Multiple View Methods

Cmpt 767 - Visualization

Steven Bergner

sbergner@sfu.ca

[based on slides by Munzner / Möller]

Overview

- Combining views
- Partitioning
- Coordinating Multiple Side-by-Side Views
  - Encoding Channels Shared
  - Data Shared
  - Navigation Synchronized
  - Views Linked With Marks
  - Combinations
- Superimposing Layers
  - Static Layers
  - Dynamic Layers

Readings

- Munzner, “Visualization Analysis and Design”:
  - Chapter 12 (Facet: Multiple Views)

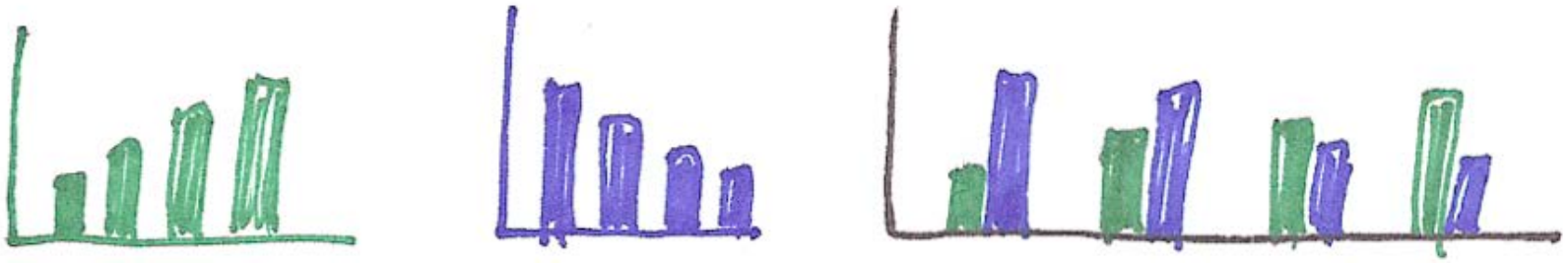
Combining views

- often information too complex for a single view
- show multiple views side by side
- **Eyes Over Memory**: two simultaneous views have lower cognitive load than remembering previous view
- real-estate trade-off: popup view vs. static side-by-side
- OR - single view that is changed through interaction (filtering, aggregation, navigation)

Partitioning

Partitioning — Multiple keys

- e.g. 2 keys
  - use two perpendicular axis OR
  - use alignment on one axis
    - separate by A first and then by B (left)
    - separate by B first and then by A (right)
- also known as dimensional stacking



Partitioning — Multiple keys

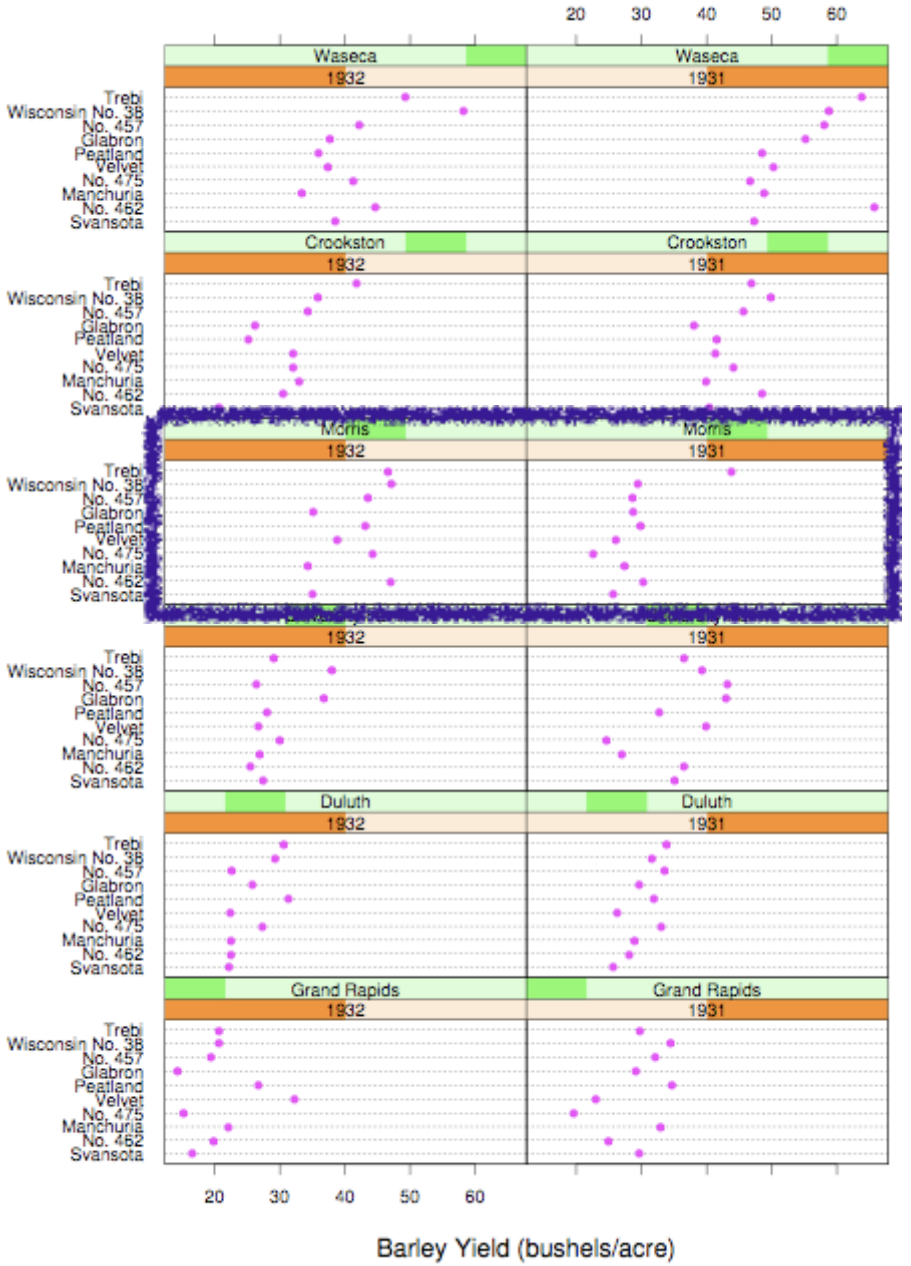
- we have a choice of order of stacking
- typically should be based on some order
- example: main-effects order by Trellis

- we'll get back to this when we talk about "partition" :)

The Visual Design and Control of Trellis Display. Becker, Cleveland, and Shyu. JCSG 5:123-155 1996

Alphabetical

Median value

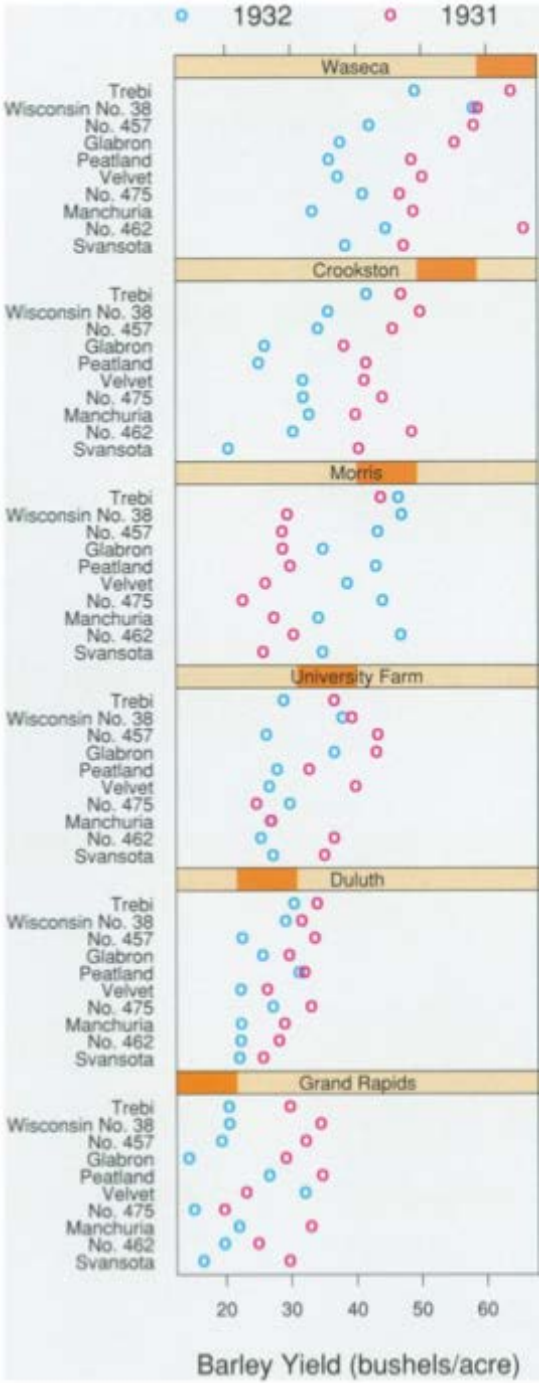


Trellis structure

- conditioning/trellising: choose structure
  - pick how to subdivide into panels
  - pick x/y axes for indiv panels
  - explore space with different choices
    - multiple conditioning
- ordering
  - large-scale: between panels
  - small-scale: within panels
  - main-effects: sort by group median
    - derived space, from categorical to ordered

confirming hypothesis

- dataset error with Morris switched?
- old trellis: yield against variety given year/site
- new trellis: yield against site and year given variety
  - exploration suggested by previous main-effects ordering



Partitioning by value attributes

- looses uniqueness
- pick one, now we have a bunch of data items belonging to it
- creates partitioning of data
- hierarchical partitioning —> dimensional stacking
- if done on multiple values at once: clustering / labeling of data items

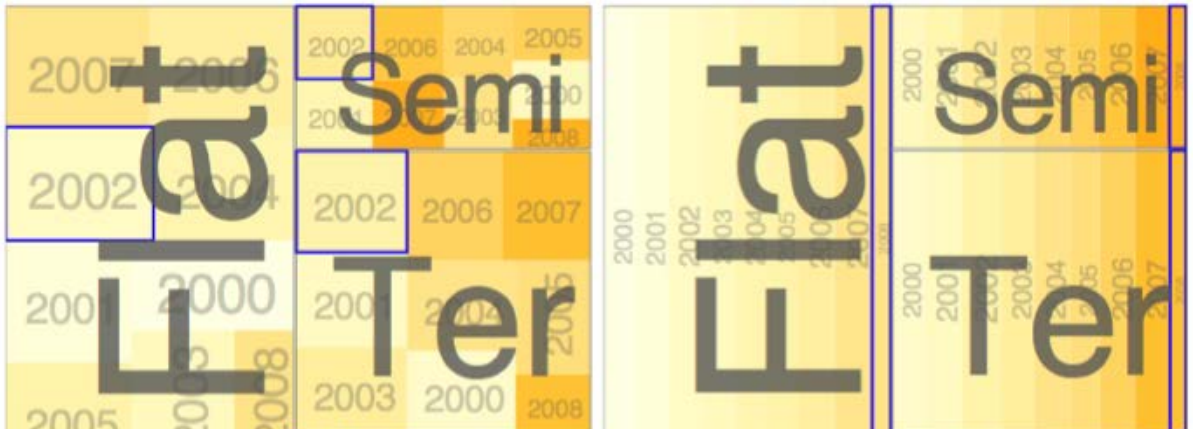
HiVE

- London property transactions
  - first split into subsets by house type (left)
  - first split by neighborhood (right)

Slingsby, A., Dykes, J. and Wood, J. 2009. Configuring Hierarchical Layouts to Address Research Questions. IEEE TVCG 2009

HiVE: conditioning

- reconfigure conditioning hierarchies to explore data space
- treemaps as spacefilling rectangular layouts
  - each rectangle is conditioned subset of data
  - nested graphical summaries
    - size, shape, color used to show subset properties
    - ordered by conditioning variable
- dimensional stacking:
  - discretization and recursive embedding of dimensions



Slingsby, A., Dykes, J. and Wood, J. 2009. Configuring Hierarchical Layouts to Address Research Questions. IEEE TVCG 2009

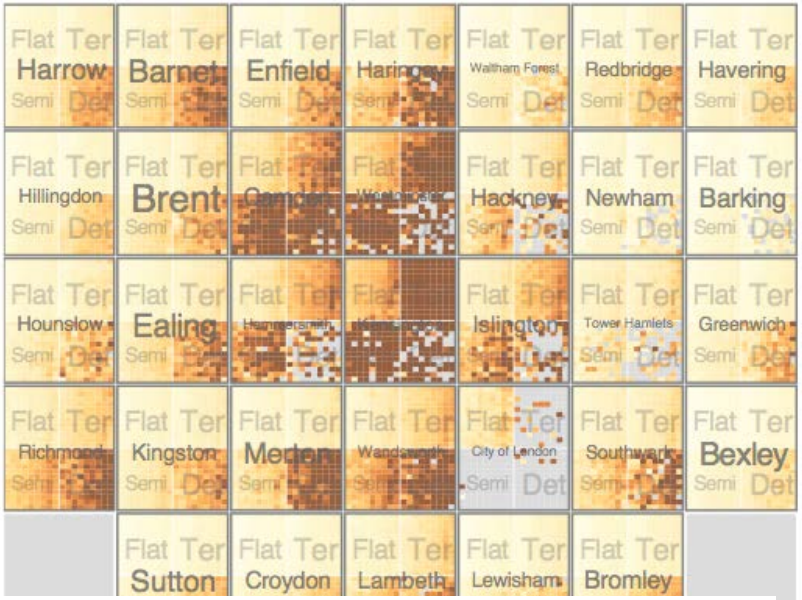
HiVE Example: London Property

- top split: house type. next: neighborhood. next: time
- color: price variance. size: number of sales
- resulting patterns:
  - between neighborhood have different house distribution
  - within neighborhoods have similar prices

Slingsby, A., Dykes, J. and Wood, J. 2009. Configuring Hierarchical Layouts to Address Research Questions. IEEE TVCG 2009

HiVE Example: London Property

- top split: neighborhood. next: house type. next: sale time (year). next: sale time (month)
- color: average price. size: fixed
- resulting patterns:
  - expensive neighborhoods near center



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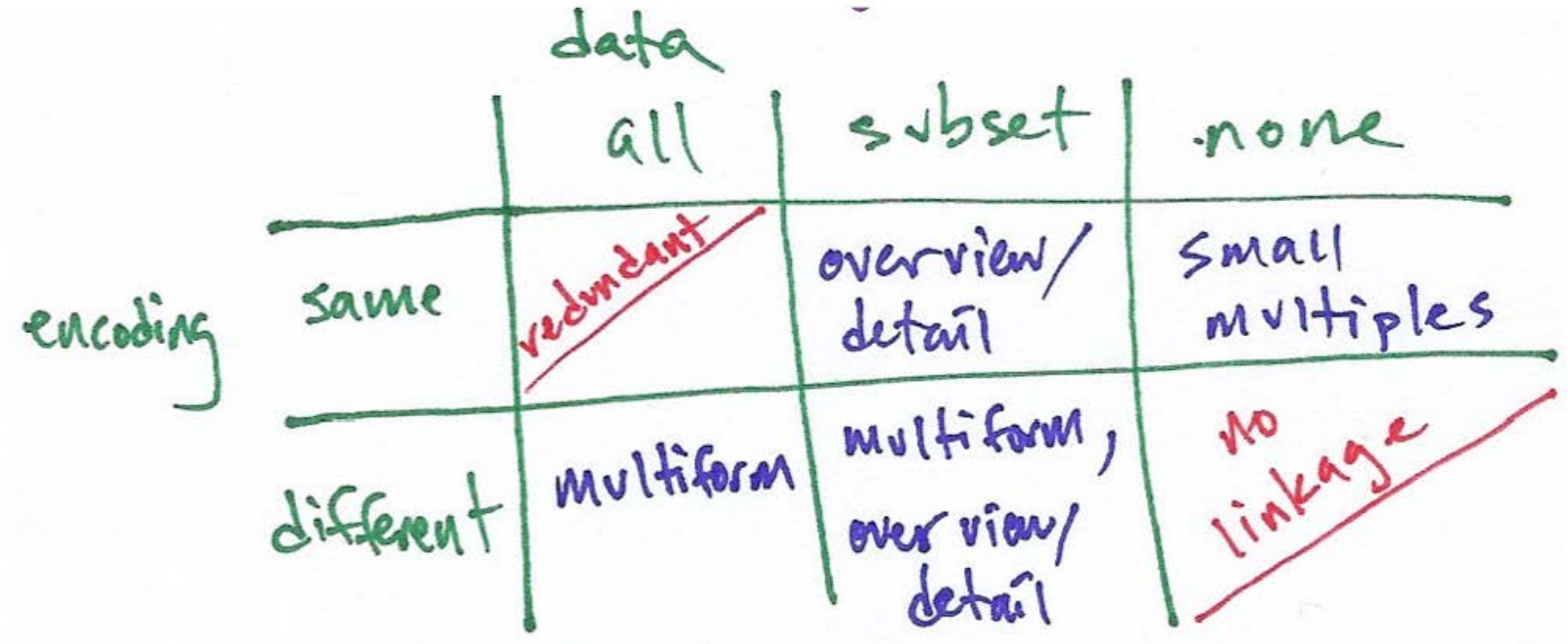
Multiple side-by-side views

- visual encoding, data, subsets
- navigation synchronized
- linked by explicit marks



Multiform: Linked views / highlighting

- also known as brushing
- shared encoding

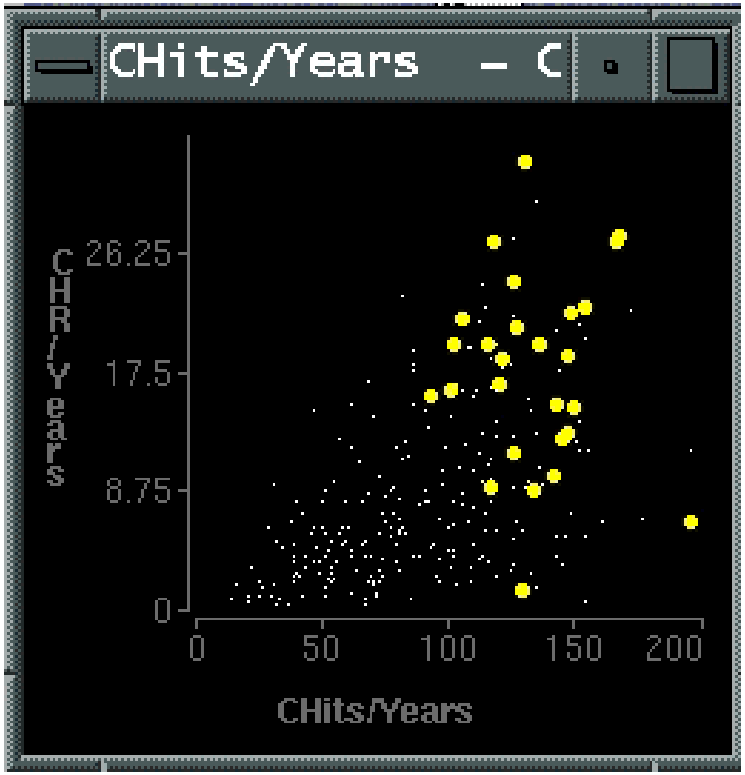
EDV

- Exploratory Data Visualizer

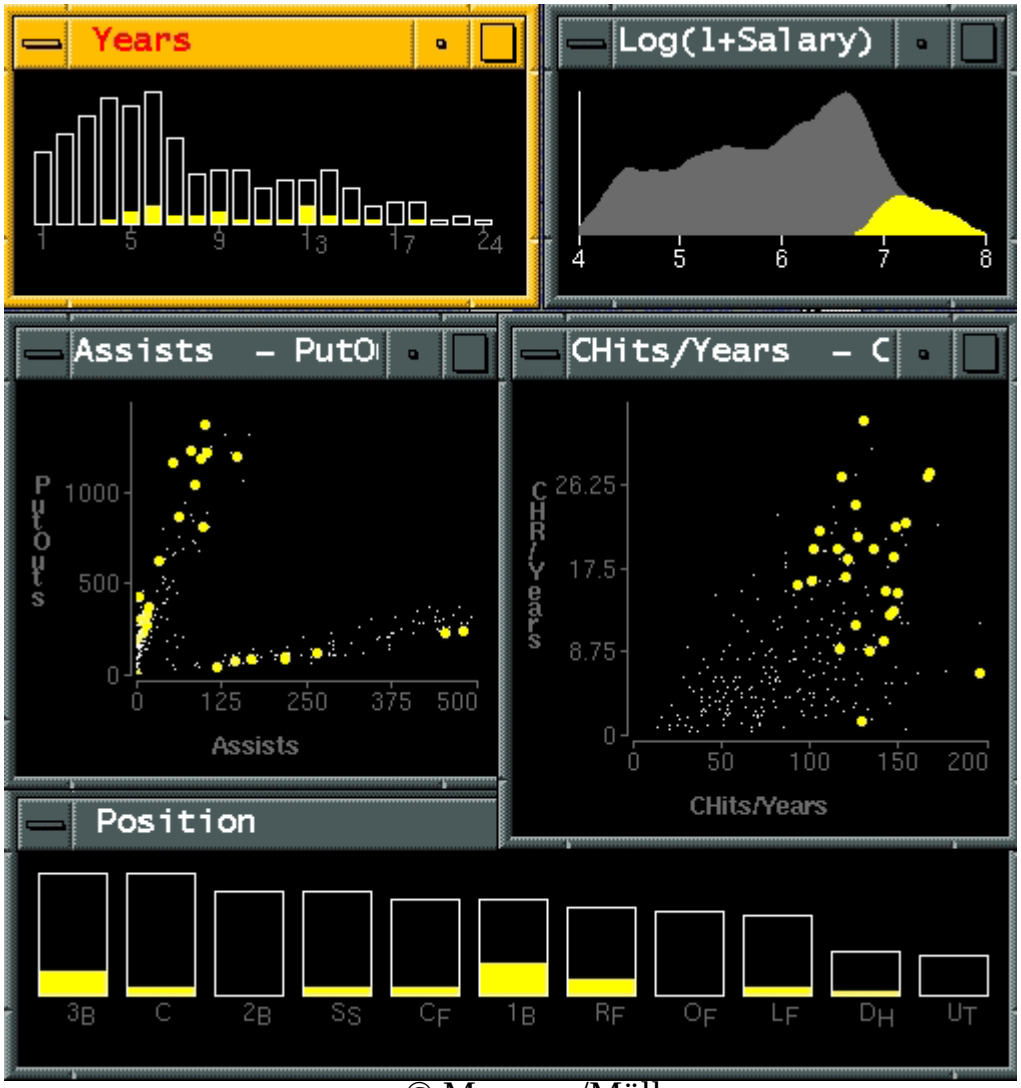
- Graham J. Wills. Visual Exploration of Large Structured Datasets. In New Techniques and Trends in Statistics, 237-246. IOS Press, 1995.

Highlighting (Focusing)

- Focus user attention on a subset of the data within one graph (from Wills 95)

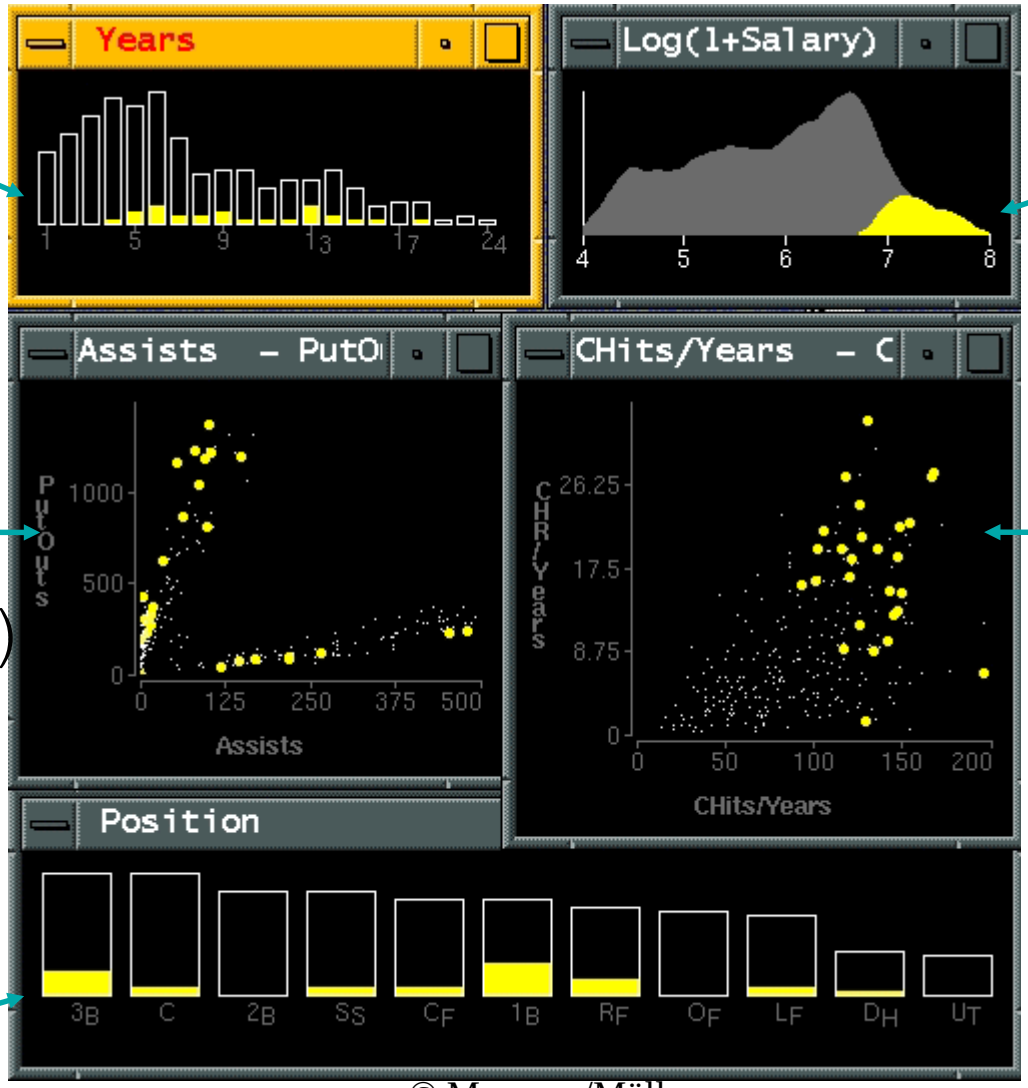


Link different types of graphs: Scatterplots and histograms and bars (from Wills 95)



Baseball data: Scatterplots and histograms and bars (from Wills 95)

how long in majors



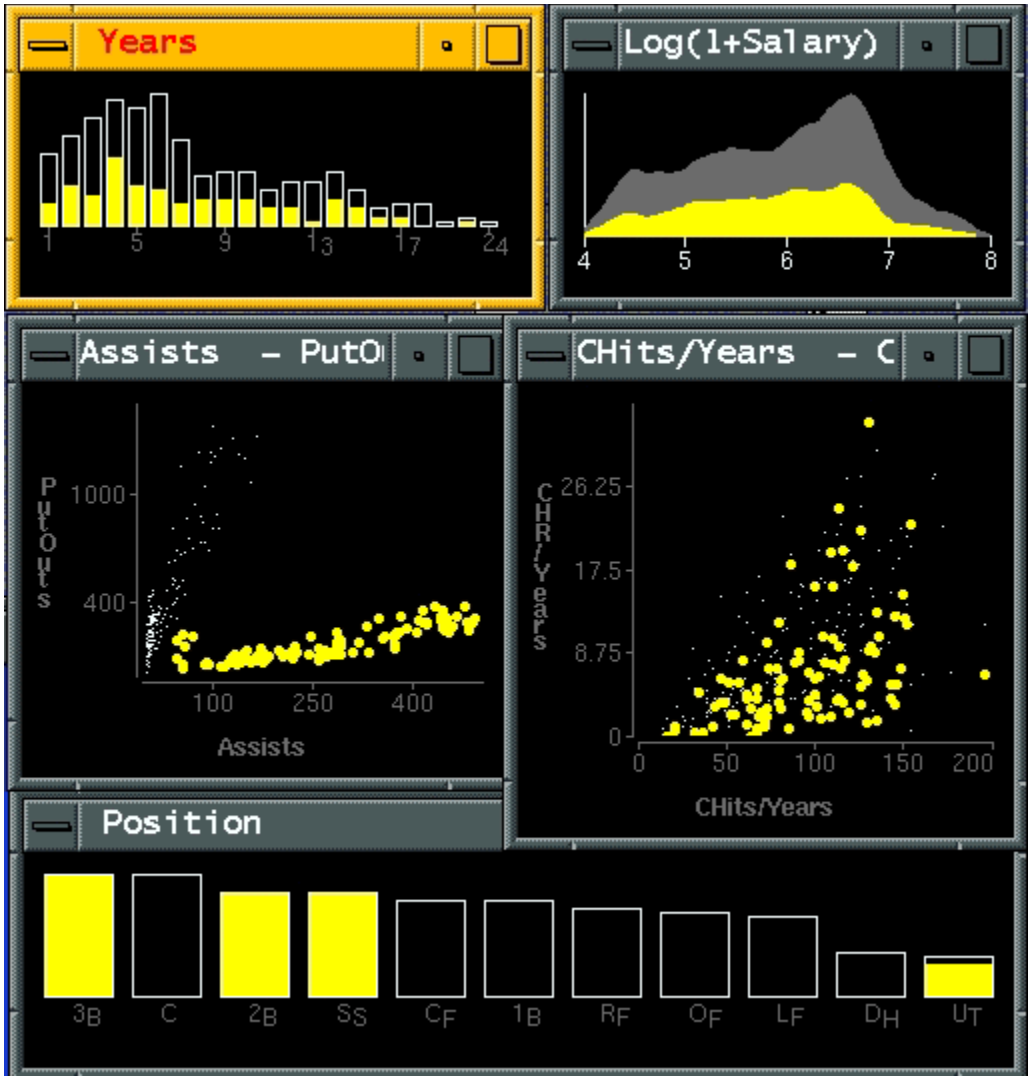
select high salaries

avg assists vs avg putouts (fielding ability)

avg career HRs vs avg career hits (batting ability

distribution of positions played

Linking types of assist behavior to position played (from Wills 95)



Shared data

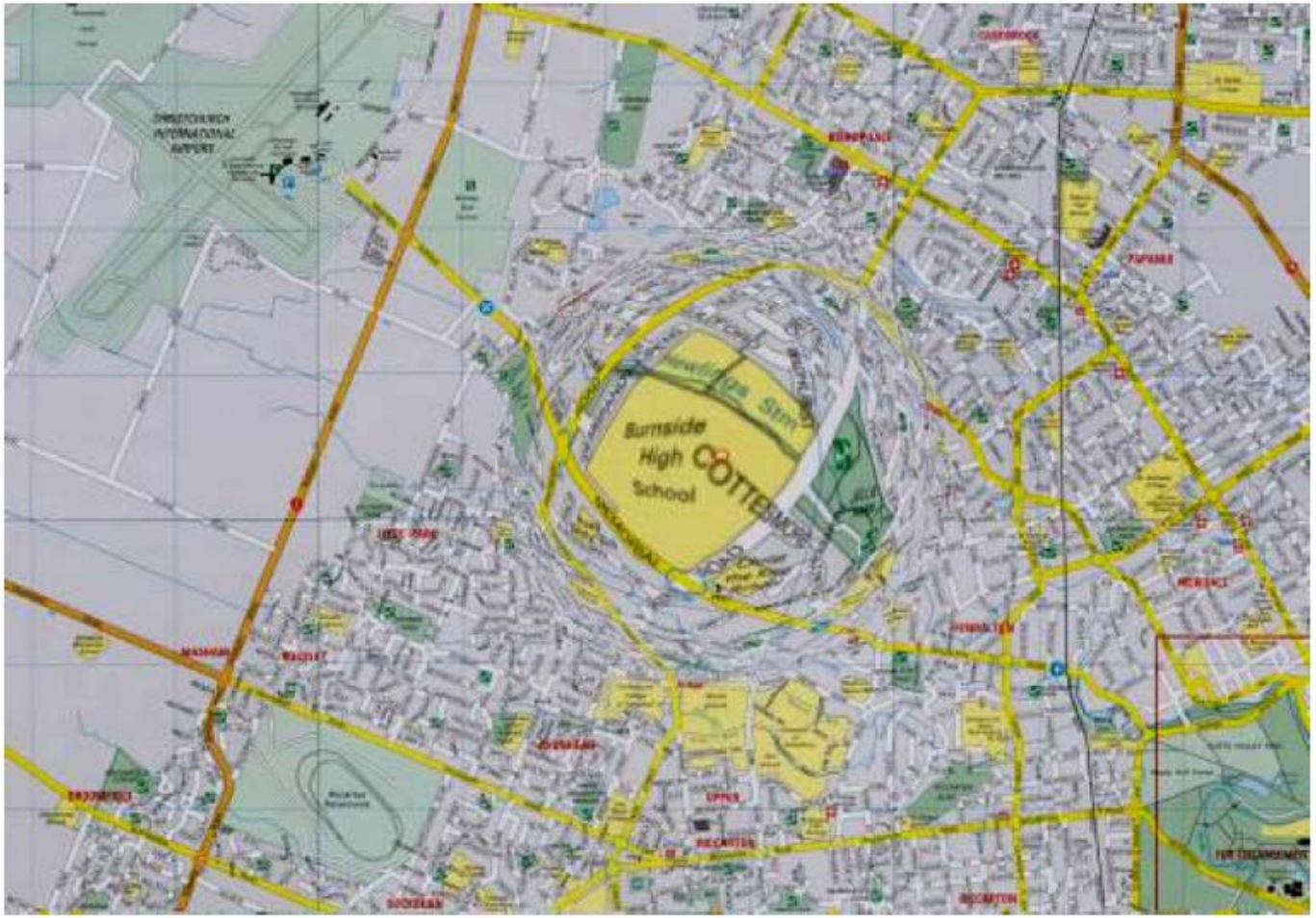
- three possibilities:
  - both views could each show all of the data (shared-data)
  - one could show a subset of what is in the other (overview-detail)
  - or they could show different partitions of the dataset into disjoint pieces (small-multiple)

Overview-and-detail

- Example: tooltip's -- show details about a data item on demand (***detail-on-demand***)
- Example: Geographic birdseye

Overview-and-detail

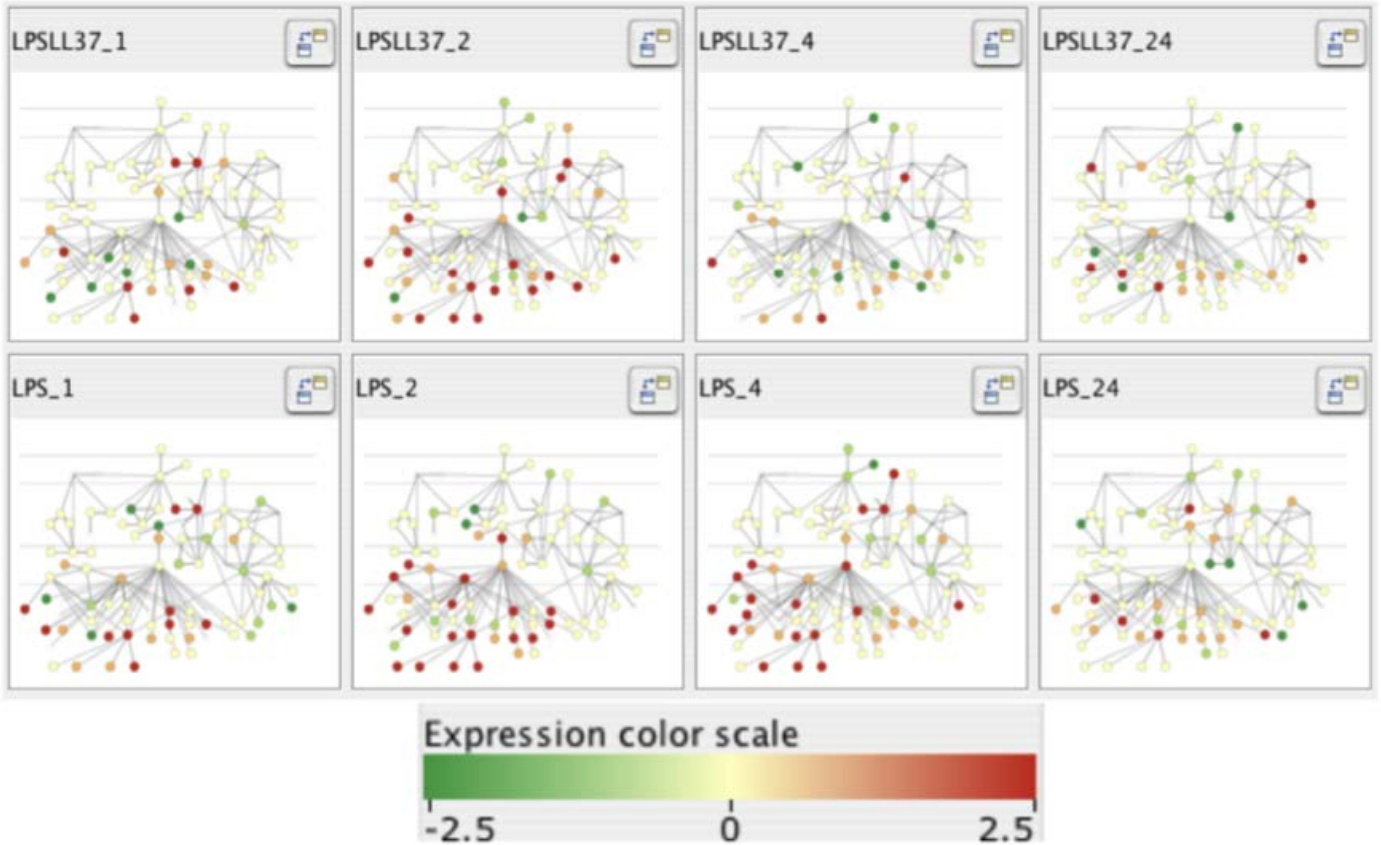
- fisheye lens technique



Small multiple

- shared encoding, different partition
- views have a common reference frame
- facilitates comparison
- often used as a better alternative to animation
- drawback -- screen real-estate

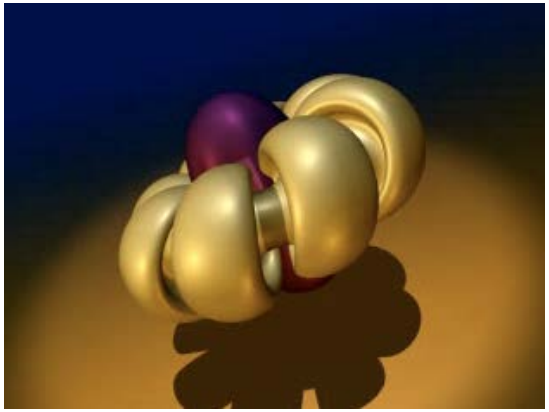
Example: Cerebral



Barsky et al. Cerebral: Visualizing Multiple Experimental Conditions on a Graph with Biological Context. Proc. InfoVis 2008.

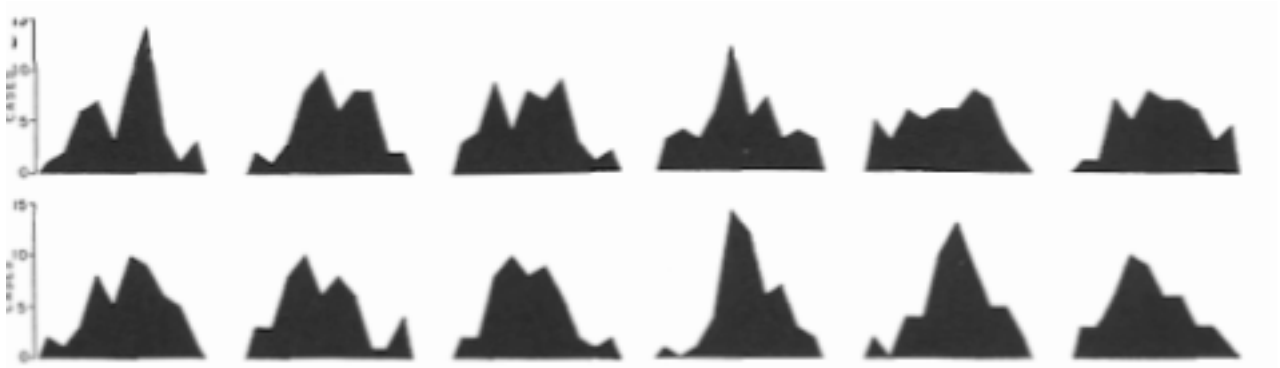
Space vs. Time: Showing Change

- animation: show time using temporal change
  - good: show process
  - good: compare by flipping between two things
  - bad: compare between many things
    - interference from intermediate frames



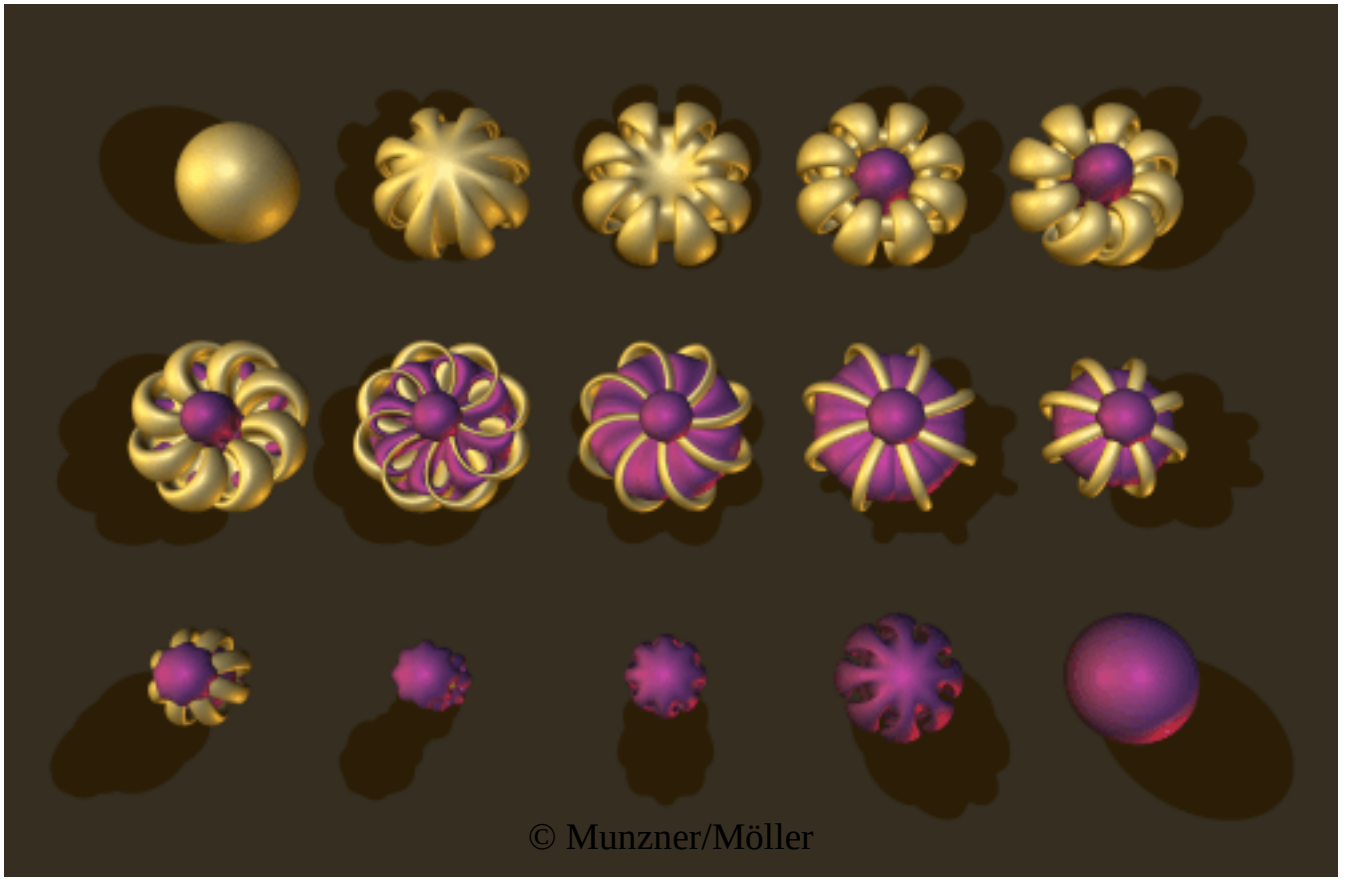
Space vs. Time: Showing Change

- small multiples: show time using space
  - overview: show each time step in array
  - compare: side-by-side easier than temporal
    - external cognition instead of internal memory
  - general technique, not just for temporal changes



Space vs. Time: Showing Change

- small multiples: show time using space
  - also can be good for showing process



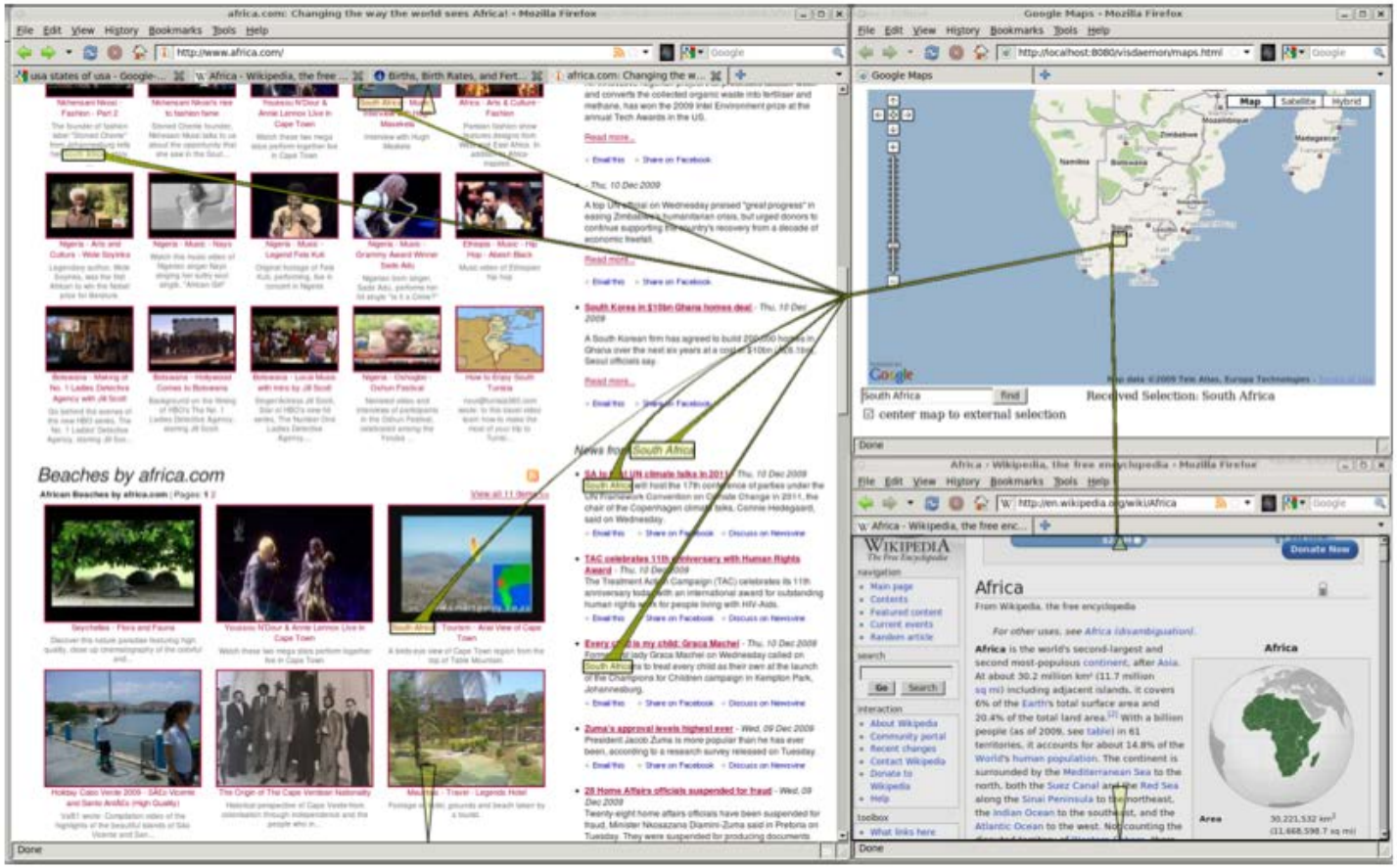
Animation vs. Small Multiplies

- Tversky argument: intuition that animation helps is wrong
  - meta-review of previous studies
  - often more info shown in animation view so not a fair comparison
  - carefully chosen segmentation into small multiples better than animation if equivalent information shown

[Animation: Can It Facilitate? Barbara Tversky, Julie Morrison, Mireille Betrancourt. International Journal of Human Computer Studies 57:4, pp 247-262, 2002.]

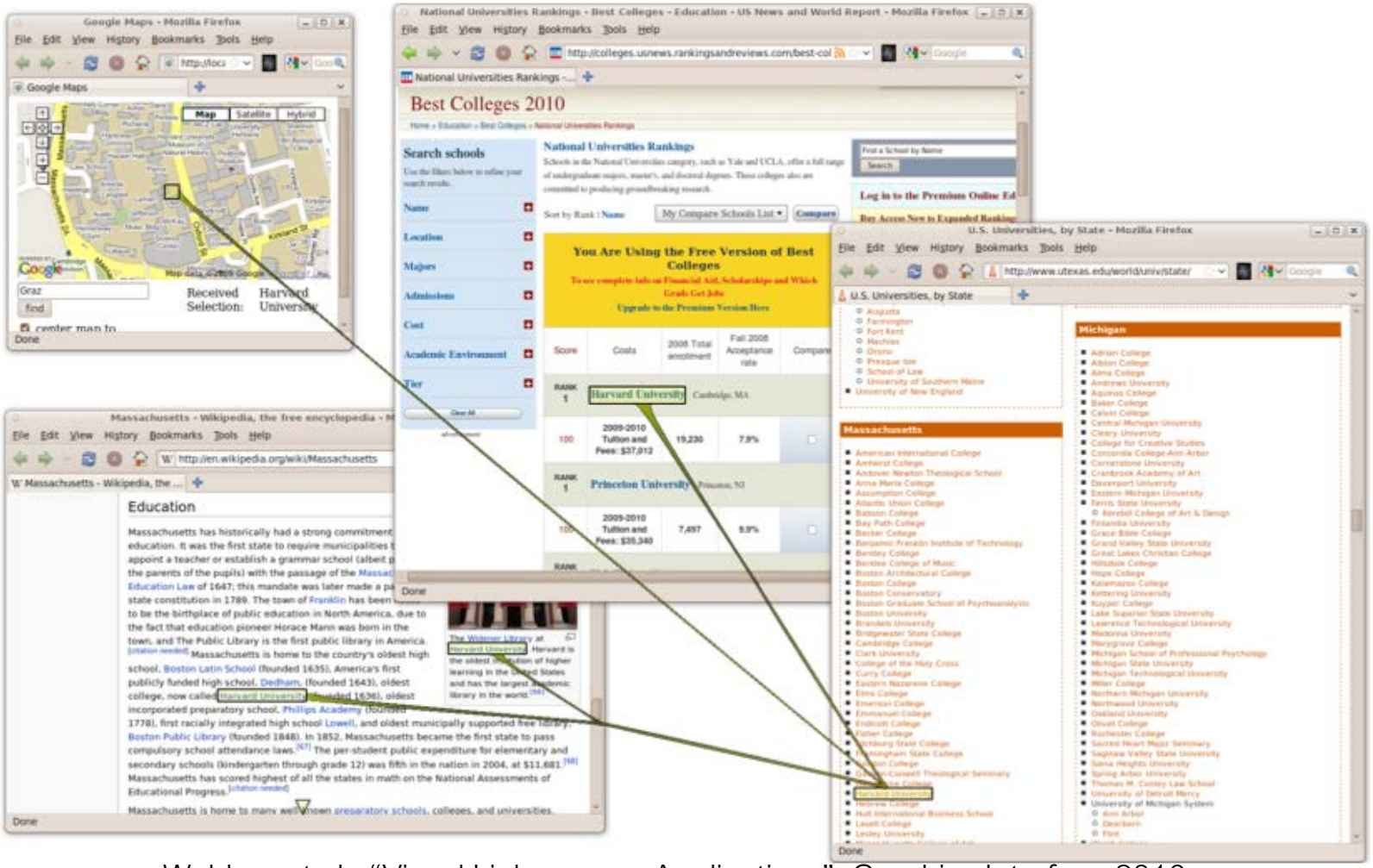
Navigation synchronized

Views linked by marks



Waldner et al., “Visual Links across Applications”, Graphics Interface 2010

Views linked by marks



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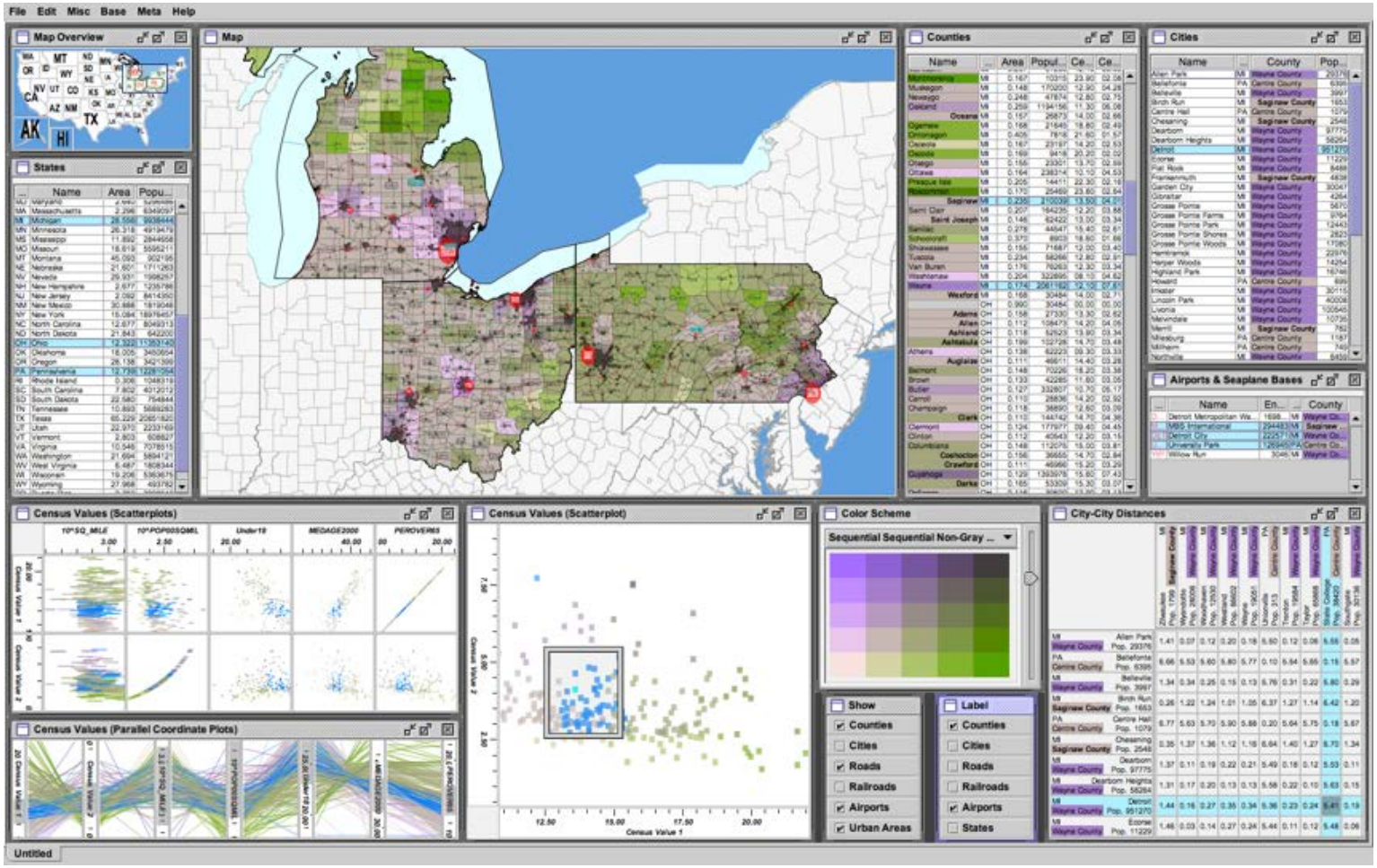
Combined Views -- Improvise



Weaver. "Building Highly-Coordinated Visualizations In Improvise". InfoVis 2004, Examples: http://www.cs.ou.edu/~weaver/improvise/examples.html

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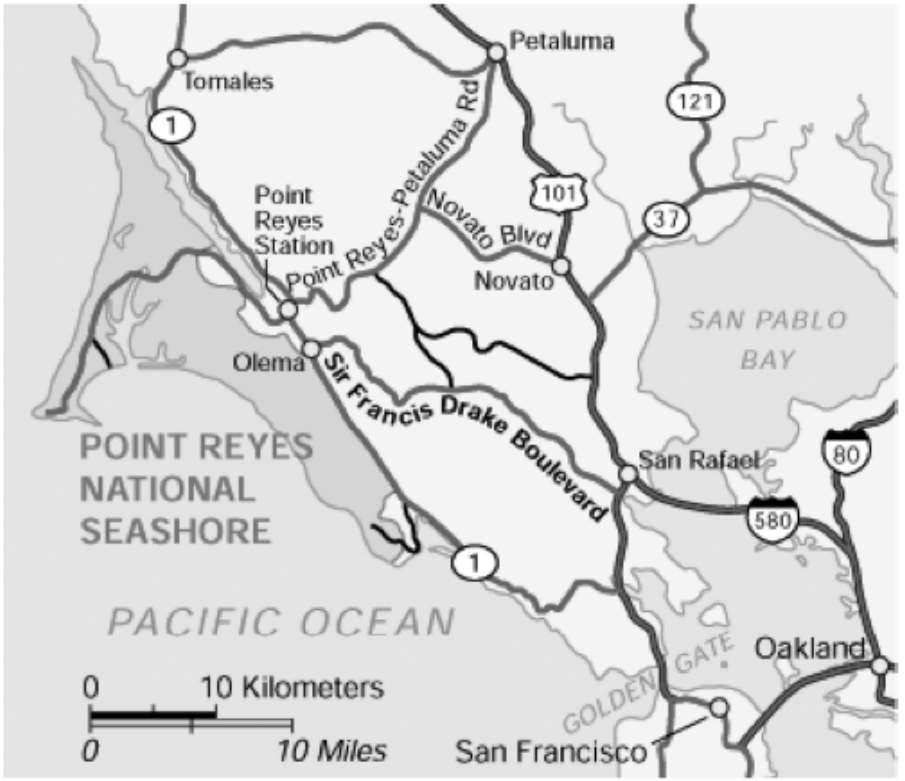
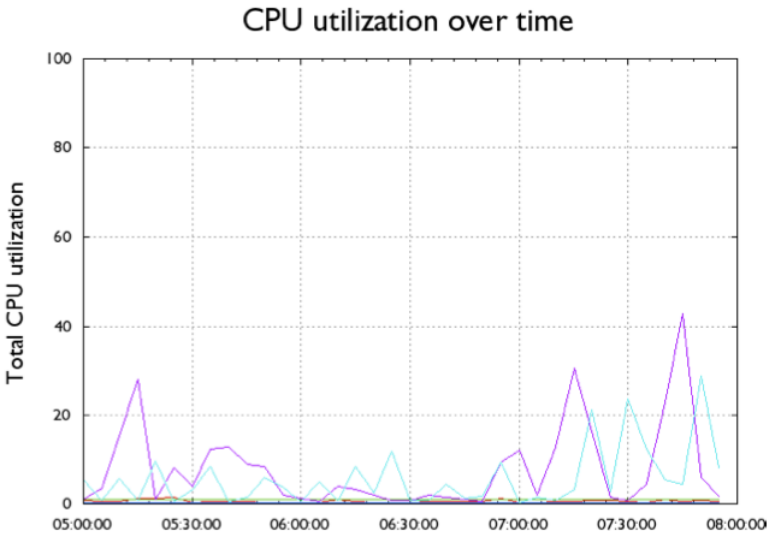
Visual layering

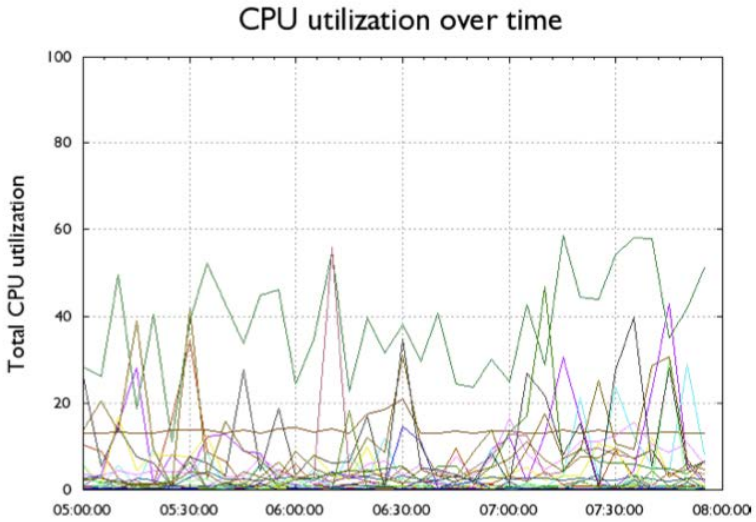
- beyond simple use of visual channels
- method variants
  - global compositing: everything superimposed
  - item-level stacking
- major consideration
  - static layers: disjoint ranges in channels safest
  - dynamic/interactive layers: more freedom

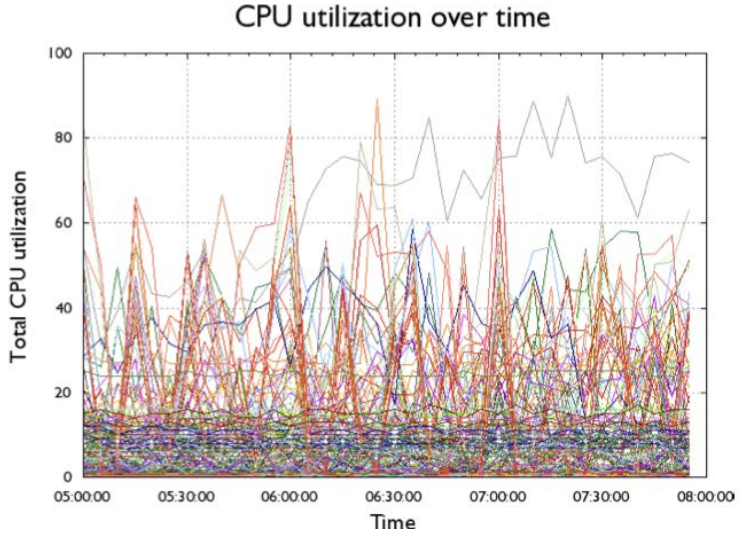
Static layers



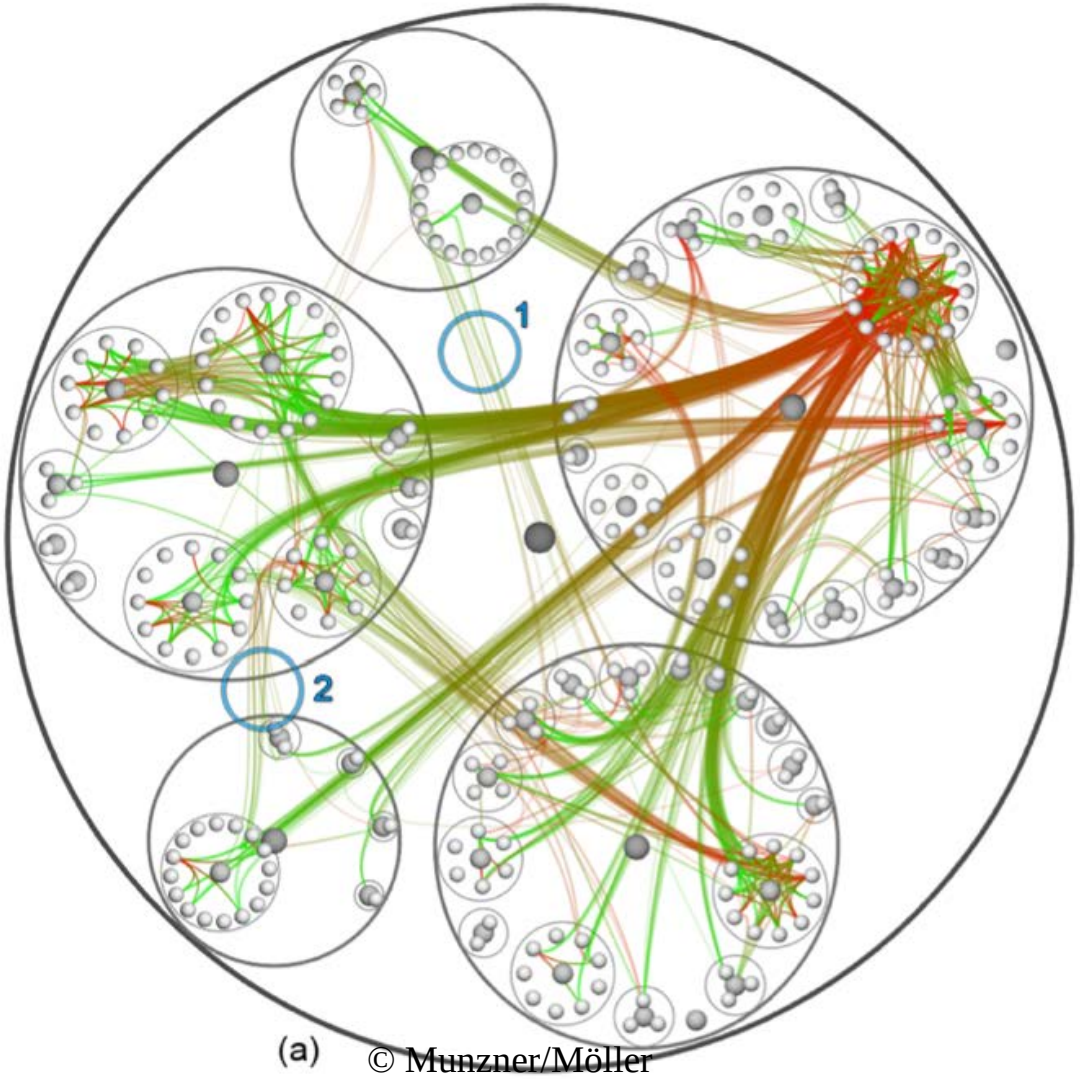
Static layers







Hierarchical edge bundles



Dynamic layers