

CSC 544

Data Visualization

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Lecture 11

Views, Focus+Context

Feb. 20, 2023

Today's Agenda

- Reminders:
 - A02 due! A03 posted
 - P01 due on Wed!
- Goals for today:
 - Discuss views and focus+context

**Views:
One vs. Multiple**

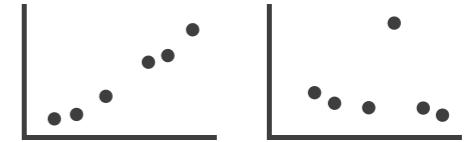
Multiple Views

- A **view** is a single visual layout or plot
- Whereas **multiple views** combine (facet) views together to produce more sophisticated visualization
 - Relies on “Eyes over memory”
 - Trade off: display space vs. working memory

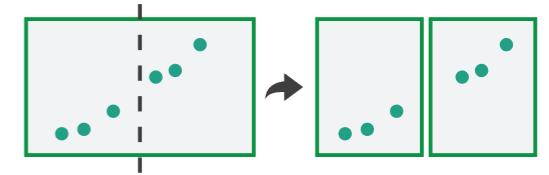
View Faceting Choices

Facet

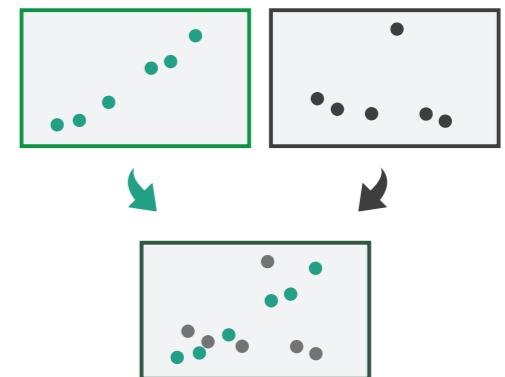
→ Juxtapose



→ Partition



→ Superimpose



④ Juxtapose and Coordinate Multiple Side-by-Side Views

→ Share Encoding: Same/Different

→ *Linked Highlighting*



→ Share Data: All/Subset/None



→ Share Navigation



⑤ Partition into Side-by-Side Views



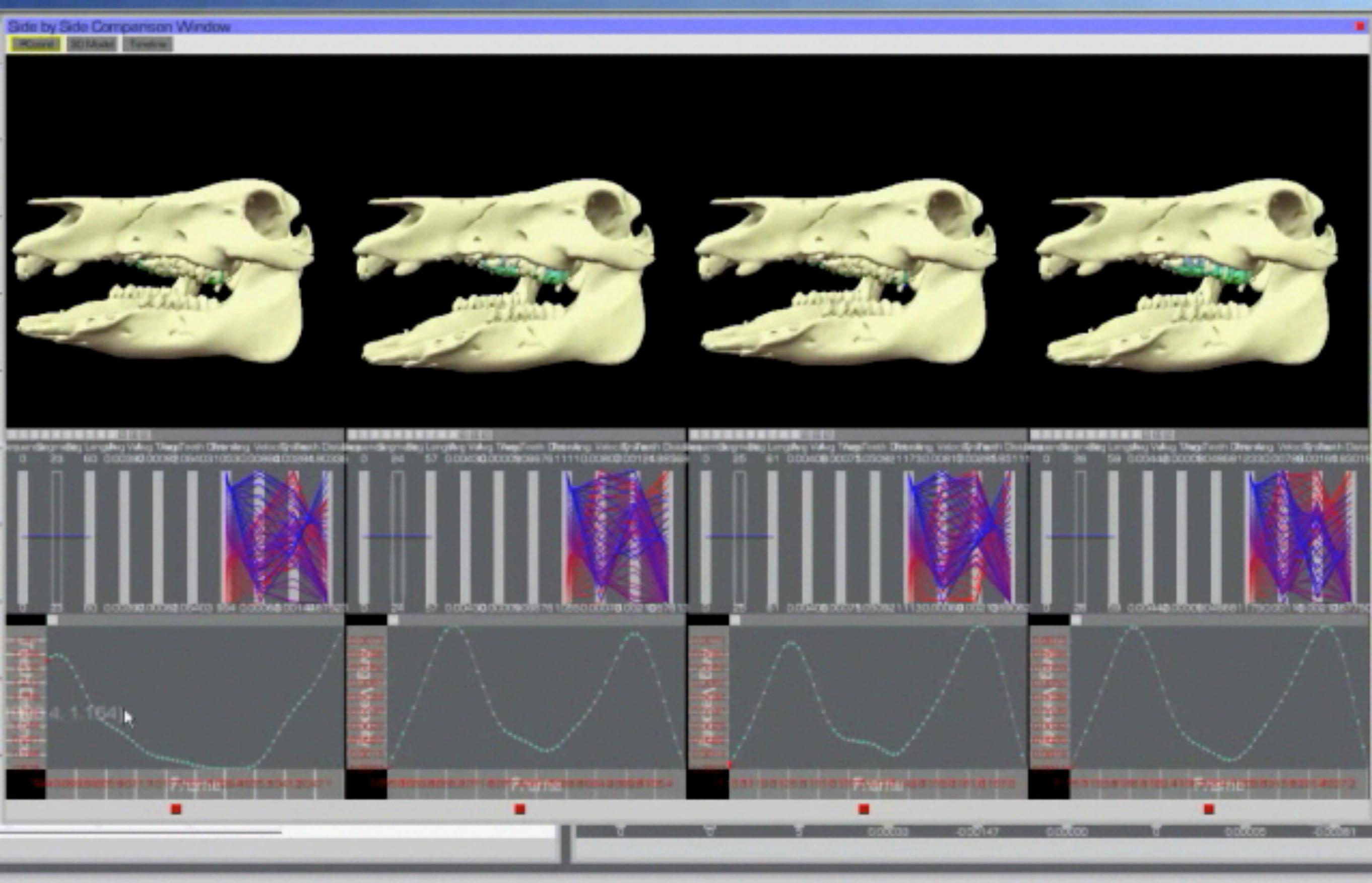
		Data		
		All	Subset	None
Encoding	Same	Redundant	Overview/ Detail	Small Multiples
	Different	Multiform	Multiform, Overview/ Detail	No Linkage

⑥ Superimpose Layers



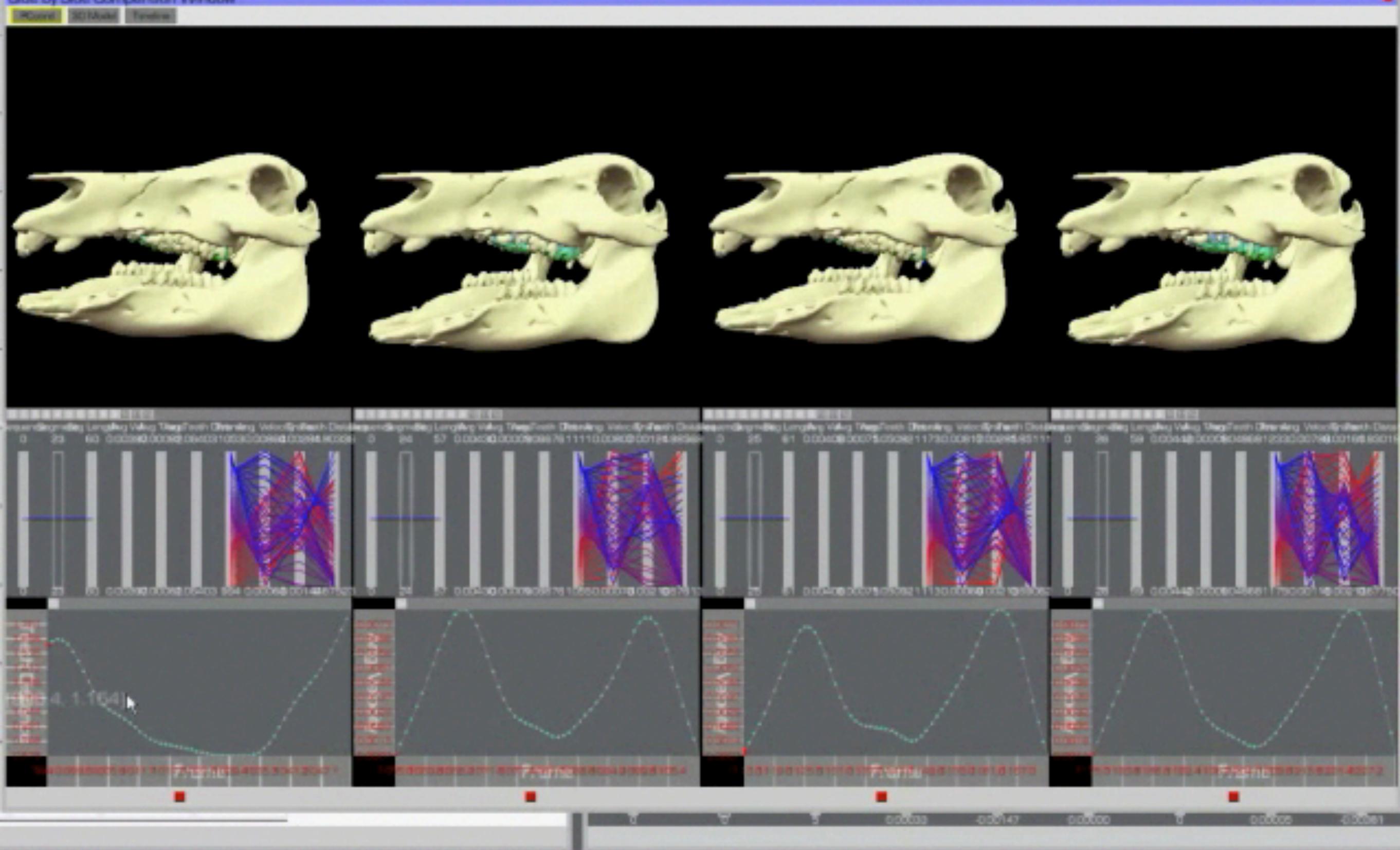
Linked Views

- Multiple views that are
 1. simultaneously visible
 2. linked together such through interactions that in one view affect the others



Keefe et al. Interactive Coordinated Multiple-View Visualization of Biomechanical Motion Data, IEEE TVCG, 2009.

Side by Side Comparison Window



Keefe et al. Interactive Coordinated Multiple-View Visualization of Biomechanical Motion Data, IEEE TVCG, 2009.

View Juxtaposition

- Juxtaposition refers to side-by-side views

④ Juxtapose and Coordinate Multiple Side-by-Side Views

→ Share Encoding: Same/Different

→ *Linked Highlighting*



→ Share Data: All/Subset/None



→ Share Navigation



- Design choices:

- **Encoding:** same or multiform

- **Dataset:** share all, subset, or none

		Data		
		All	Subset	None
Encoding	Same	Redundant		Overview/ Detail
	Different	Multiform	Multiform, Overview/ Detail	
				No Linkage

Multiform Encoding

- Idea: different visual encodings are used between the views
- Rationale: single, monolithic view has strong limits on the number of attributes that can be shown simultaneously



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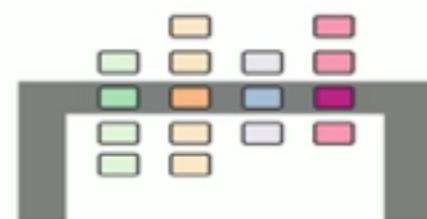
VisBricks: Multiform Visualization of Large, Inhomogeneous Data

caleydotugraz

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VisBricks: Multiform Visualization of Large, Inhomogeneous Data



Alexander Lex, Hans-Jörg Schulz, Marc Streit,
Christian Partl and Dieter Schmalstieg

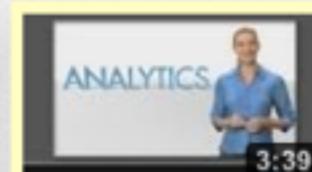
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143 views

Uploaded by [caleydotugraz](#) on Jul 12, 2011

Large volumes of real-world data often exhibit inhomogeneities: vertically in the form of correlated or independent dimensions, horizontally in the form of clustered or scattered data items. In essence, these inhomogeneities form

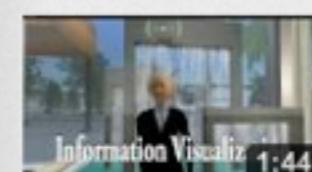
1 likes, 0 dislikes



Put Text Into Usable Data
by SASsoftware
5,776 views



Will Hunsinger shows off Evri
by TechFlashVideos
158 views



Information Visualization
by UTHealthSBMI
183 views



code_swarm - A Design Study in Organic
by michaelogawa
190 views



Caleydo Matchmaker Commercial
by caleydotugraz
172 views



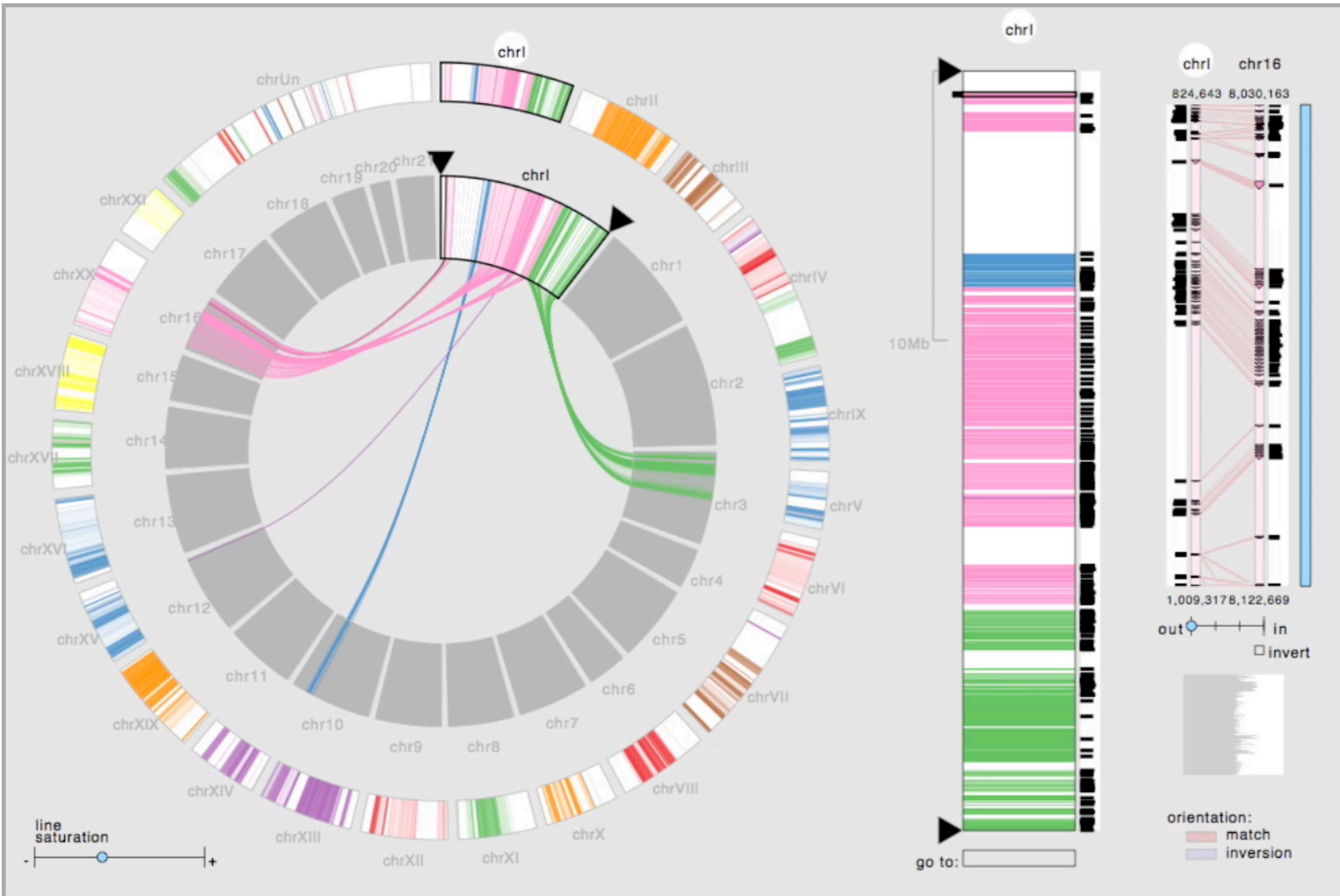
Model-Driven Design for the Visual Analysis of ...
by caleydotugraz
109 views

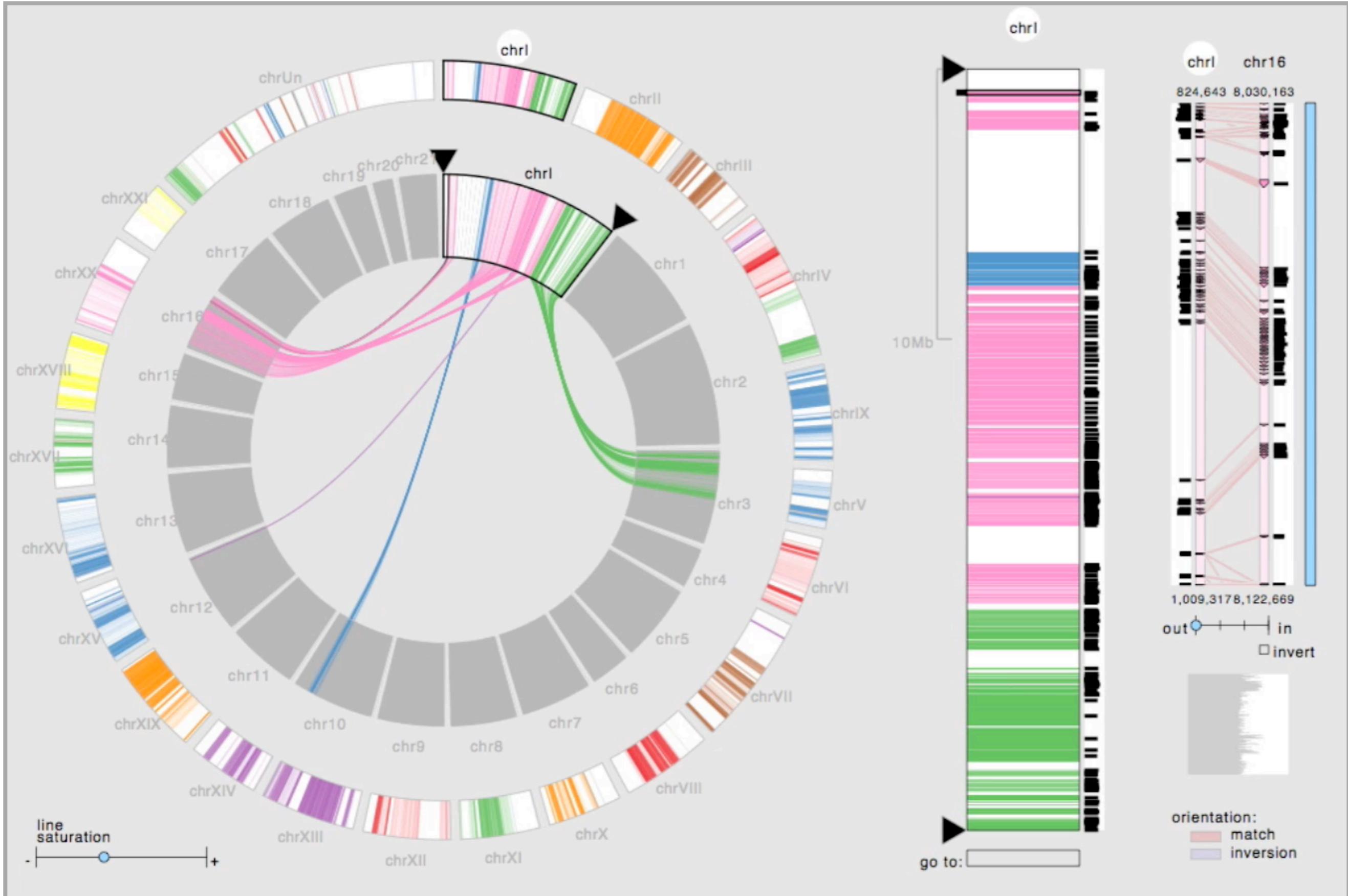


The Caleydo Jukebox

Overview + Detail

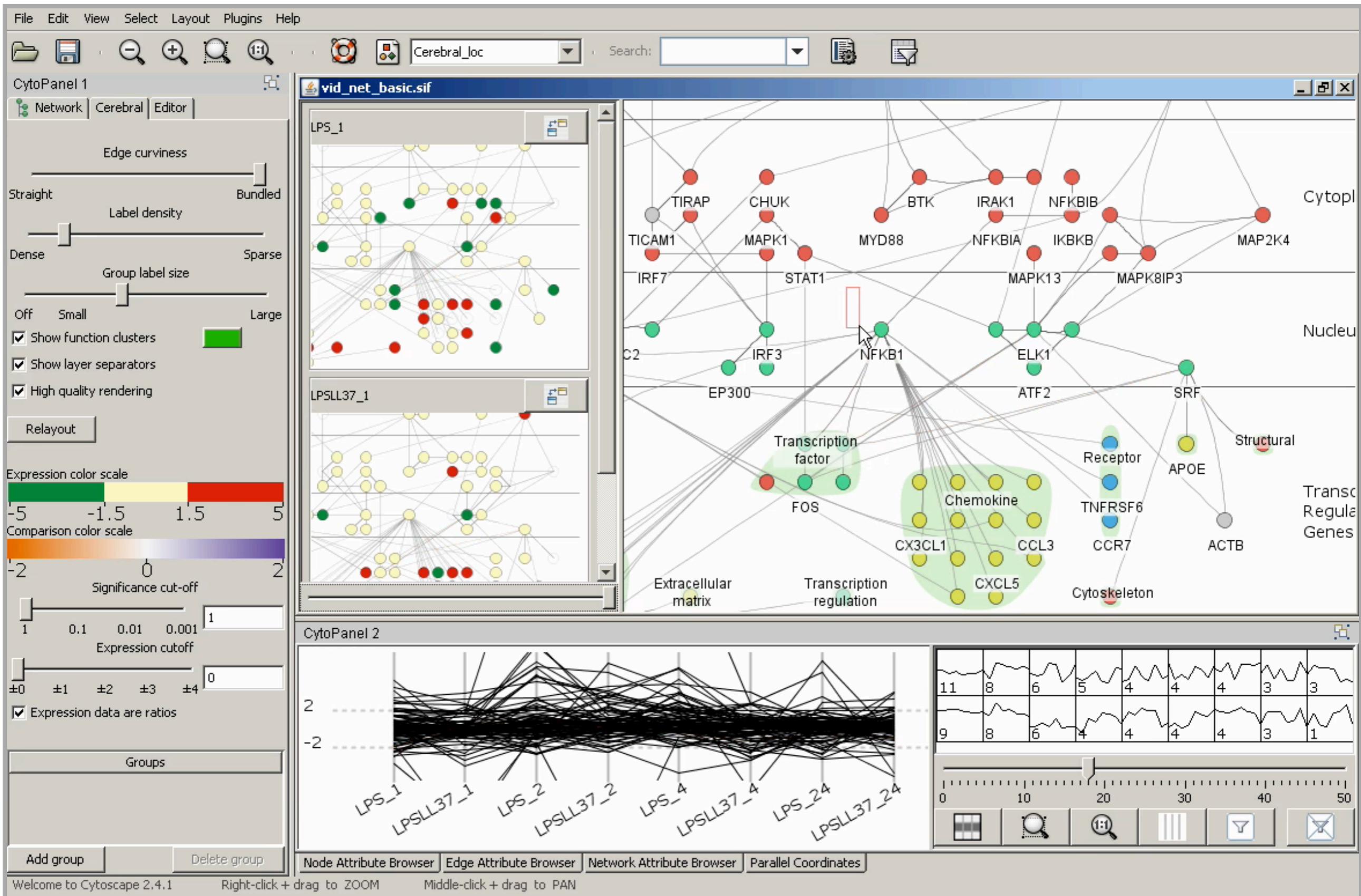
- Idea: one view shows (often summarized) information about entire dataset, while additional view(s) shows more detailed information about a subset of the data
- Rationale: for large or complex data, a single view of the entire dataset cannot capture fine details

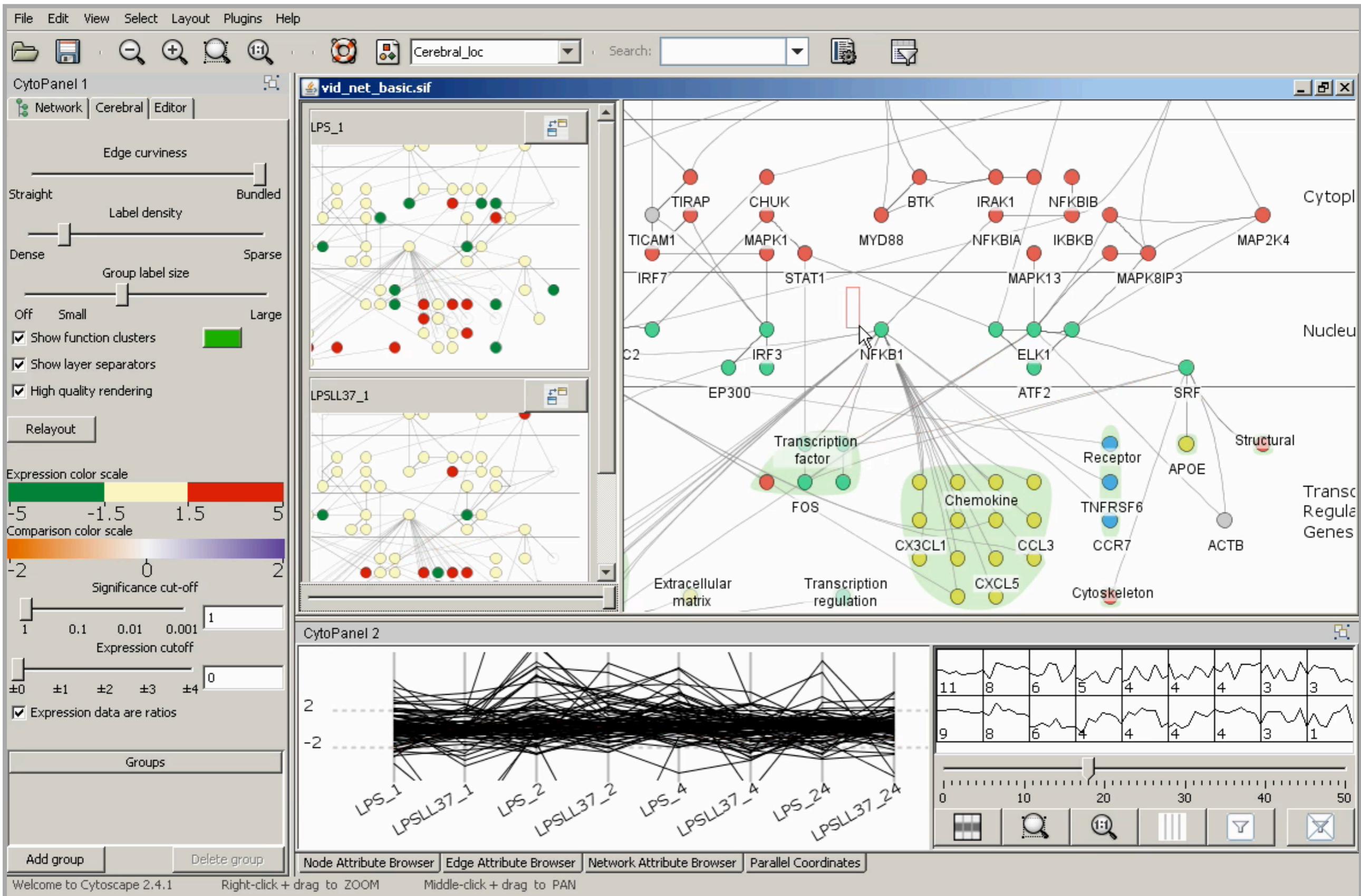




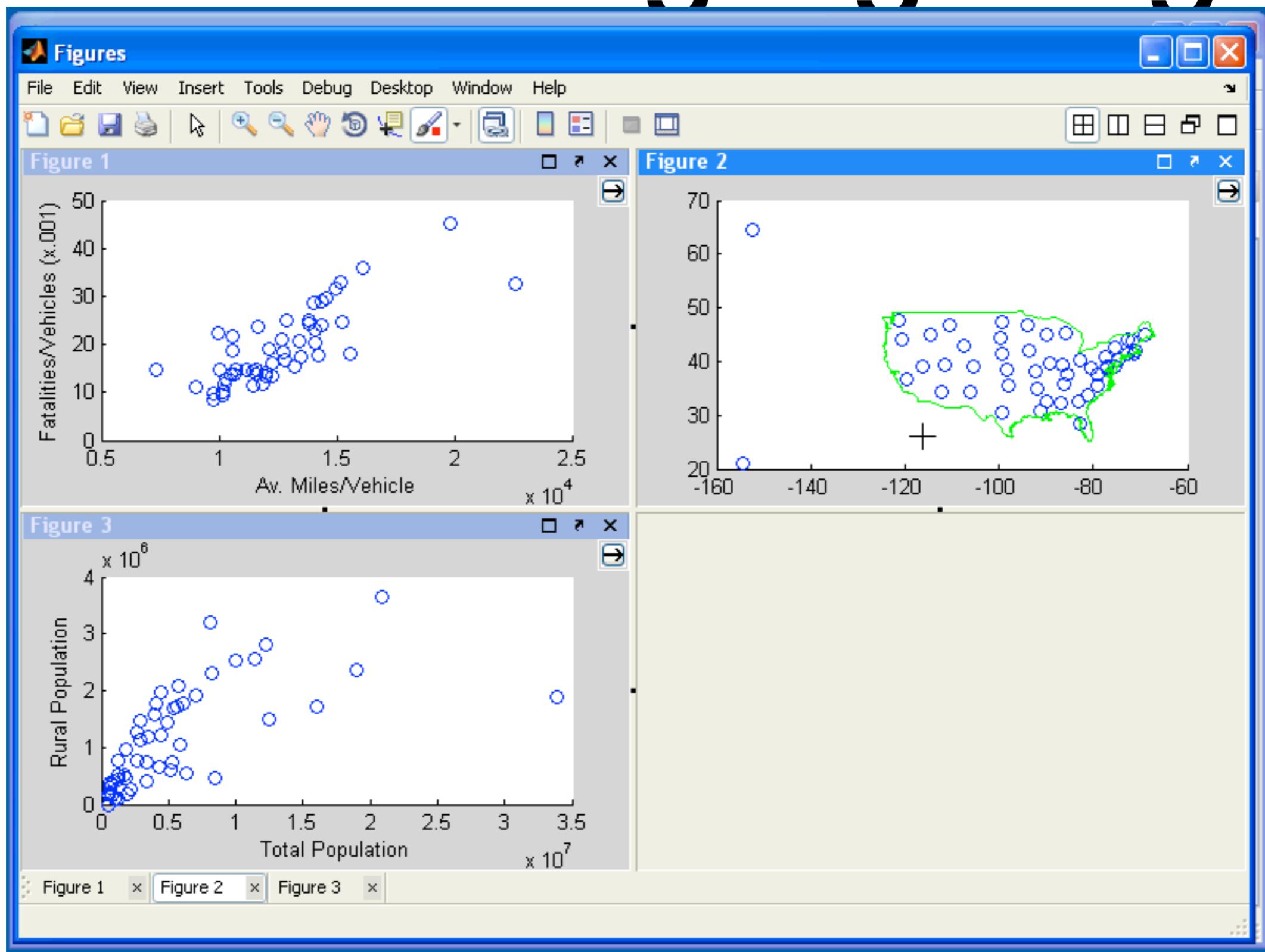
Small Multiples

- Idea: each view uses the same visual encoding, but shows a different subset of the data
- Rationale: quickly compare different parts of a data set, relying on eyes instead of memory

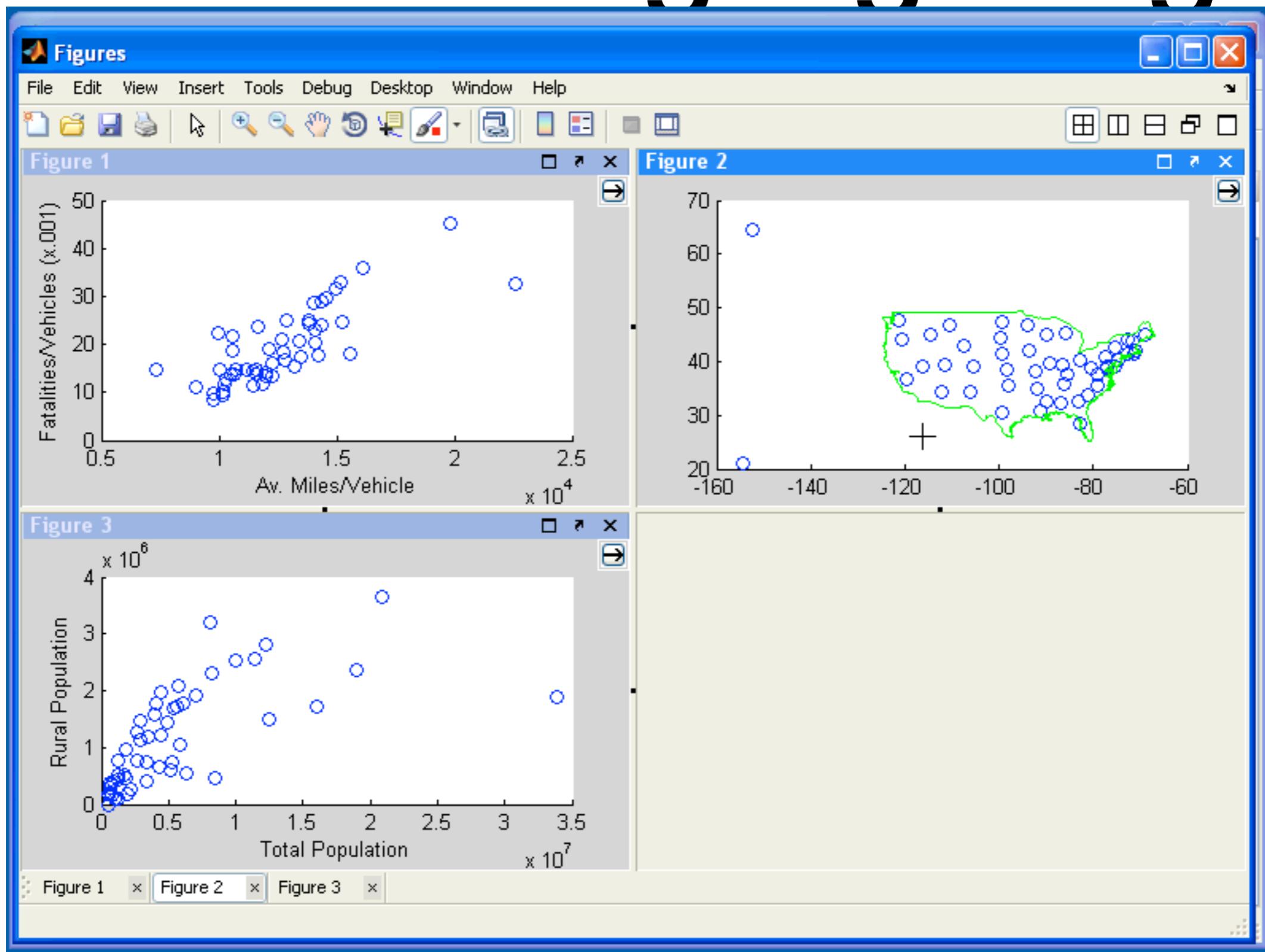




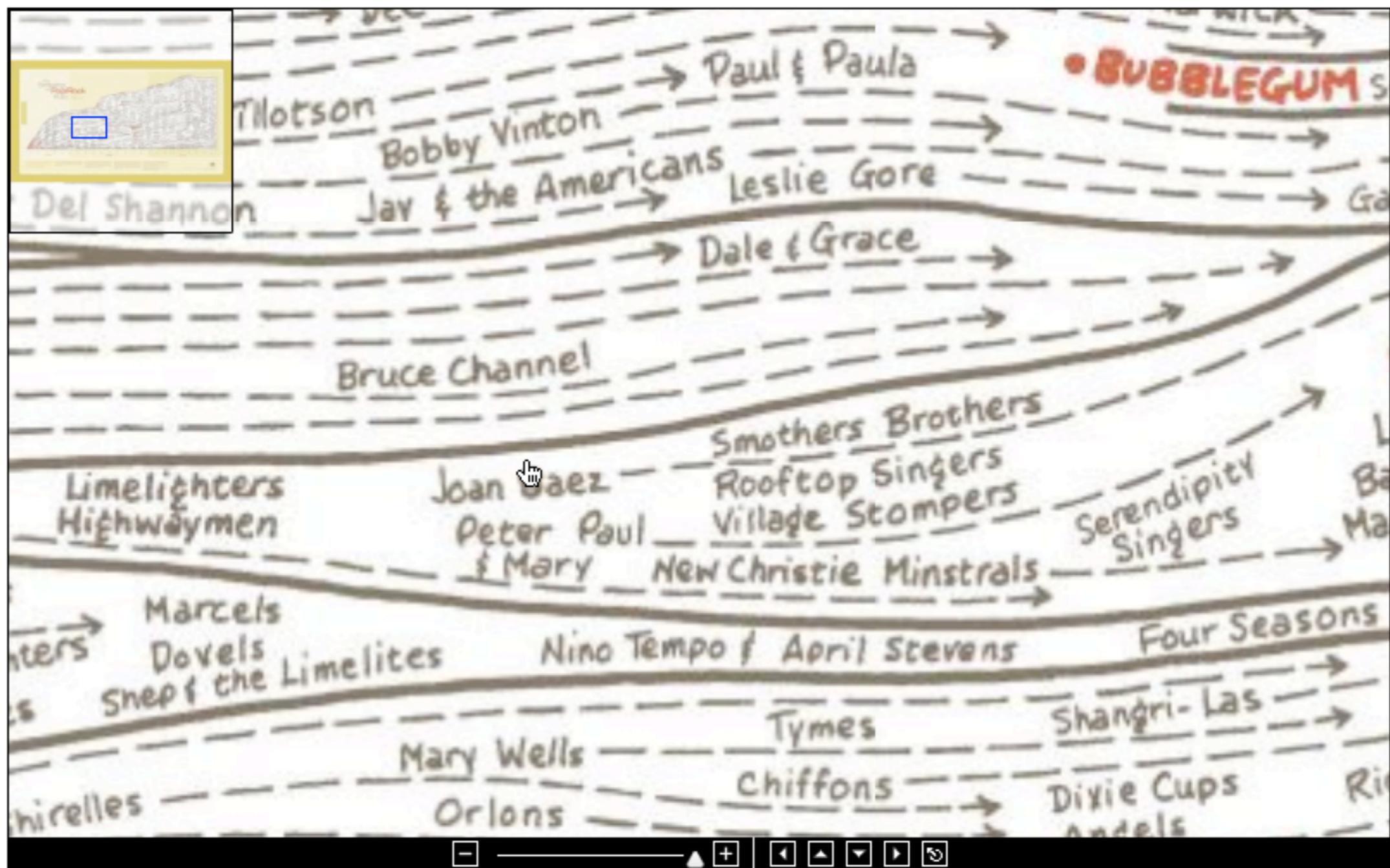
Linked Highlighting



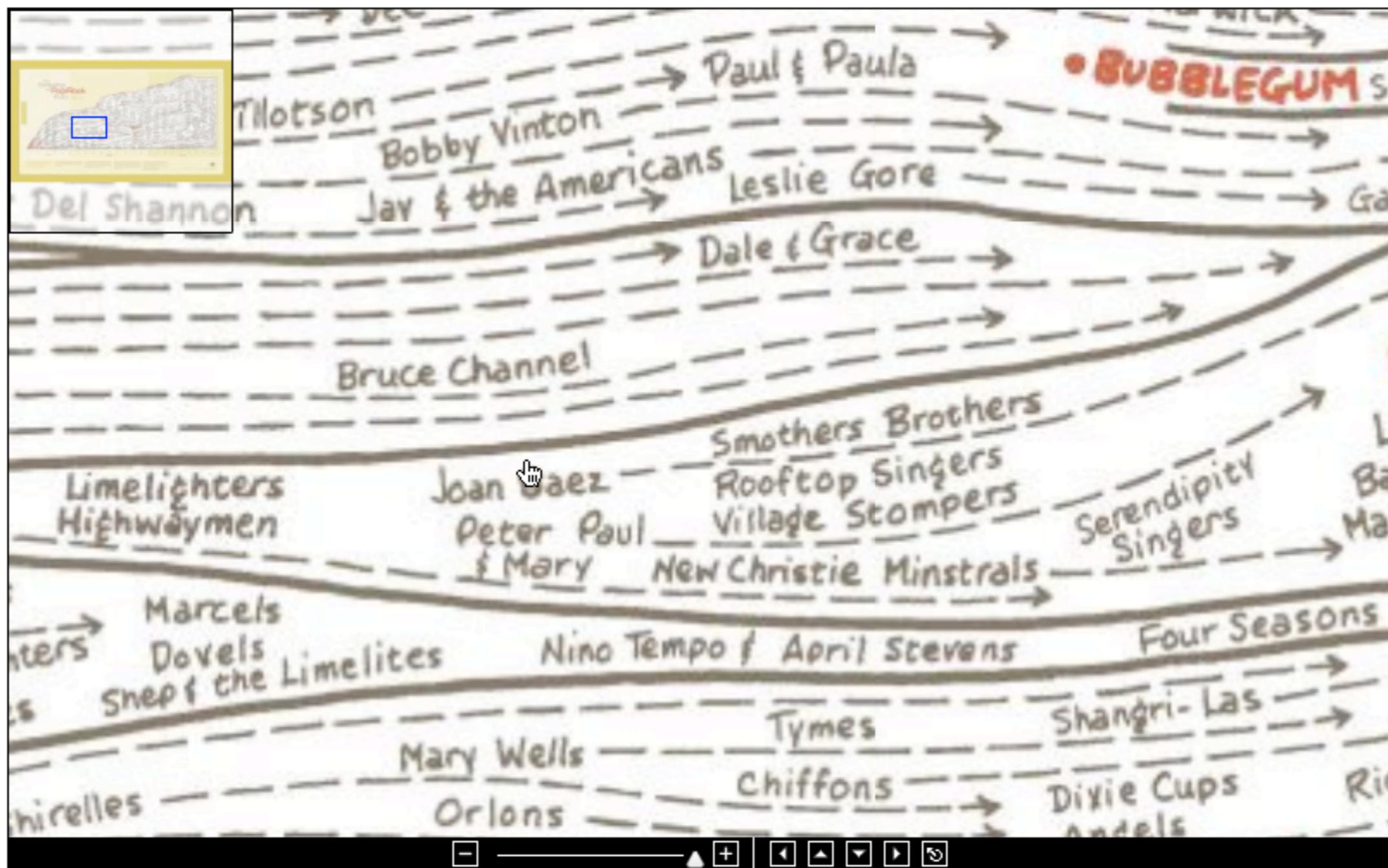
Linked Highlighting



Linked Navigation



Linked Navigation



Summary

- Juxtaposition choices
 - **Encoding:** same or multiform
 - **Dataset:** share all, subset, or none

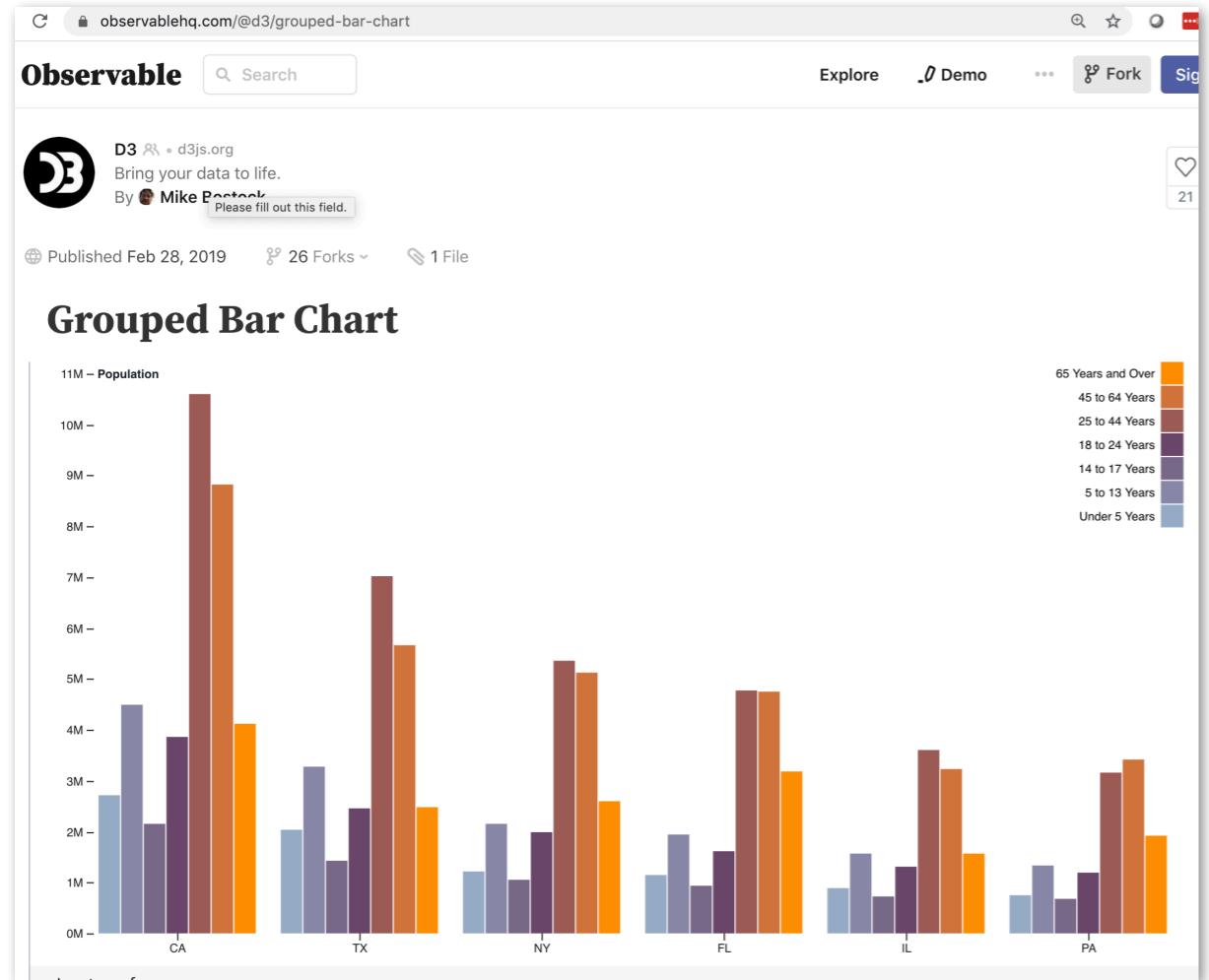
Summary

- Juxtaposition choices
 - **Encoding:** same or multiform
 - **Dataset:** share all, subset, or none
- Coordination choices
 - **Highlighting:** to link, or not
 - **Navigation:** to share, or not

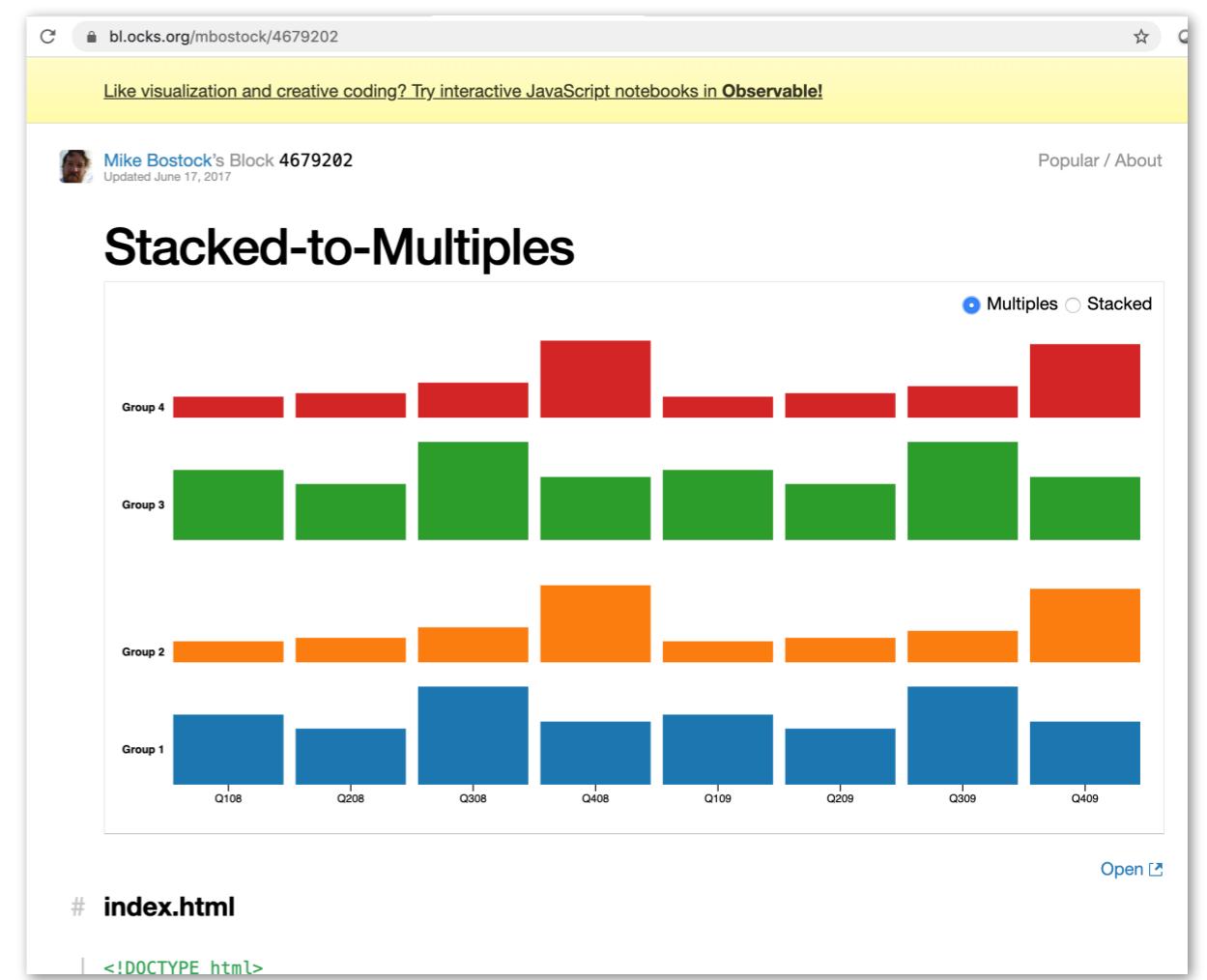
View Partitioning

Partitioning

- Action on the dataset that separates the data into groups
- Design choices:
 - How to divide data up between views, given a hierarchy of attributes
 - How many splits, and order of splits
 - How many views (usually data driven)
- Partition attribute(s) are typically categorical



<https://observablehq.com/@d3/grouped-bar-chart>



<https://bl.ocks.org/mbostock/4679202>

Scatterplot Matrix

observablehq.com/@d3/brushable-scatterplot-matrix

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D3 • d3js.org Bring your data to life. By Mike Bostock

Published Jun 15, 2019 Fork of Scatterplot Matrix • 5 Forks 1 File Listed in d3-brush

Brushable Scatterplot Matrix

This scatterplot matrix allows brushing to select data points in one cell, and highlight them across all other cells.

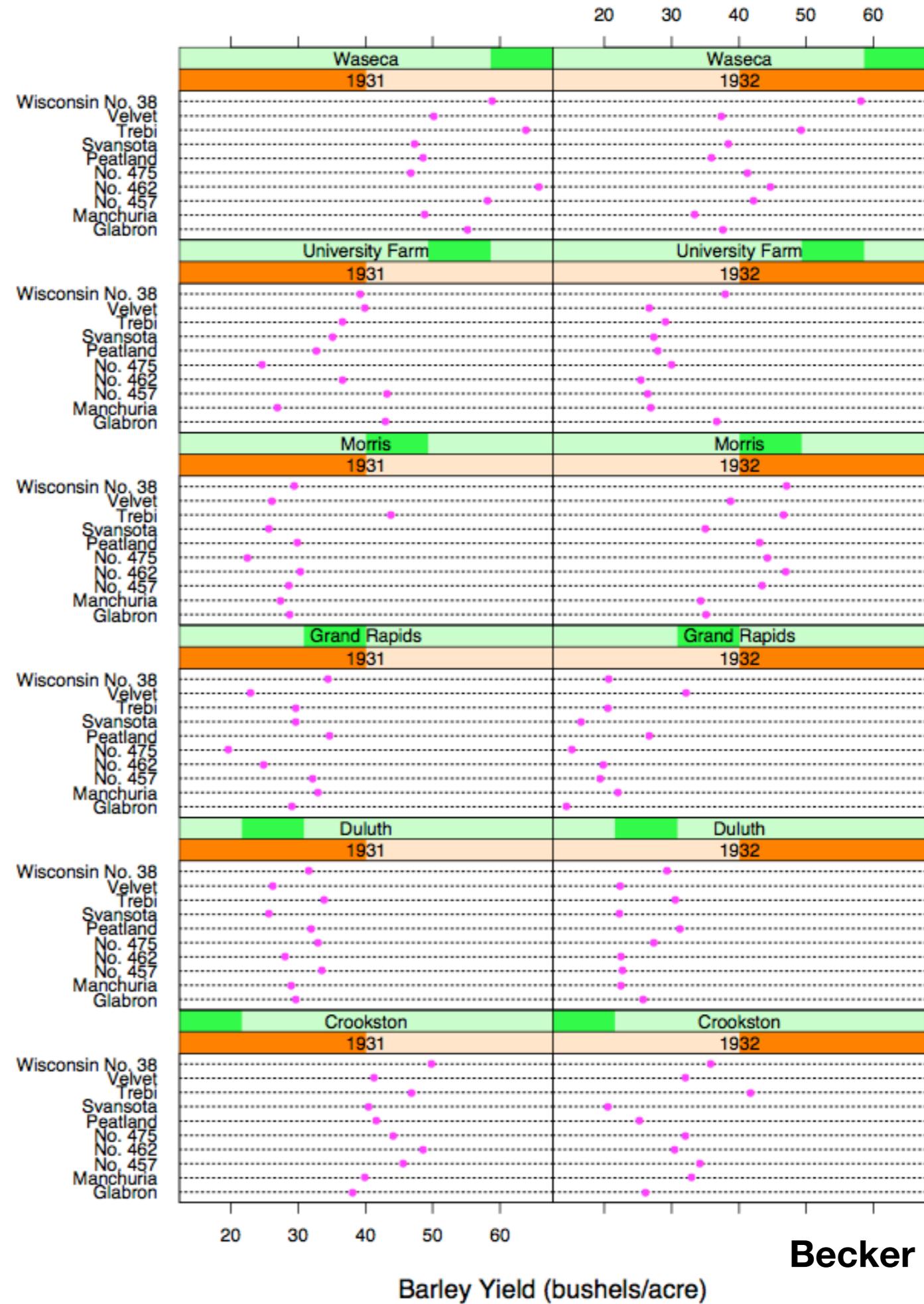
Legend: setosa (blue), versicolor (orange), virginica (green)

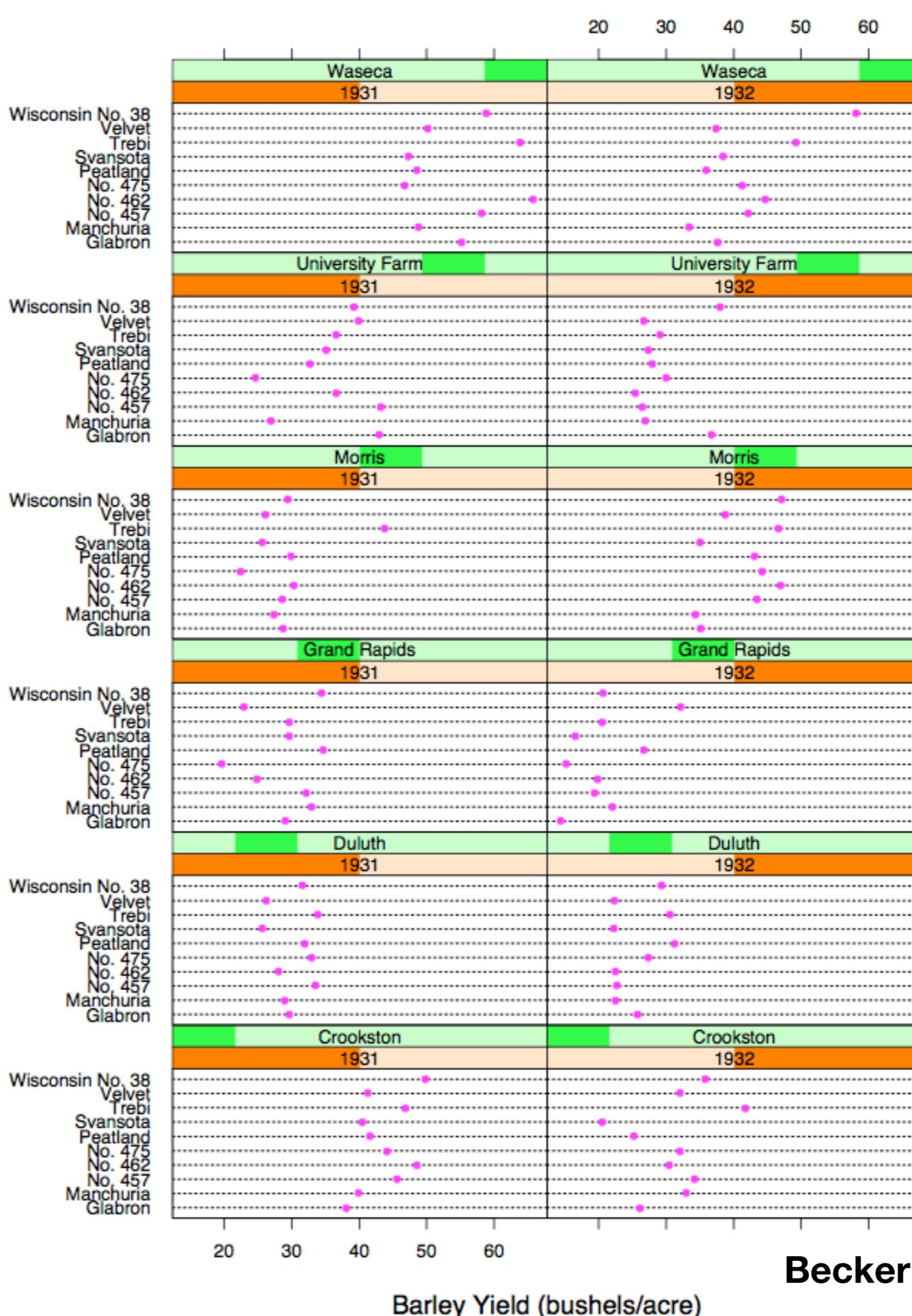
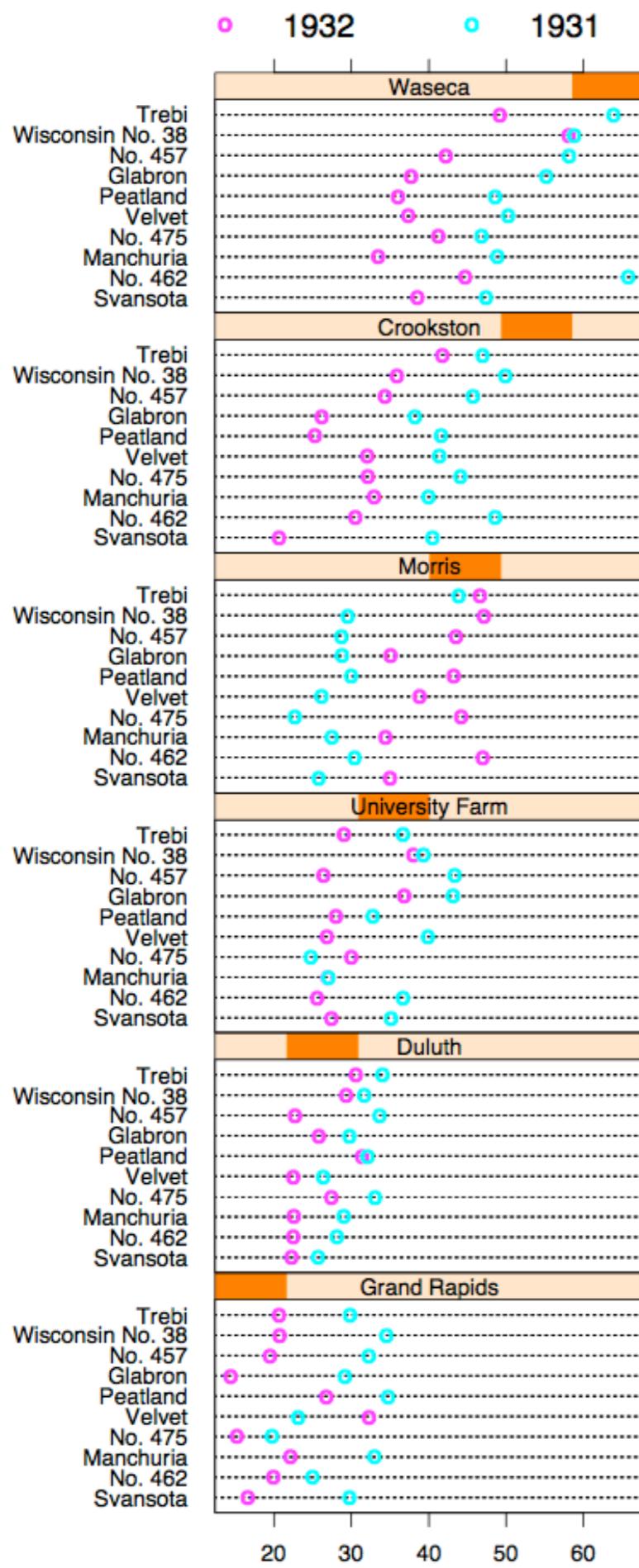
<https://observablehq.com/@d3/brushable-scatterplot-matrix>

Example: Trellis

- Panel variables
 - Attributes encoded in individual views
- Partitioning variables
 - Partitioning attributes assigned to columns, rows, and pages
- Main-effects ordering
 - Order partitioning variable levels/states based on derived data
 - Support perception of trends and structure in data

Sort by Group Medians





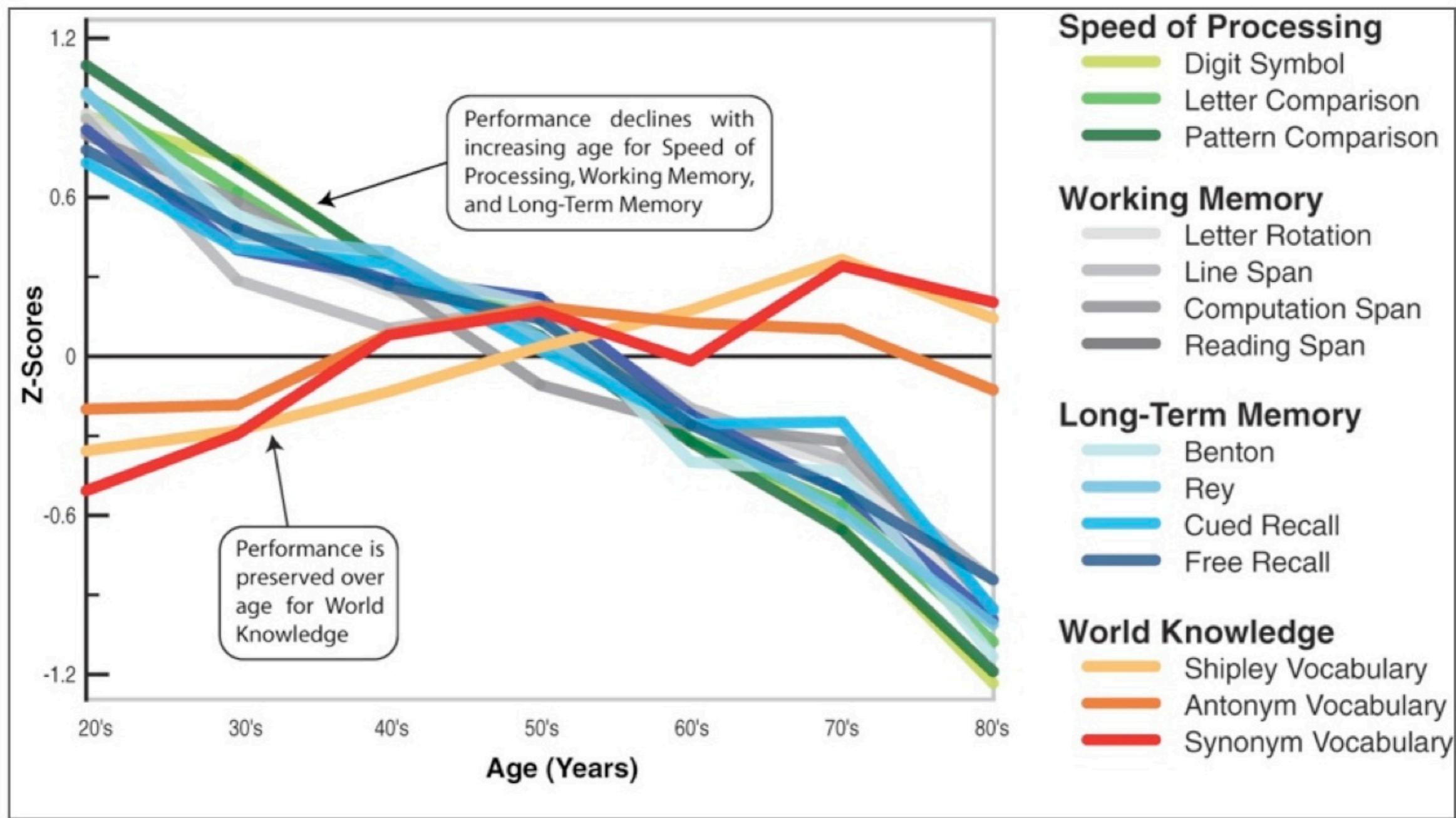
Becker 1996

View Layering with Superposition

Layering

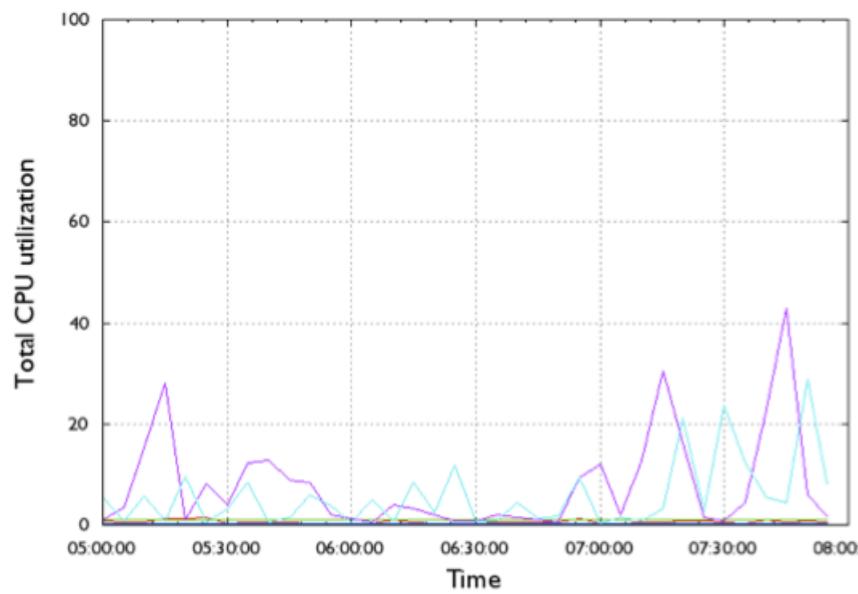
- Combining multiple views on top of one another to form a composite view
- Rationale: supports a larger, more detailed view than using multiple views
- Trade off: layering imposes constraints on visual encoding choice as well as number of layers that can be shown

Overlays

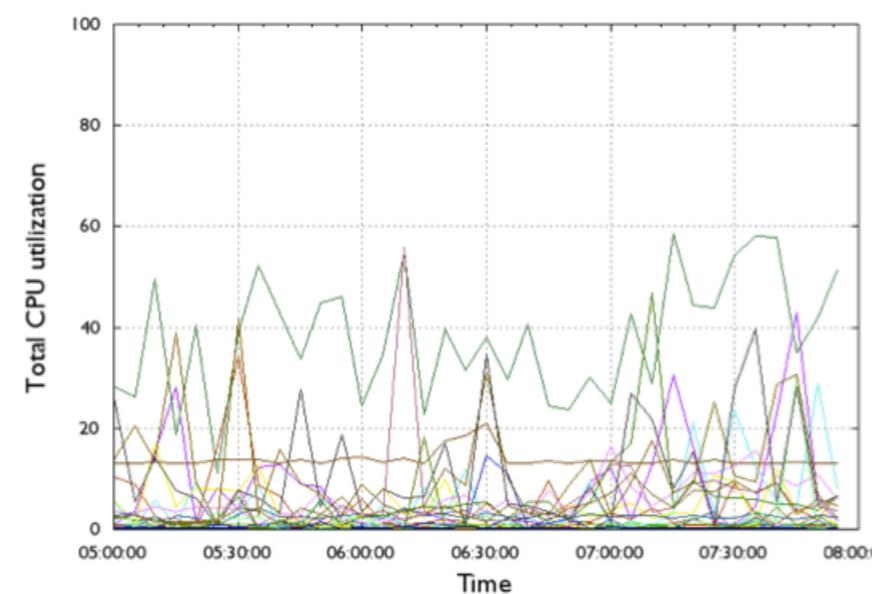


Overlays

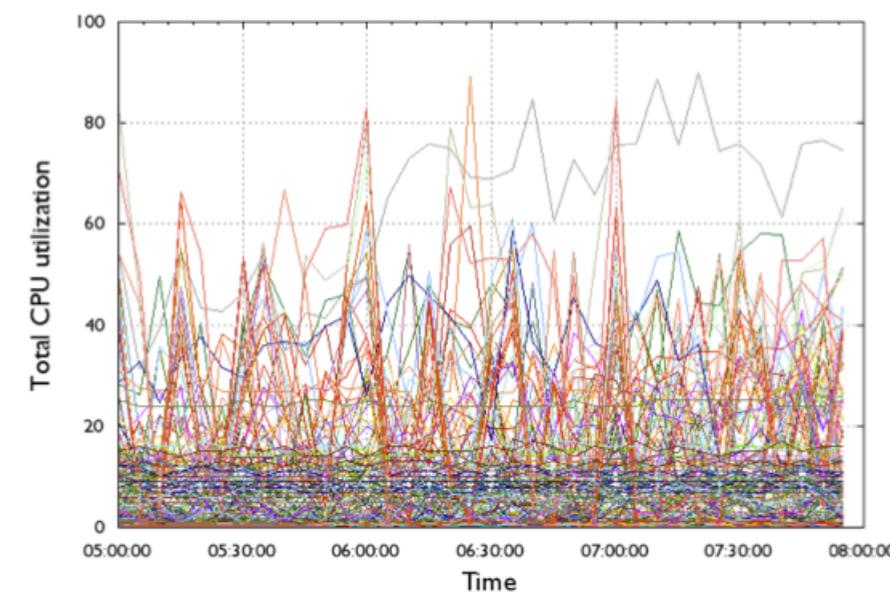
CPU utilization over time



CPU utilization over time



CPU utilization over time



Charles Joseph Minard

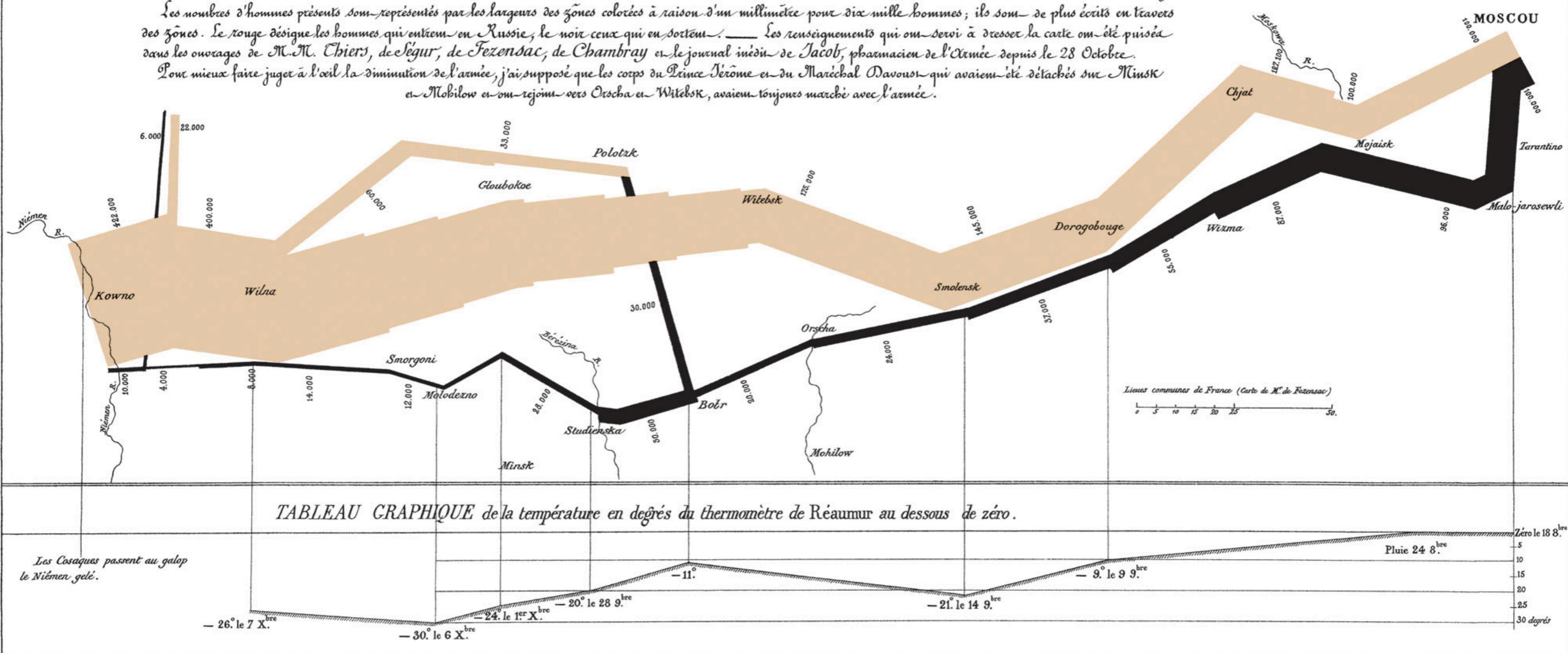
(1781-1870)

Carte Figurative des pertes successives en hommes de l'Armée Française dans la Campagne de Russie 1812-1813.

Dressée par M. Minard, Inspecteur Général des Ponts et Chaussées en retraite Paris, le 20 Novembre 1869.

Les nombres d'hommes présents sont représentés par les largeurs des zones colorées à raison d'un millimètre pour dix mille hommes; ils sont de plus écrits en travers des zones. Le rouge désigne les hommes qui entrent en Russie, le noir ceux qui en sortent. — Les renseignements qui ont servi à dresser la carte ont été puisés dans les ouvrages de M. M. Chiers, de Léger, de Fezensac, de Chambray et le journal inédit de Jacob, pharmacien de l'Armée depuis le 28 Octobre.

Pour mieux faire juger à l'œil la diminution de l'armée, j'ai supposé que les corps du Prince Jérôme et du Maréchal Davout qui avaient été détachés sur Minsk et Mogilow et qui rejoignirent Orsha et Witebsk, avaient toujours marché avec l'armée.



<https://cartographia.wordpress.com/2008/04/30/napoleons-invasion-of-russia/>

https://en.wikipedia.org/wiki/Charles_Joseph_Minard

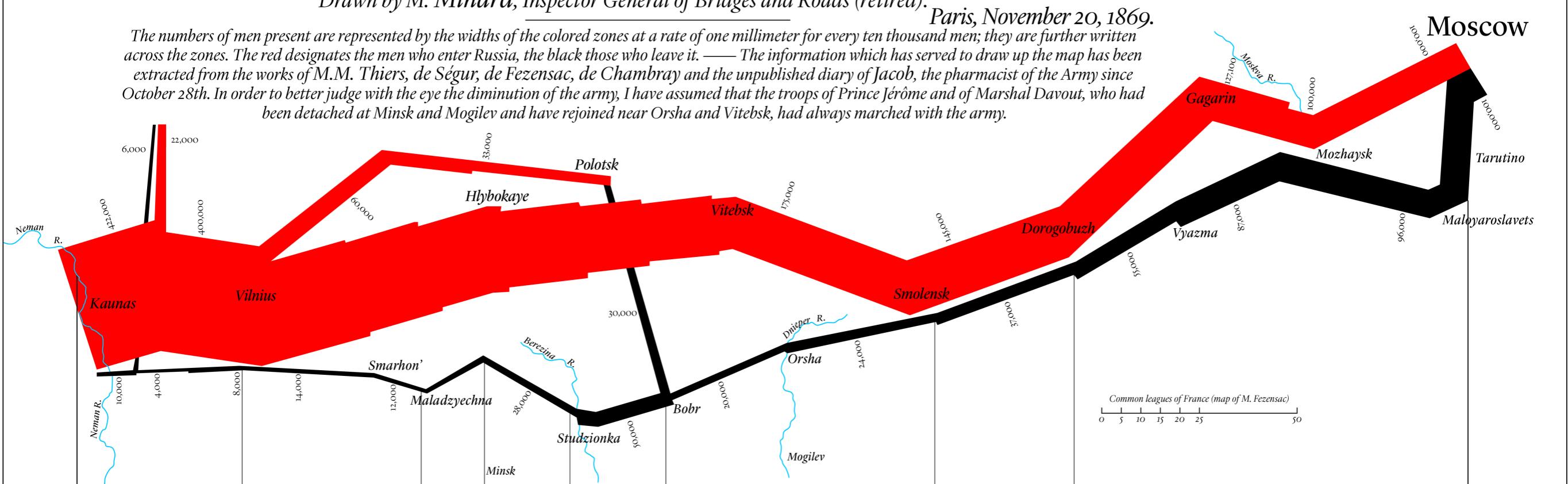
Charles Joseph Minard

(1781-1870)

*Figurative Map of the successive losses in men of the French Army in the Russian campaign 1812 ~ 1813
Drawn by M. Minard, Inspector General of Bridges and Roads (retired).*

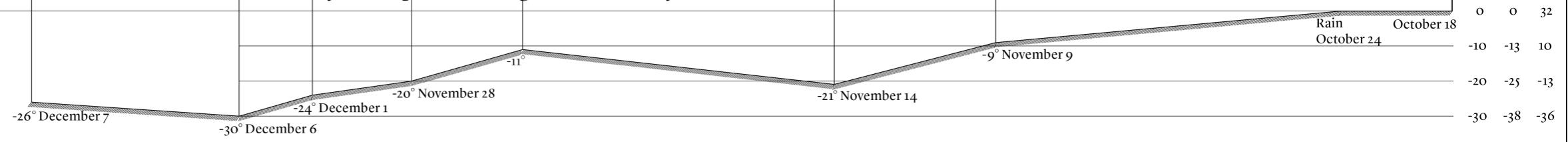
Paris, November 20, 1869.

The numbers of men present are represented by the widths of the colored zones at a rate of one millimeter for every ten thousand men; they are further written across the zones. The red designates the men who enter Russia, the black those who leave it. — The information which has served to draw up the map has been extracted from the works of M.M. Thiers, de Ségur, de Fezensac, de Chambray and the unpublished diary of Jacob, the pharmacist of the Army since October 28th. In order to better judge with the eye the diminution of the army, I have assumed that the troops of Prince Jérôme and of Marshal Davout, who had been detached at Minsk and Mogilev and have rejoined near Orsha and Vitebsk, had always marched with the army.



GRAPHIC TABLE of the temperature in degrees below zero of the Réaumur thermometer.

The Cossacks pass the frozen Neman at a gallop.



<https://cartographia.wordpress.com/2008/04/30/napoleons-invasion-of-russia/>

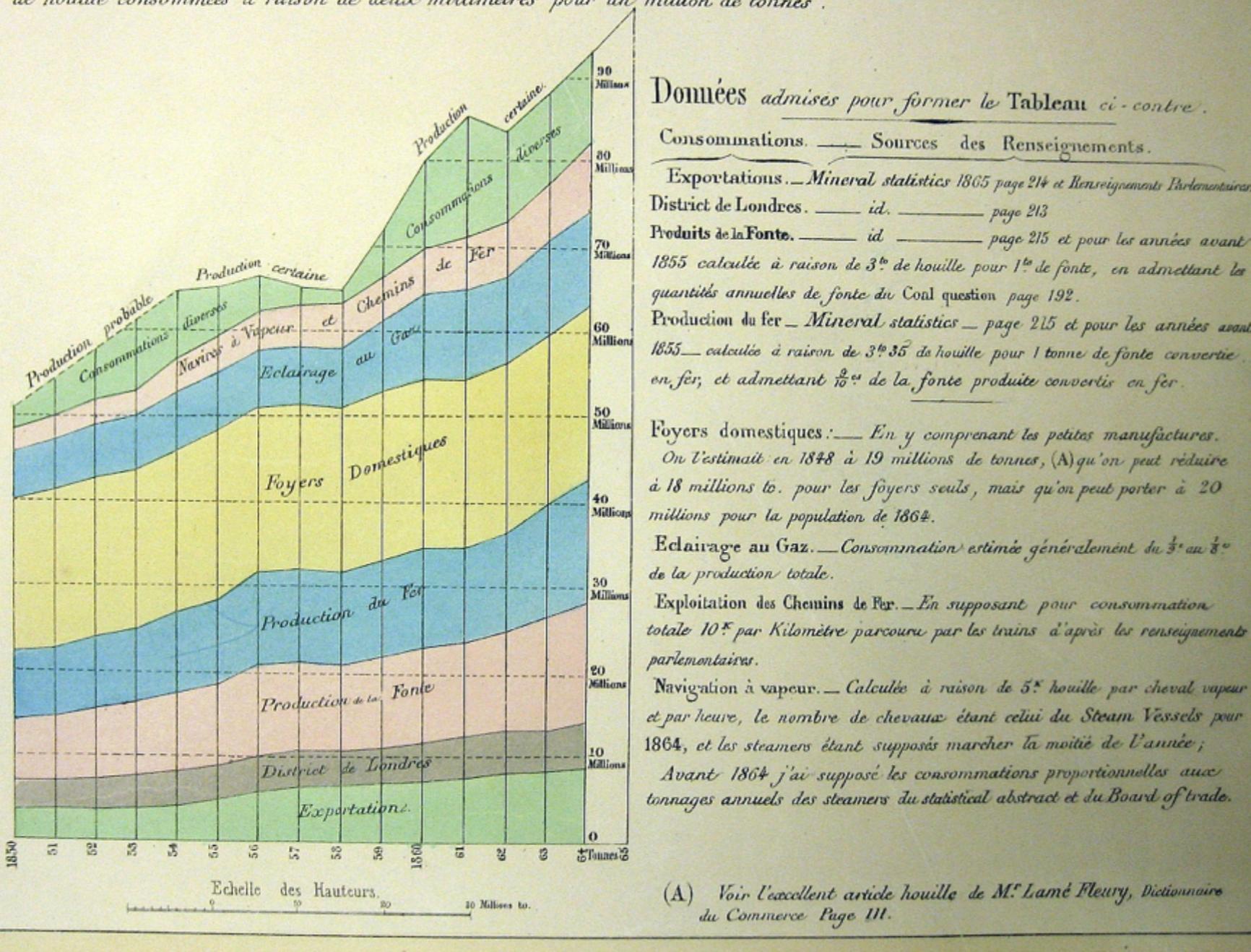
https://en.wikipedia.org/wiki/Charles_Joseph_Minard

Item-Level Stacking

Charles Joseph Minard

Consommations approximatives de la Houille dans la Grande Bretagne de 1850 à 1864.

Les abscisses représentent les années et les ordonnées les quantités annuelles de houille consommée. Les couleurs indiquent les espèces de consommations. Les longueurs d'ordonnées comprises dans une couleur sont les quantités de houille consommées à raison de deux millimètres pour un million de tonnes.



The major uses of British coal, according to the chart, are:

- “Navires a Vapeur et Chemins de Fer”: steamships and trains
- “Eclairage au gaz”: gas lighting
- “Foyers Domestiques”: domestic fireplaces
- “Fer” and “Fonte”: the production of iron and cast iron

The Ebb and Flow of Movies – Box Office Receipts 1986 — 2008 – Interactive Graphic – NYTimes.com

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February 23, 2008

E-MAIL FEEDBACK

The Ebb and Flow of Movies: Box Office Receipts 1986 — 2008

Summer blockbusters and holiday hits make up the bulk of box office revenue each year, while contenders for the Oscars tend to attract smaller audiences that build over time. Here's a look at how movies have fared at the box office, after adjusting for inflation.

Find Movie

Go

Jan.
1998

The Last Legion

March
This sword-and-sandal spectacle from those epic-loving De Laurentiises invokes a lot of better movies on its circuitous trip from the Roman empire to the Arthurian legend, but it doesn't do the one bit of borrowing that could have made this journey enjoyable.

[NYT movie overview »](#)

April

May

June

July

Aug.

S

Each shape shows how one film did at the box office.

↑
Height
shows weekly box office revenue
↓

← Width →
shows longevity

The area of the shape (and its color) corresponds to the film's total domestic gross, through Feb. 21

Good Will Hunting

As Good as It Gets

• City of Angels

• Mulan
• The Truman Show

• Armageddon

• Saving Private Ryan
• There's Something About Mary

Focus + Context

Carefully pick what to show

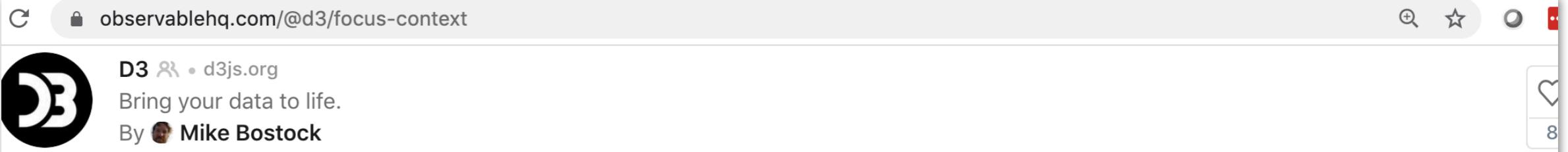
Focus + Context

Focus + Context

Hint at what you are not showing

Focus + Context

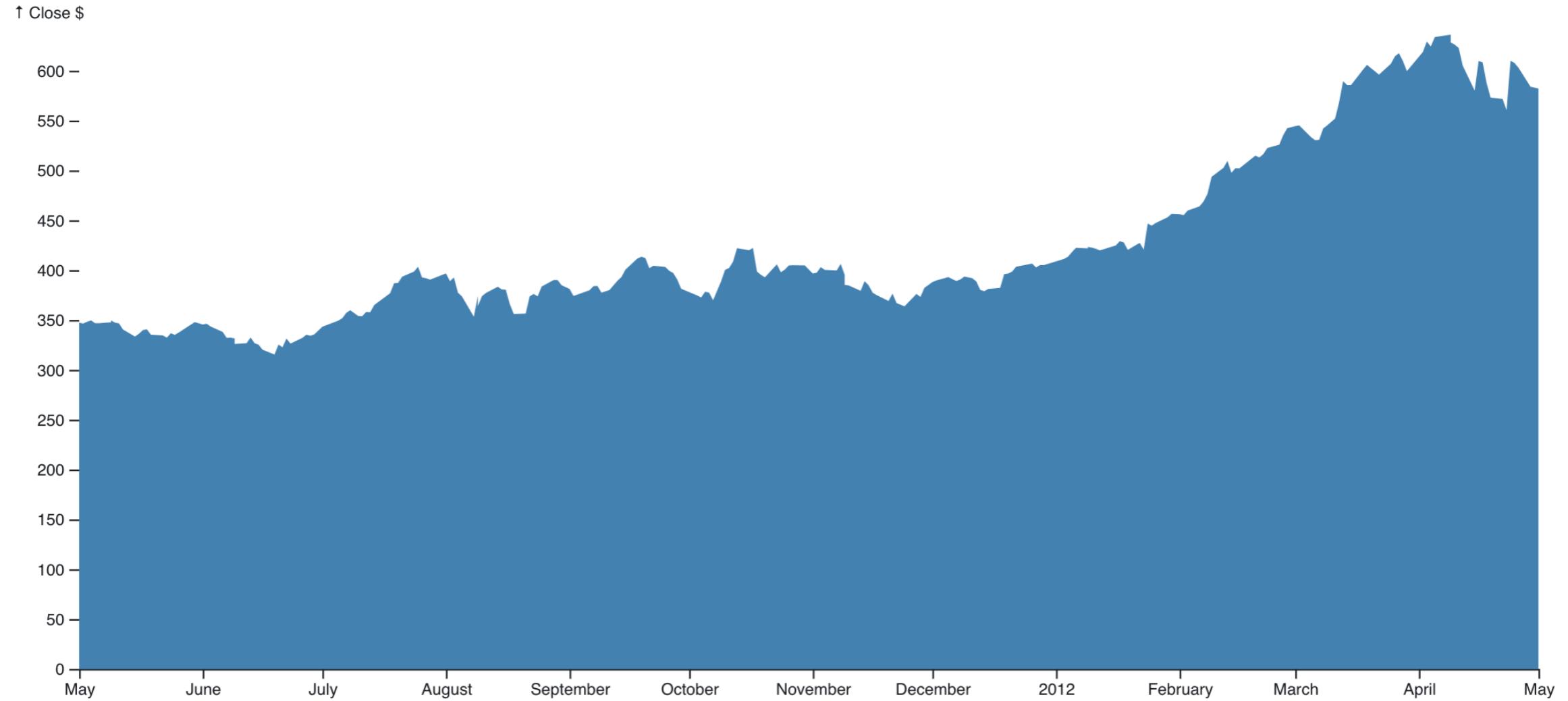
- Synthesis of visual encoding and interaction
- User selects region of interest (focus) through navigation or selection
- Provide context through aggregation, reduction, or layering
- Typically, the focus view is *embedded* in the context



Published Feb 19 Fork of Line Chart • 2 Forks 1 File Listed in d3-brush

Focus + Context

This [area chart](#) uses brushing to specify a focused area. Drag the gray region to pan, or brush to zoom. Compare to a [zoomable chart](#). Data: [Yahoo Finance](#)



<https://observablehq.com/@d3/focus-context>

Using Embedding to Reduce

Reduce

→ Embed

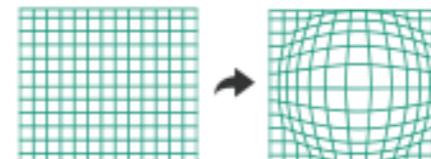
→ Elide Data



→ Superimpose Layer



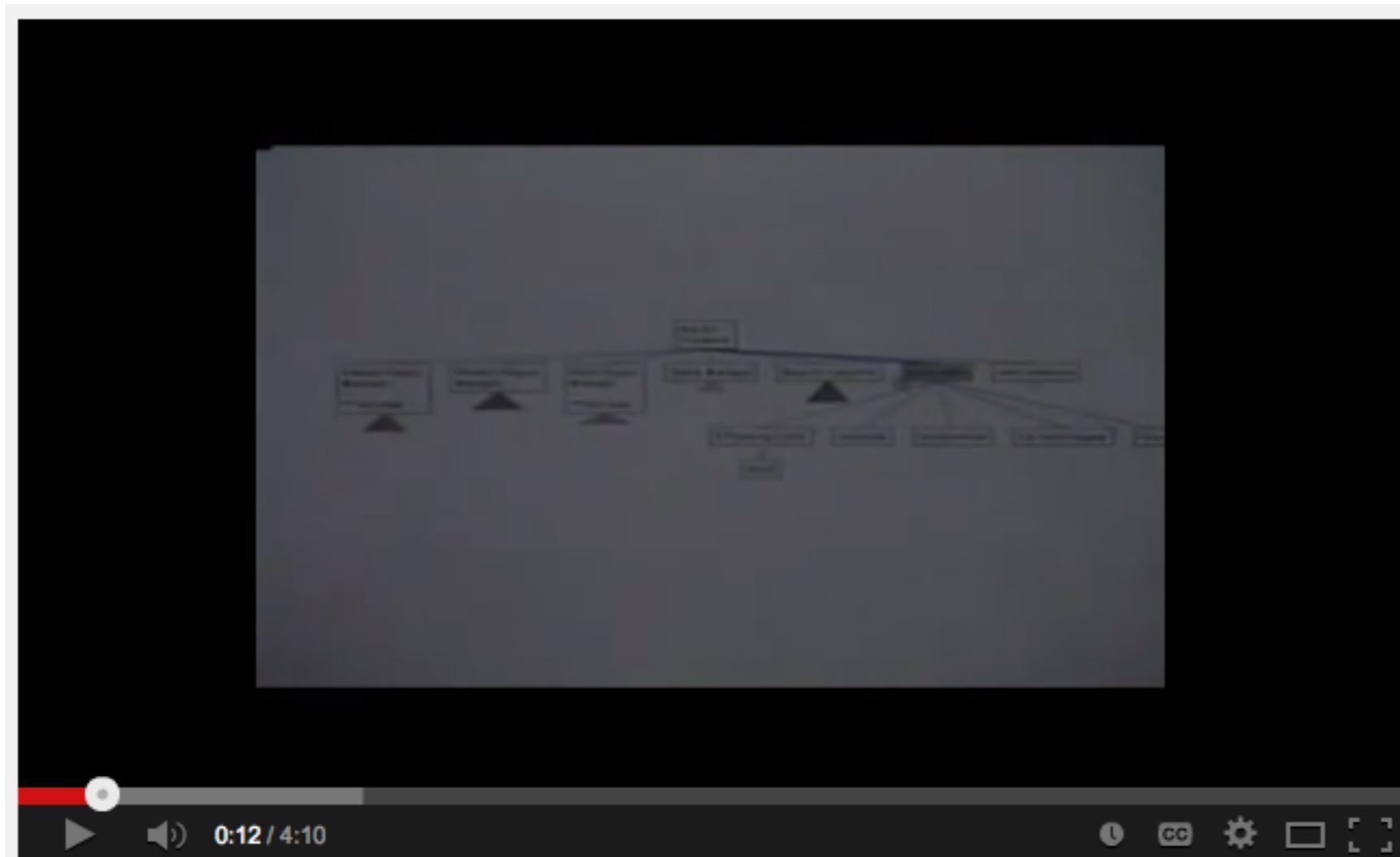
→ Distort Geometry



Elision

Focus items shown in detail, some items summarized
for context, other items are **omitted**

SpaceTree



2002 spacetree



Catherine Plaisant



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38

87 views



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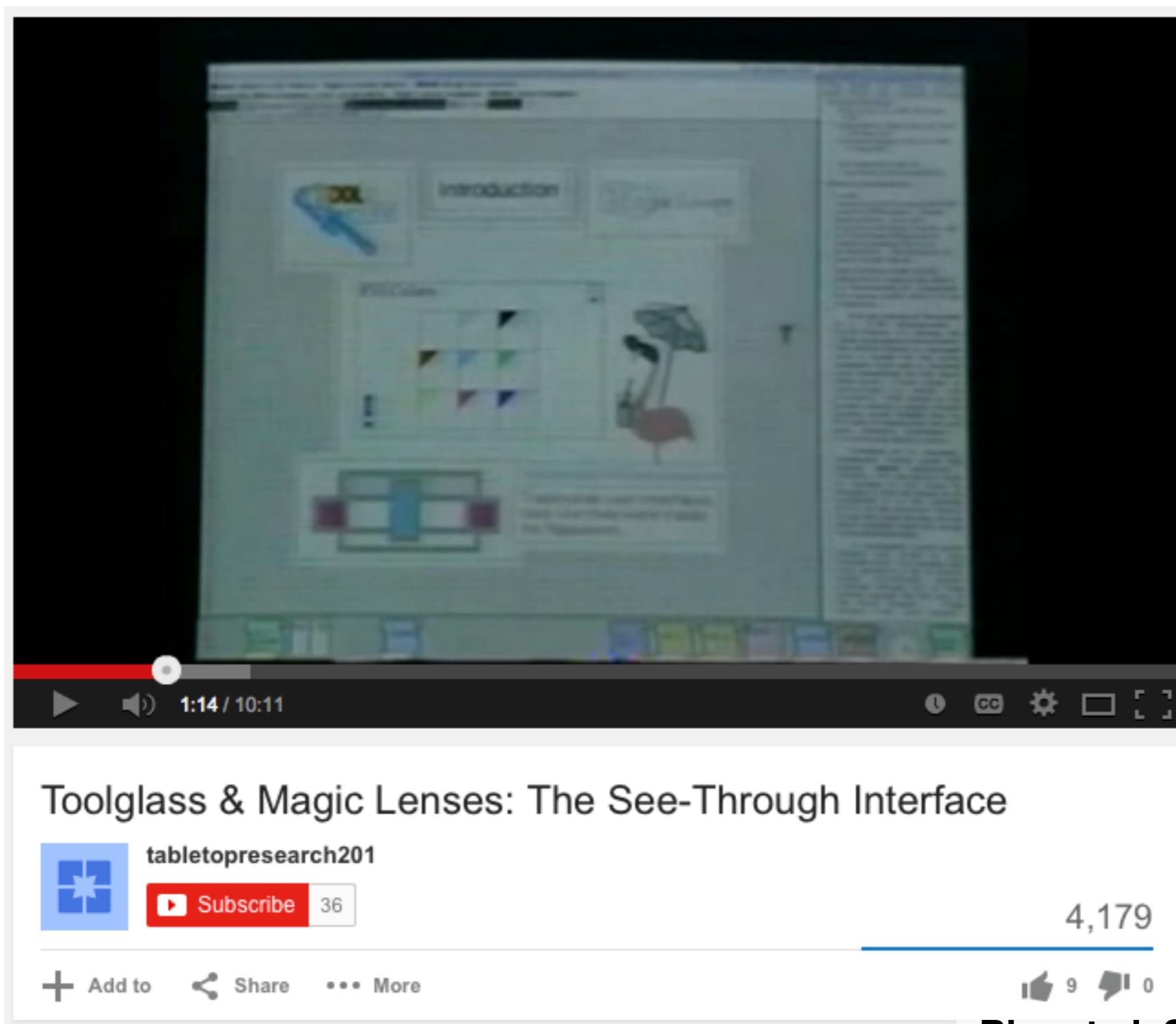
0

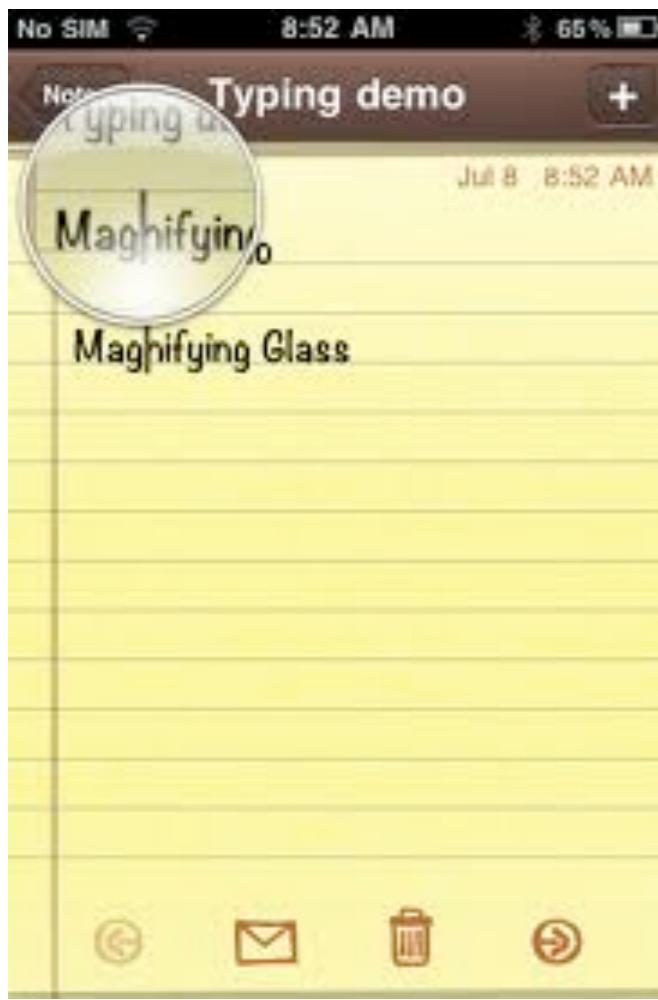
Grosjean et al., IEEE Symposium on Information Visualization 2002

Superimpose

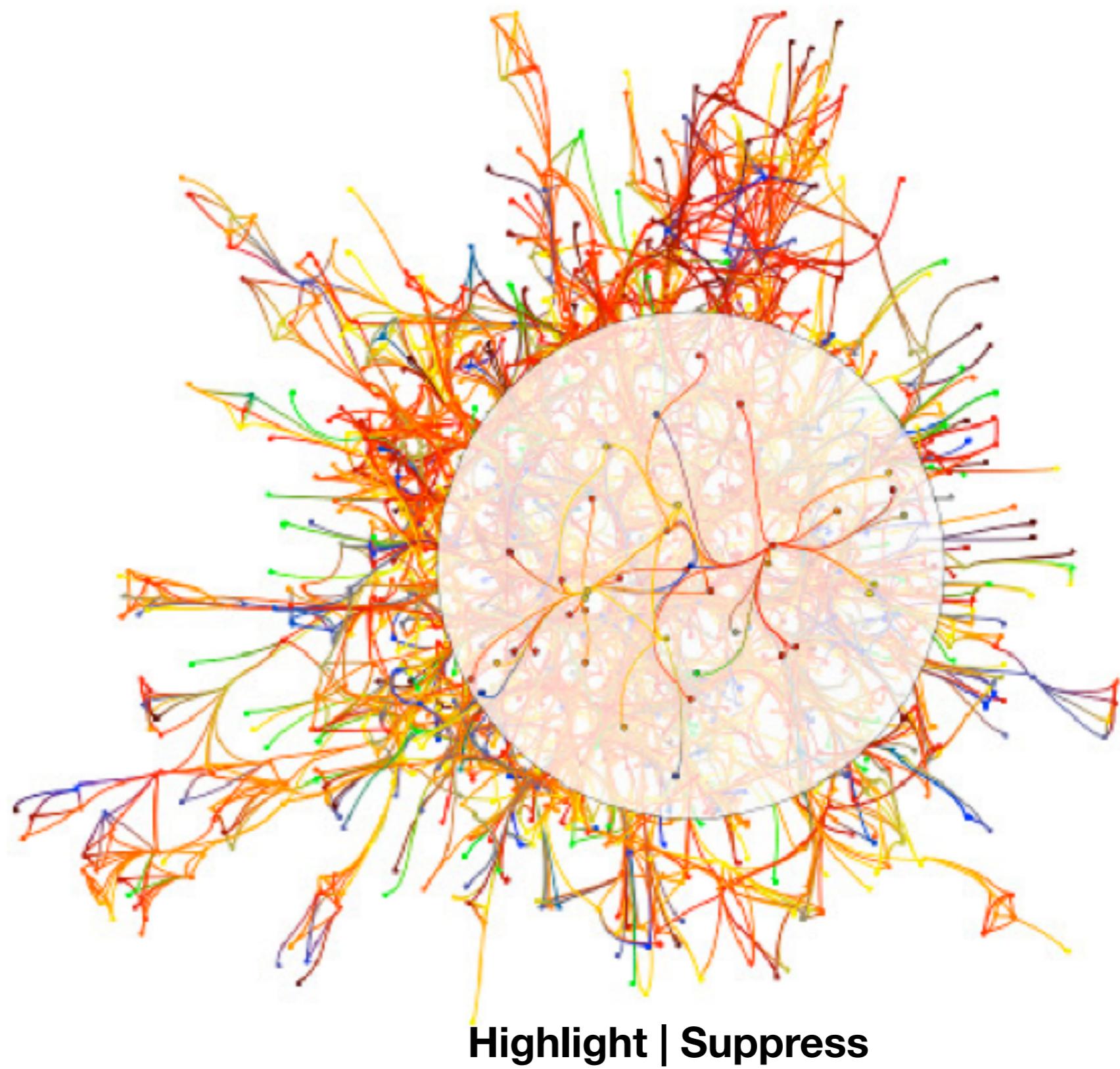
Focus layer **limited to a local region** of view, instead
of stretching across the entire view

Toolglass & Magic Lenses





Magnification



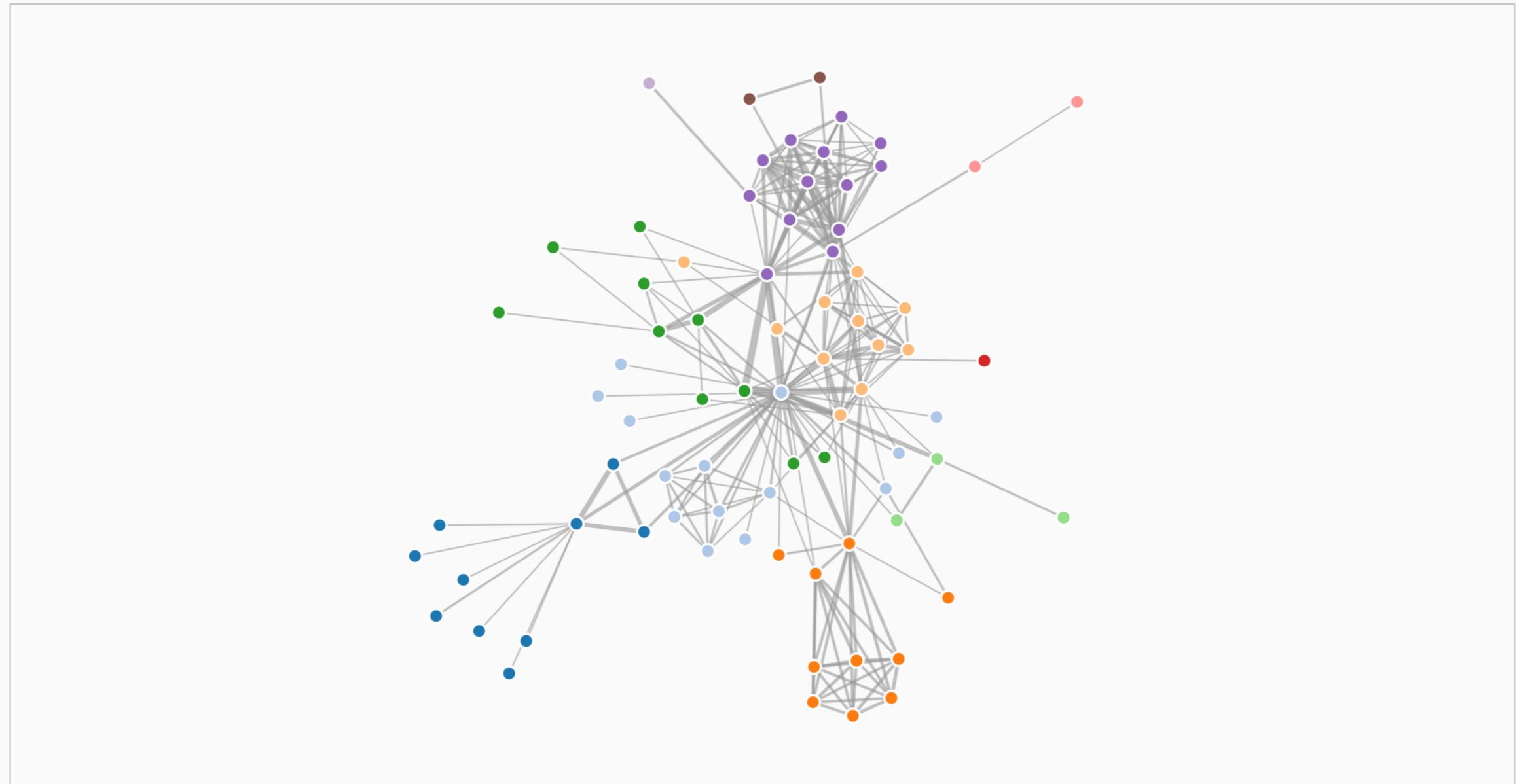
Highlight | Suppress

Distort

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

June 21, 2012 / Mike Bostock

Fisheye Distortion



It can be difficult to observe micro and macro features simultaneously with complex graphs. If you zoom in for detail, the graph is too big to view in its entirety. If you zoom out to see the overall structure, small details are lost. Focus + context techniques allow interactive exploration of an area of interest (the *focus*) in greater detail, <https://bost.ocks.org/mike/fisheye/>.

Mouseover to distort the nodes.



Unfolding - Fisheye and Zoom lens example

<https://vimeo.com/54025047>



Fisheye Tree View



ctominski

[Subscribe](#) 2

100 views

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Distortion Concerns

- Unsuitable for relative spatial judgements
- Overhead of tracking distortion
- Visual communication of distortion
 - Gridlines, shading

Summary: Ben Shneiderman's “Visual information seeking mantra”

- Overview first, zoom and filter, then details-on-demand
1. **Overview first:** Before all else, show a “highlevel” view, possibly through appropriate aggregation
 2. **Zoom and filter:** Use interaction to create user-specified views
 3. **Details-on-demand:** Individual points or attributes should be available, but only as requested

Summary of L10/L11

How?

Manipulate

→ Change



→ Select

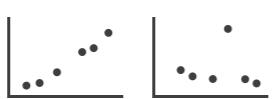


→ Navigate

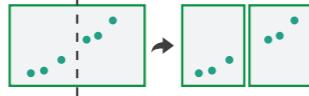


Facet

→ Juxtapose



→ Partition



Reduce

→ Filter



→ Aggregate



**Filter/Aggregate is covered in Ch.13,
but we left this out of our discussion**

→ Embed

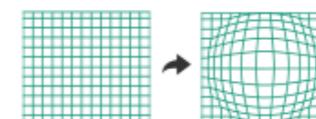
→ Elide Data



→ Superimpose Layer



→ Distort Geometry



Ch.11

Ch.12

Ch.14

Lec12 Reading

- Munzner, Ch. 7, 15.3-15.5
- Hierarchical Parallel Coordinates for Exploration of Large Datasets. Ying-Huey Fua, Matthew O. Ward, and Elke A. Rundensteiner. IEEE Visualization 1999.

Reminder

Project Milestone 01

Assigned: Monday, January 25

Due: Wednesday, February 22, 4:59:59 pm

Assignment 03

Assigned: Monday, February 20

Due: Monday, March 13, 4:59:59 pm