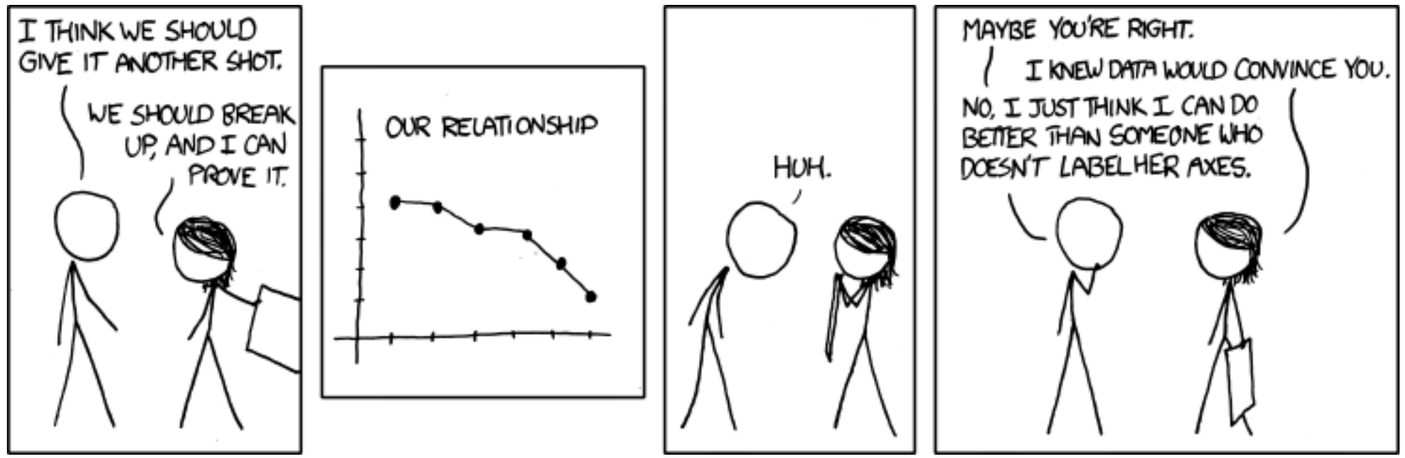
THE UNIVERSITY OF UTAH



[xkcd]

Project

It’s time to start thinking about your project.

Announce your project by Oct 7

Your project proposal, due Oct 21

- Come to office hours!

Peer feedback session on Oct 25 (mandatory attendance)

What you need:

- A team – use #looking-f-teammember channel
- An idea
- A dataset (that you actually can get!) https://www.dataviscourse.net/2022/resources/

More Info: https://www.dataviscourse.net/2022/project/

Stages

Announcement (not graded)

Proposal (5%)

Project Milestone (10%)

Final Project (25%)

- Process Book
- Narrated Video
- Vis live on website

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

Dos and Don’ts

Do a custom visualization

Do a newspaper-style visualization – add narration and storytelling

Don’t build a generic exploration tool – focus on one dataset

Communicate your project well, on website, on video.

IEEE VIS

THE Conference for data visualization

ieeevis.org

Oct 16-21 (week after fall break)

Most of course staff is traveling -> no class!

Use the time to work on project proposals

We'll post highlight videos instead of lectures

Interaction

Spectrum

Static Content

e.g., infographics, books

Dynamic Content

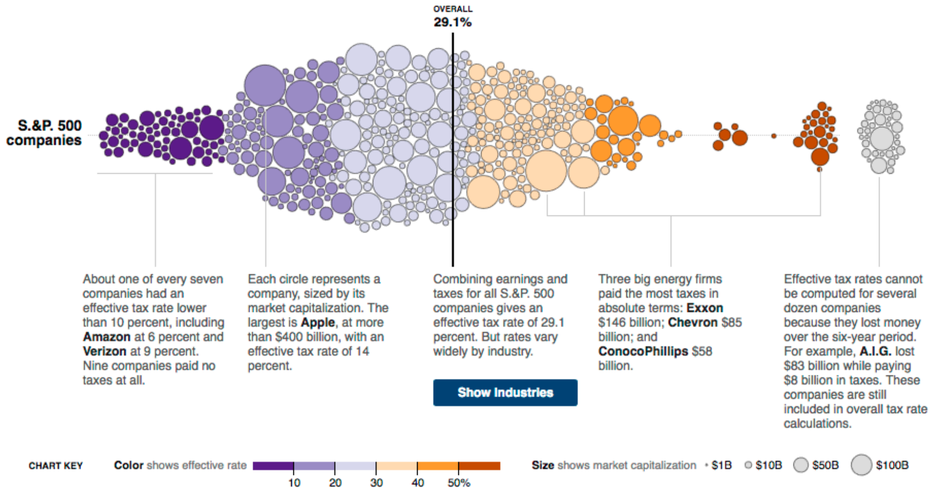
1. Animated Content
   “Auto-play”, user not in control
2. Interactive Content
   Changes are a result of user actions

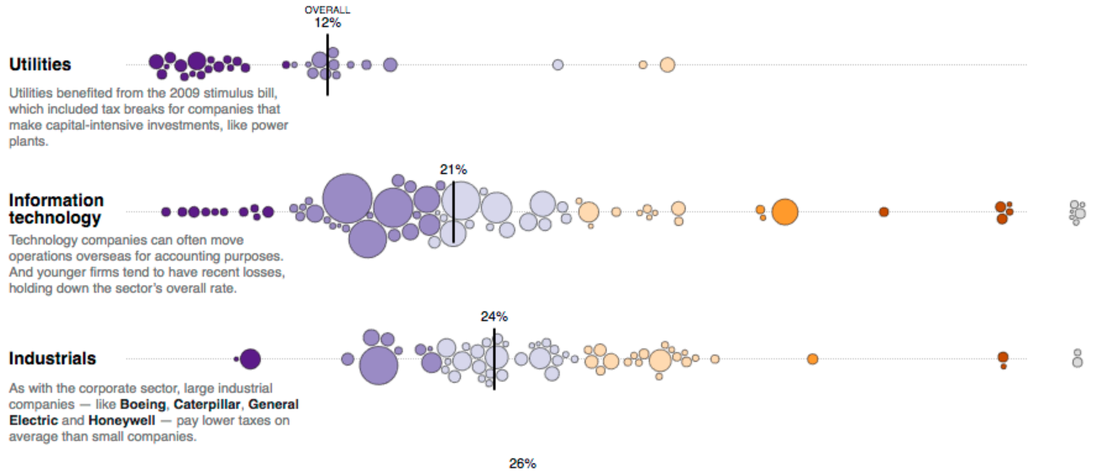
Why Interact with Visualization?

Explore data that is big / complex

There is too much data

There are too many ways to show it





http://www.nytimes.com/interactive/2013/05/25/sunday-review/corporate-taxes.html

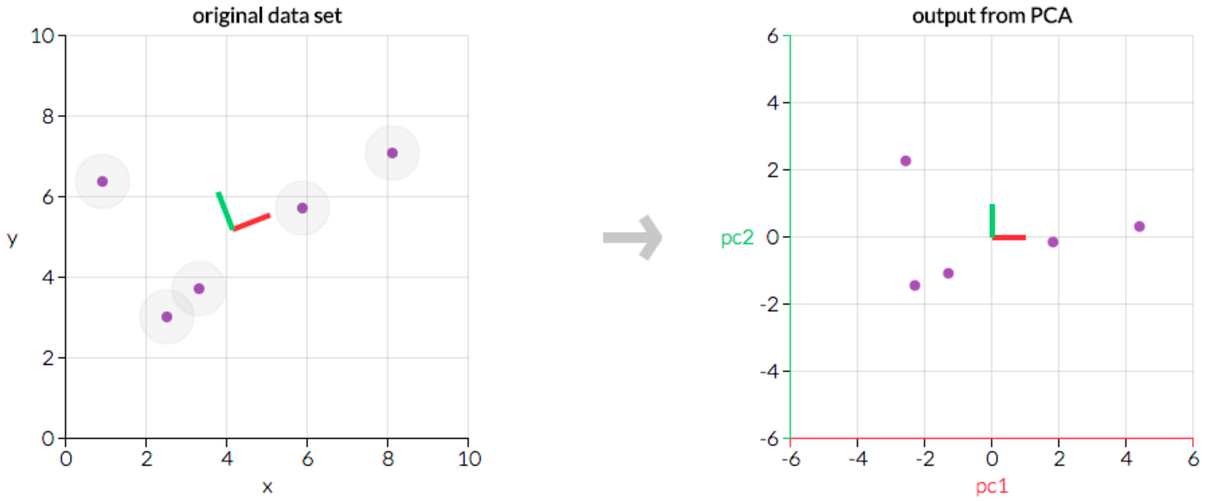
Why Interact with Visualization?

Interaction amplifies cognition

We understand things better

if we can touch them

if we can observe cause and effect



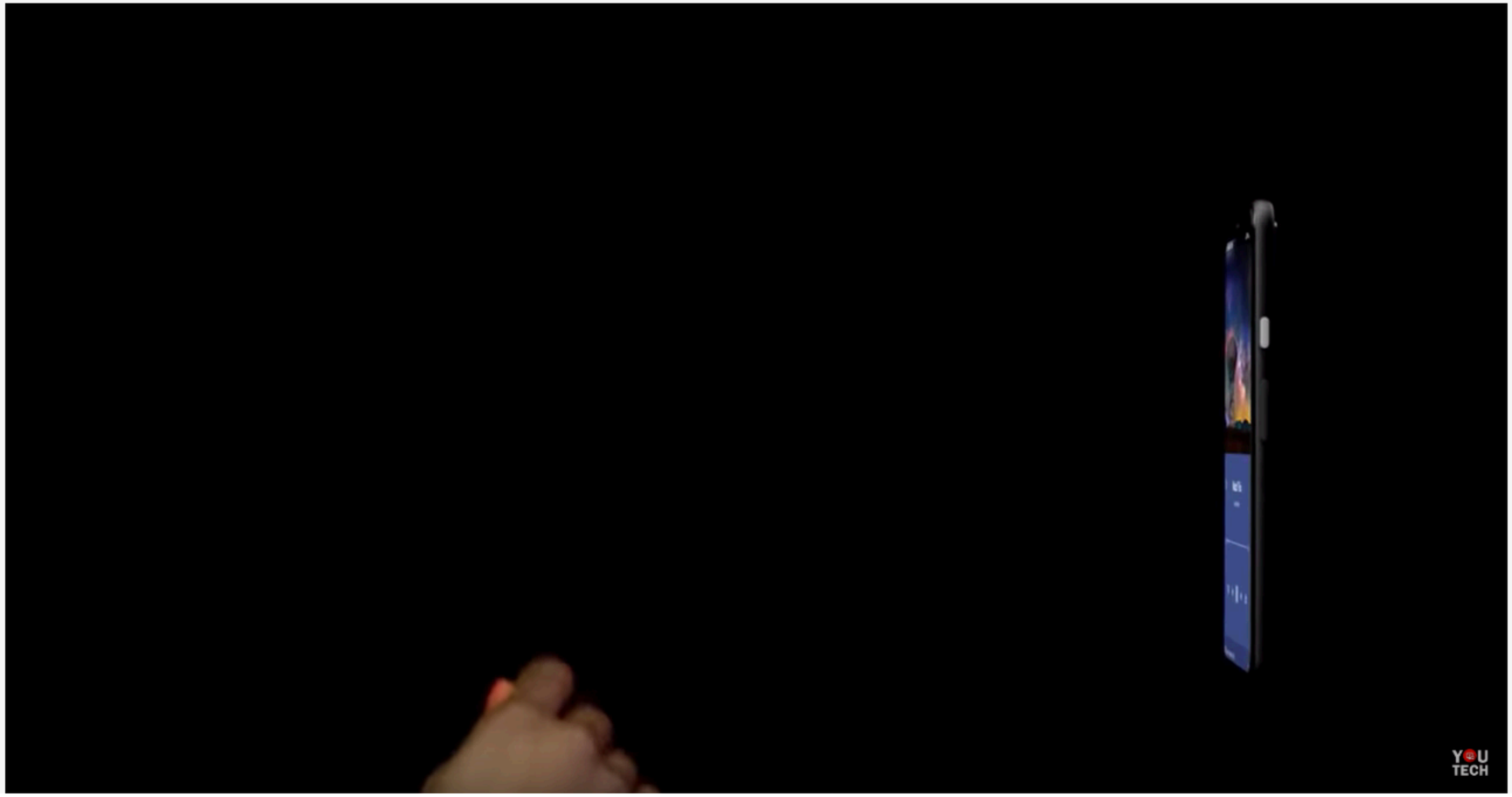
Interaction Methods

What do you design for?

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

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

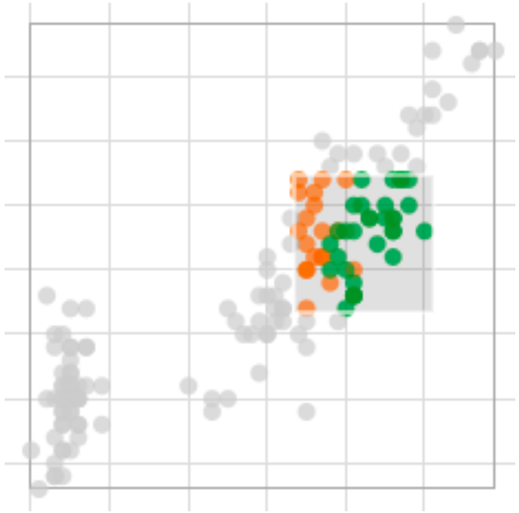

QUEUE DELETE PREV
BACK REPLY NEXT
CD RDS DAB
Bowers & Wilkins


YOU
TECH

Direct Manipulation

Interact directly with object

Continuous feedback / updates



Compare to using a query, a slider, etc.

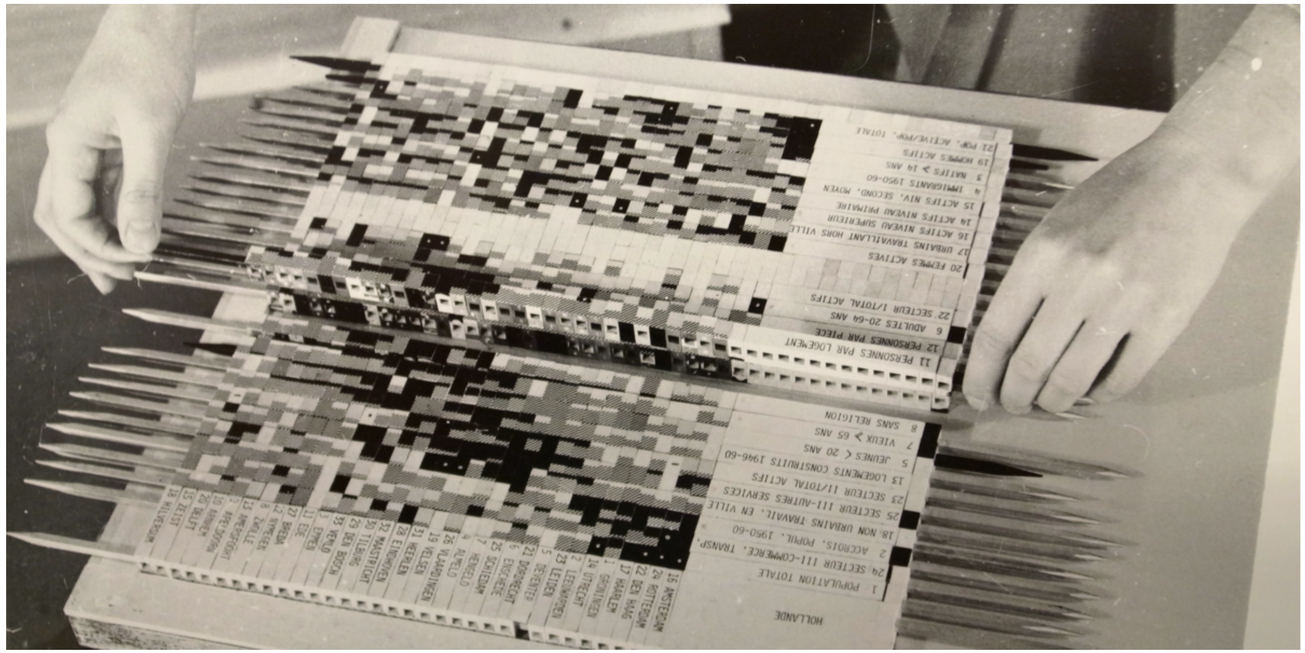


PHOTO SERGE BONIN, ARCHIVES NATIONALES

[Bertin's Reorderable Matrices]

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

Future Lecture

Purposes of Interaction

DOI:10.1145/2133806.2133821

Article development led by acmqueue
queue.acm.org

A taxonomy of tools that support the fluent and flexible use of visualizations.

BY JEFFREY HEER AND BEN SHNEIDERMAN

Interactive Dynamics for Visual Analysis

THE INCREASING SCALE and availability of digital data provides an extraordinary resource for informing public policy, scientific discovery, business strategy, and even our personal lives. To get the most out of such data, however, users must be able to make sense of it: To pursue questions, uncover patterns of interest, and

identify (and potentially correct) errors. In concert with data-management systems and statistical algorithms, analysis requires contextualized hu-

analysis consists of repeated explorations as users develop insights about significant relationships, domain-specific contextual influences, and causal

TABLE 1: Taxonomy of interactive dynamics for visual analysis

Data & View Specification	**Visualize** data by choosing visual encodings. **Filter** out data to focus on relevant items. **Sort** items to expose patterns. **Derive** values or models from source data.
View Manipulation	**Select** items to highlight, filter, or manipulate them. **Navigate** to examine high-level patterns and low-level detail. **Coordinate** views for linked, multi-dimensional exploration. **Organize** multiple windows and workspaces.
Process & Provenance	**Record** analysis histories for revisitation, review and sharing. **Annotate** patterns to document findings. **Share** views and annotations to enable collaboration. **Guide** users through analysis tasks or stories.

Data & View Specification, View Manipulation

https://taggle-daily.caleydoapp.org /

Process and Provenance:

https://gapminder.caleydoapp.org/#clue_graph=clue_gapminder0&clue_state=30&clue=P&clue_slide=41

Change over Time / Transitions

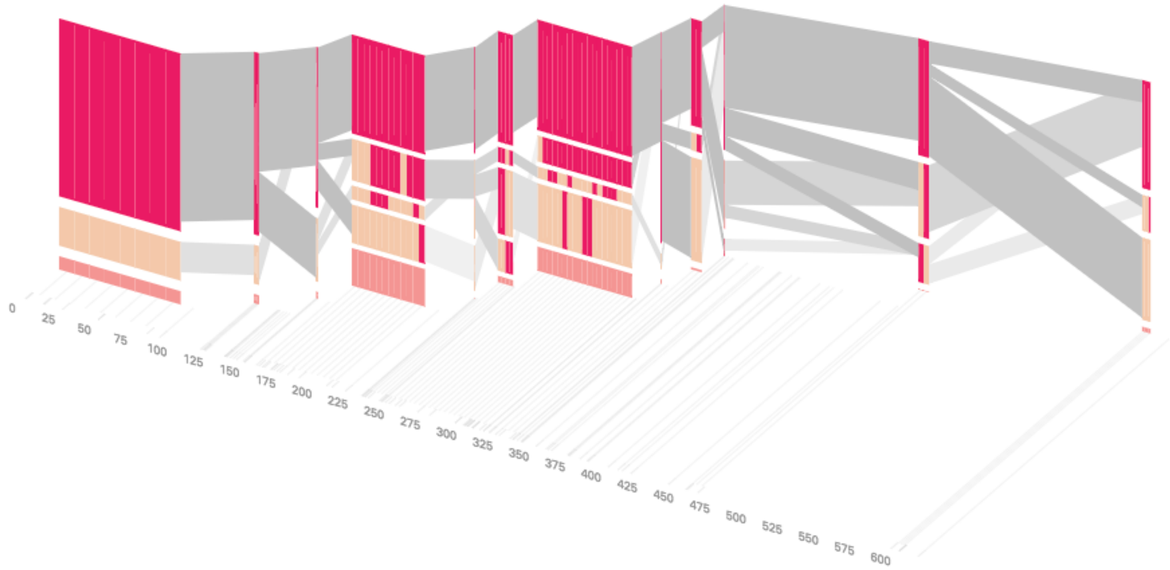
Why Change?

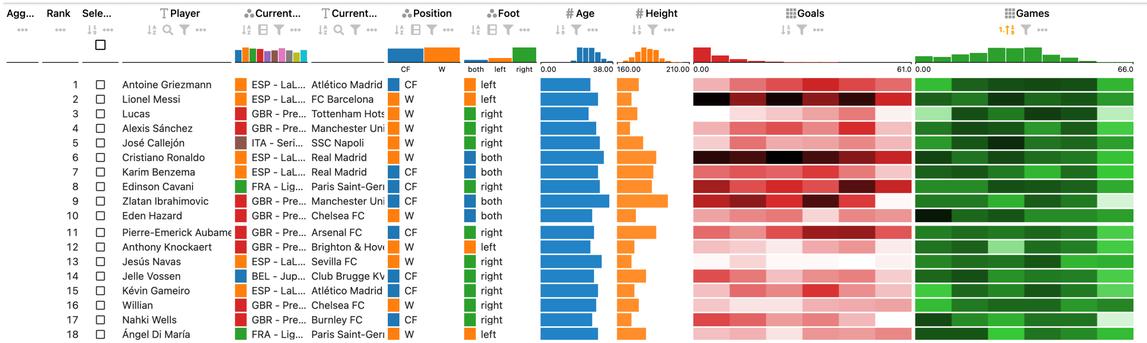
Different representations support different tasks

bar chart, vs stacked bar chart

Change Ordering, Layouts, Mapping, ….

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

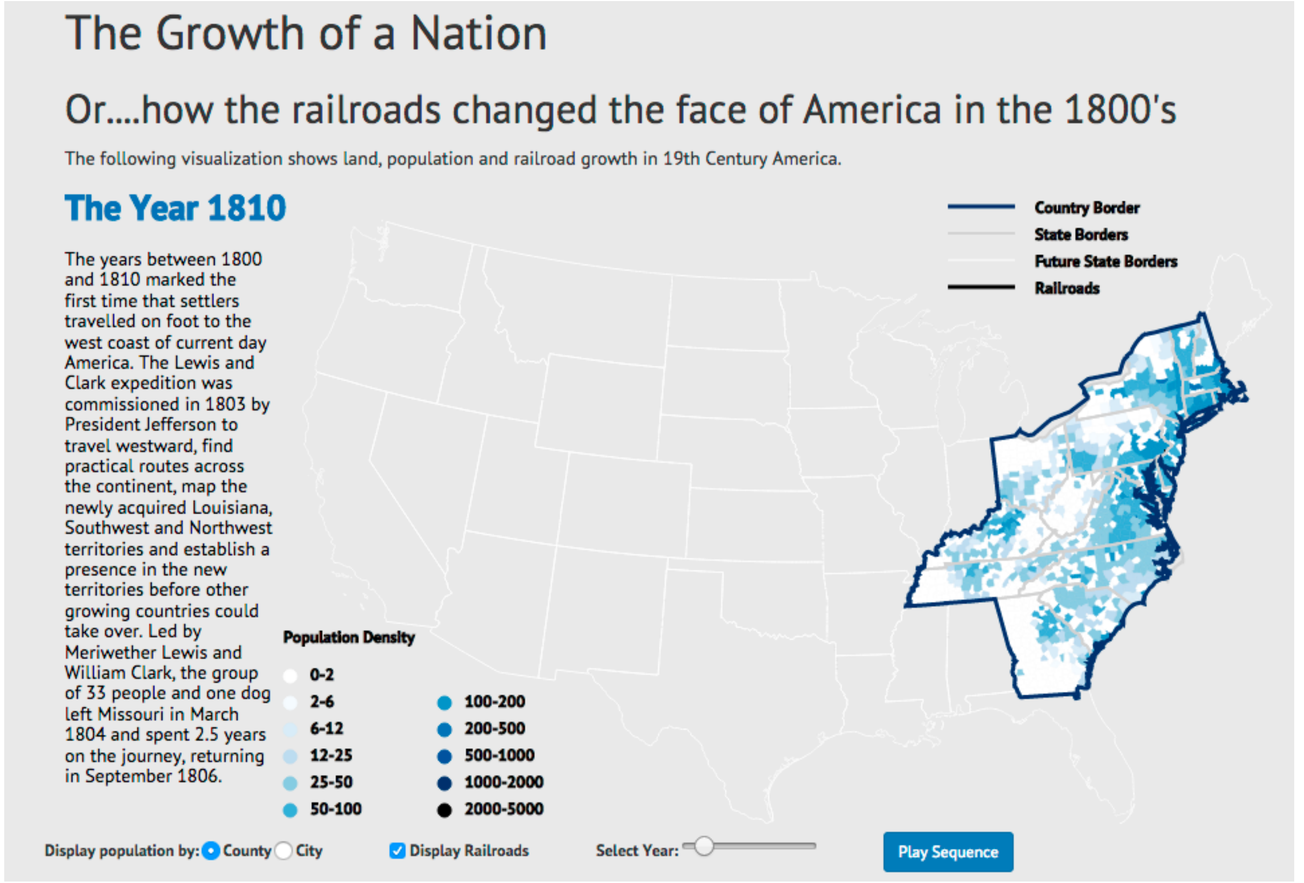




Change

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

Sometimes better to show difference explicitly



[Lauren Wood]

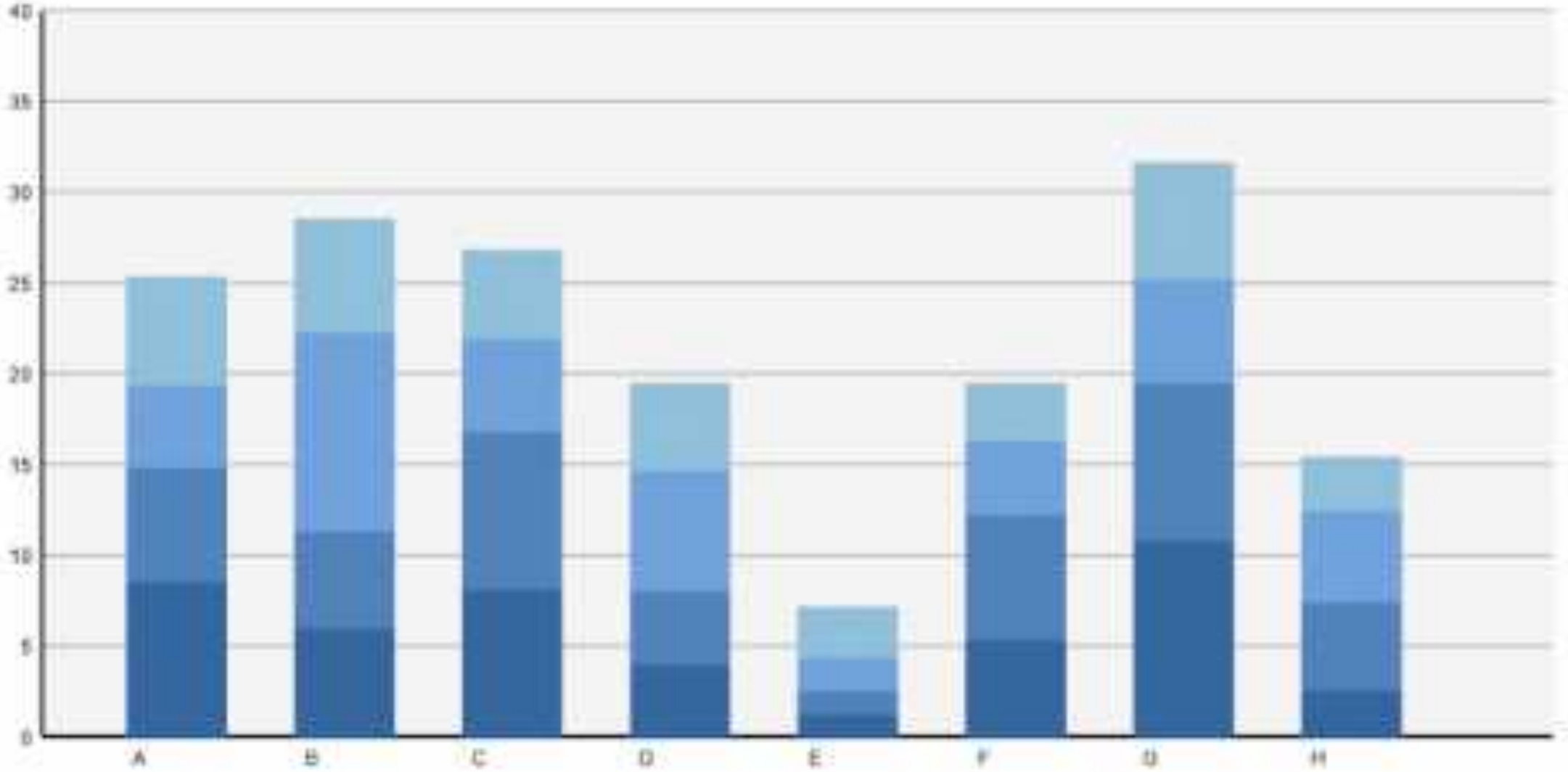
Animated Transitions

Smooth interpolation between states or visualization techniques

Keep track of items

Understand relationships between states

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



[Heer & Robertson, 2007]

Animation Caveats

Changes can be hard to track

Eyes over memory!

- Show all states in multiple views

Navigation

Navigation

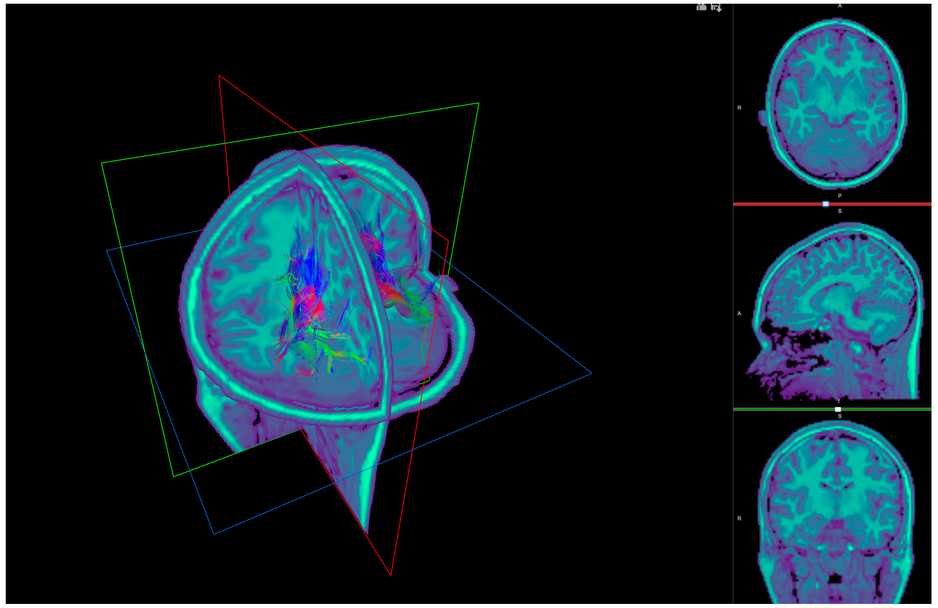
Pan

move around

Zoom

enlarge/ make smaller (move camera)

Rotate



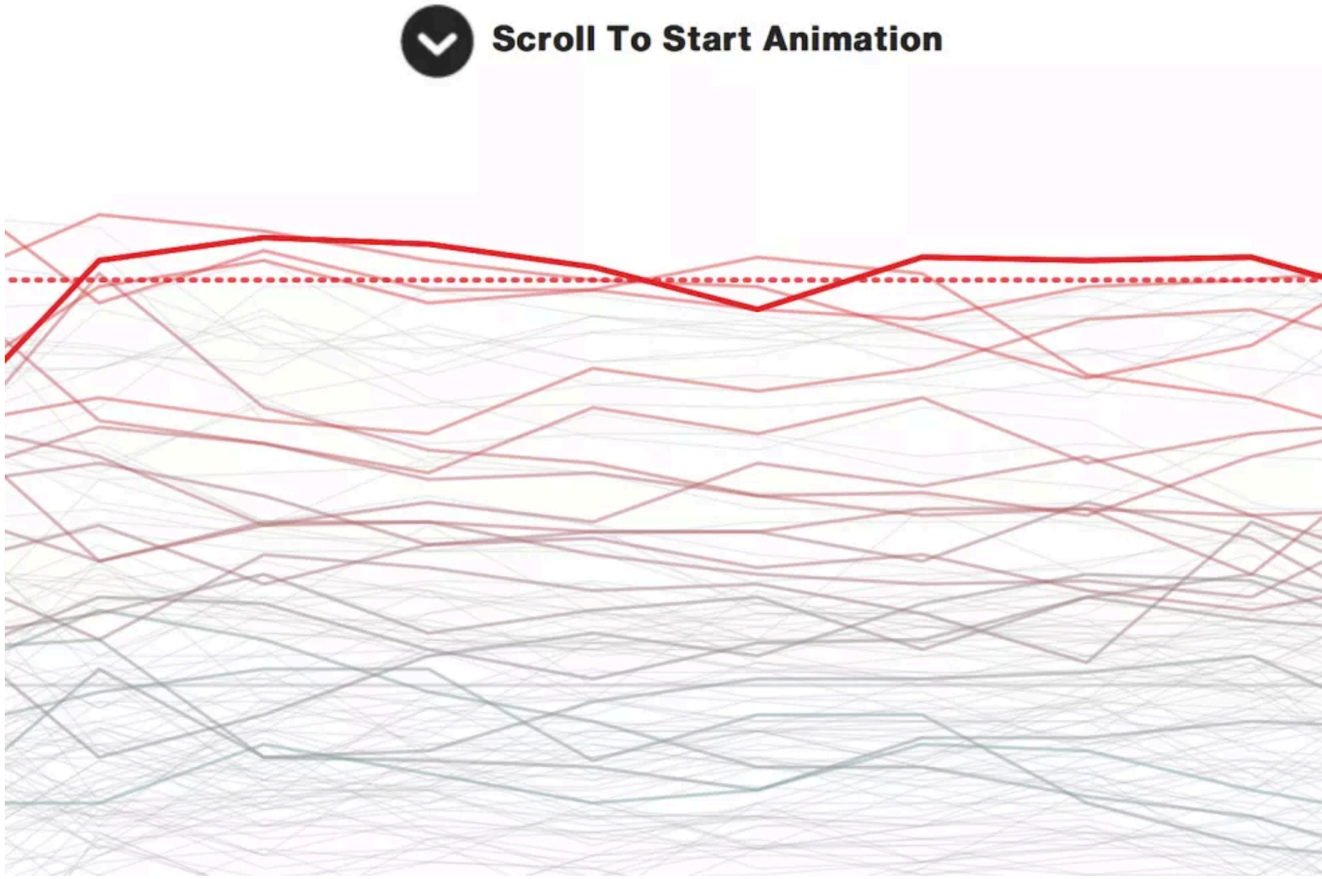
Navigating a Story: Scrollytelling

Telling an interactive story

Interaction by scrolling

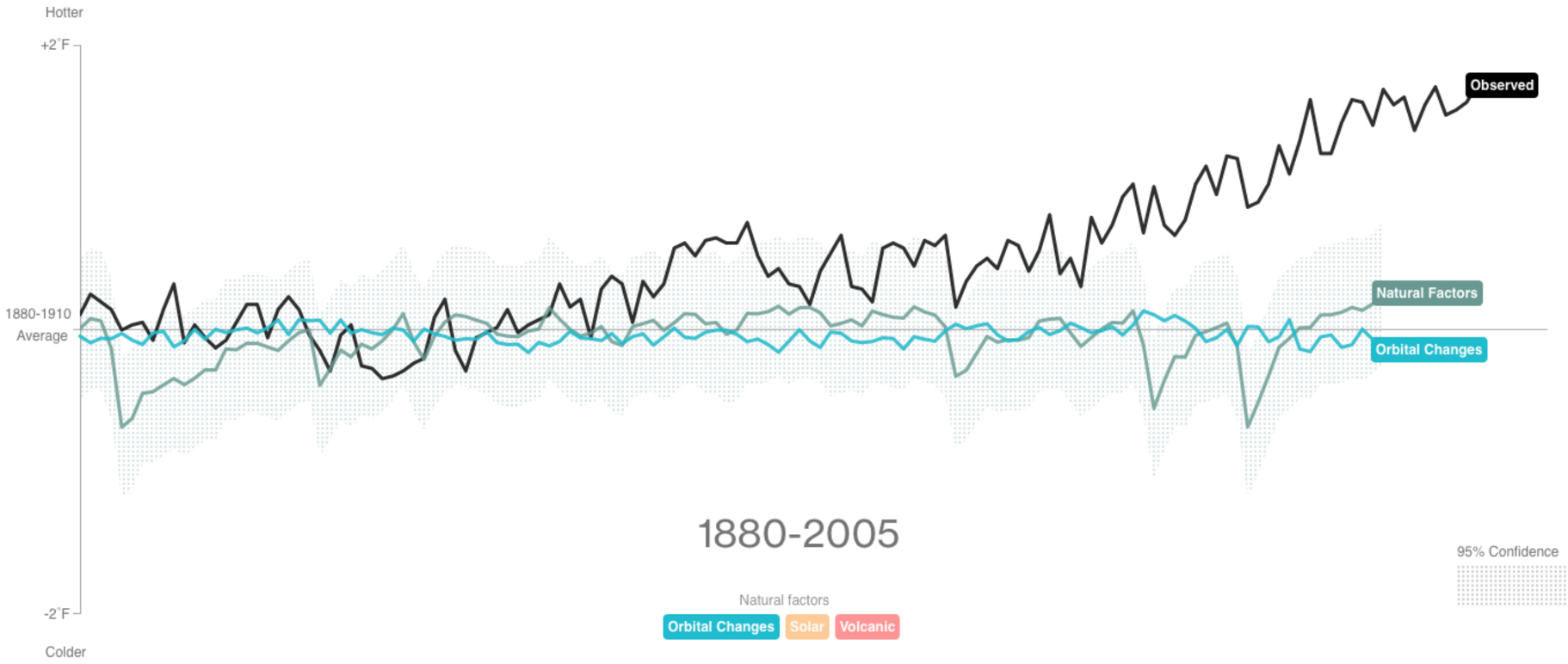
Nice but

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



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

Example: What's Warming the World



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

Sent in by Siddartha Ravichandran

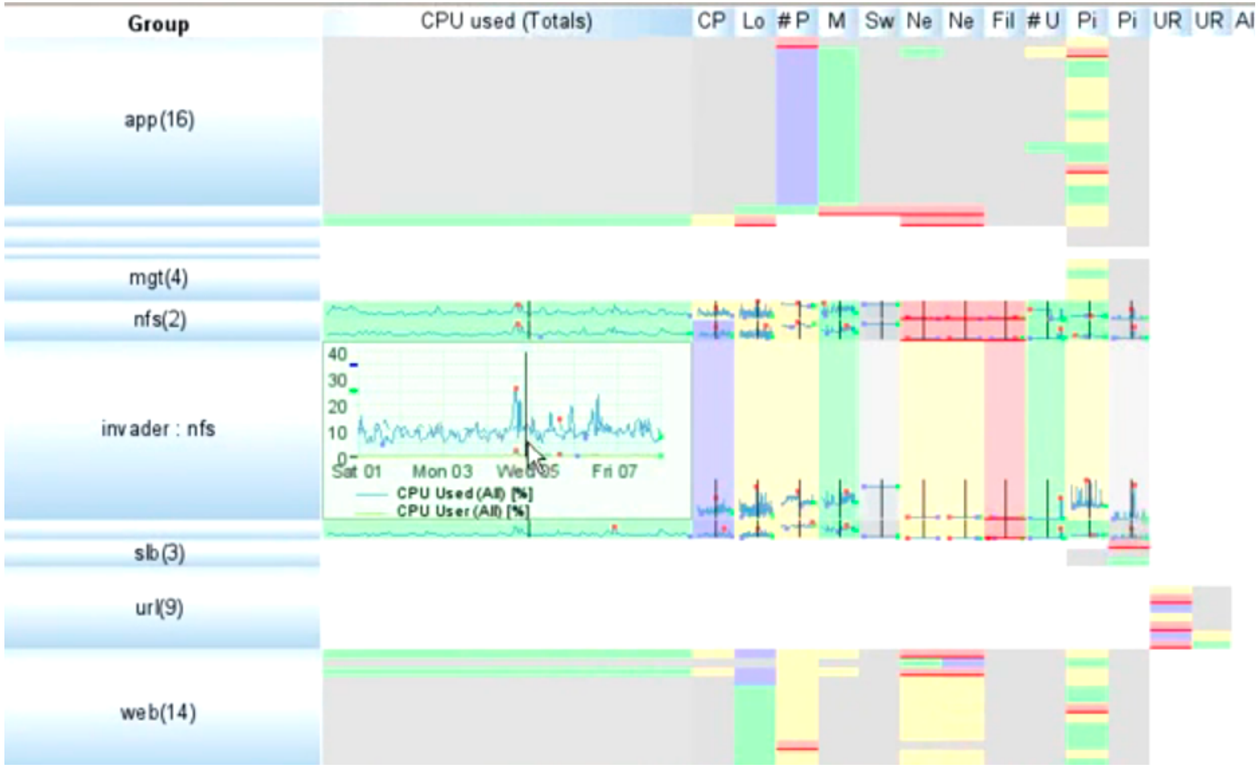
Semantic Zooming

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

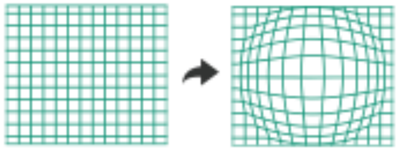
- aggregation
- reduction
- layering

Embed

- Elide Data

- Superimpose Layer

- Distort Geometry



➔ Elide Data

Elision

focus items shown in detail,

other items summarized for context

e·li·sion

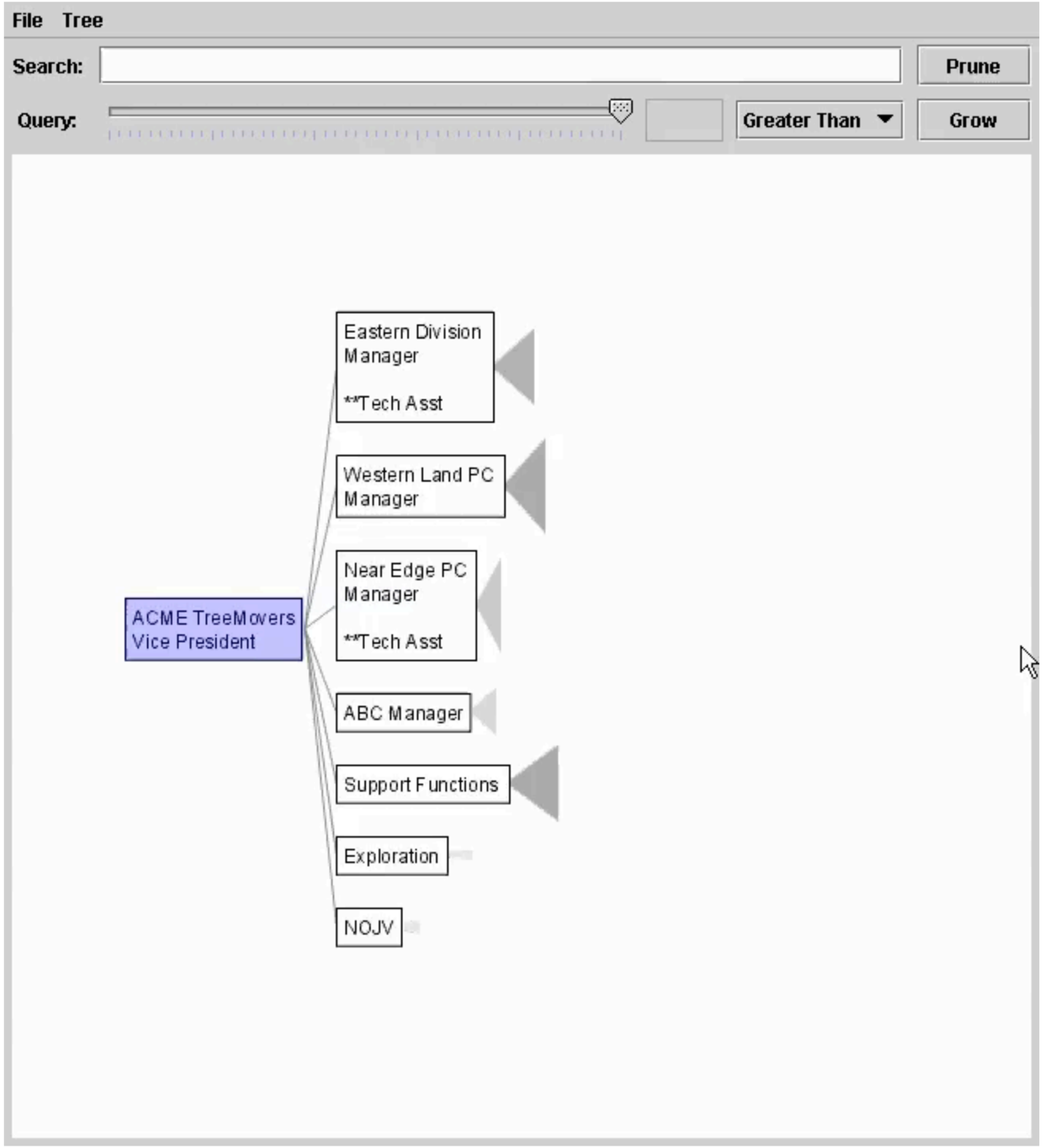
/iˈliZHən/

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



➔ Elide Data

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

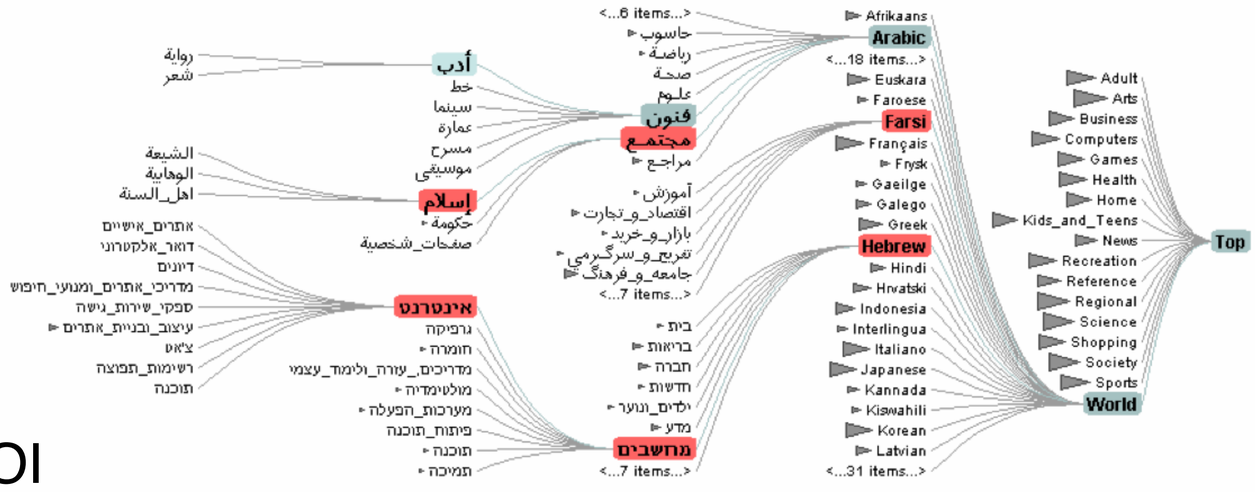
DOI Tree

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

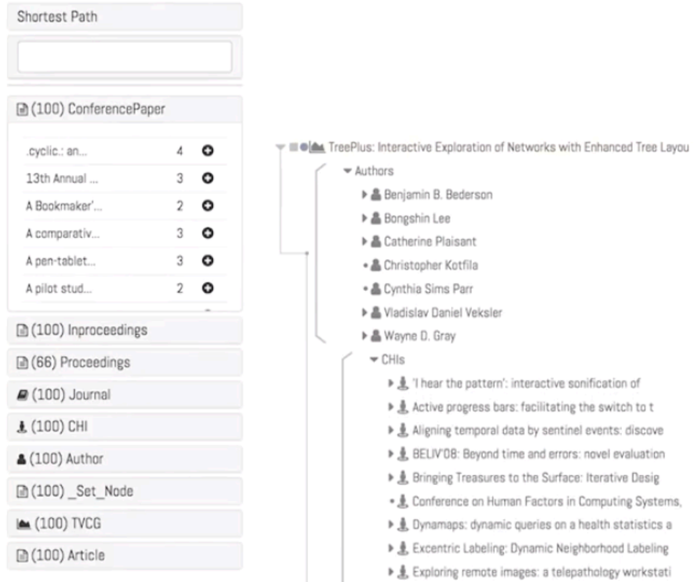


[Heer 2004]

DOI without distance function

Distance function can lead to big, involuntary changes.

Useful also without distance function



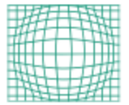
https://youtu.be/EAjNxFgsJ58?t=244

Superimpose

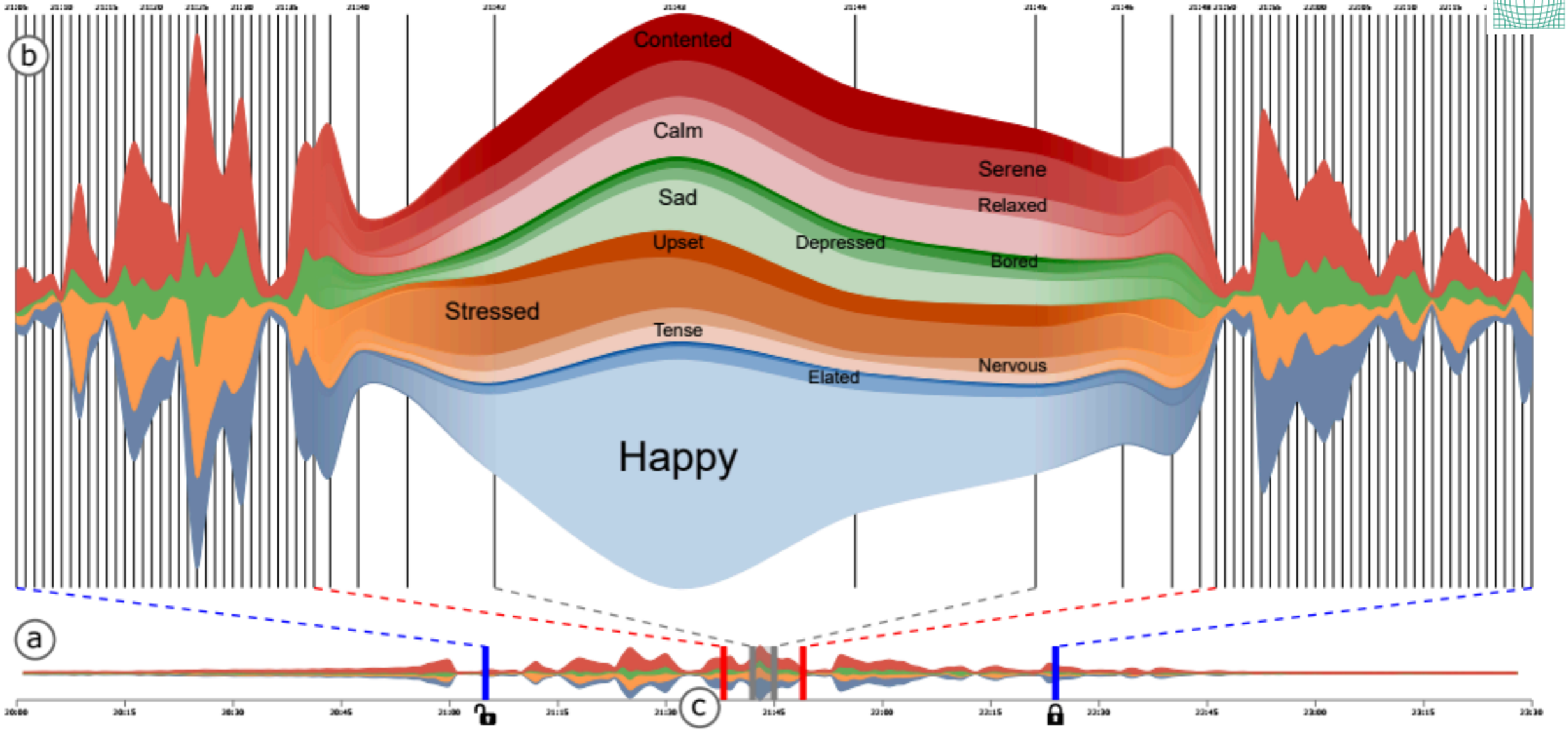
focus layer limited to a local region of view,

instead of stretching across the entire view

Distortion



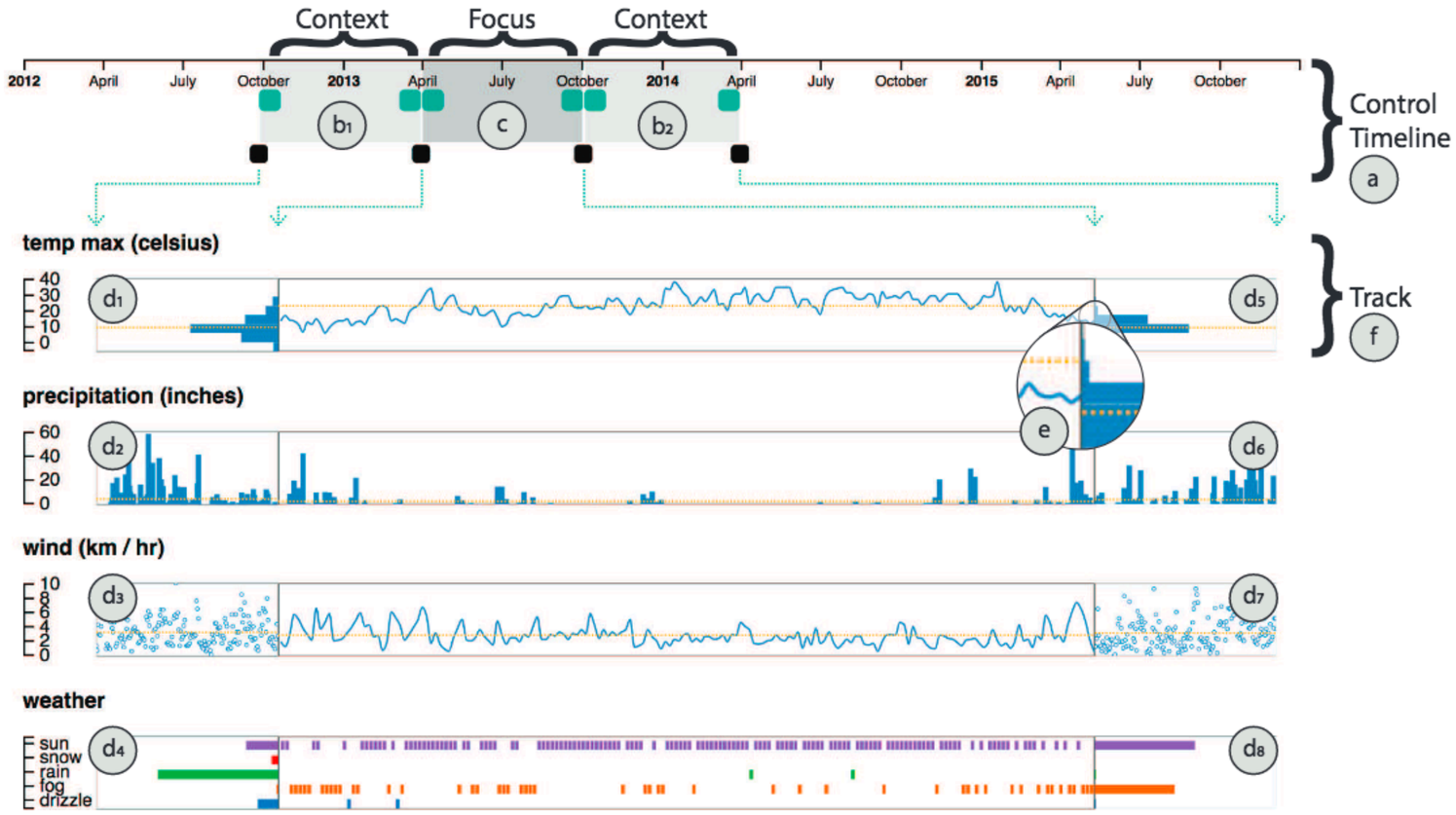
use geometric distortion of the contextual regions to make room for the details in the focus region(s)



http://advanse.lirmm.fr/multistream/

[Cuenca, MultiStream, 2017]

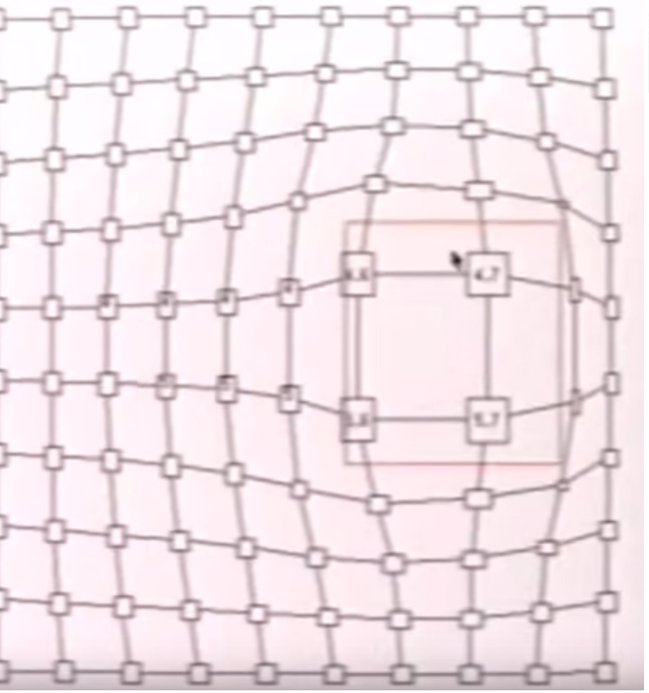
Distortion Alternative: Smart Aggregation



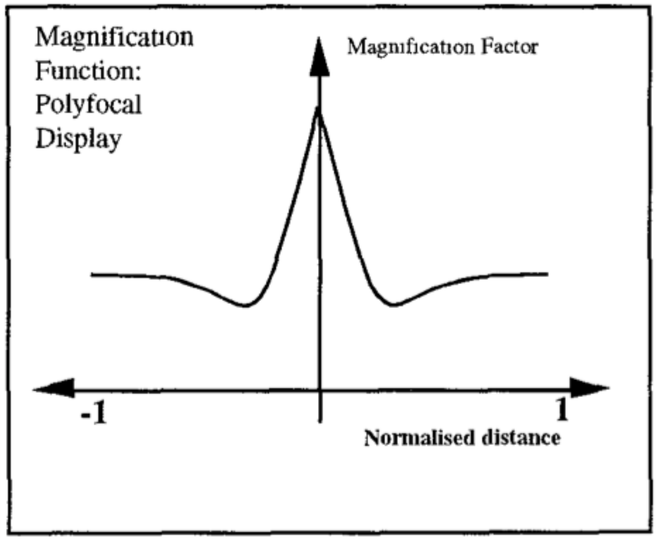
https://precisionvissta.github.io/PeripheryPlots/

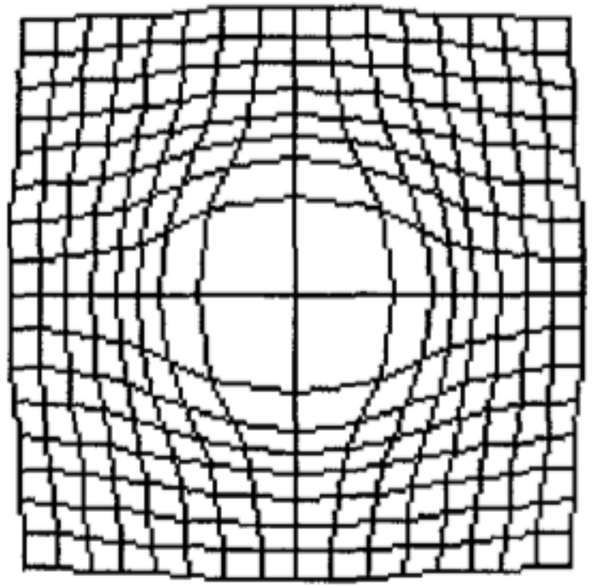
[Morrow 2019]

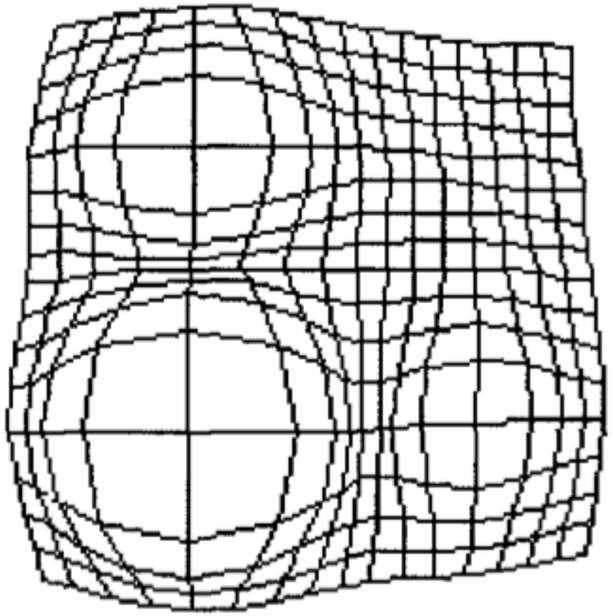
Fisheye



[Sarkar, 1993]

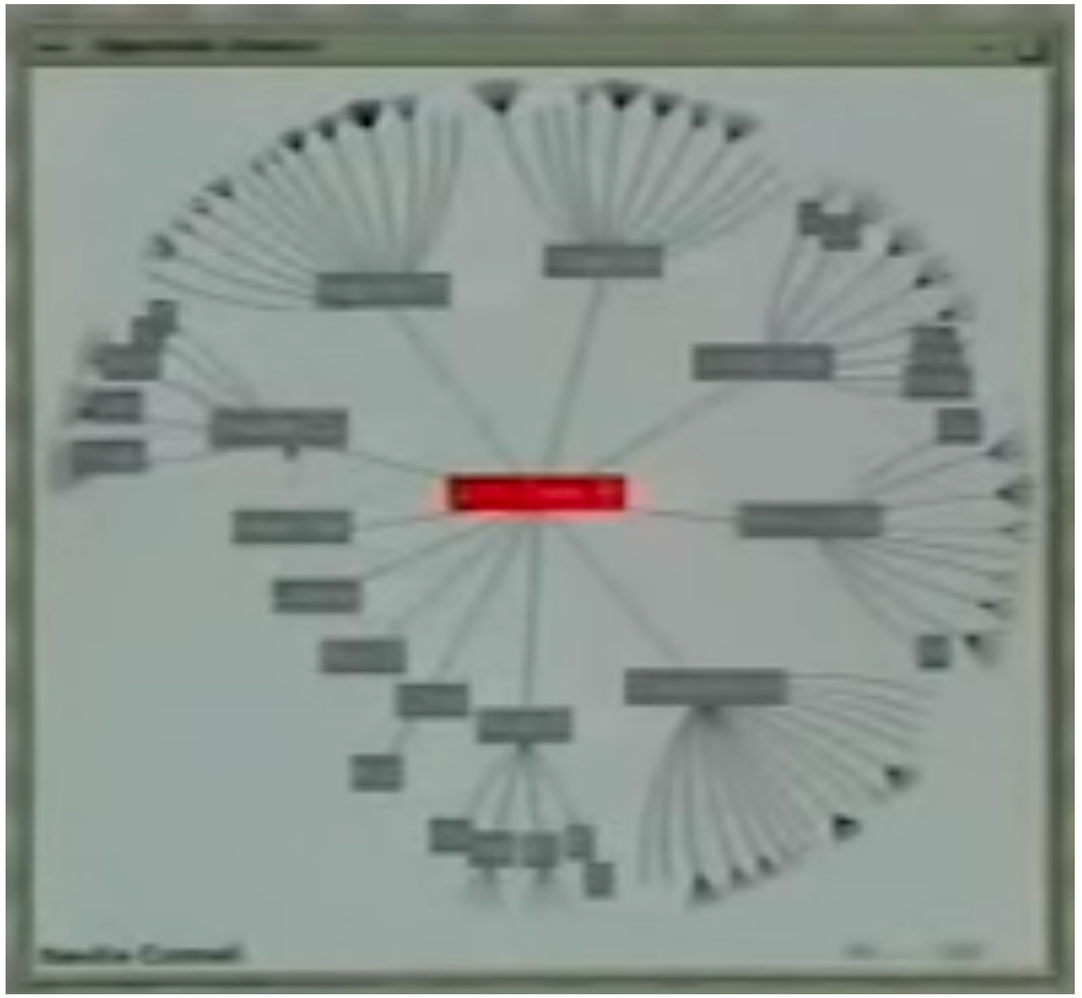




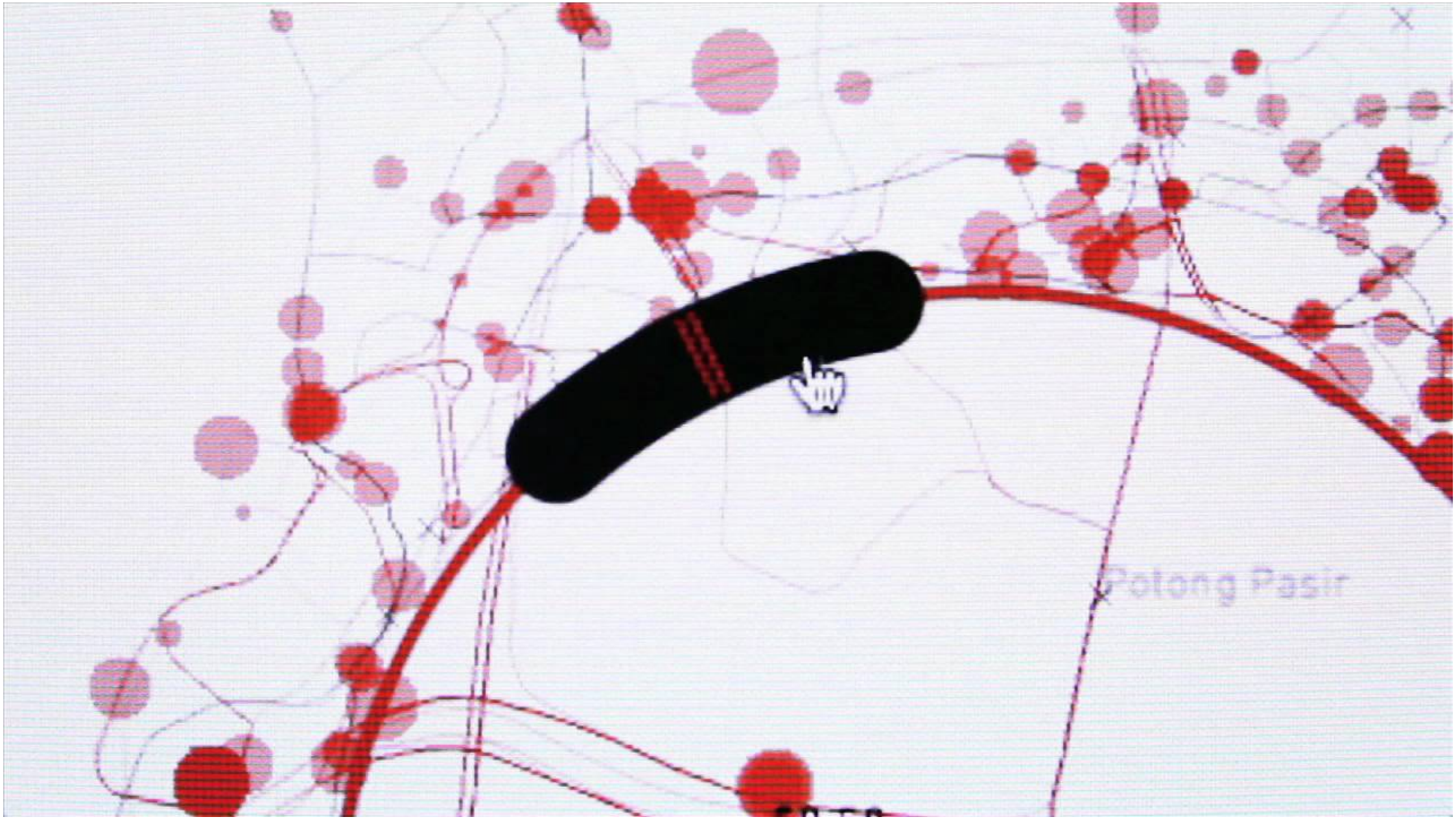


Leung 1994

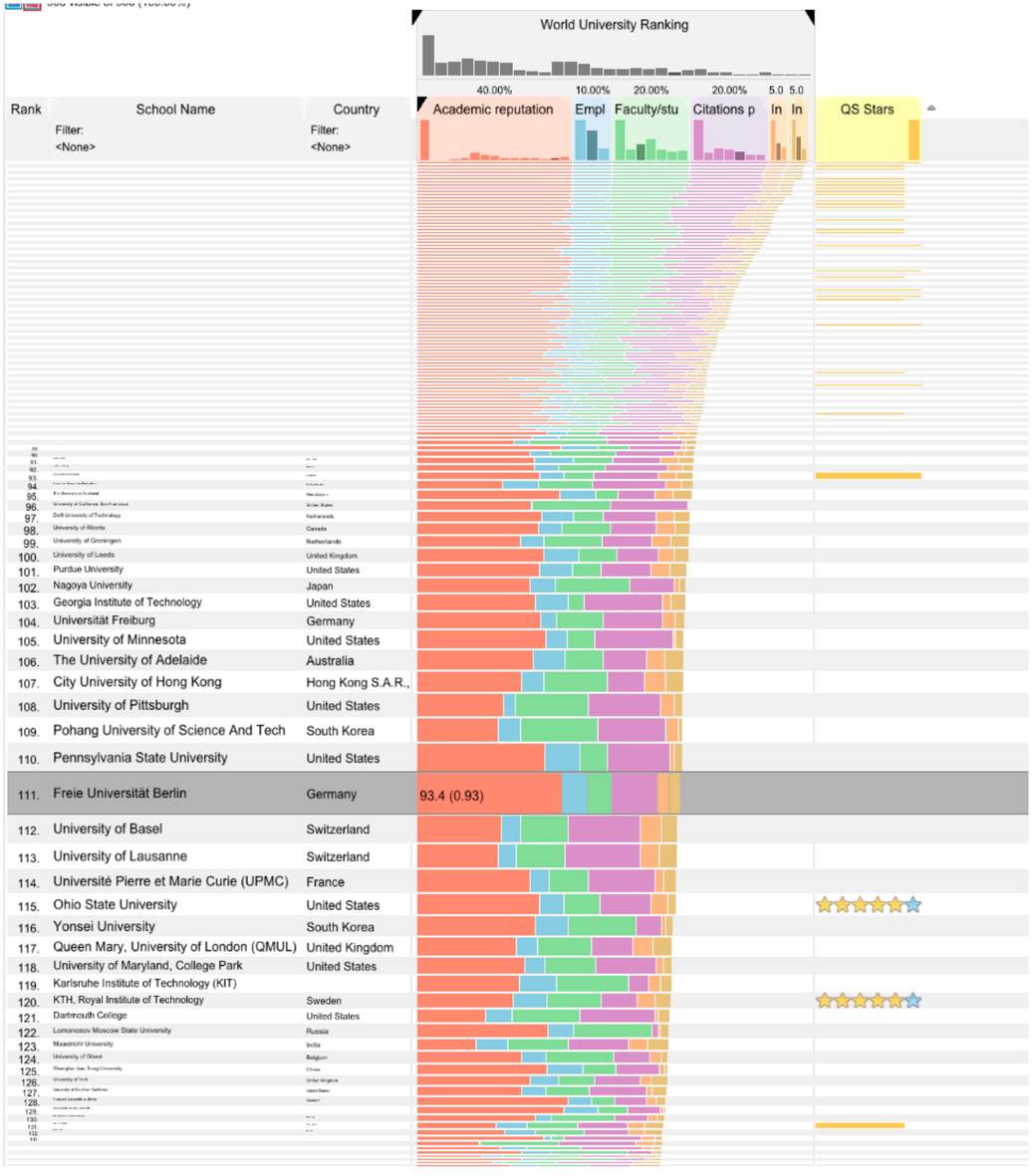
Hyperbolic Geometry



[Lamping, 1995]



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



Fisheye Tree View

ctominski

Subscribe 2

100 views

Add to Share More

0 0

What do you think about distortion?

Distortion Concerns

unsuitable for relative spatial judgements

overhead of tracking distortion

visual communication of distortion

- gridlines, shading

target acquisition problem

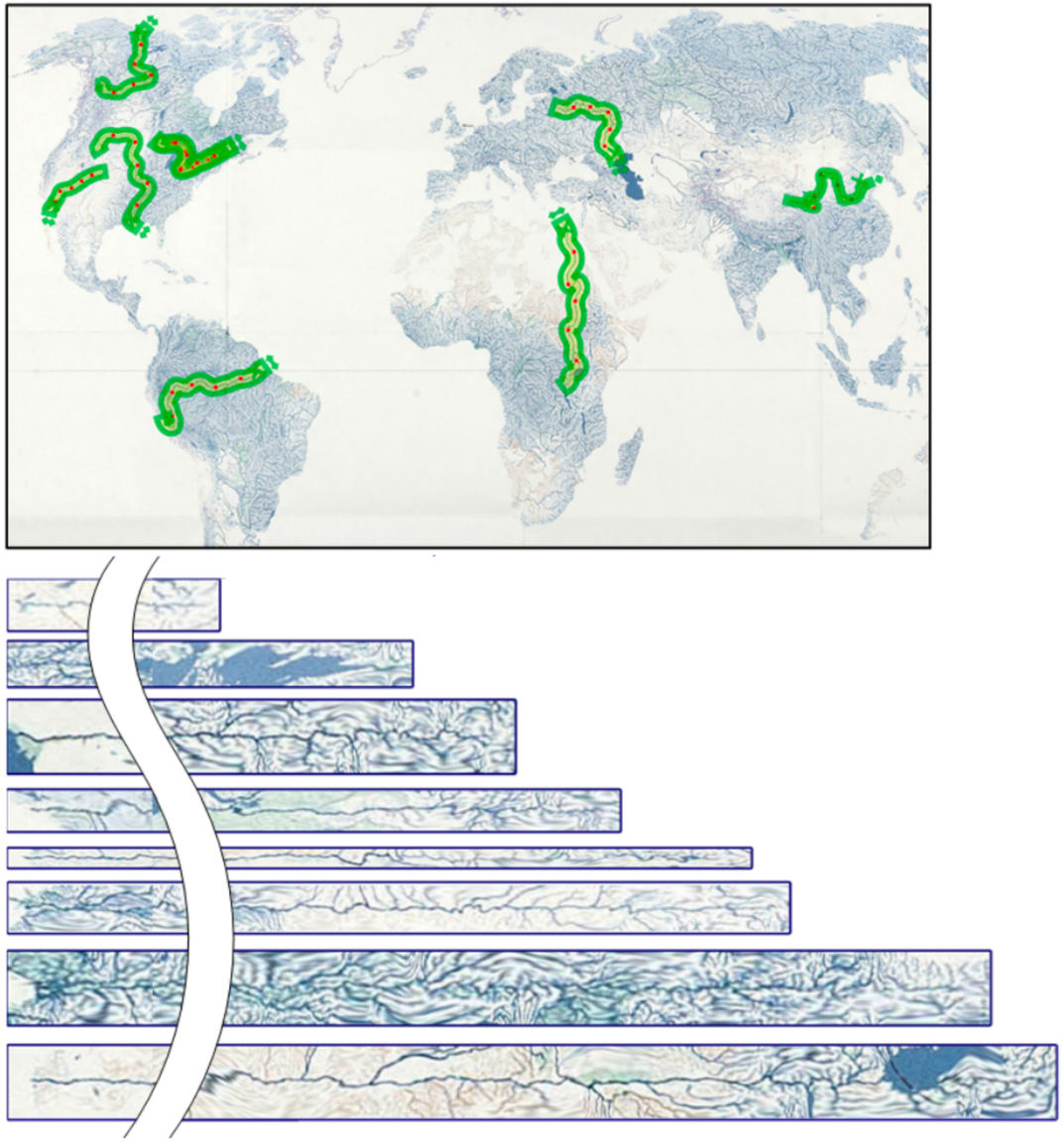
- lens displacing items away from screen location

mixed results compared to separate views and temporal navigation

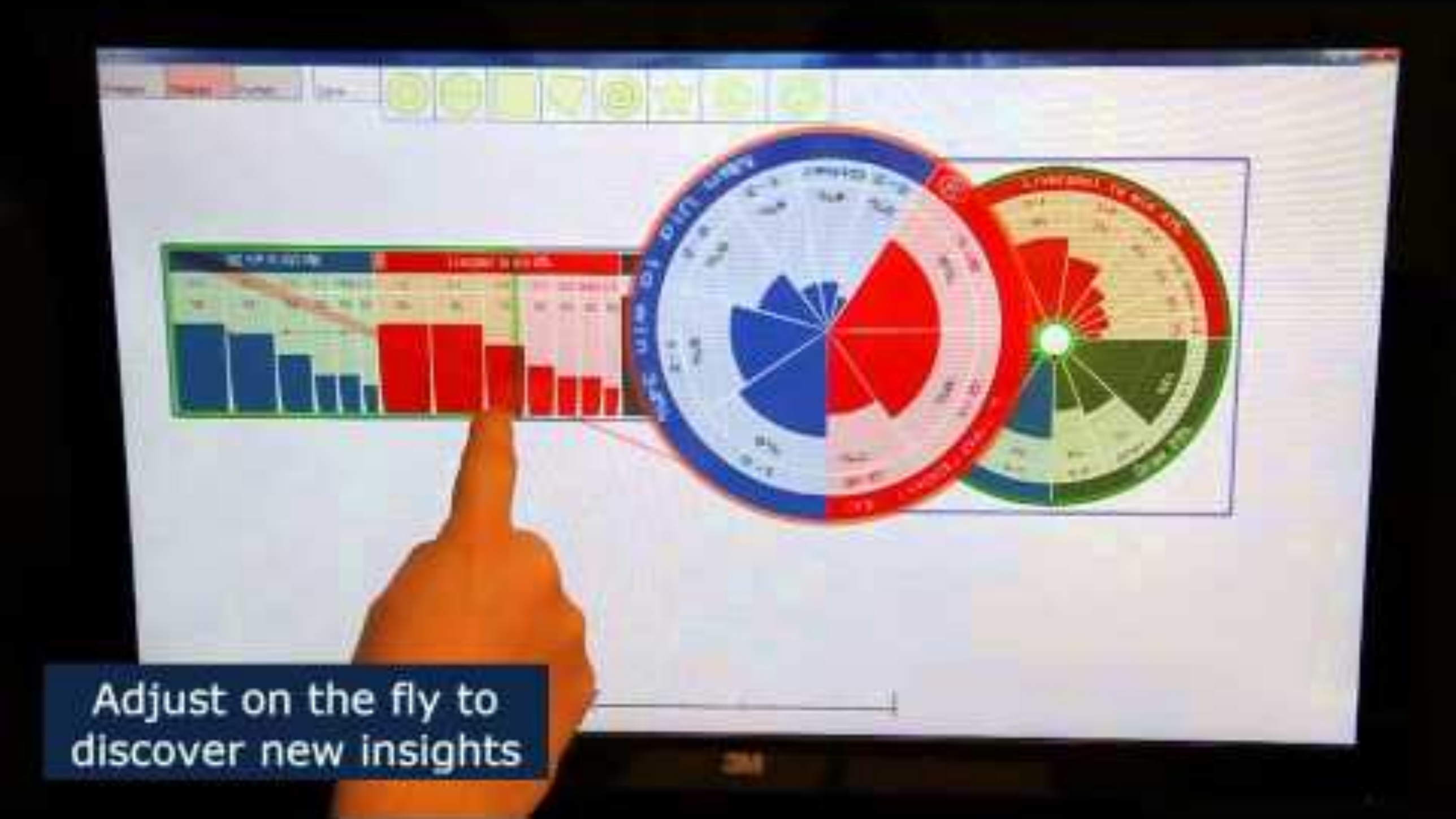
Transmorgification

Idea: straighten complex shapes in image space

Can be spatial data,
but also other vis techniques



[Brosz, 13]


Adjust on the fly to
discover new insights

Overview + Detail

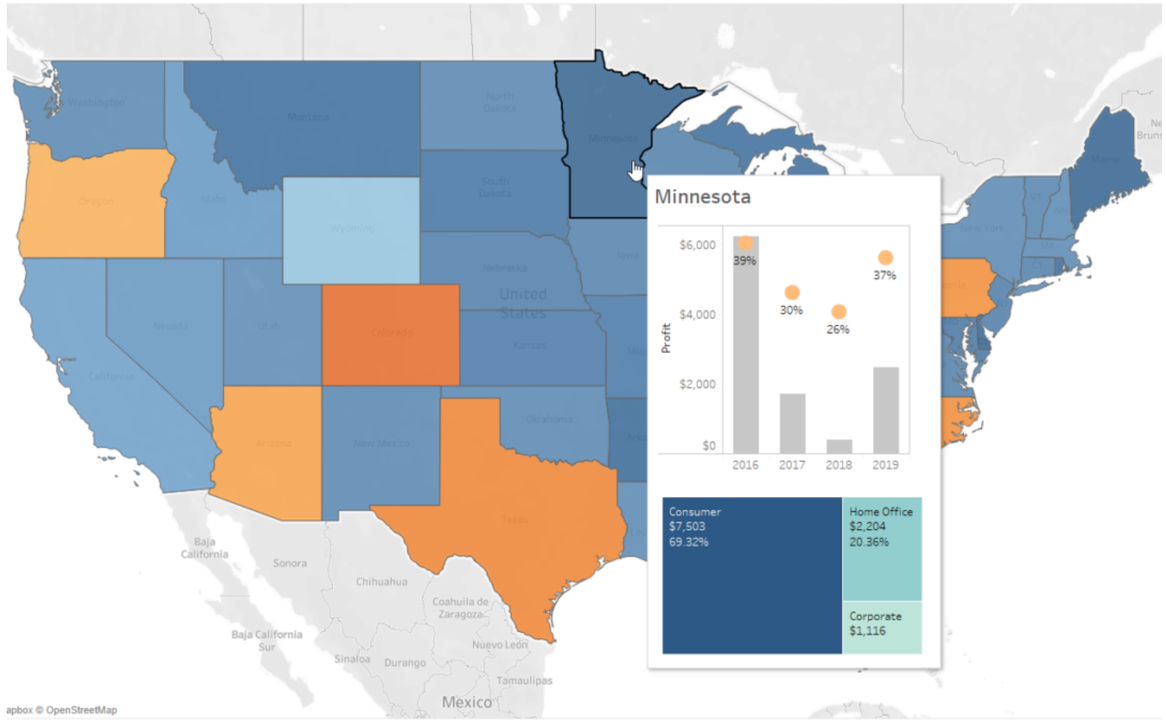
Overview and Detail

One view shows overview

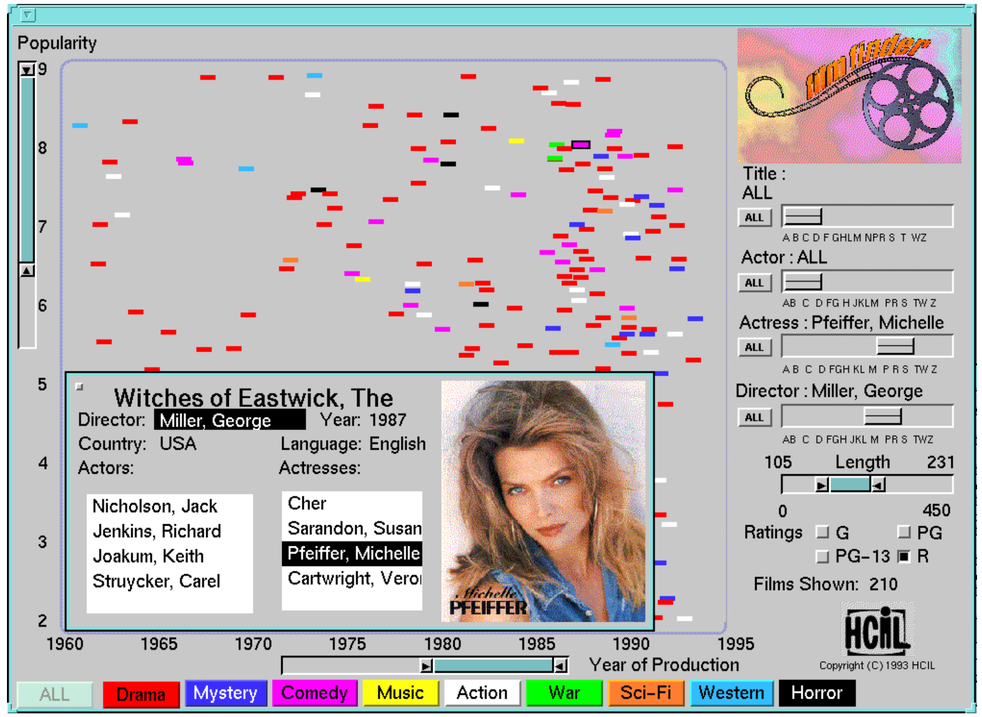
Other shows detail

Warcraft III

Tool-Tips Can Provide Details



[Tool Tips in Tableau]



[FilmFinder, Ahlberg & Shneiderman, 1994]

Filtering
& dynamic querying

aka brushing, aka selecting

The MANTRA

Visual Information Seeking Mantra (Shneiderman, 1996)

Overview first,

zoom and filter,

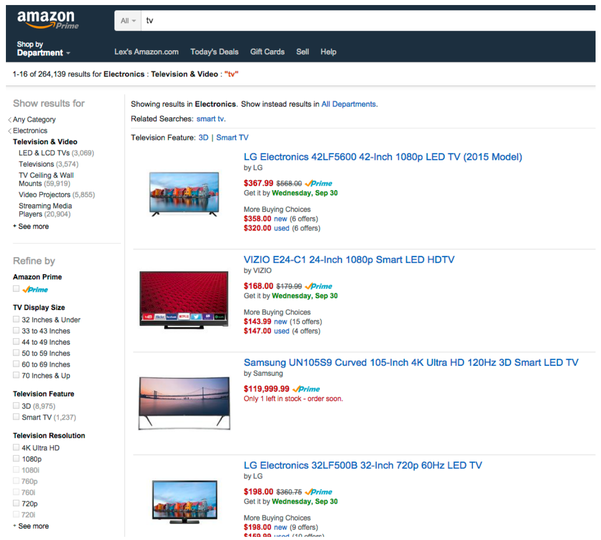
then details on demand

relate, history, extract

Dynamic Queries

Define criteria for inclusion/ exclusion

“Faceted Search”



[Ahlberg & Shneiderman, 1994]

Exercise: Redesign

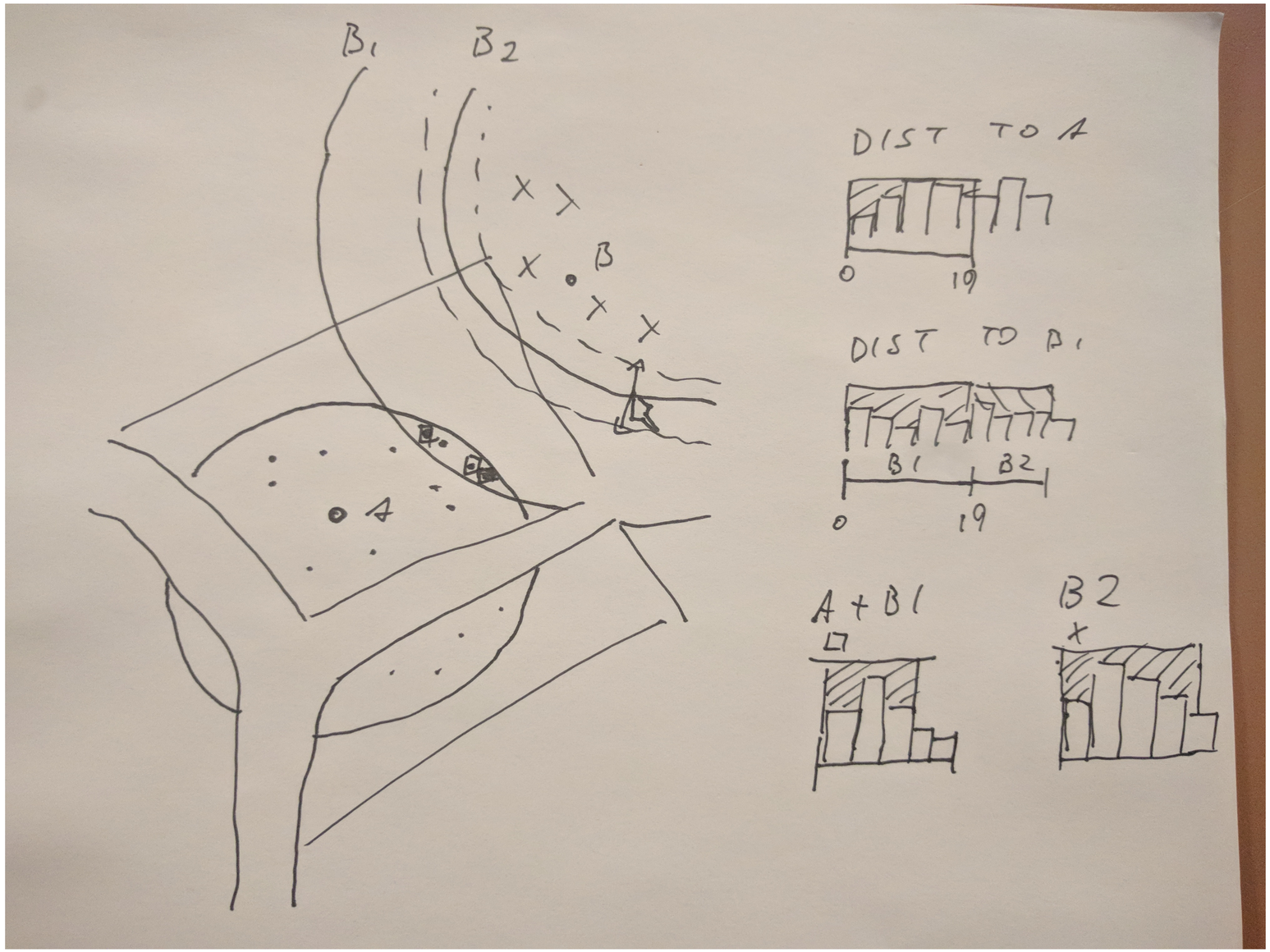
Include Direct Manipulation

Show distribution of homes across variable

Sketch alternative interface to use different criteria in different areas.

Teams of 2-3; 15 minutes

[Inspired by Petra Isenberg's class]

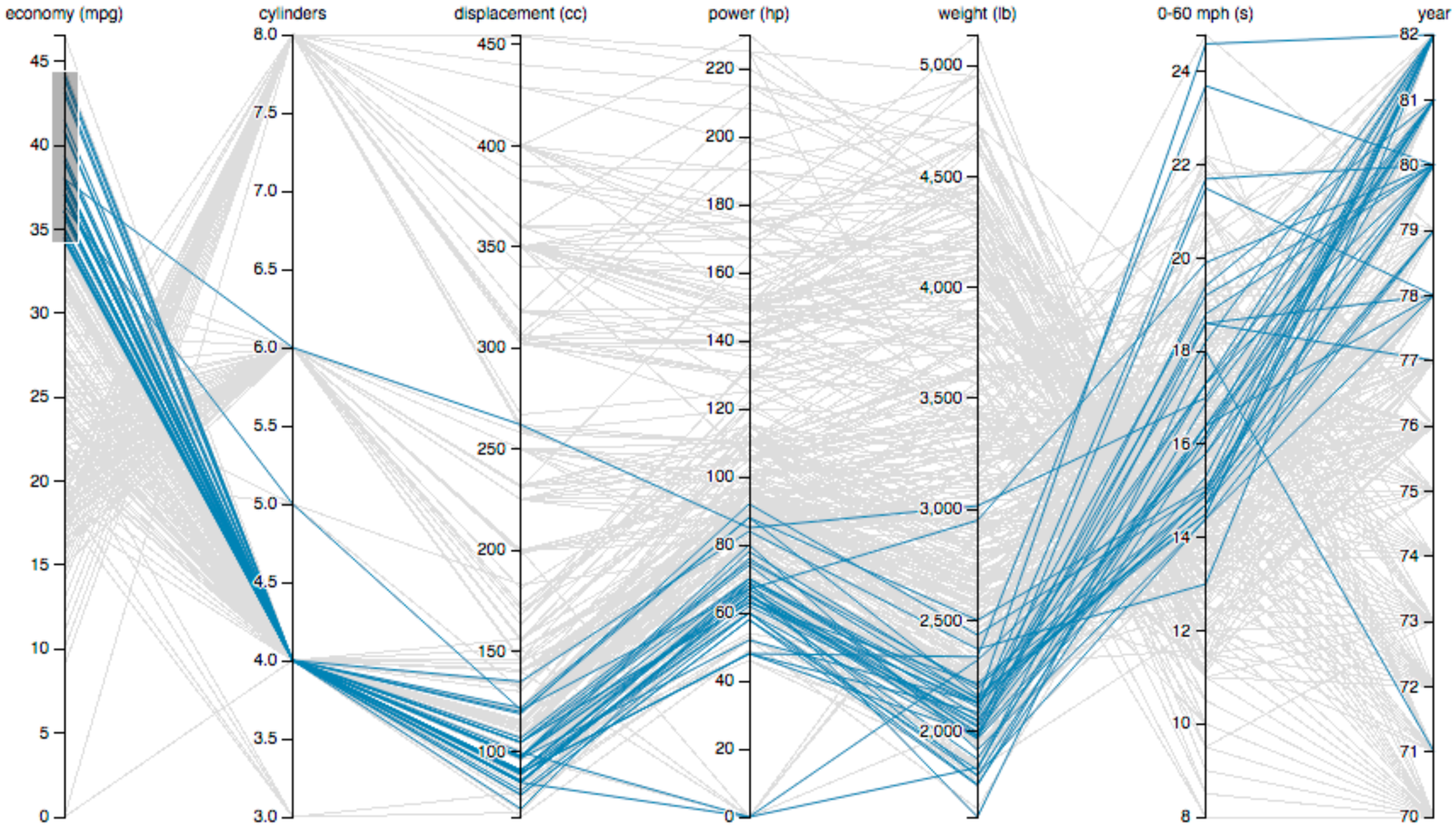


Direct manipulation realized for distance with the circles

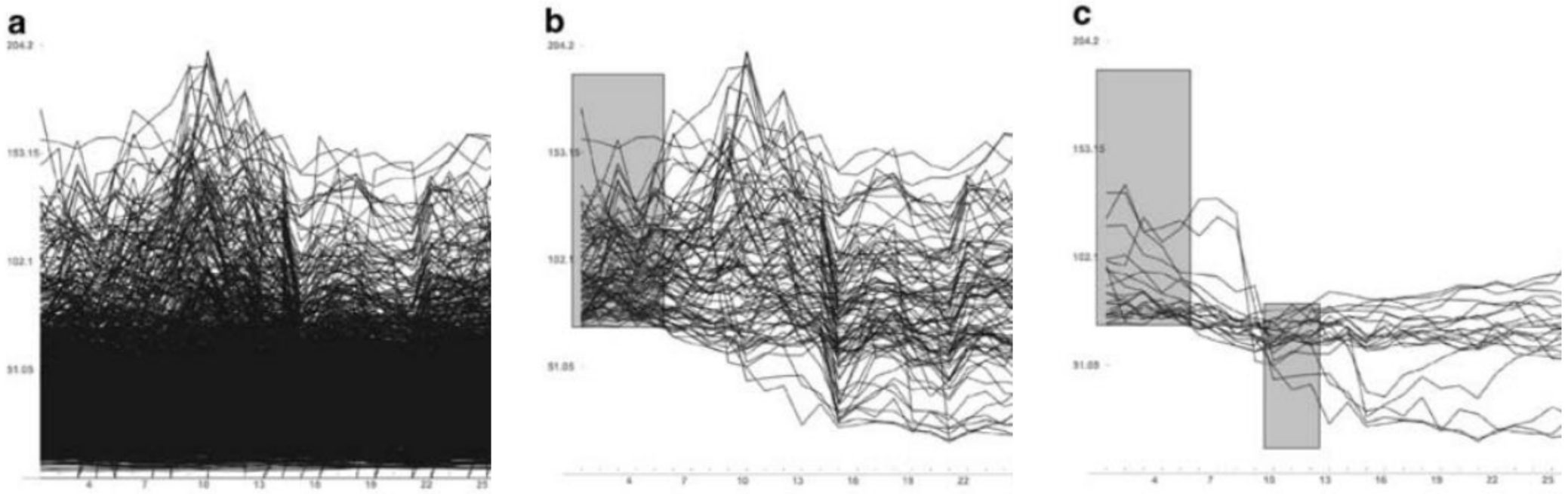
Two filters applied to B, B1 and B2,

Split up for A+B1 and just B2 for other parameters

Visual Queries

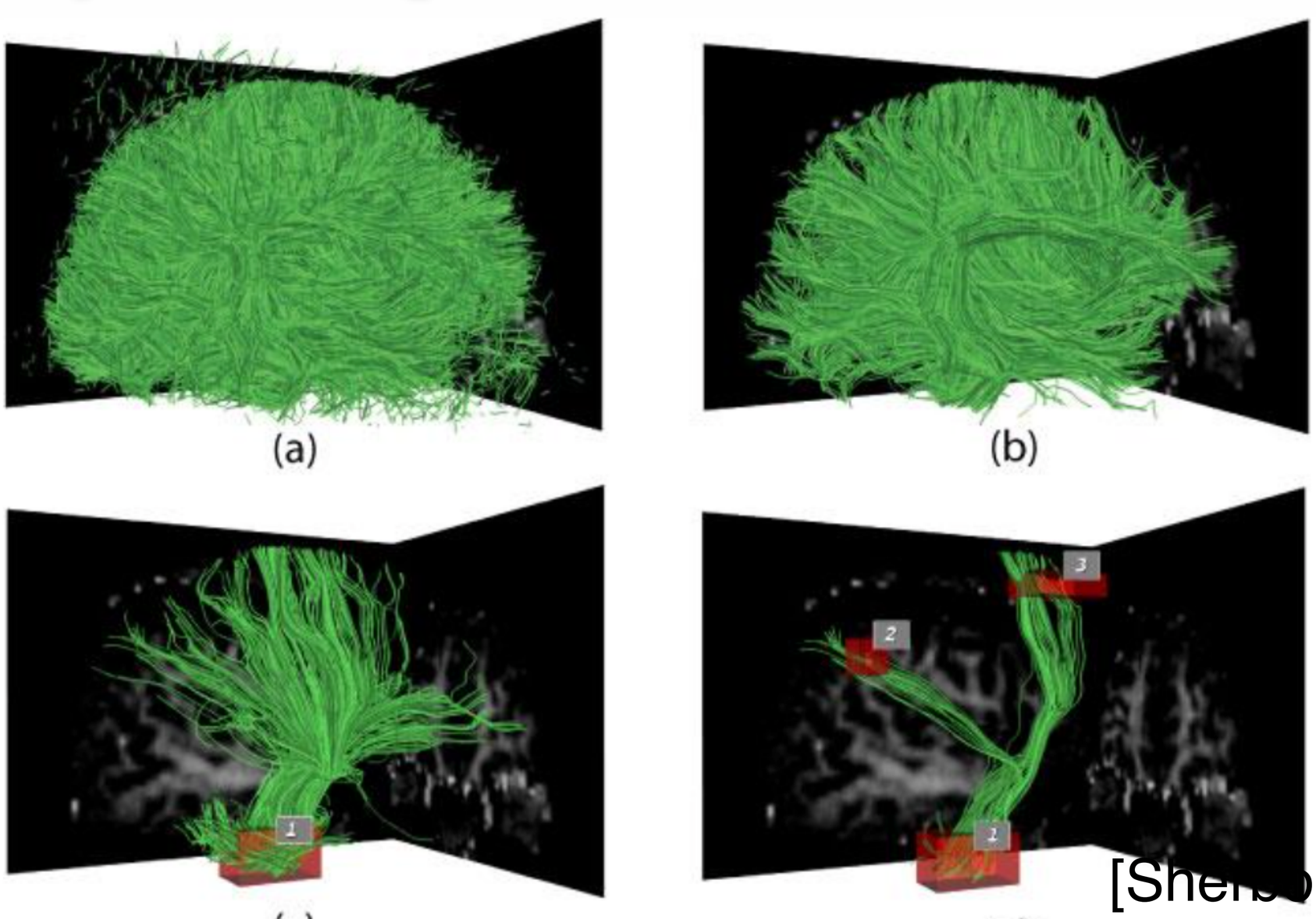


Visual Queries



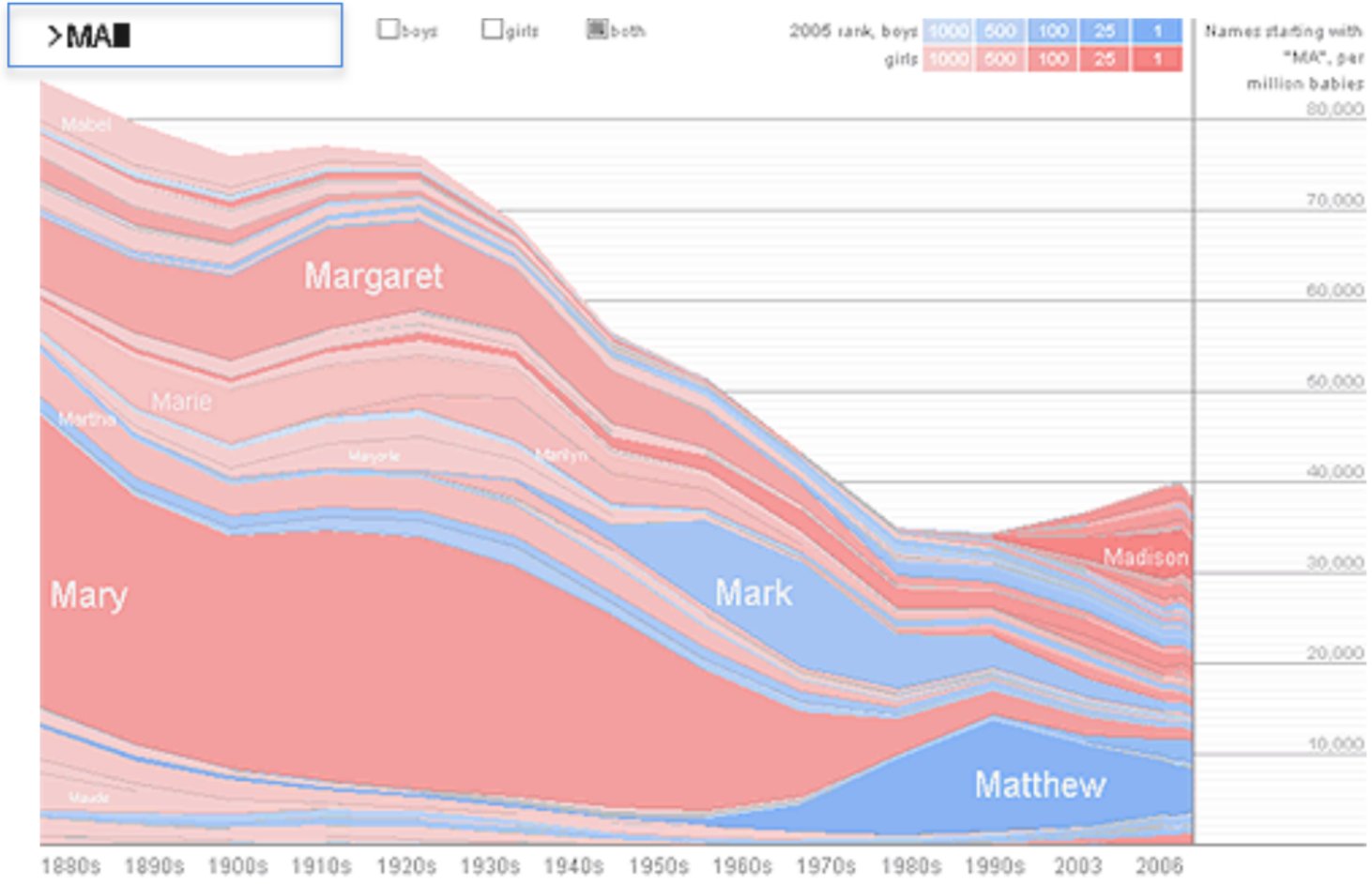
Time Searcher (Hocheiser, 2003)

Dynamic Queries for Volumes

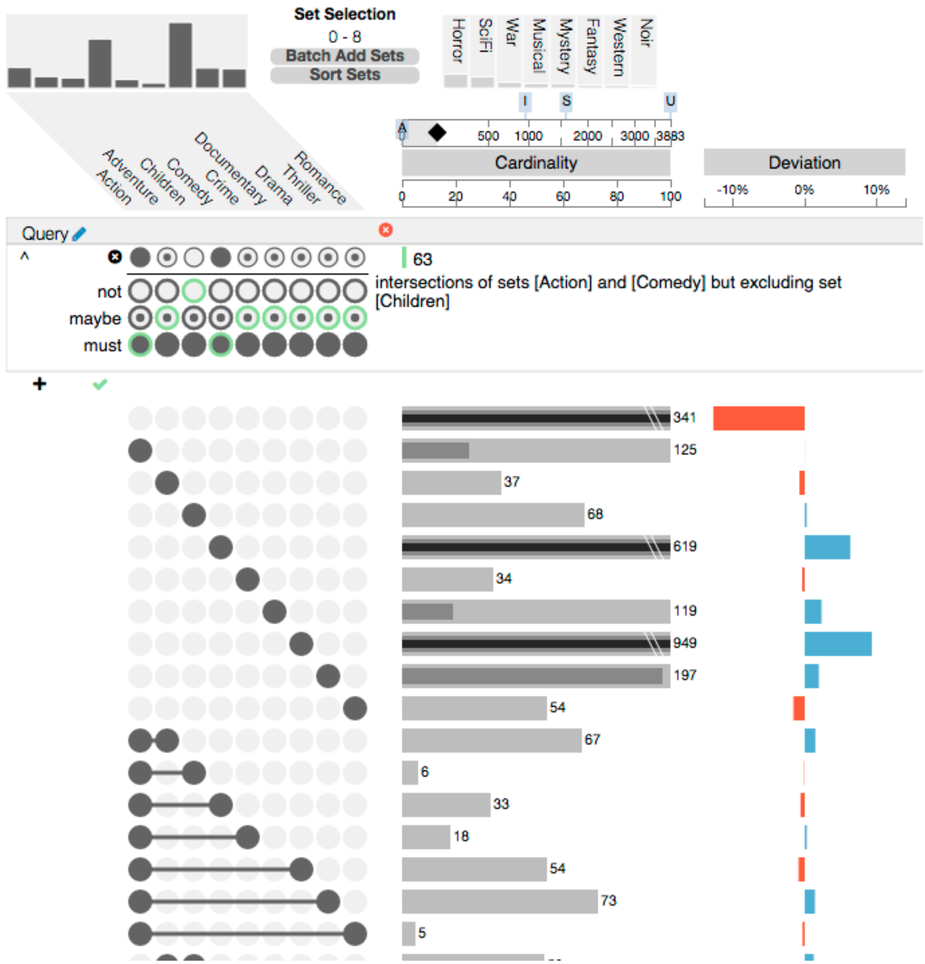


[Shen & Ondy 2004]

Incremental Text Search



Query Interfaces



More on Filters In Future Lecture