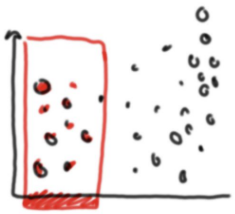
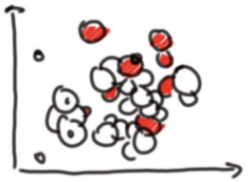
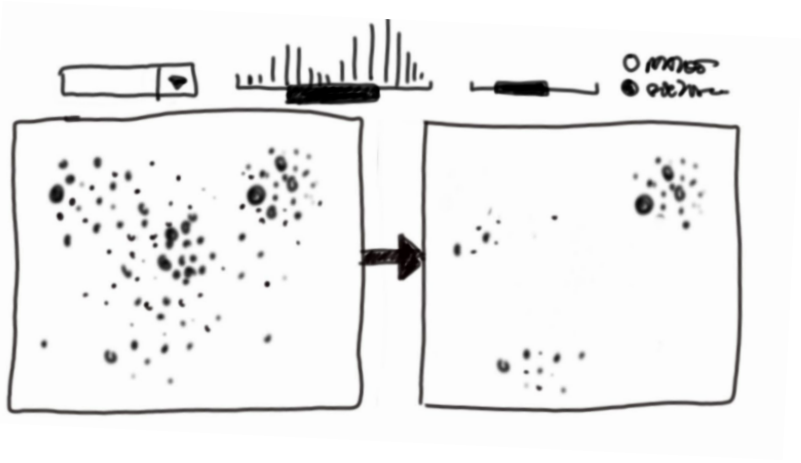
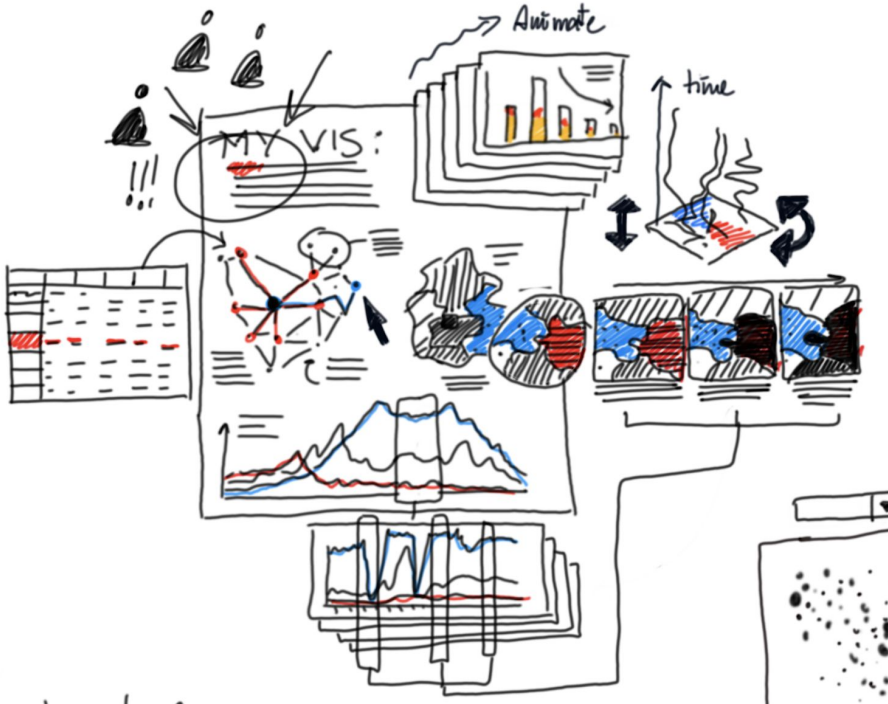




Advanced
Interaction for Visualization

Benjamin Bach
http://benjbach.me
University of Edinburgh
2020

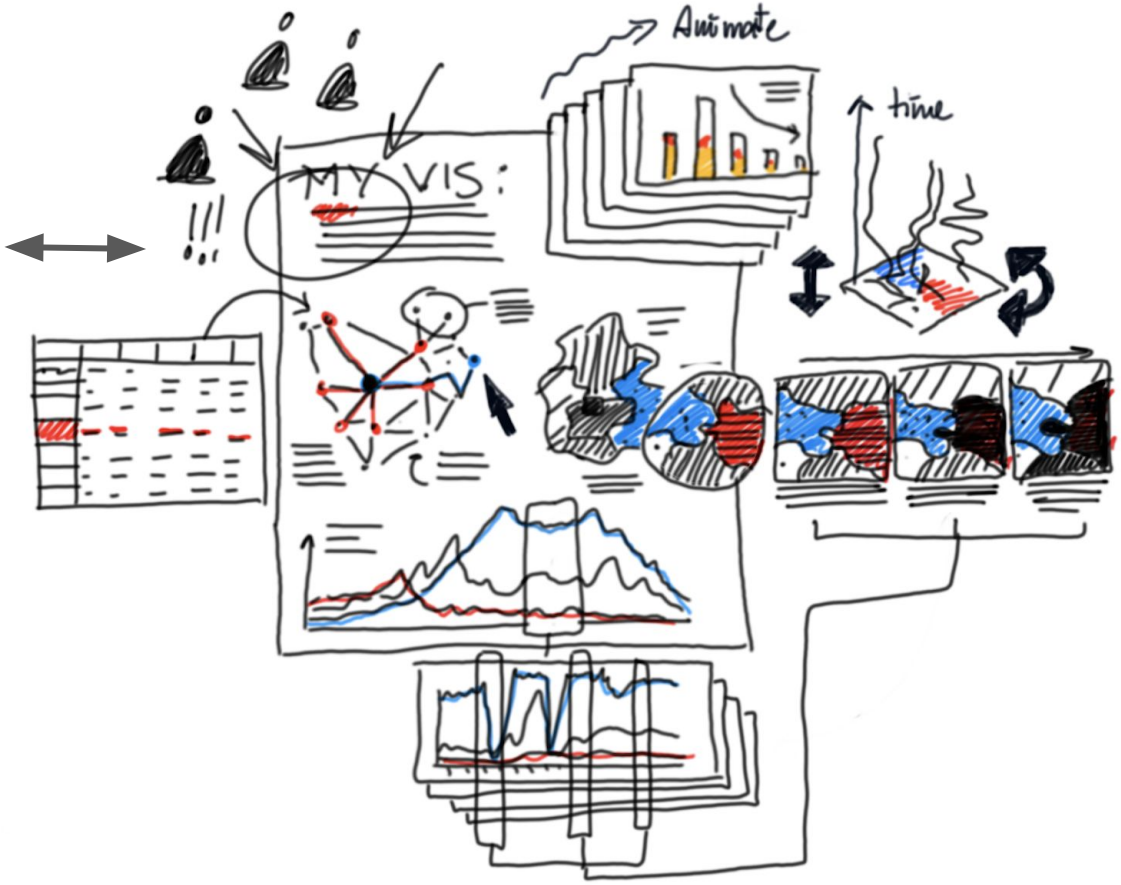



Interaction

Static Visualization

- Single perspective
- **Interaction**: Ask, Move, Search,Annotate, ...a

Interaction



Static Visualization

- Single perspective
- **Interaction**: Ask, Move, Search,Annotate, ...a

Dynamic Visualization

- Multiple perspectives
- Interaction: Click, Filter, change, explore, connect,

Why Interaction?

- Large data
- Multivariate data
- Complex problems
- 3D visualization
- Simulations & parameters

Interaction

Human-Computer Interaction:

Click, point, touch, drag, drop, pan, zoom, select, swipe, scroll, double-click, right-click, search, browse, type, spell, confirm, reject, filter, upload, download, color, customize, expand, collapse, open, close, annotate, flag, tag, rename, rotate, scale ...

Interaction

Human-Computer Interaction:

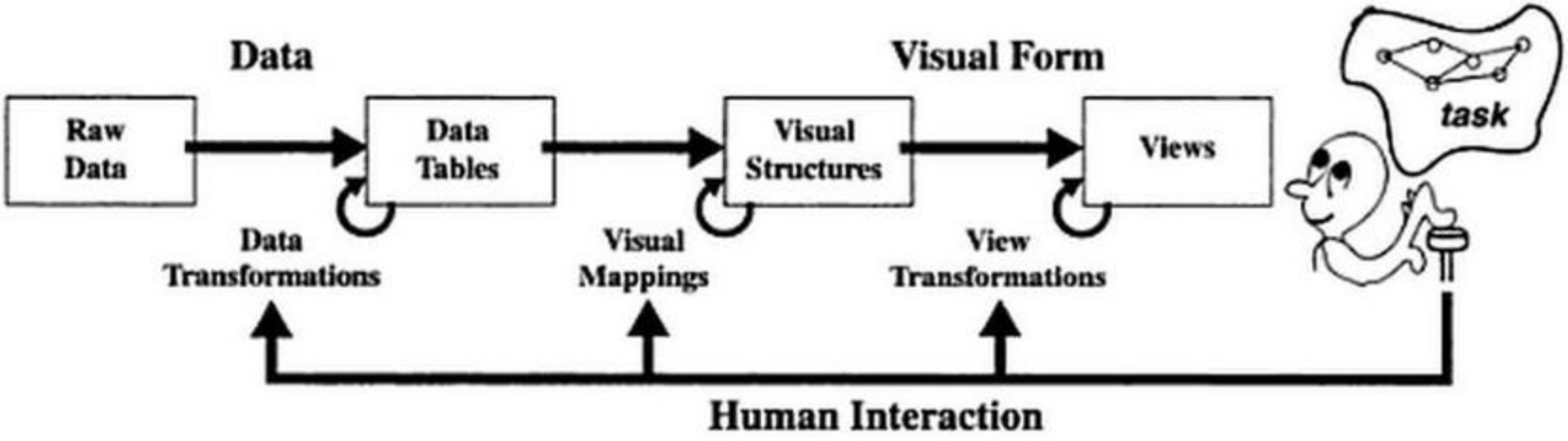
Click, point, touch, drag, drop, pan, zoom, select, swipe, scroll, double-click, right-click, search, browse, type, spell, confirm, reject, filter, upload, download, color, customize, expand, collapse, open, close, annotate, flag, tag, rename, rotate, scale ...

Visualization:

"features that provide users with the ability to directly or indirectly manipulate and interpret representations"

Yi, Ji Soo, Youn ah Kang, and John Stasko. "Toward a deeper understanding of the role of interaction in information visualization." *IEEE transactions on visualization and computer graphics* 13, no. 6 (2007): 1224-1231.

Info Visualization Pipeline:
(A technical view on interaction)

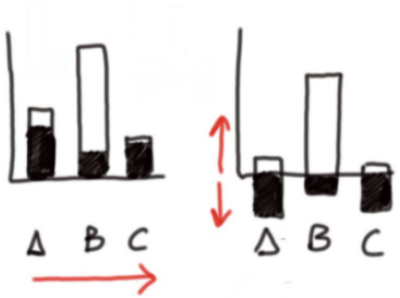


Interaction Techniques

Interaction

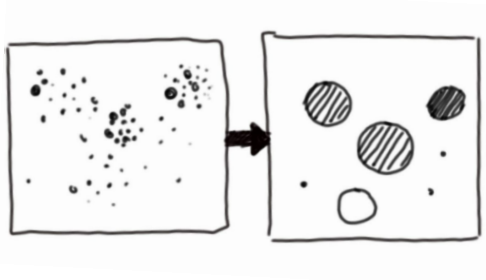
Select

Explore

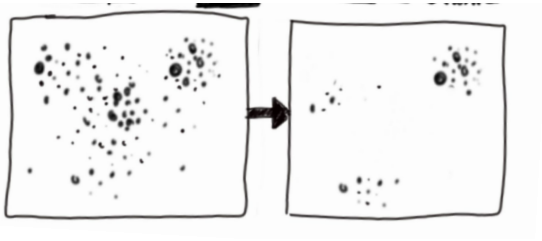


Reconfigure

Encode



Abstract

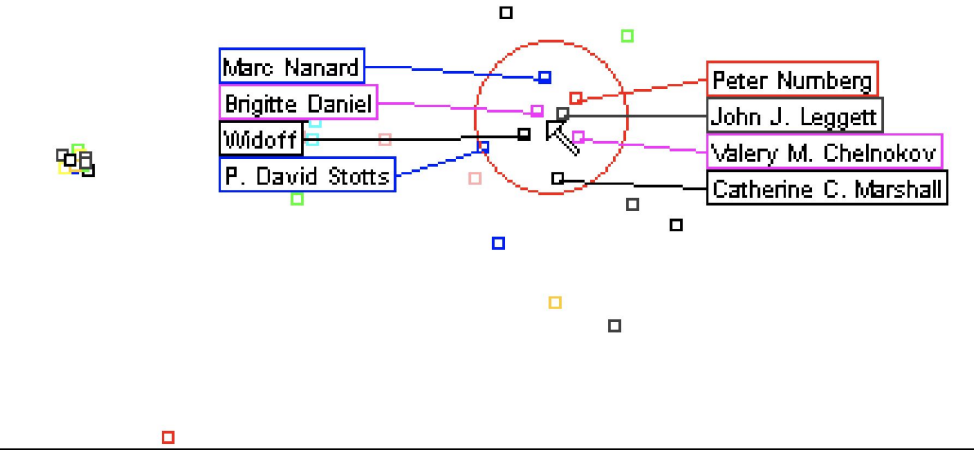


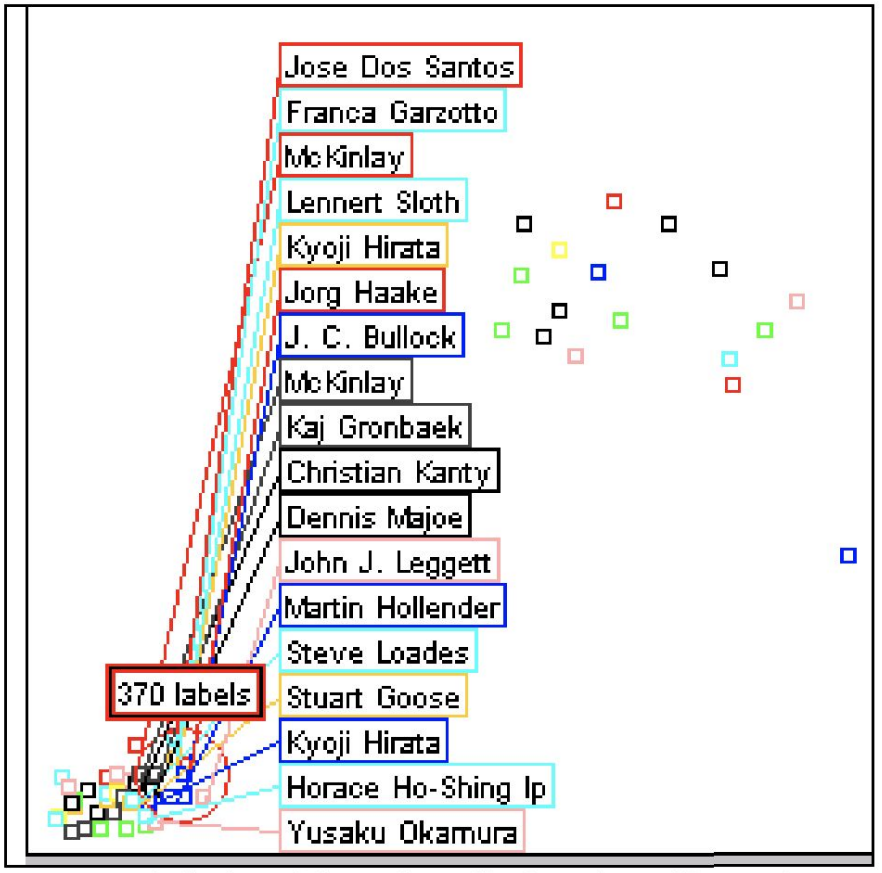
Filter

Connect

Select: "*Mark data items*"

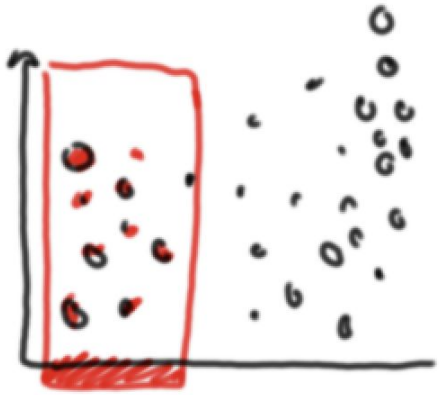
Select: Excentric labeling

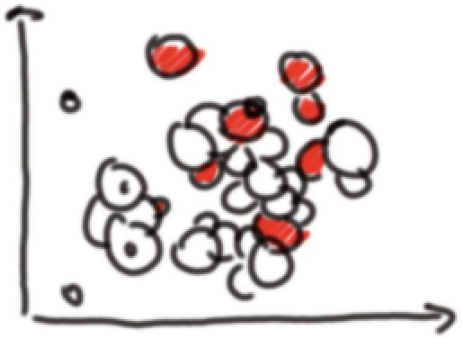




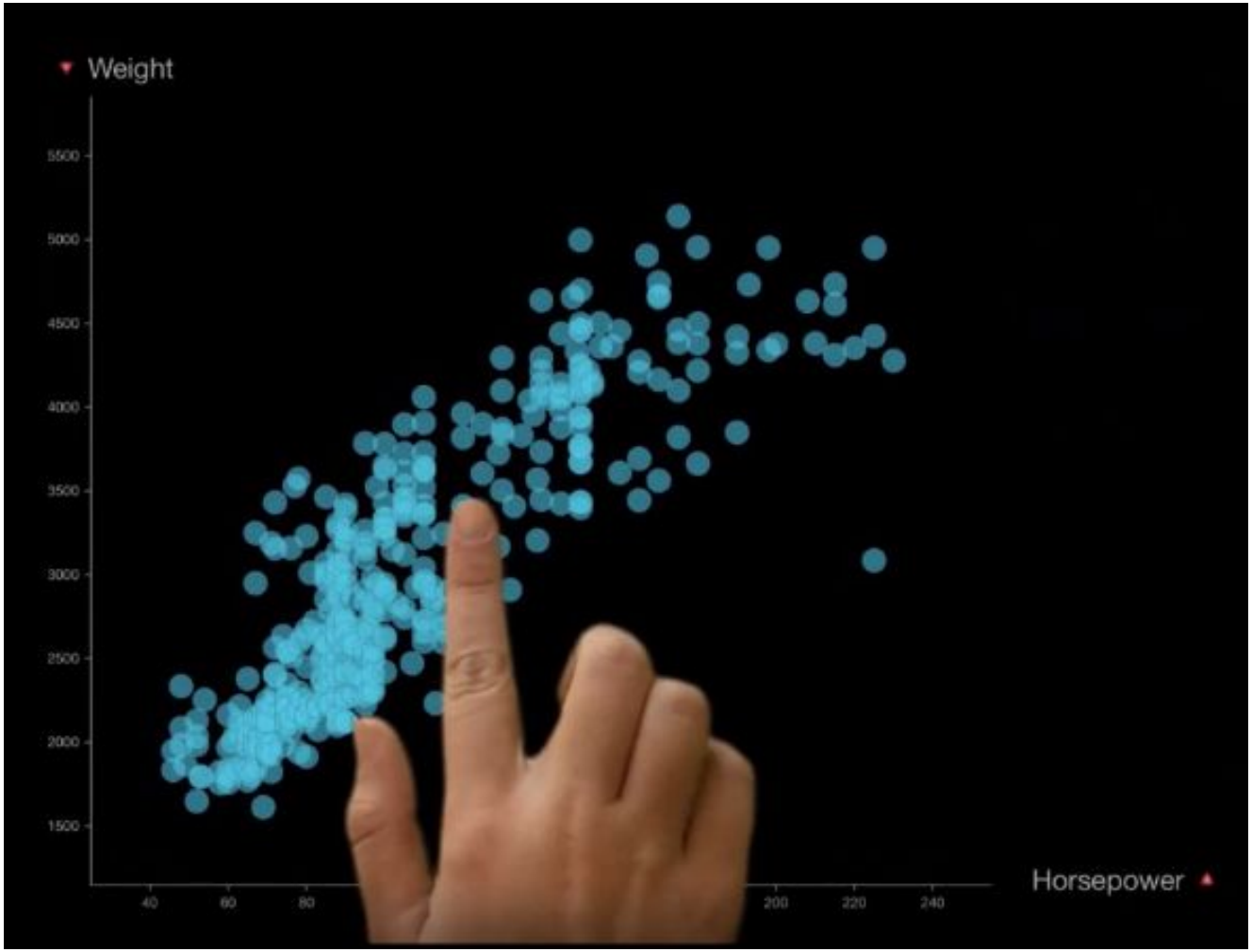
Fekete, Jean-Daniel, and Catherine Plaisant. "Excentric labeling: dynamic neighborhood labeling for data visualization." *Proceedings of the SIGCHI conference on Human Factors in Computing Systems*. 1999.

Select: "*Mark data items*"



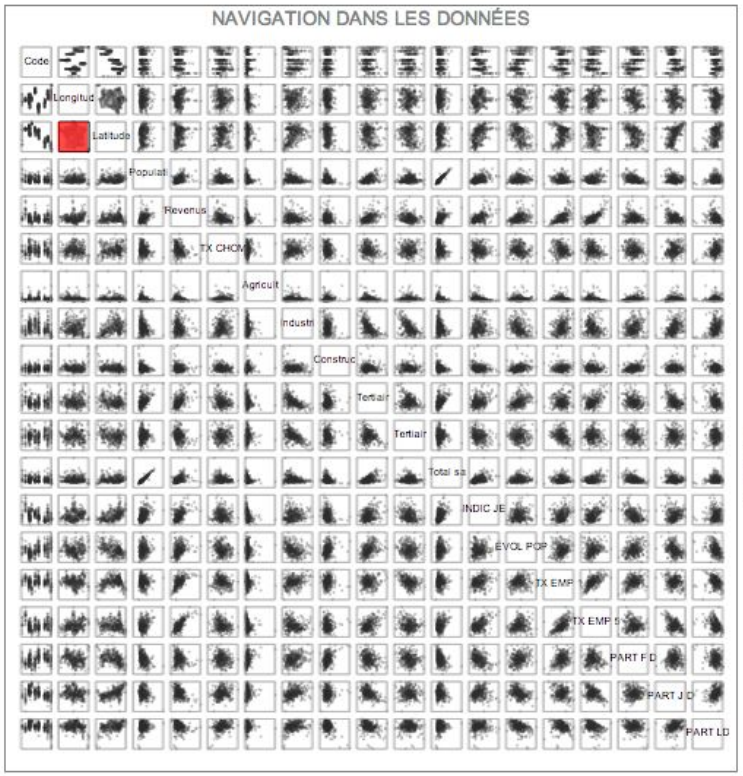


Select: "*Mark data items*"



https://ramiksadana.com/video/tangere/select.webm

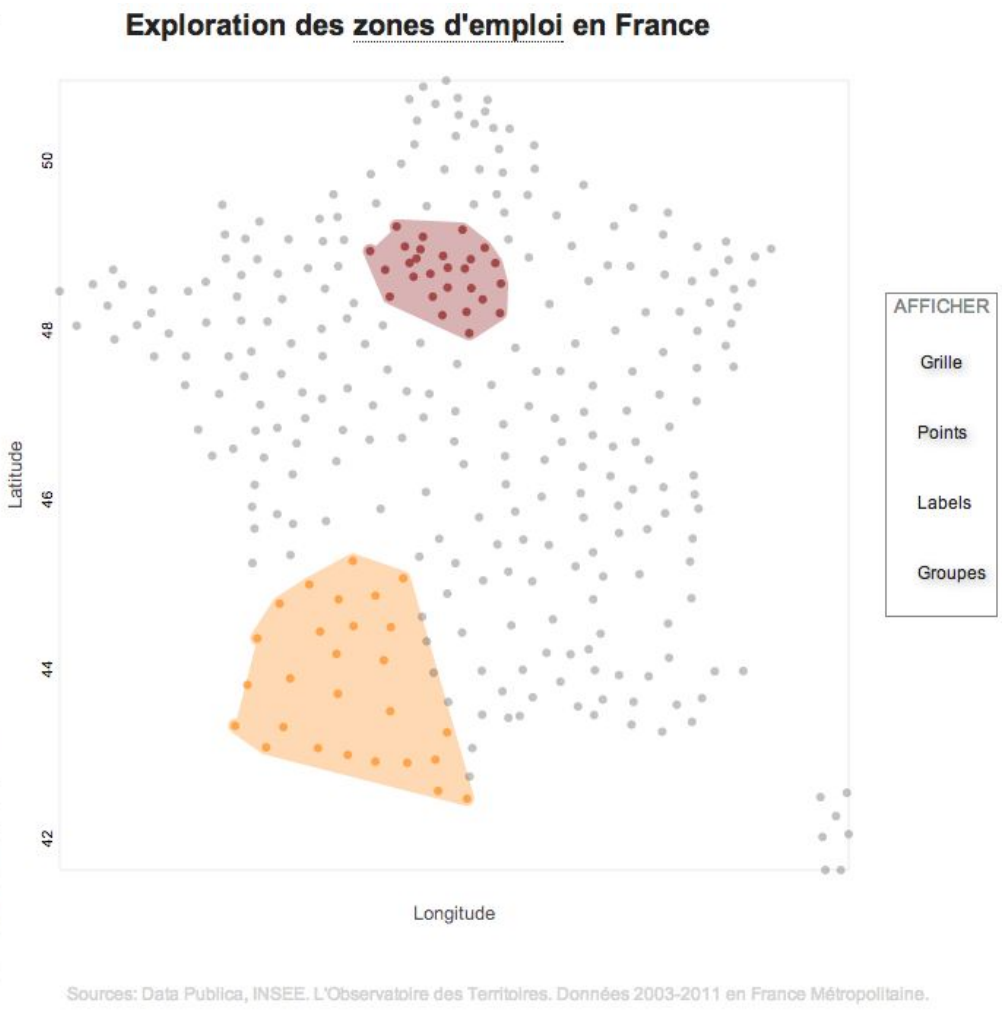
Scatterdice



En savoir plus sur cette visualisation.
Testé avec Chrome, Safari et Firefox.
Ecrivez-nous pour toute question ou commentaire.

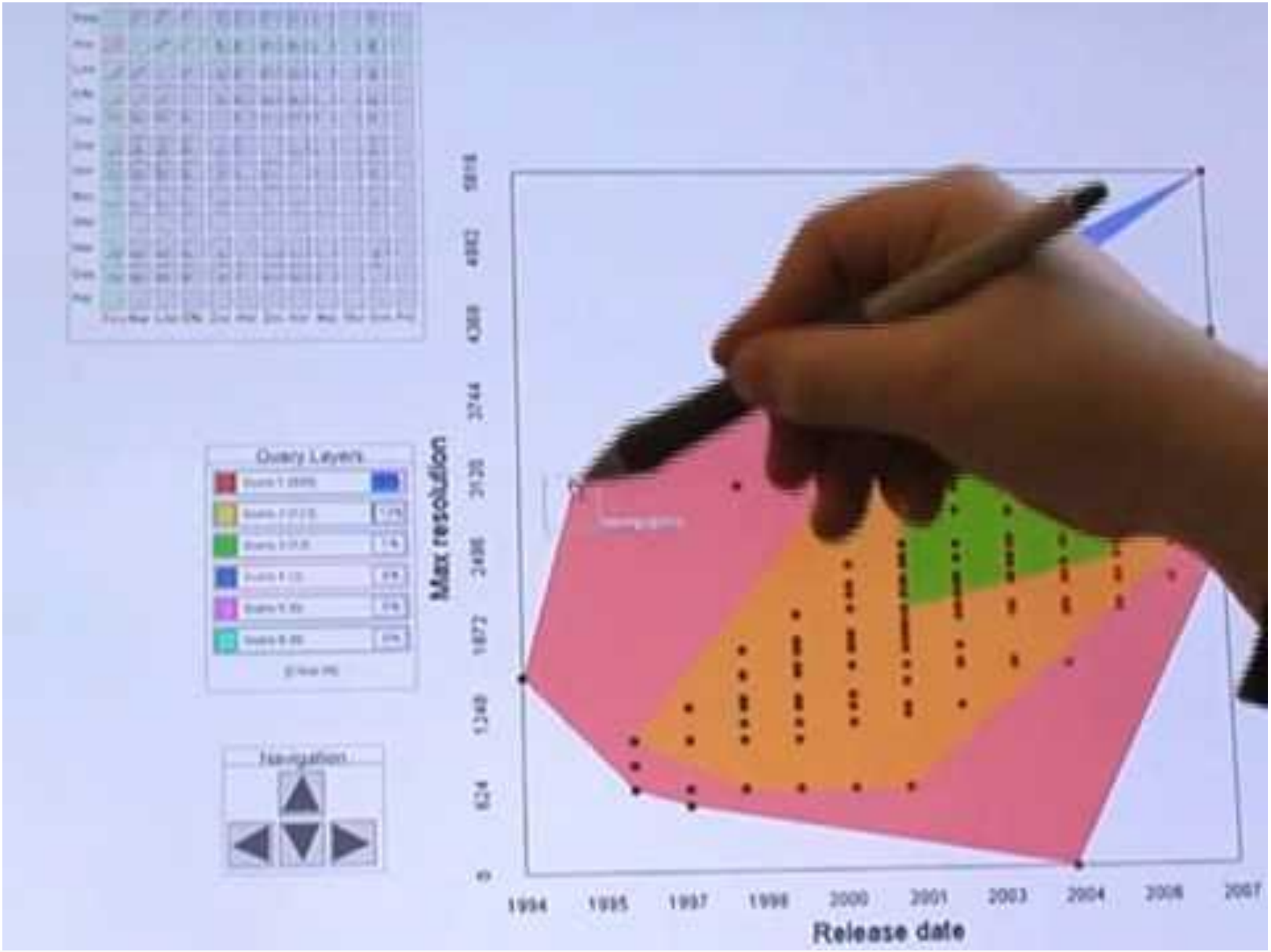
Aviz Inria
DATA PUBLICA

LISTE DES SÉLECTIONS	
Sélection 1	27/304
Sélection 2	27/304
Sélection 3	0/304
Sélection 4	0/304
[Effacer]	



https://www.youtube.com/watch?v=2bYIRcO-gwg

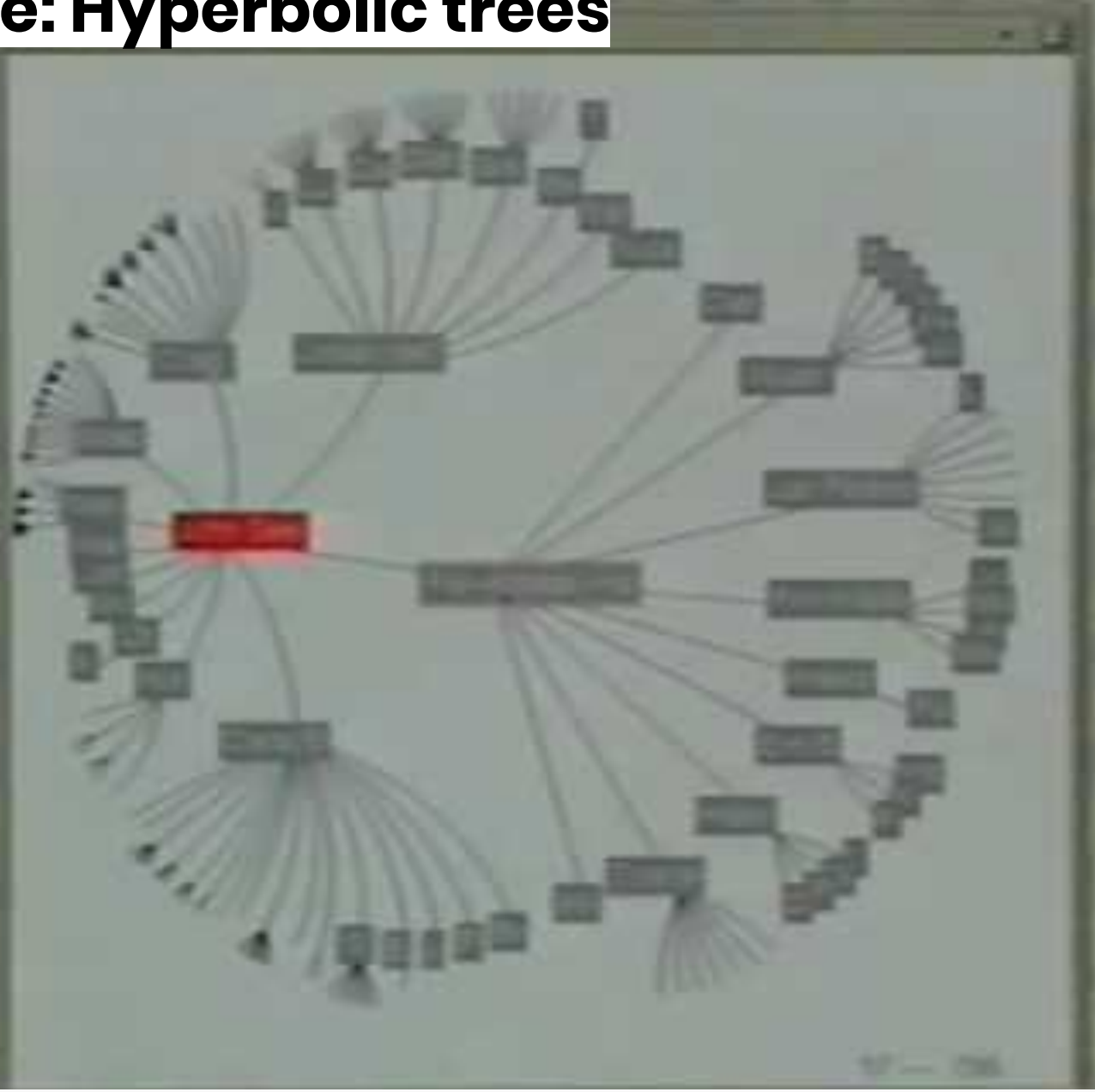
Select: Lasso+highlight (Scatterdice)



Elmqvist, Niklas, Pierre Dragicevic, and Jean-Daniel Fekete. "Rolling the dice: Multidimensional visual exploration using scatterplot matrix navigation." *IEEE transactions on Visualization and Computer Graphics* 14.6 (2008): 1539-1148.

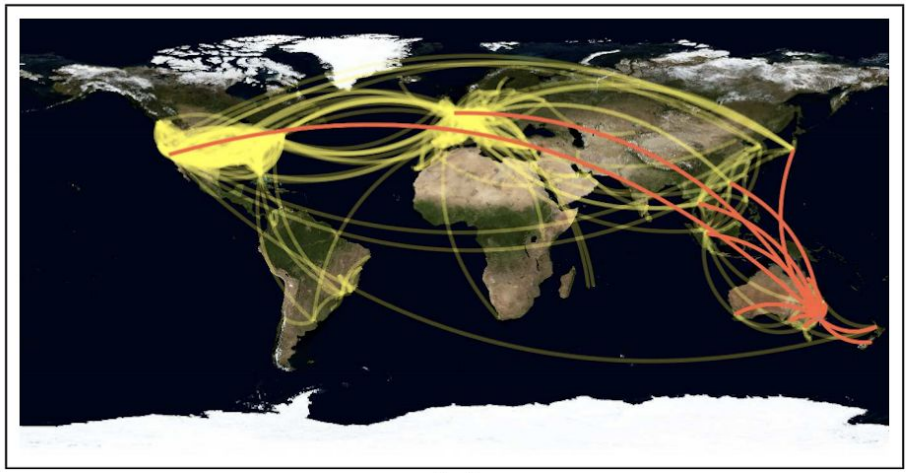
Explore: "*Show me something else*"

Explore: Hyperbolic trees

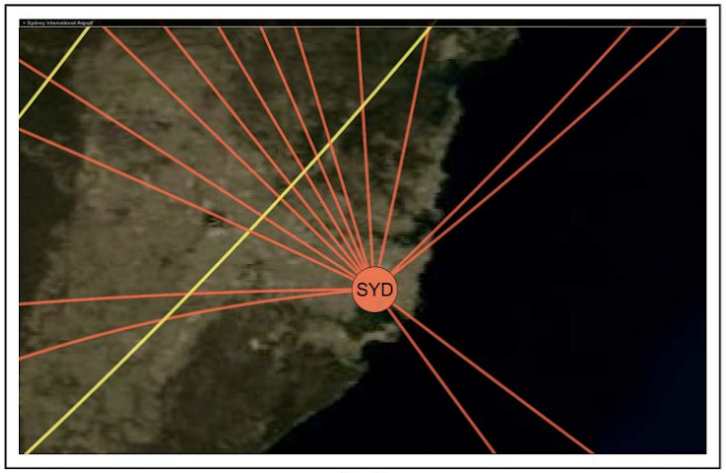


Lamping, John, and Ramana Rao. "Laying out and visualizing large trees using a hyperbolic space." *Proceedings of the 7th annual ACM symposium on User interface software and technology*. 1994.

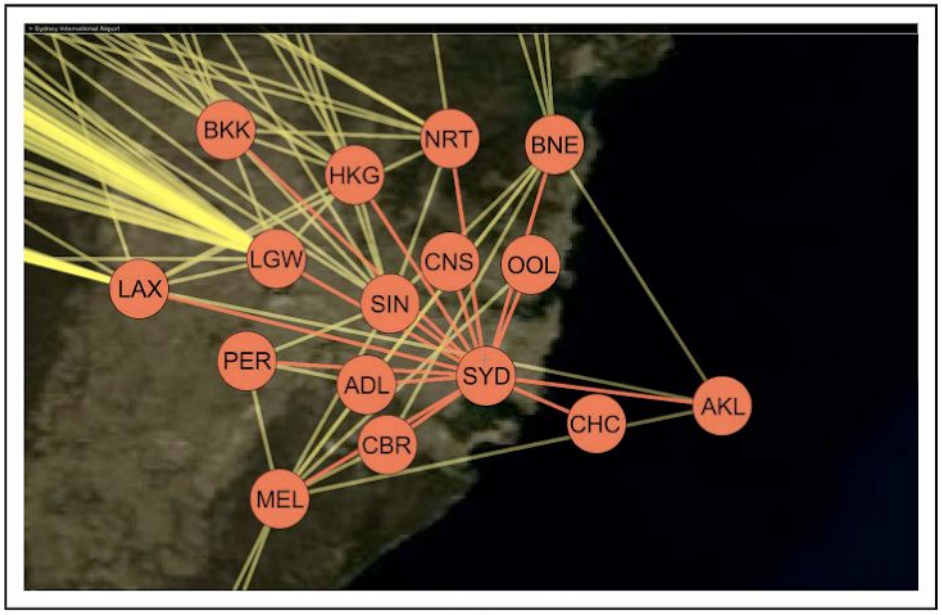
Bring and go (for networks)



(a)



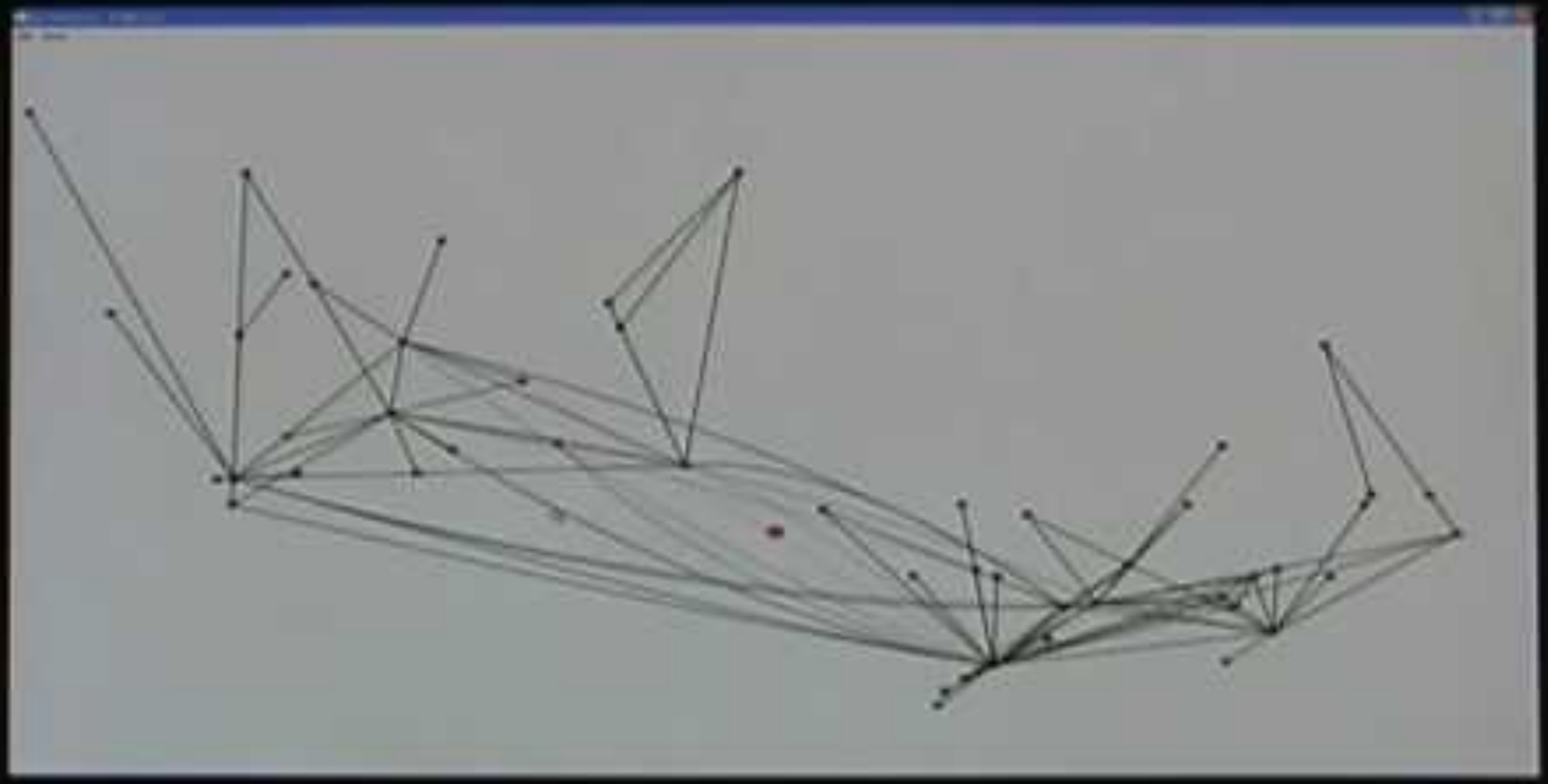
(b)



(c)

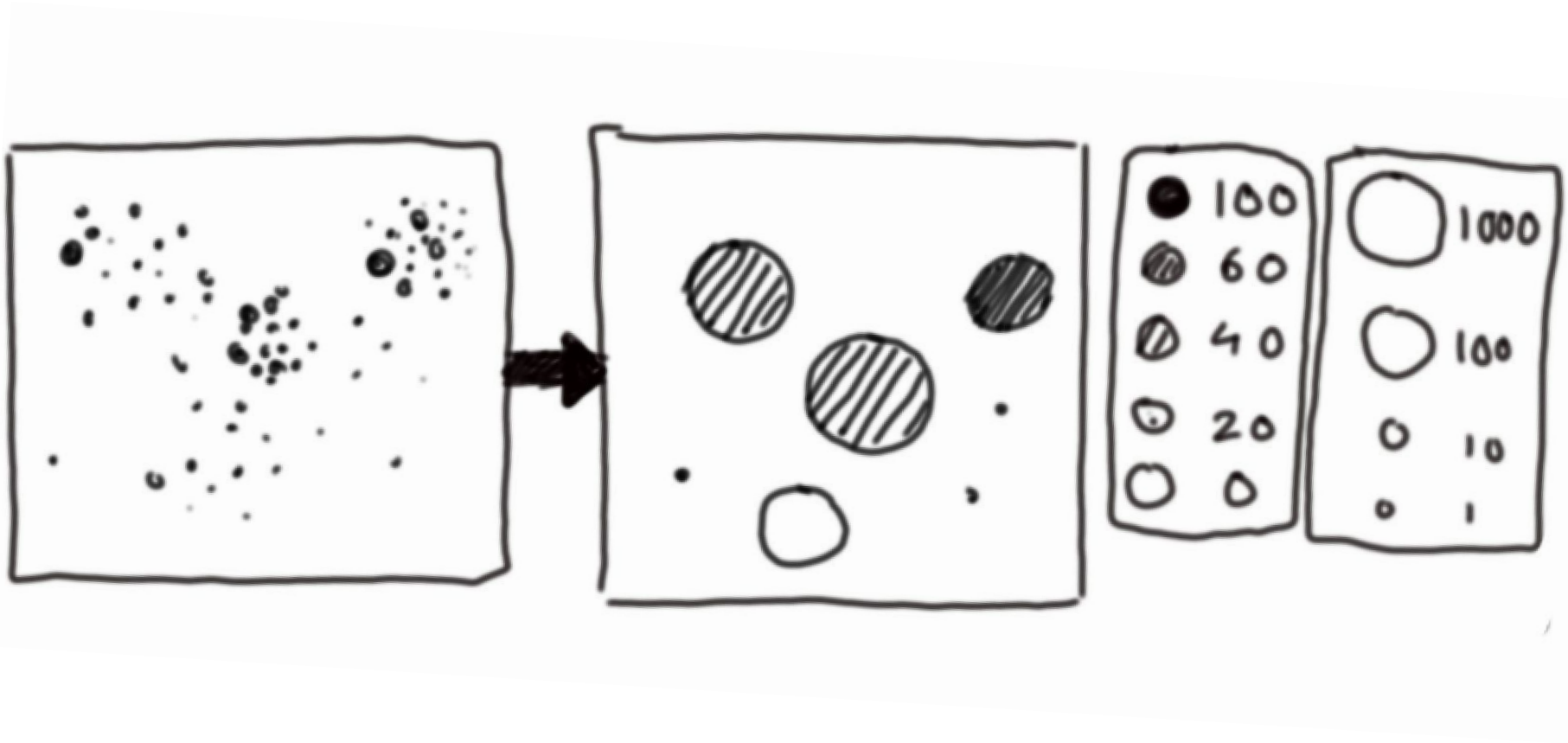
Moscovich, Tomer, et al. "Topology-aware navigation in large networks." *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. 2009.

Explore: EdgeLens

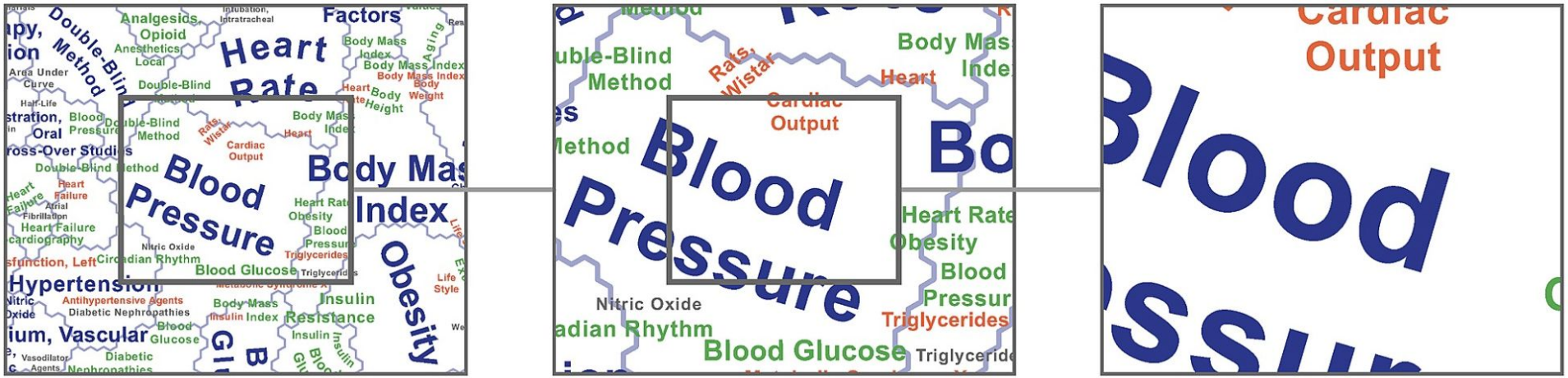


Wong, Nelson, Sheelagh Carpendale, and Saul Greenberg. "Edgelens: An interactive method for managing edge congestion in graphs." *IEEE Symposium on Information Visualization 2003 (IEEE Cat. No. 03TH8714)*. IEEE, 2003.

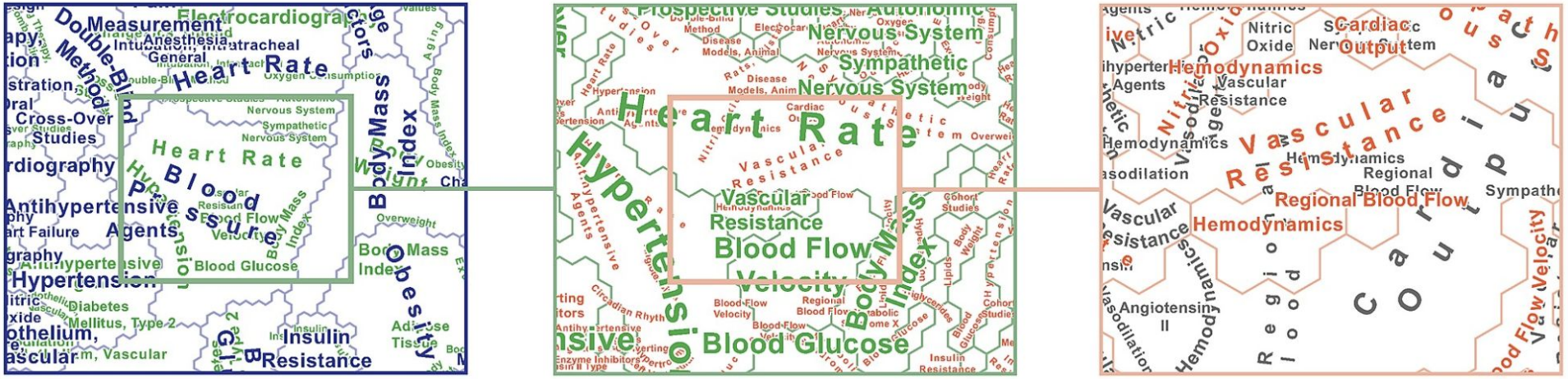
Abstract/Elaborate



Geometric Zoom ..

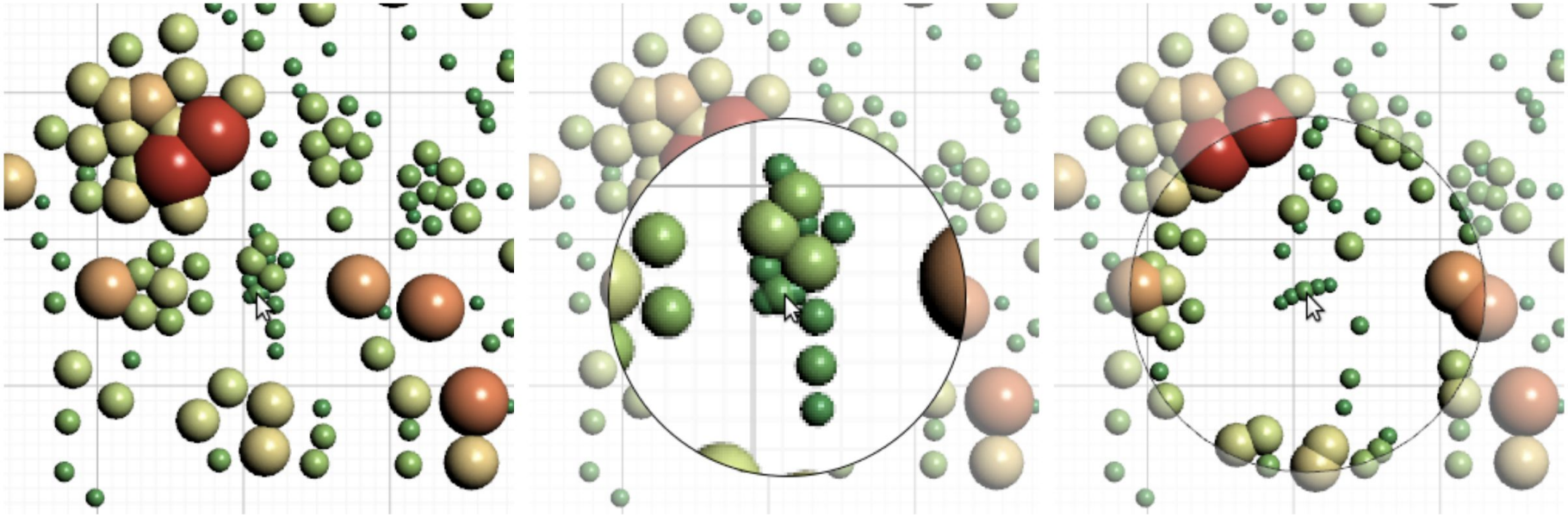


vs. Semantic Zoom:



https://www.researchgate.net/figure/Juxtaposed-are-examples-of-geometric-zooming-into-the-static-display-of-multiple-levels_fig8_236105790

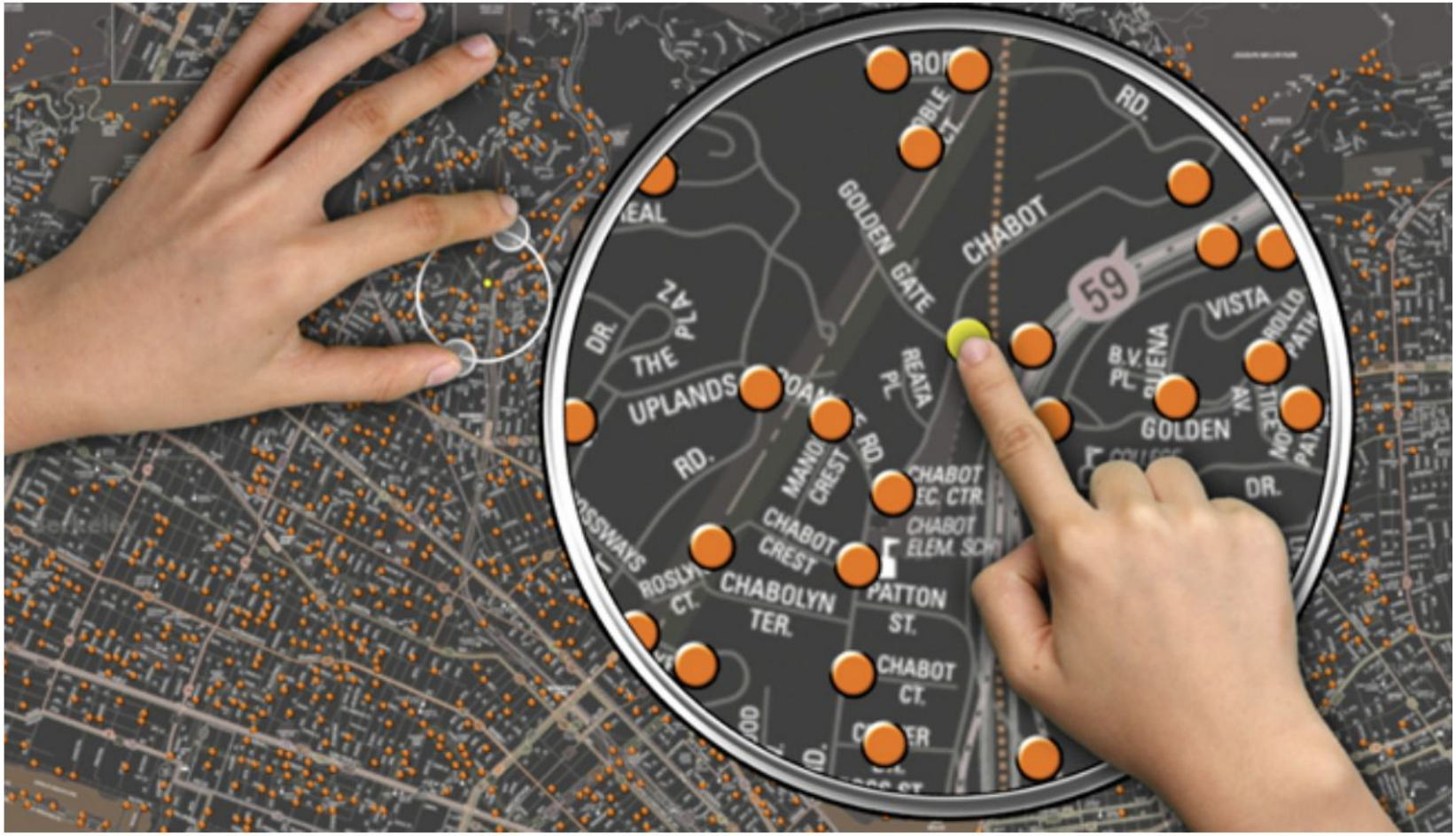
Explore: Lenses



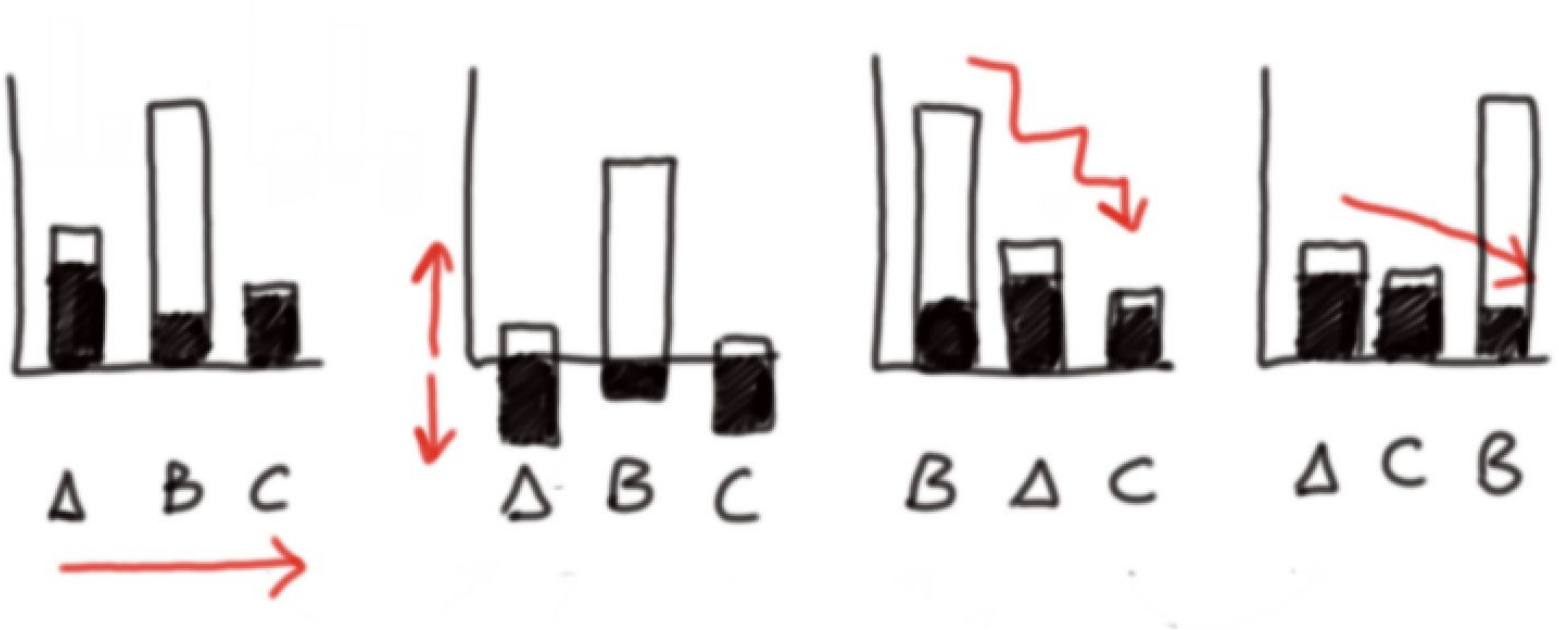
(a) Regular visualization (b) Simple magnification (c) Fish-eye distortion

Tominski, Christian, et al. "Interactive lenses for visualization: An extended survey."
Computer Graphics Forum. Vol. 36. No. 6. 2017.

Explore: Zoom

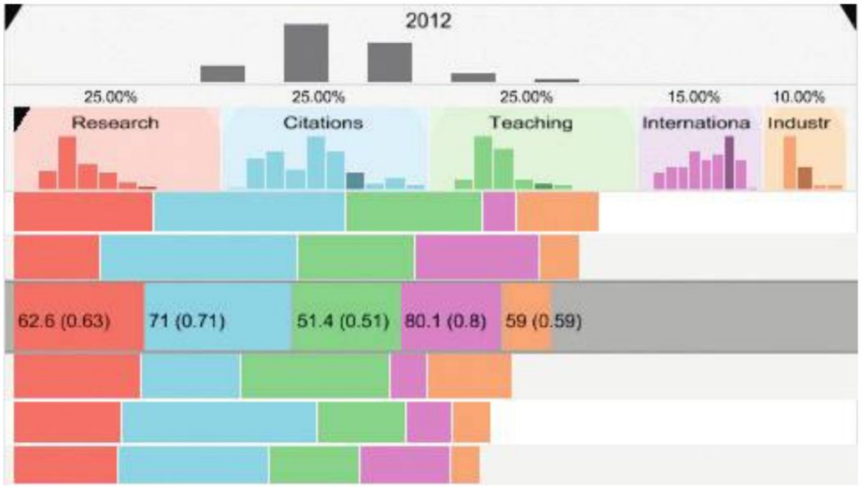


Reconfigure: "*Show me a different arrangement*"

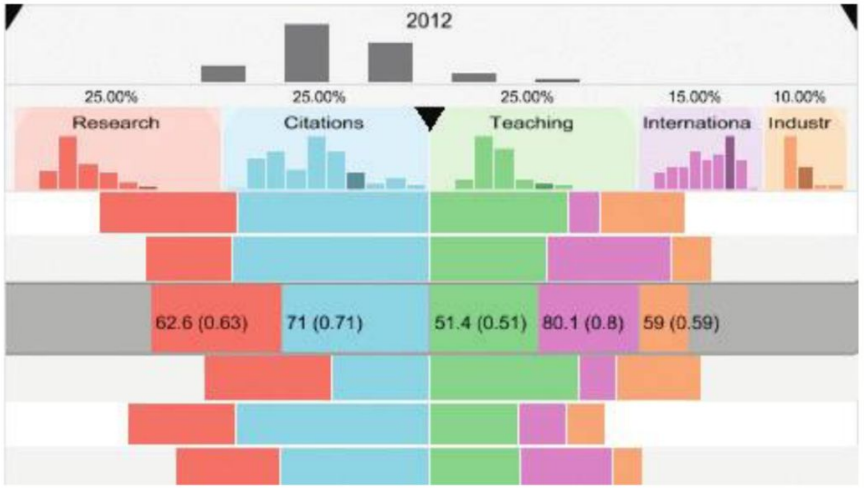


Stacked Bar Charts

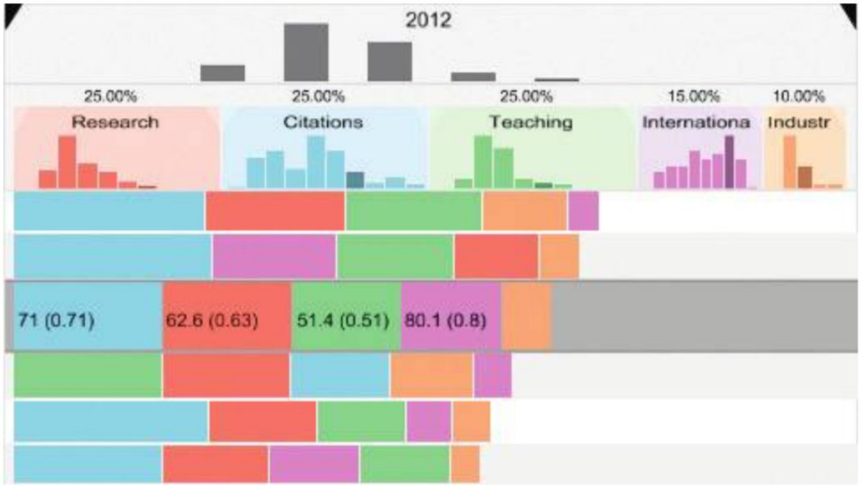
Gratzl, Samuel, et al. "Lineup: Visual analysis of multi-attribute rankings." *IEEE transactions on visualization and computer graphics* 19.12 (2013): 2277-2286.



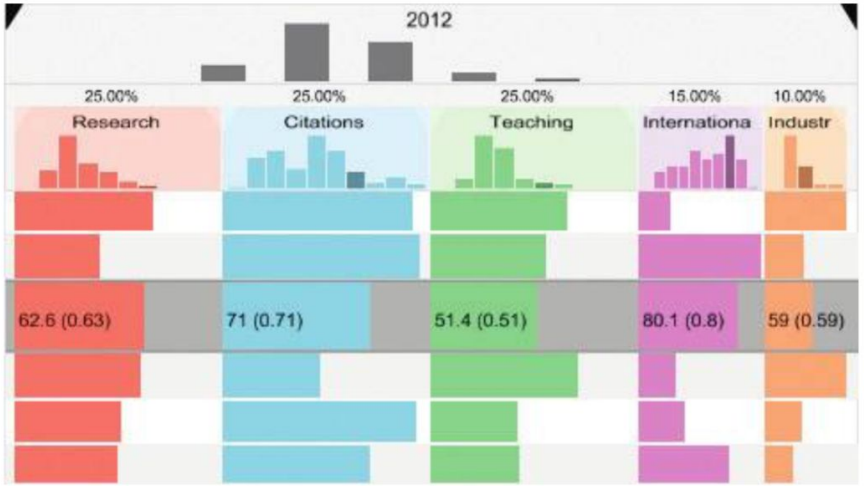
(a)



(b)

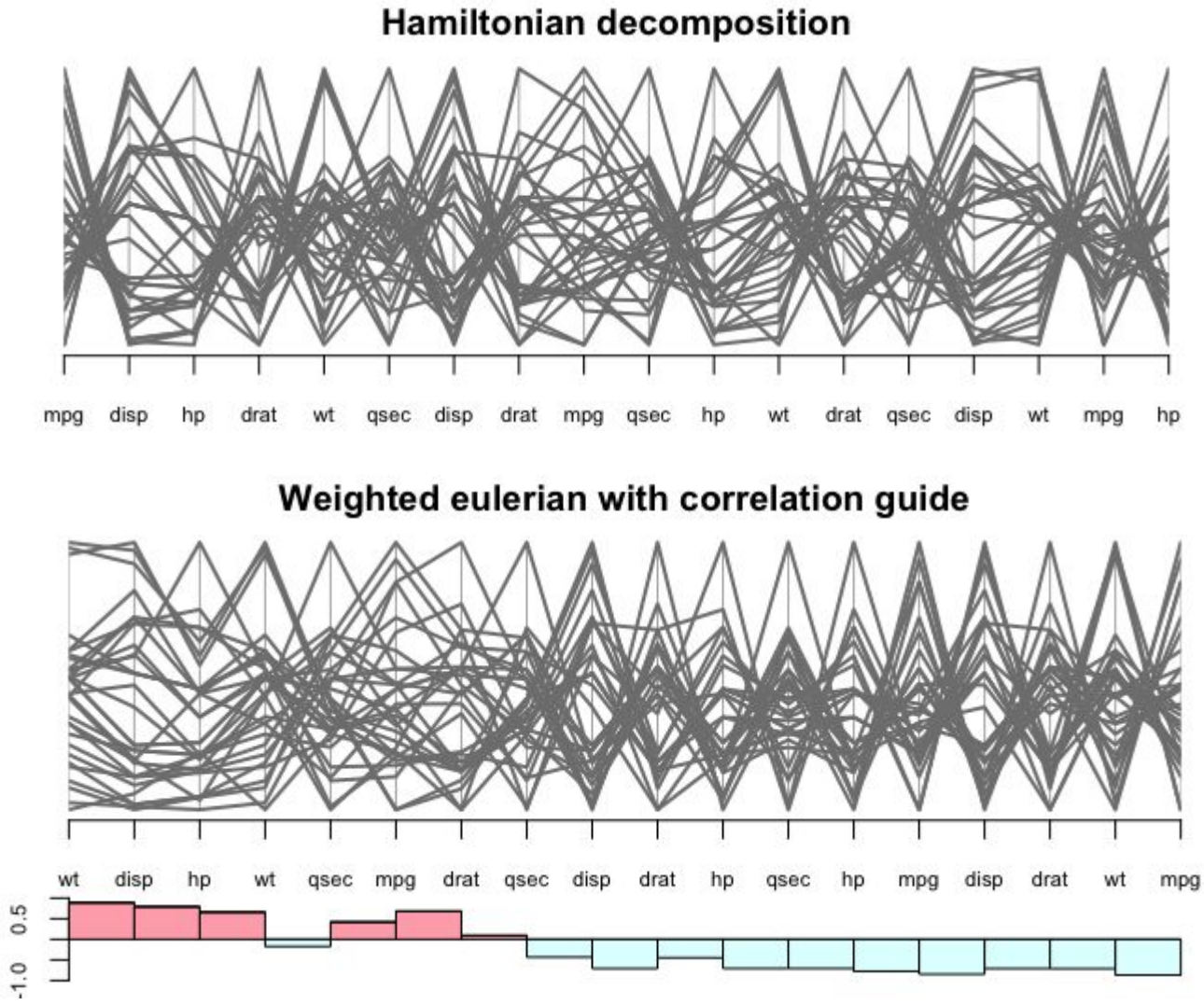


(c)



(d)

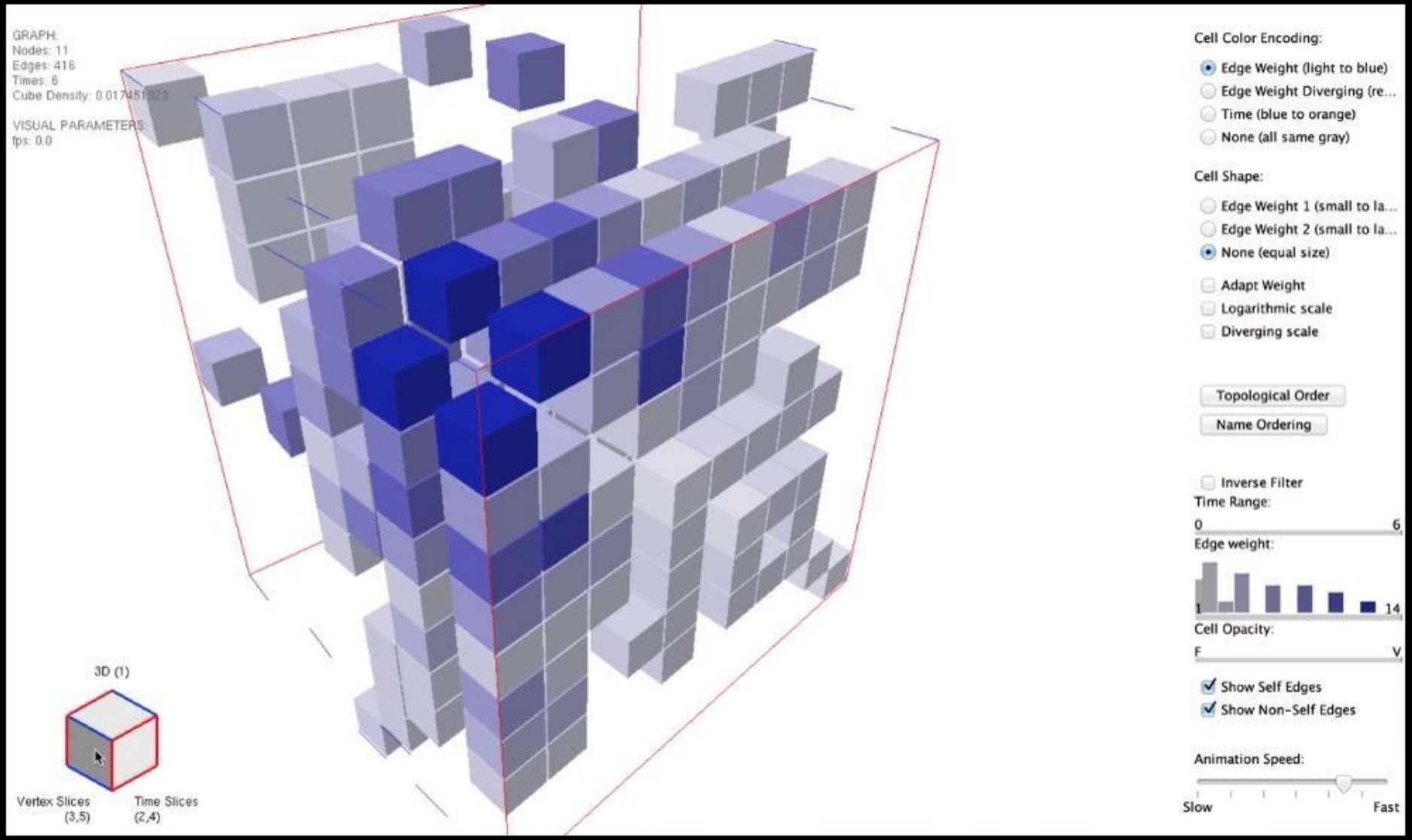
Reconfigure: Axes in PCP



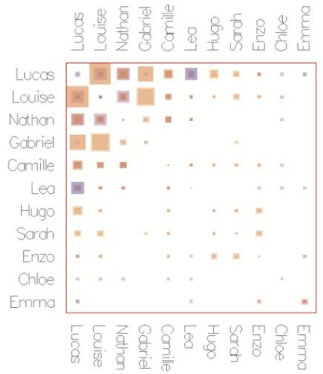
https://cran.r-project.org/web/packages/PairViz/vignettes/pcp.html

Reconfigure: 3D visualizations

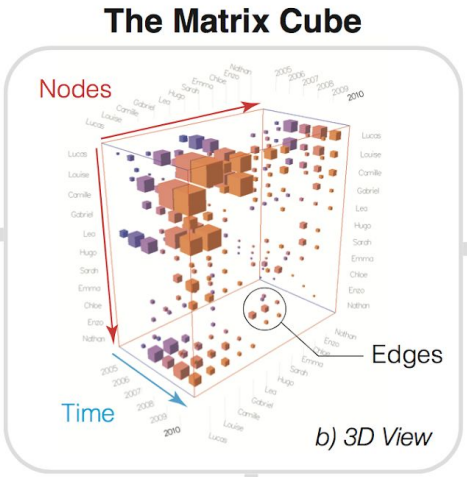
Bach, Benjamin, Emmanuel Pietriga, and Jean-Daniel Fekete. "Visualizing dynamic networks with matrix cubes." *Proceedings of the SIGCHI conference on Human Factors in Computing Systems*. 2014.

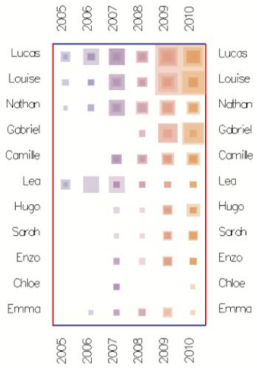


Reconfigure: 3D visualizations

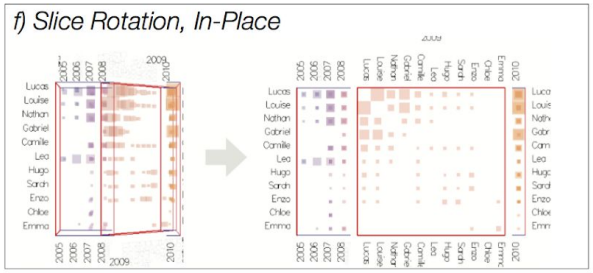


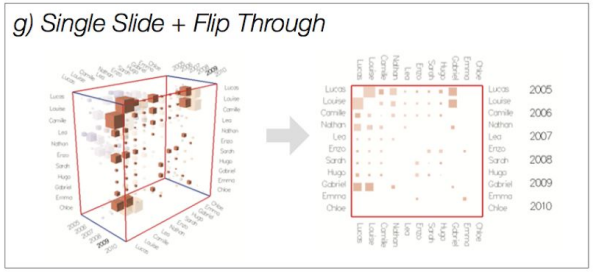
a) Rotation and Time Projection



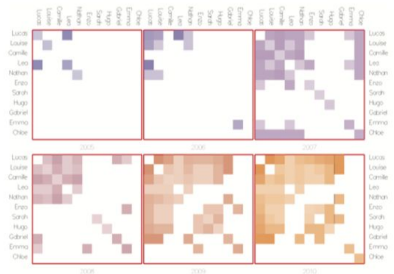


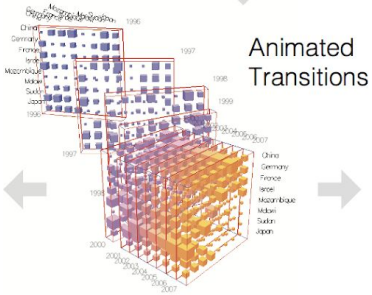
c) Rotation and Node Projection



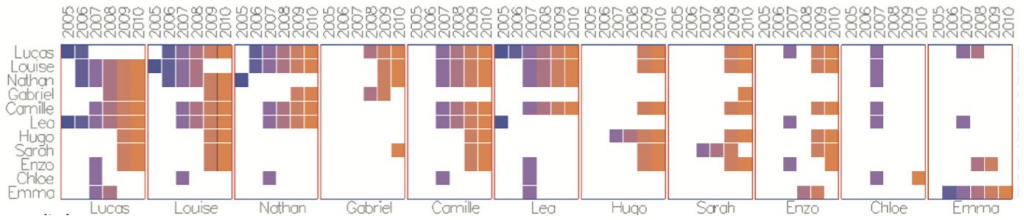


d) Time Small Multiples

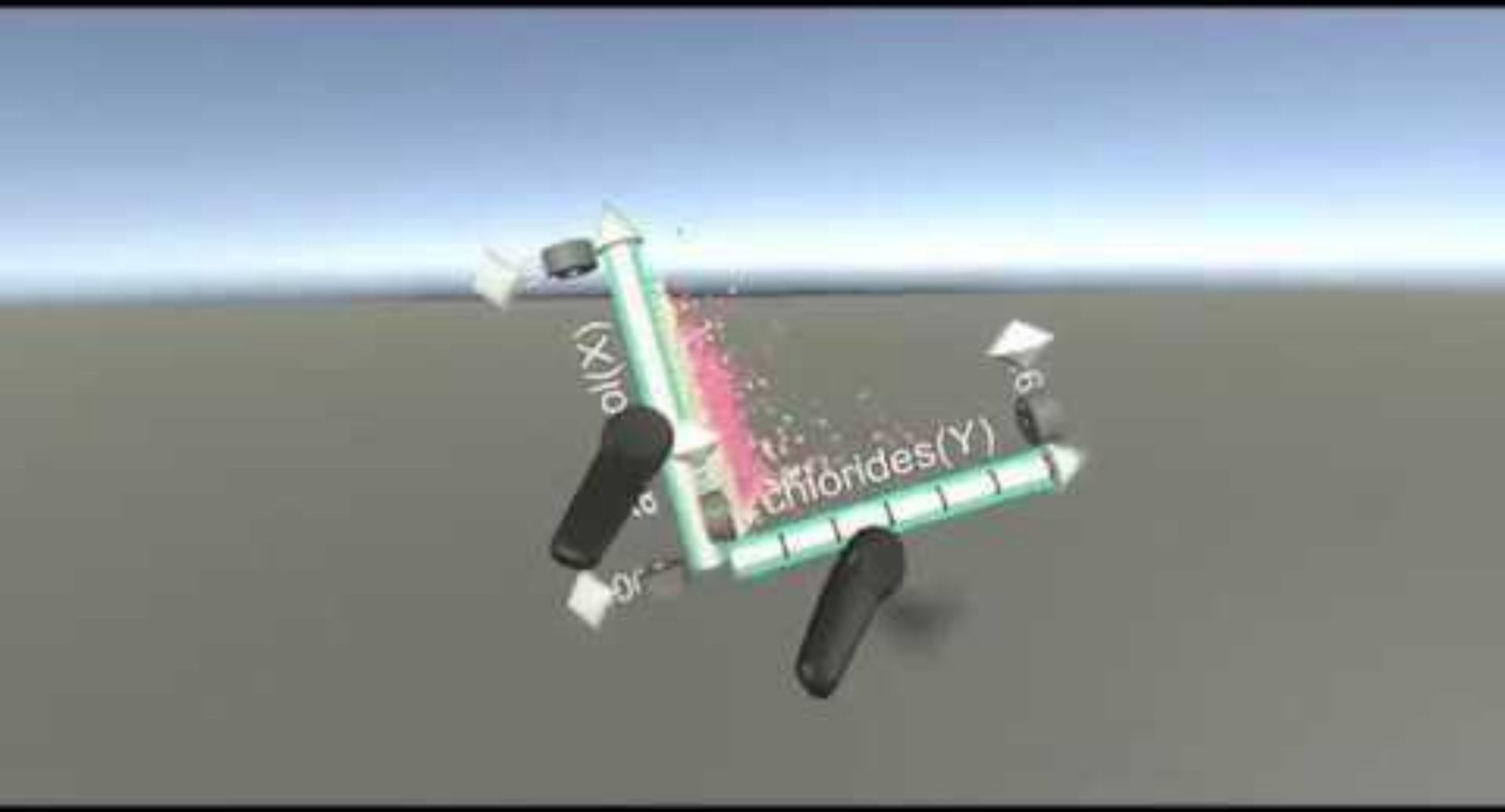




e) Node Small Multiples



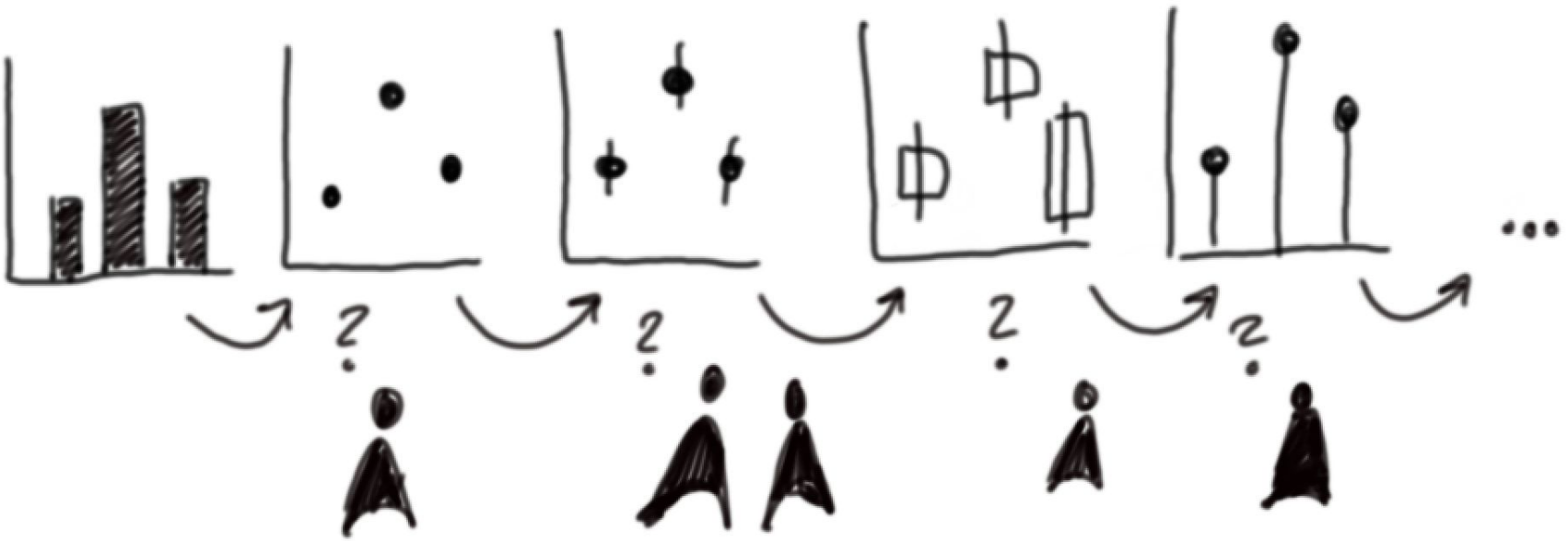
Reconfigure: Imaxis



https://www.youtube.com/watch?v=hxqJJ934Reg&feature=youtu.be

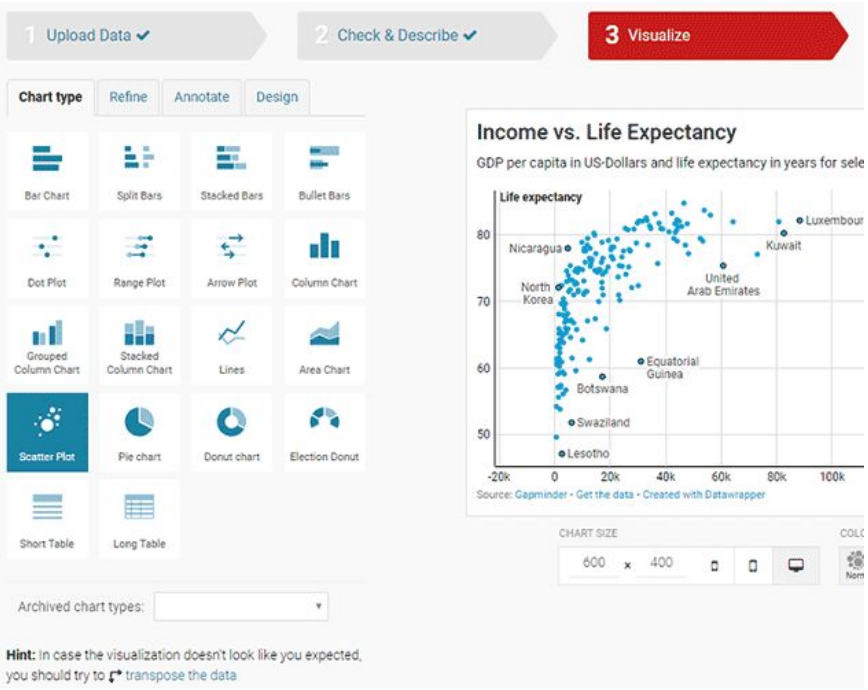
Cordeil, Maxime, et al. "ImAxes: Immersive axes as embodied affordances for interactive multivariate data visualisation." *Proceedings of the 30th Annual ACM Symposium on User Interface Software and Technology*. 2017.

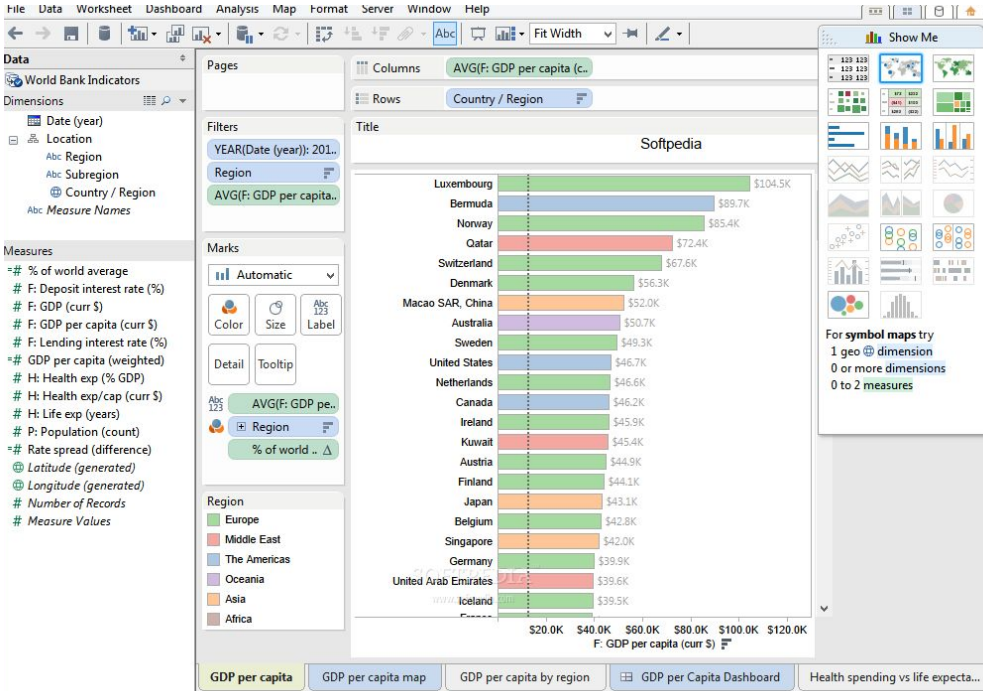
Encode: "*Show me a different representation*"



Encode: Visualization Tools

- Select visualization technique
- Select visual encodings

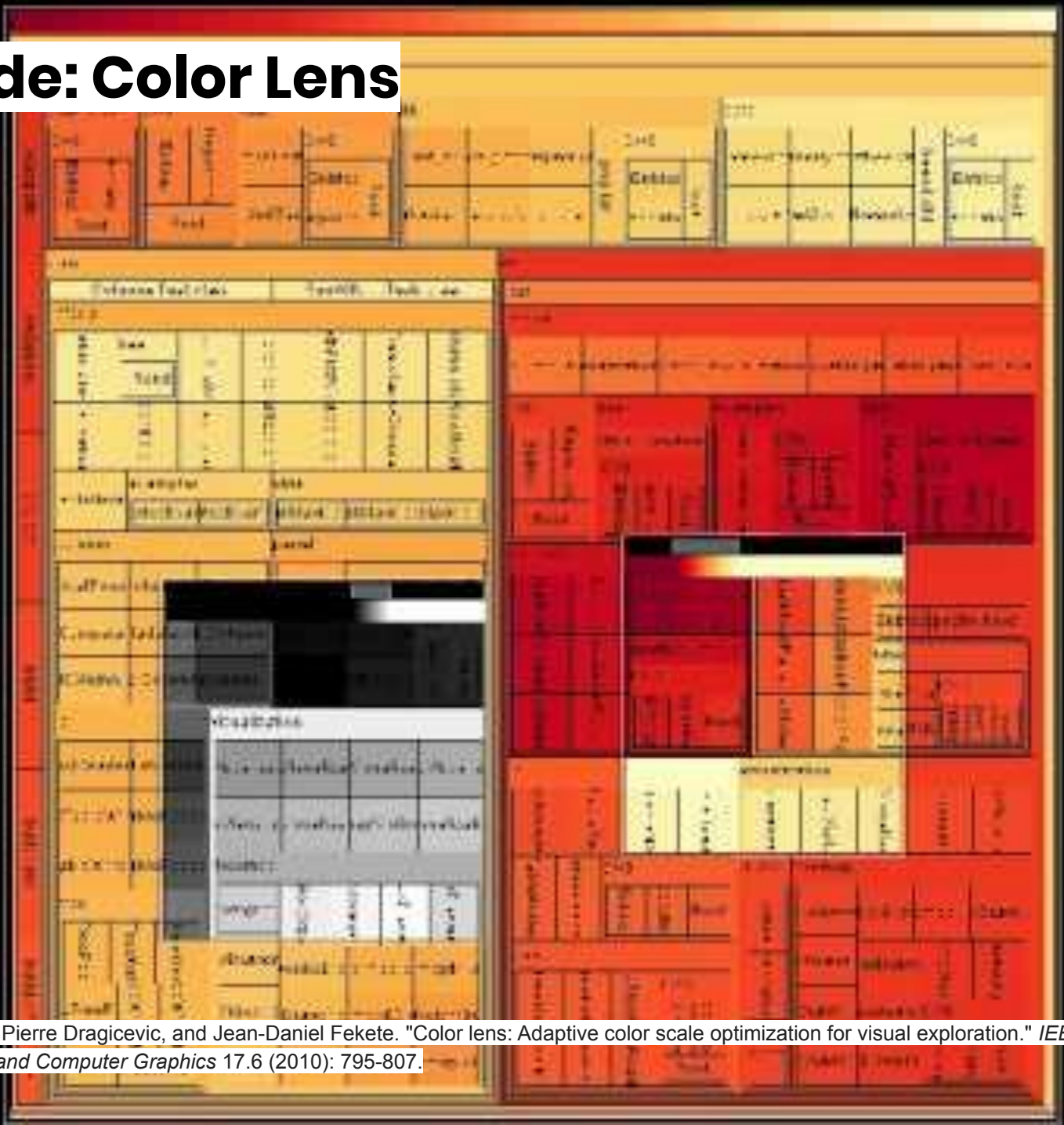




Data Wrapper

Tableau

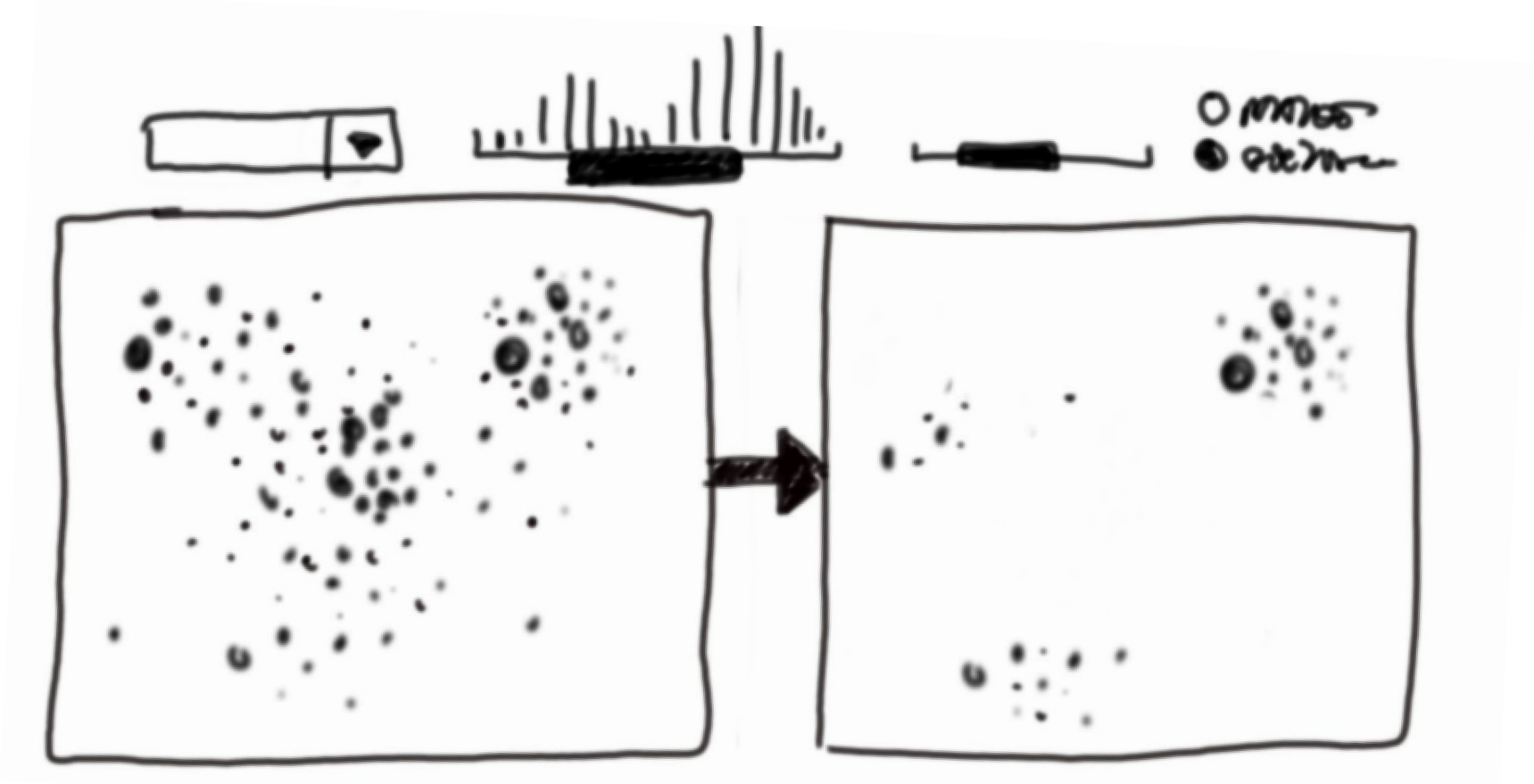
Encode: Color Lens



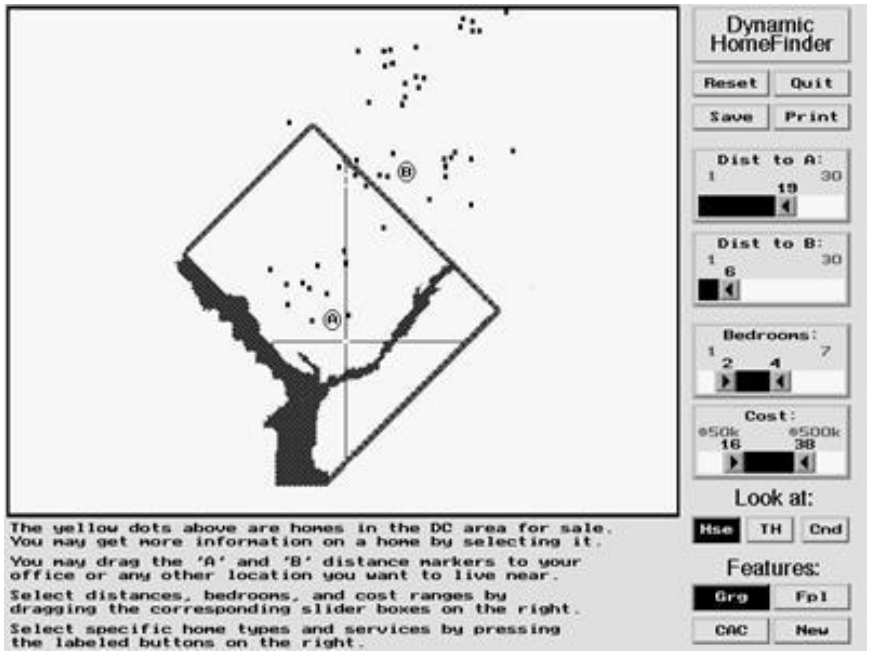
Elmqvist, Niklas, Pierre Dragicevic, and Jean-Daniel Fekete. "Color lens: Adaptive color scale optimization for visual exploration." *IEEE Transactions on Visualization and Computer Graphics* 17.6 (2010): 795-807.

Filter: "*show me something conditionally*"

- Select elements of specific properties
- Hide rest
- Filter in real-time



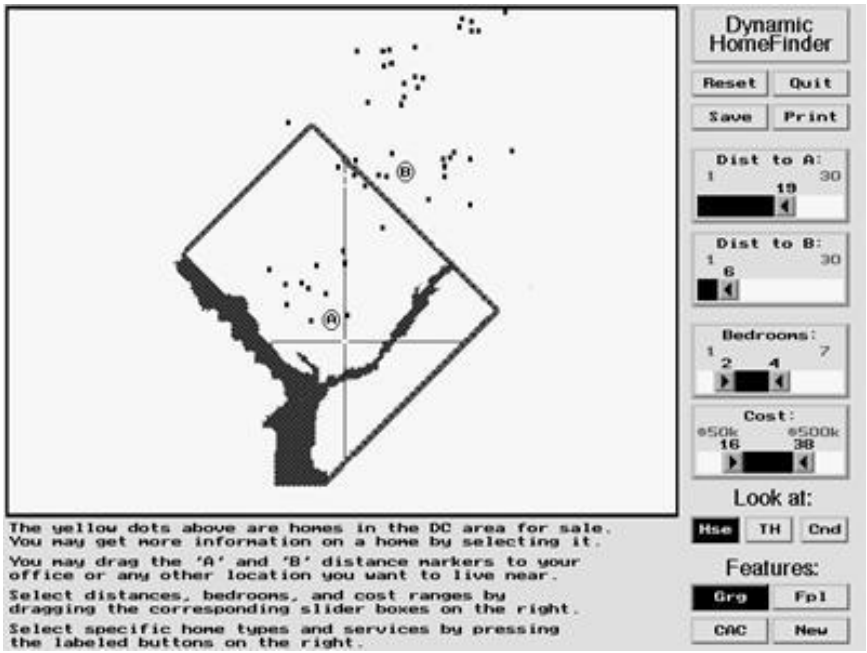
Filter: Dynamic Queries



Multiple aRnge sliders

Shneiderman, Ben. "Dynamic queries for visual information seeking." *IEEE software* 11.6 (1994): 70-77.

Filter: Dynamic Queries

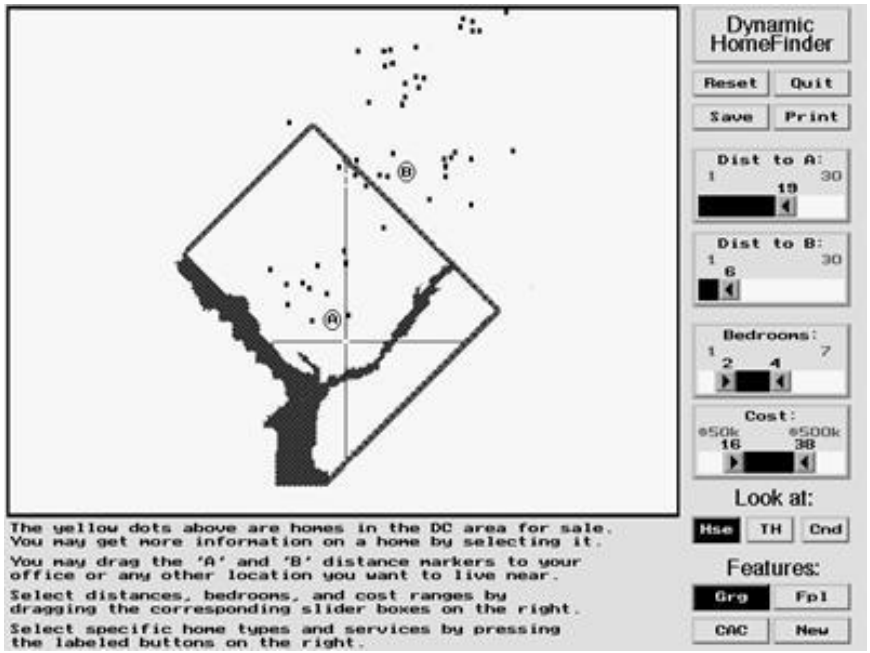


Multiple aRnge sliders

Shneiderman, Ben. "Dynamic queries for visual information seeking." *IEEE software* 11.6 (1994): 70-77.

Range slider + Histogram:

Filter: Dynamic Queries

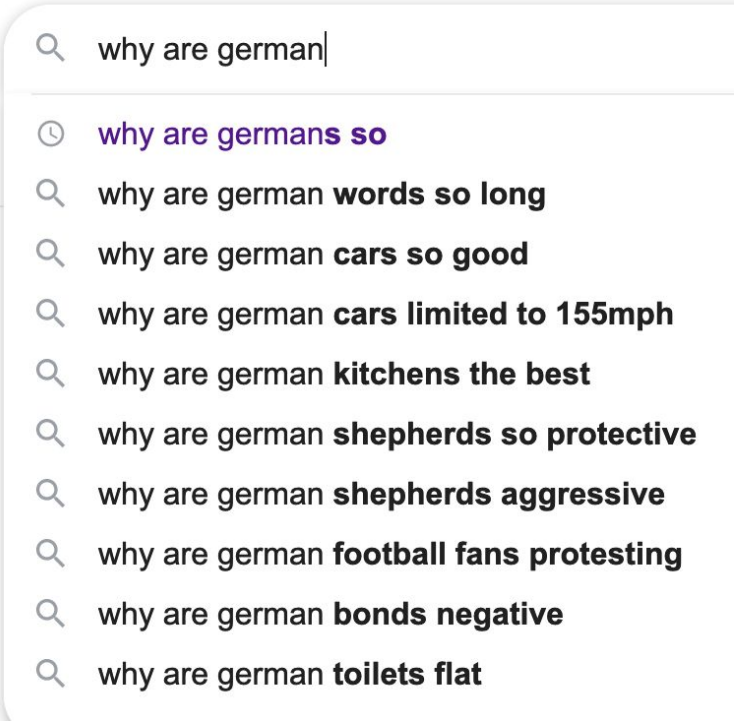


Multiple aRnge sliders

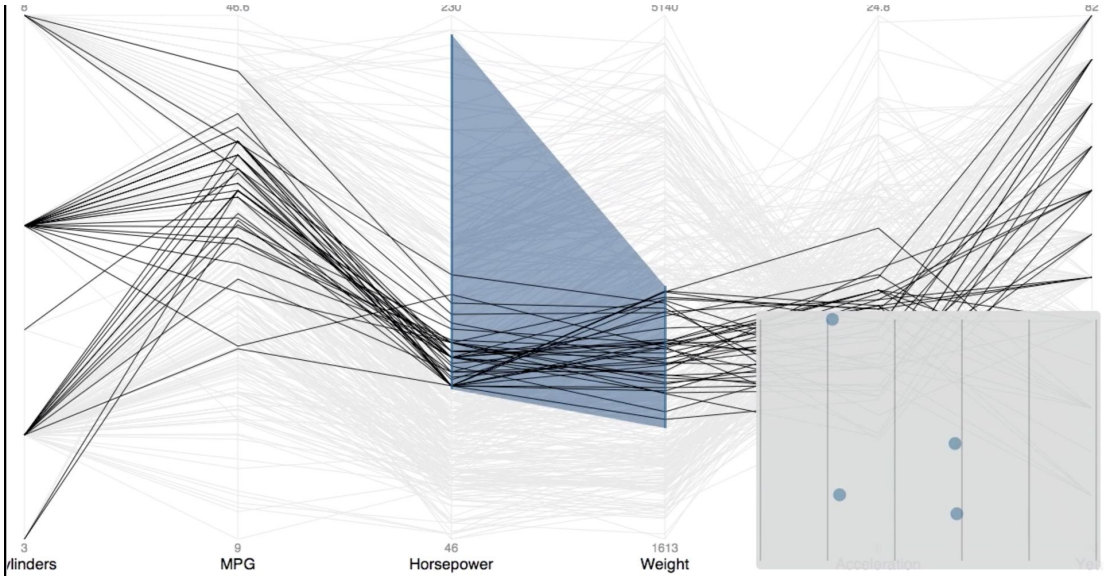
Shneiderman, Ben. "Dynamic queries for visual information seeking." *IEEE software* 11.6 (1994): 70-77.

Range slider + Histogram:

Google Suggest:

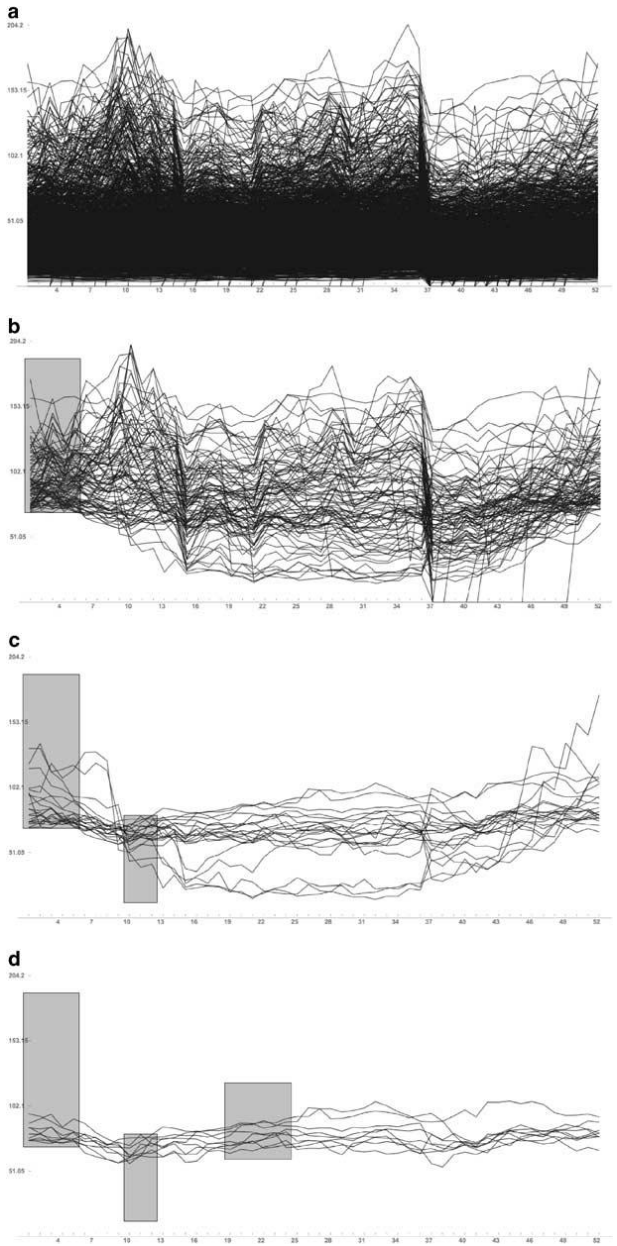


Filter: PCP + Time series



Kosara, Robert. "Indirect multi-touch interaction for brushing in parallel coordinates." *Visualization and Data Analysis 2011*. Vol. 7868. International Society for Optics and Photonics, 2011.

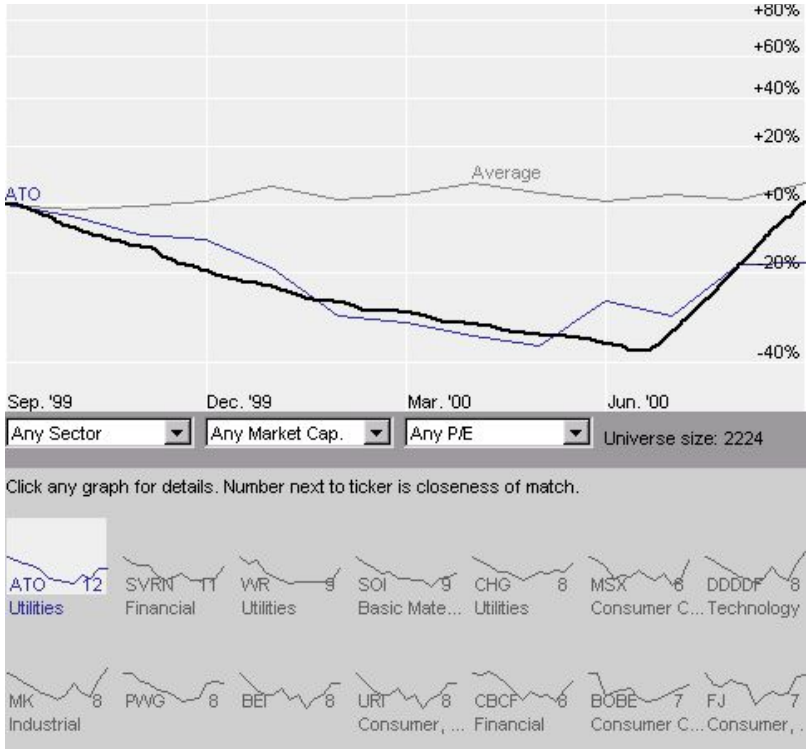
https://vimeo.com/13437693



Hochheiser, Harry, and Ben Shneiderman. "Dynamic query tools for time series data sets: timebox widgets for interactive exploration." *Information Visualization* 3.1 (2004): 1-18.

Filter: Sketch

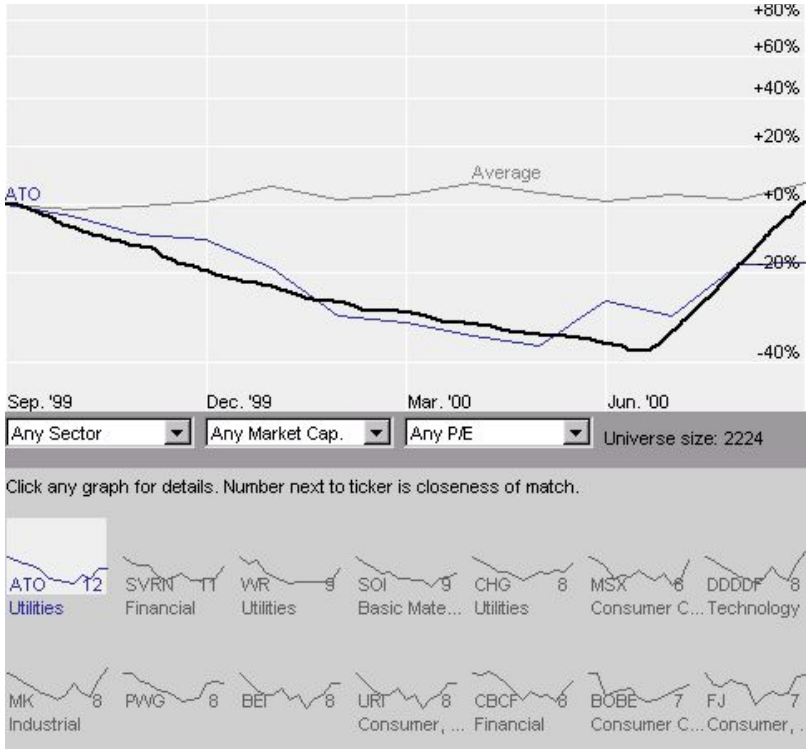
QuerySketch: sketch paths



Wattenberg, Martin. "Sketching a graph to query a time-series database." *CHI'01 Extended Abstracts on Human factors in Computing Systems*. 2001.

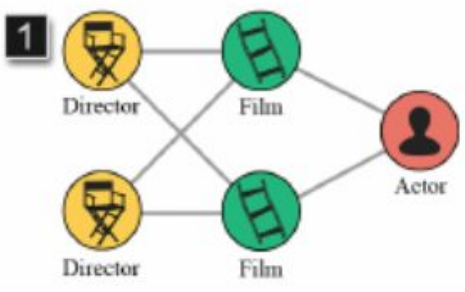
Filter: Sketch

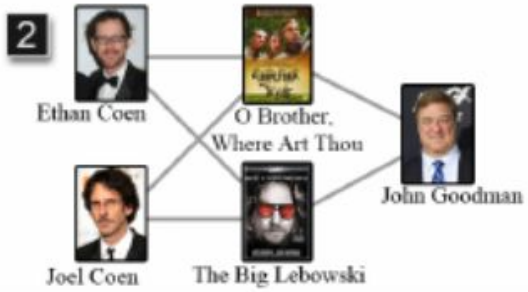
QuerySketch: sketch paths

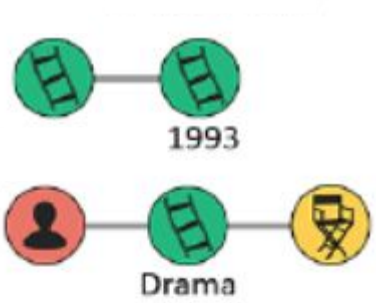


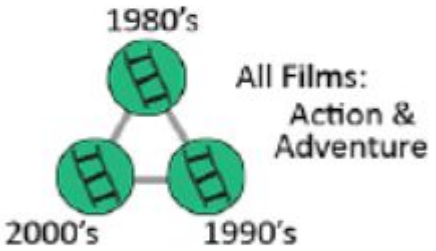
Wattenberg, Martin. "Sketching a graph to query a time-series database." *CHI'01 Extended Abstracts on Human factors in Computing Systems*. 2001.

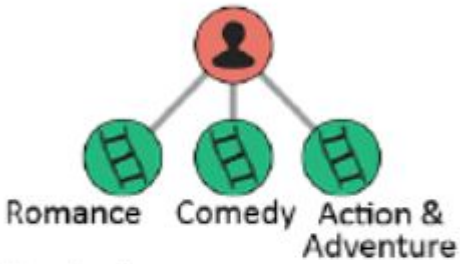
Build (Graph) Query

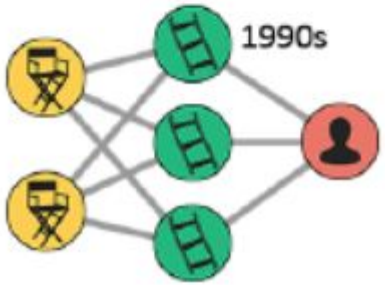








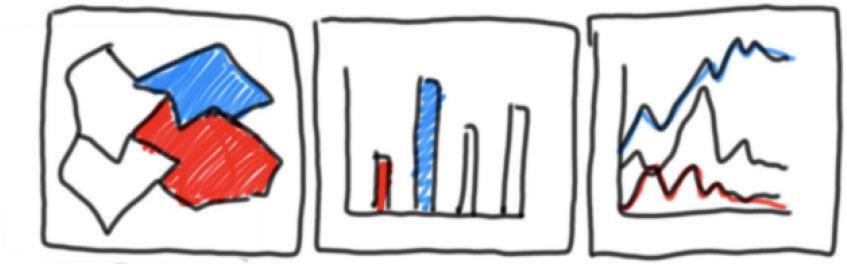




Pienta, Robert, et al. "Visage: Interactive visual graph querying." *Proceedings of the International Working Conference on Advanced Visual Interfaces*. 2016.

Connect: "Show me related Items"

- Common in multiple views
- Find related items
- Find hidden items



Connect: Brushing and Linking

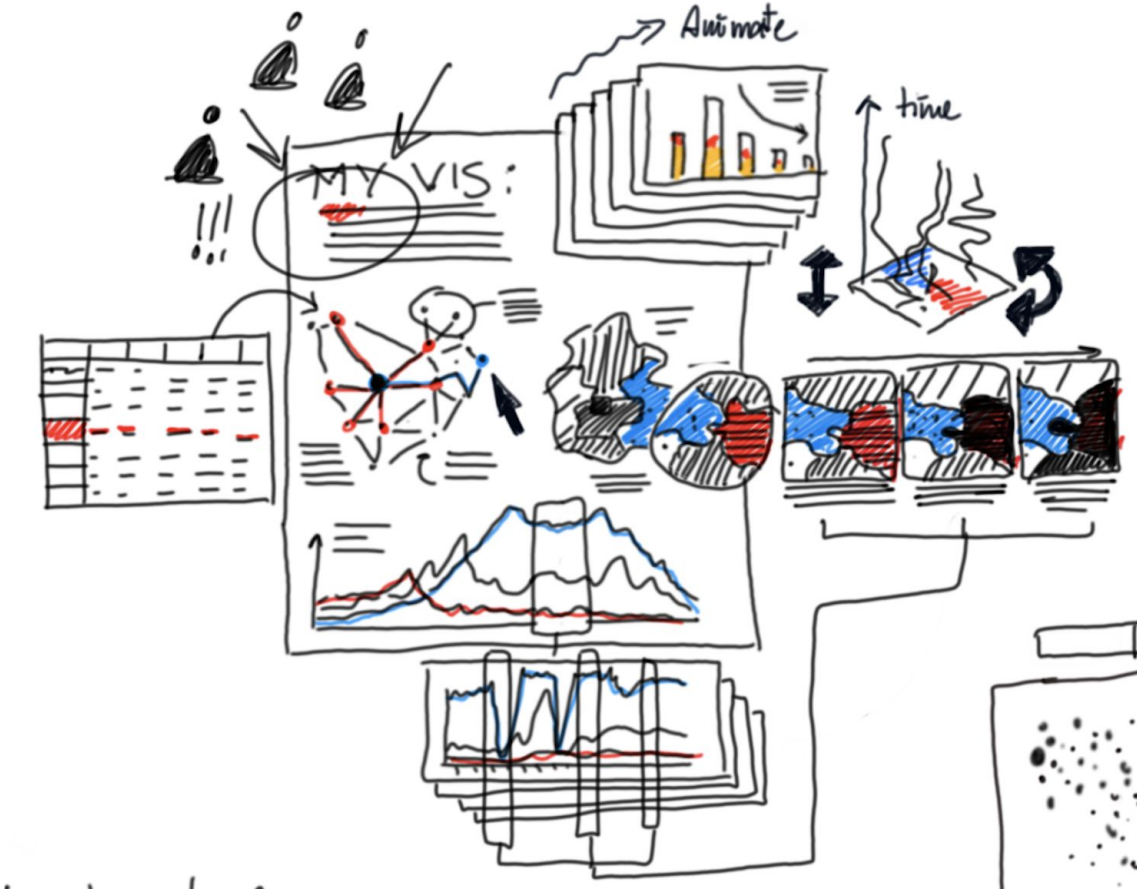
https://ramiksadana.com/video/tangere/mcvBrushing.webm

Guidelines for Interaction

Mental Map

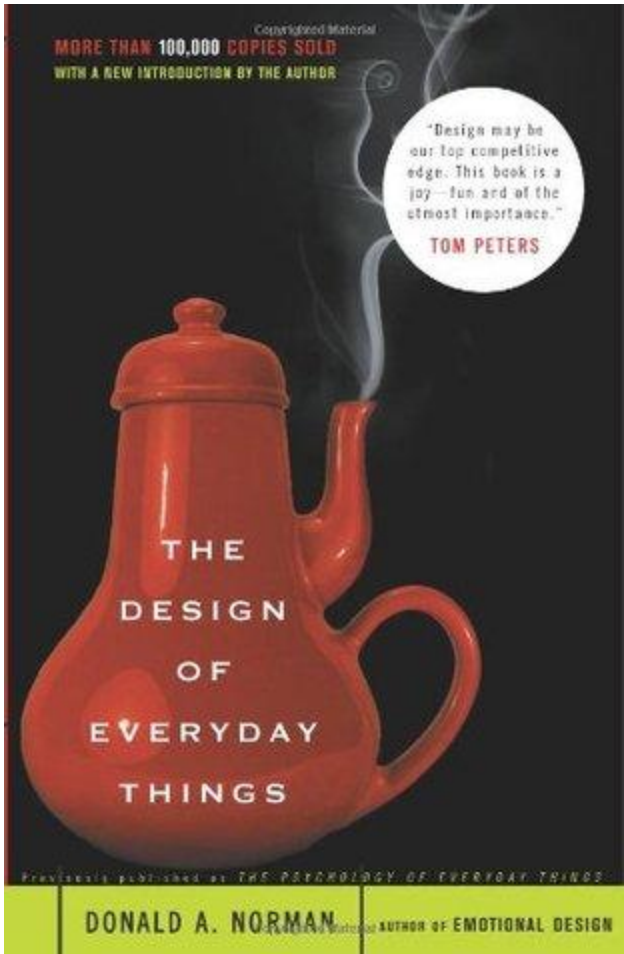
- User's mental representation of a system

- *Where am I?*
- *What can I do?*
- *How do I do that?*



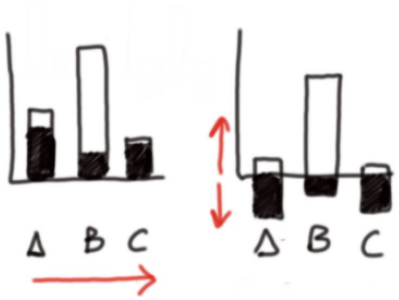
Guidelines for Interaction in Visualization

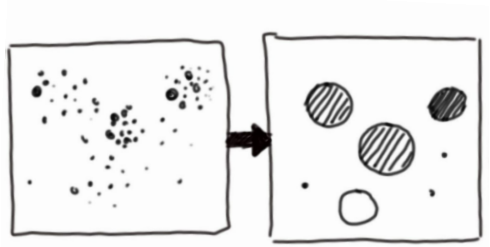
1. Try a **static visualization first**, add interaction if necessary.
2. Support users **tasks**.
3. **Overview first**, Zoom and Filter, Detail on Demand
4. **Minimize** interacion: e.g., reduce number of clicks
5. **Explain** your interactions
6. Create nteraction **affordances** -->
7. Provide for **direct manipulation**
8. Consider people's **devices.**

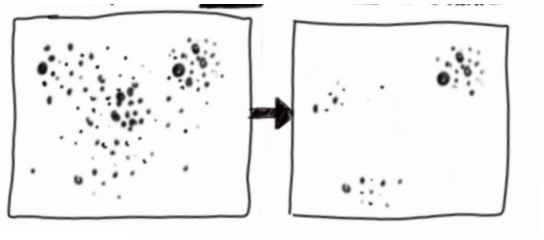


Stategies

1. Overview first
2. Zoom and filter
3. Select
4. Reconfigure
5. Expore
6. Connect
7. Abstract/Elaborate
8. Details on demand
9. Encode
10. ....







Further Literature

- Yi, Ji Soo, Youn ah Kang, and John Stasko. "**Toward a deeper understanding of the role of interaction in information visualization.**" *IEEE transactions on visualization and computer graphics* 13.6 (2007): 1224-1231.
- Amar, Robert, James Eagan, and John Stasko. "**Low-level components of analytic activity in information visualization.**" *IEEE Symposium on Information Visualization, 2005. INFOVIS 2005.*. IEEE, 2005.
- Tamara Munzner: **Manipulate View (Chapter 11)** in Tamara Munzner: Visualization Analysis & Design.
- Tominski, Christian, et al. **"Interactive lenses for visualization: An extended survey.**" *Computer Graphics Forum*. Vol. 36. No. 6. 2017.