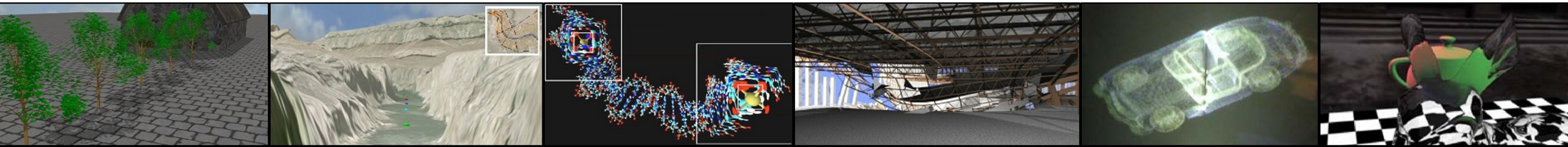
CIS 4930/6930-902
SCIENTIFIC VISUALIZATION

SINGLE VIEW, MULTIVIEW, & FOCUS+CONTEXT

Paul Rosen
Assistant Professor
University of South Florida

slides credits Miriah Meyer (U of Utah)



ADMINISTRATIVE

project 2 due Tuesday

project 3 released Tuesday

reading for Tuesday

A. Cockburn, et al. "A review of overview+detail, zooming, and focus+context interfaces."

project 2 presentations Thursday

SINGLE VS MULTIPLE VIEWS

eyes over memory—trade-off of display space and working memory

similar situation with partitioning vs layering

A variety of options…

Juxtapose and Coordinate Multiple Side-by-Side Views

- Share Encoding: Same/Different
  - *Linked Highlighting*

- Share Data: All/Subset/None

- Share Navigation

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

Partition into Side-by-Side Views

Superimpose Layers

LINKED VIEWS

multiple views that are simultaneously visible and linked together such that actions in one view affect the others

What to show

encoding: same or multiform

dataset: share all, subset, or none

How to interact

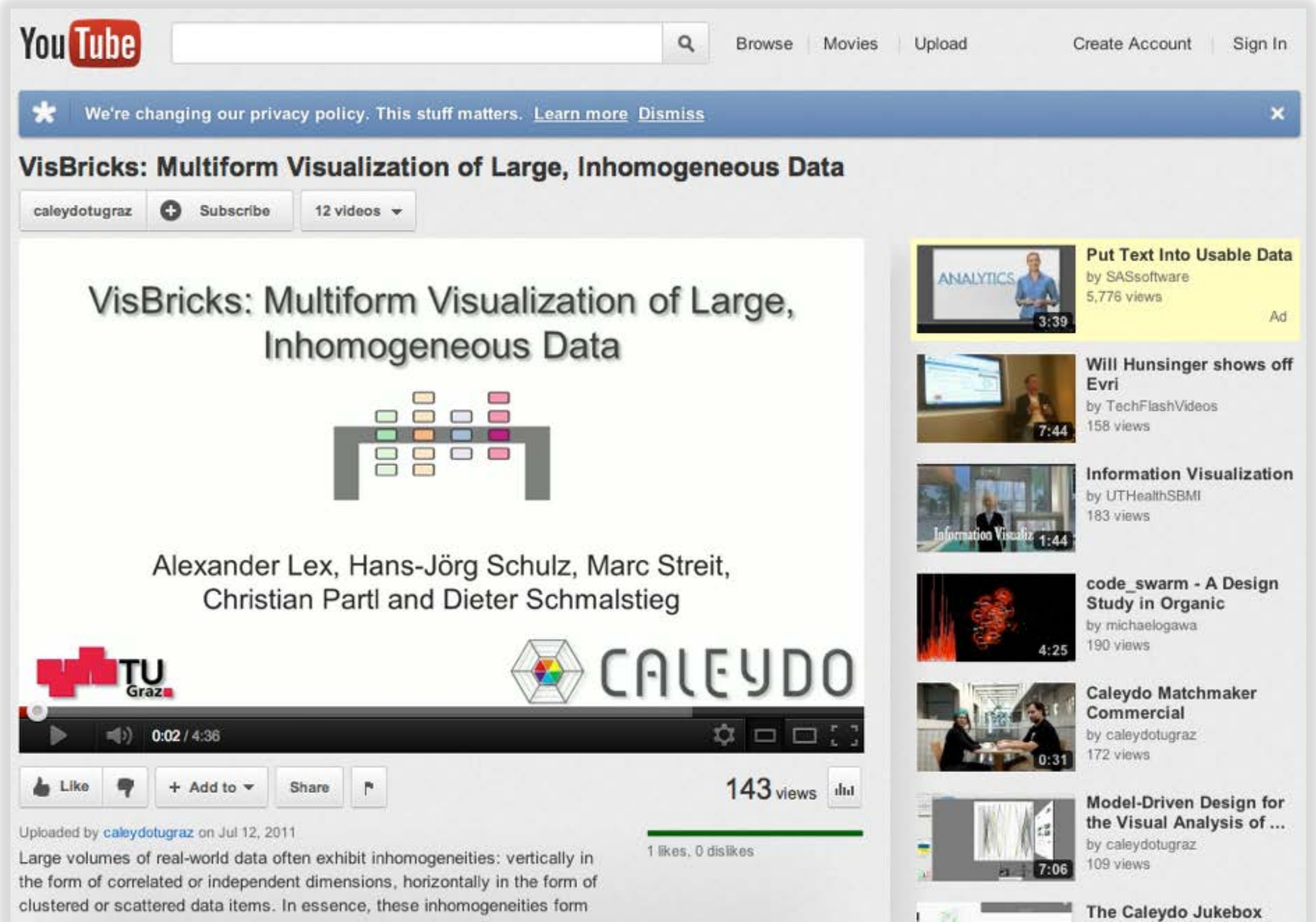
highlighting: to link, or not

navigation: to share, or not

MULTIFORM

different visual encodings are used between the views

rational: single, monolithic view has strong limits on the number of attributes that can be shown simultaneously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The Caleydo Jukebox

What to show

encoding: same or multiform

dataset: share all, subset, or none

How to interact

highlighting: to link, or not

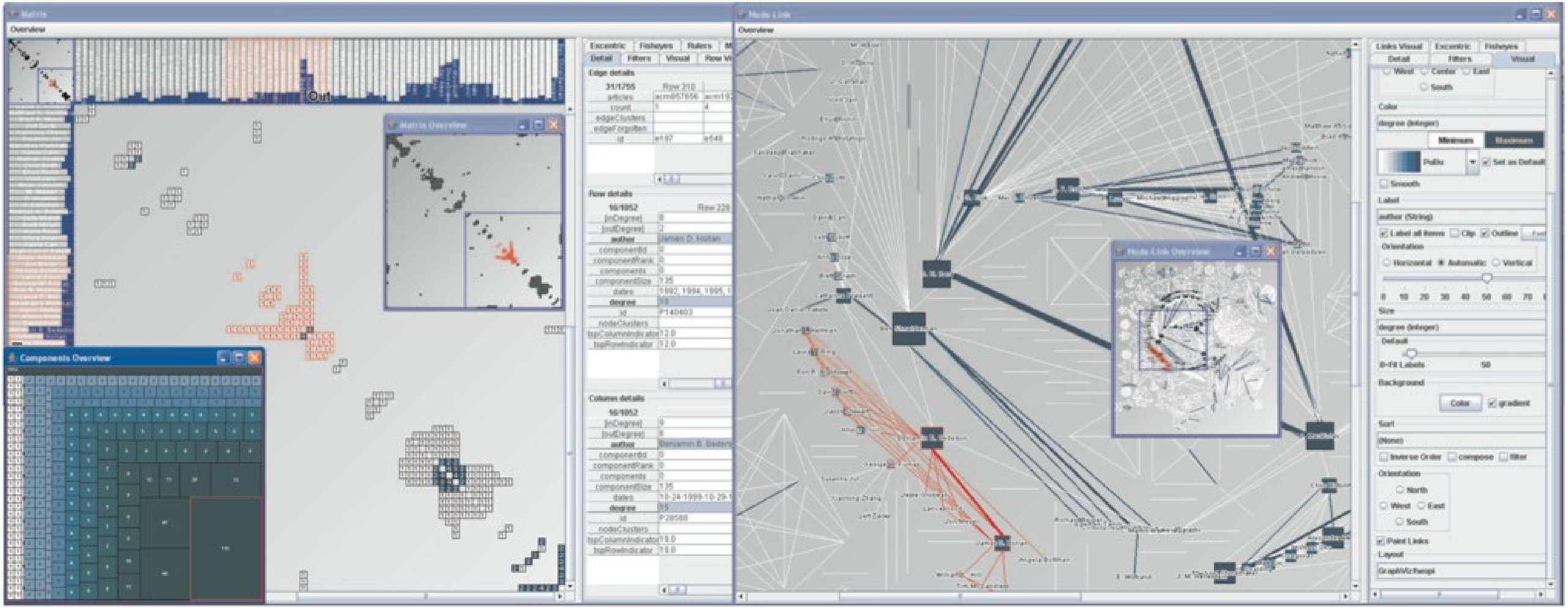
navigation: to share, or not

SHARED DATA

showing all data in each view, but
with different encoding schemes

rational: different views support different tasks

MATRIXEXPLORER

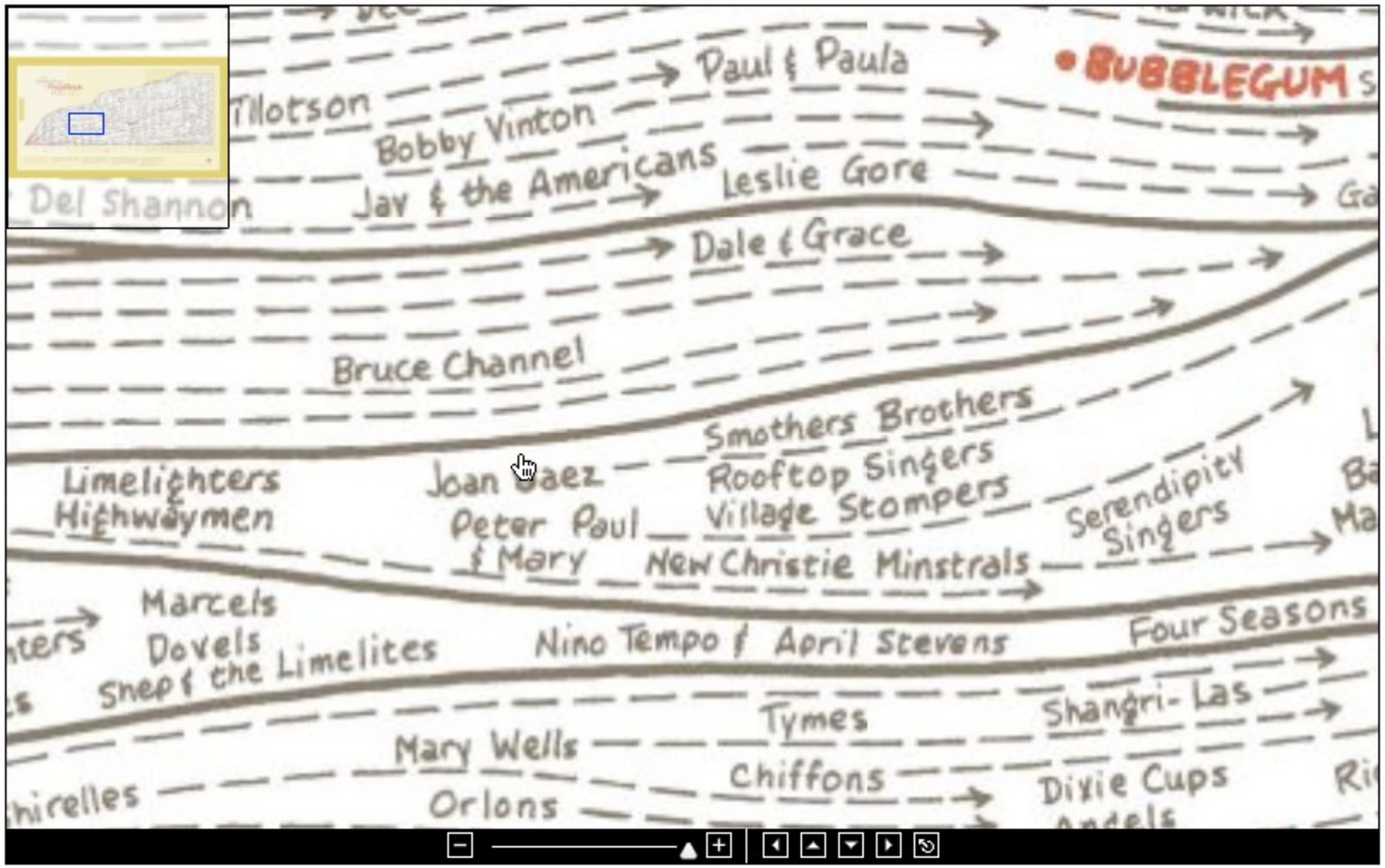


Henry 2006

OVERVIEW + DETAIL

one view shows (often summarized) information about entire dataset, while additional view(s) shows more detailed information about a subset of the data

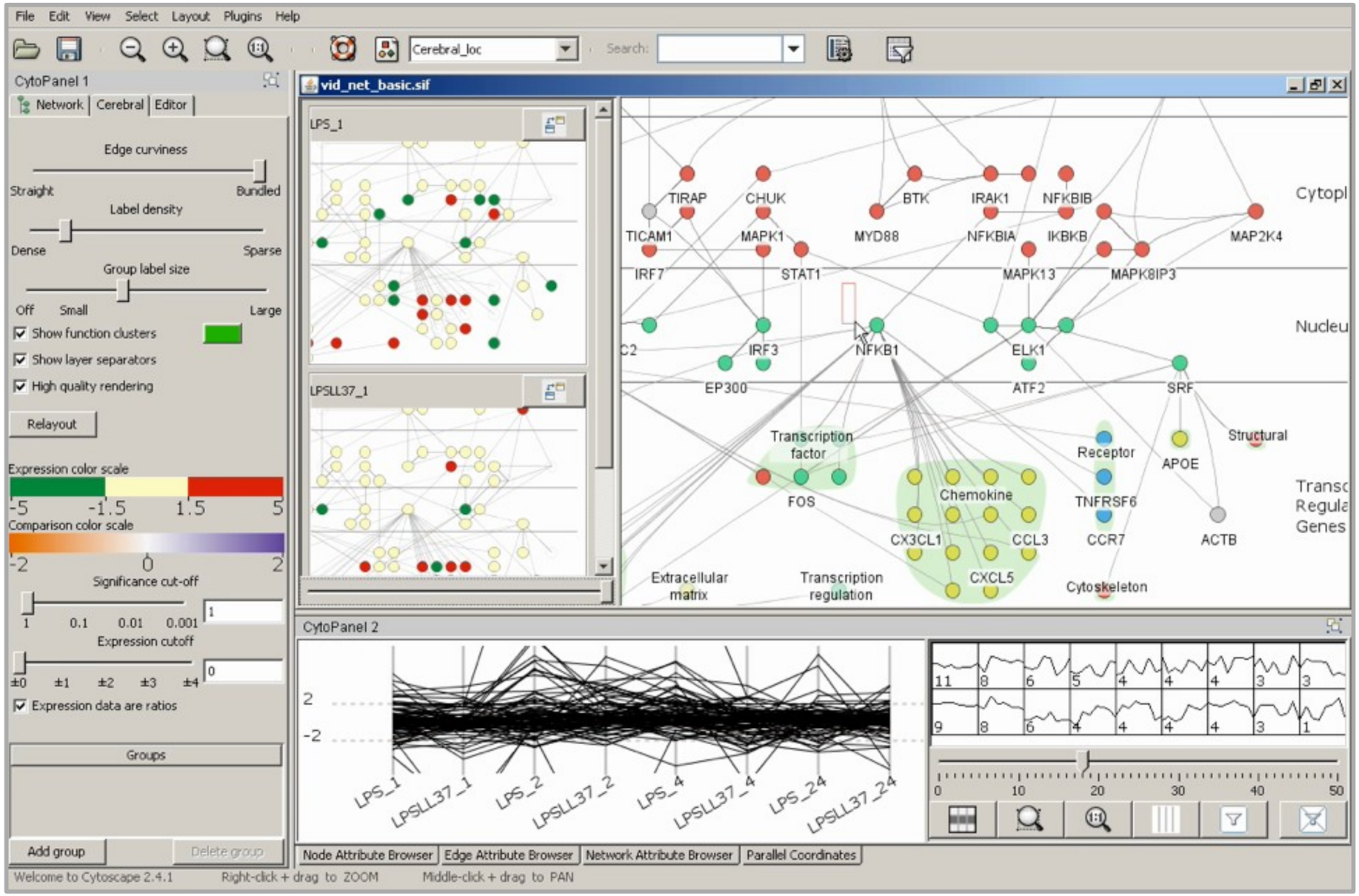
rational: for large or complex data, a single view of the entire dataset cannot capture fine details


Tillotson
Bobby Vinton
Paul & Paula
BUBBLEGUM
Del Shannon
Jay & the Americans
Leslie Gore
Dale & Grace
Bruce Channel
Smothers Brothers
Limelighters
Highwaymen
Joan Baez
Rooftop Singers
Village Stompers
Peter Paul & Mary
Serendipity Singers
New Christie Minstrals
Marcels
Dovels
Shep & the Limelites
Nino Tempo & April Stevens
Four Seasons
Tymes
Shangri-Las
Mary Wells
Chiffons
Orlons
Dixie Cups

SMALL MULTIPLES

each view uses the same visual encoding,
but shows a different subset of the data

rational: quickly compare different parts of a data set,
relying on eyes instead of memory


File Edit View Select Layout Plugins Help
Cerebral_loc
Search:
CytoPanel 1
Network Cerebral Editor
Edge curviness
Straight
Bundled
Label density
Dense
Sparse
Group label size
Off Small Large
Show function clusters
Show layer separators
High quality rendering
Relayout
Expression color scale
-5 -1.5 1.5 5
Comparison color scale
-2 0 2
Significance cut-off
1 0.1 0.01 0.001
Expression cutoff
±0 ±1 ±2 ±3 ±4
Expression data are ratios
Groups
Add group
Delete group
vid_net_basic.sif
LPS_1
LPSLL37_1
TIRAP
CHUK
BTK
IRAK1
NFKBIB
TICAM1
MAPK1
MYD88
NFKBIA
IKBKB
MAP2K4
IRF7
STAT1
MAPK13
MAPK8IP3
IRF3
NFKB1
ELK1
EP300
ATF2
SRF
Transcription factor
FOS
Chemokine
Receptor
TNFRSF6
APOE
Structural
CX3CL1
CCL3
CCR7
ACTB
CXCL5
Extracellular matrix
Transcription regulation
Cytoskeleton
CytoPanel 2
LPS_1
LPSLL37_1
LPS_2
LPSLL37_2
LPS_4
LPSLL37_4
LPS_24
LPSLL37_24
Node Attribute Browser
Edge Attribute Browser
Network Attribute Browser
Parallel Coordinates
Welcome to Cytoscape 2.4.1
Right-click + drag to ZOOM
Middle-click + drag to PAN

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

What to show

encoding: same or multiform

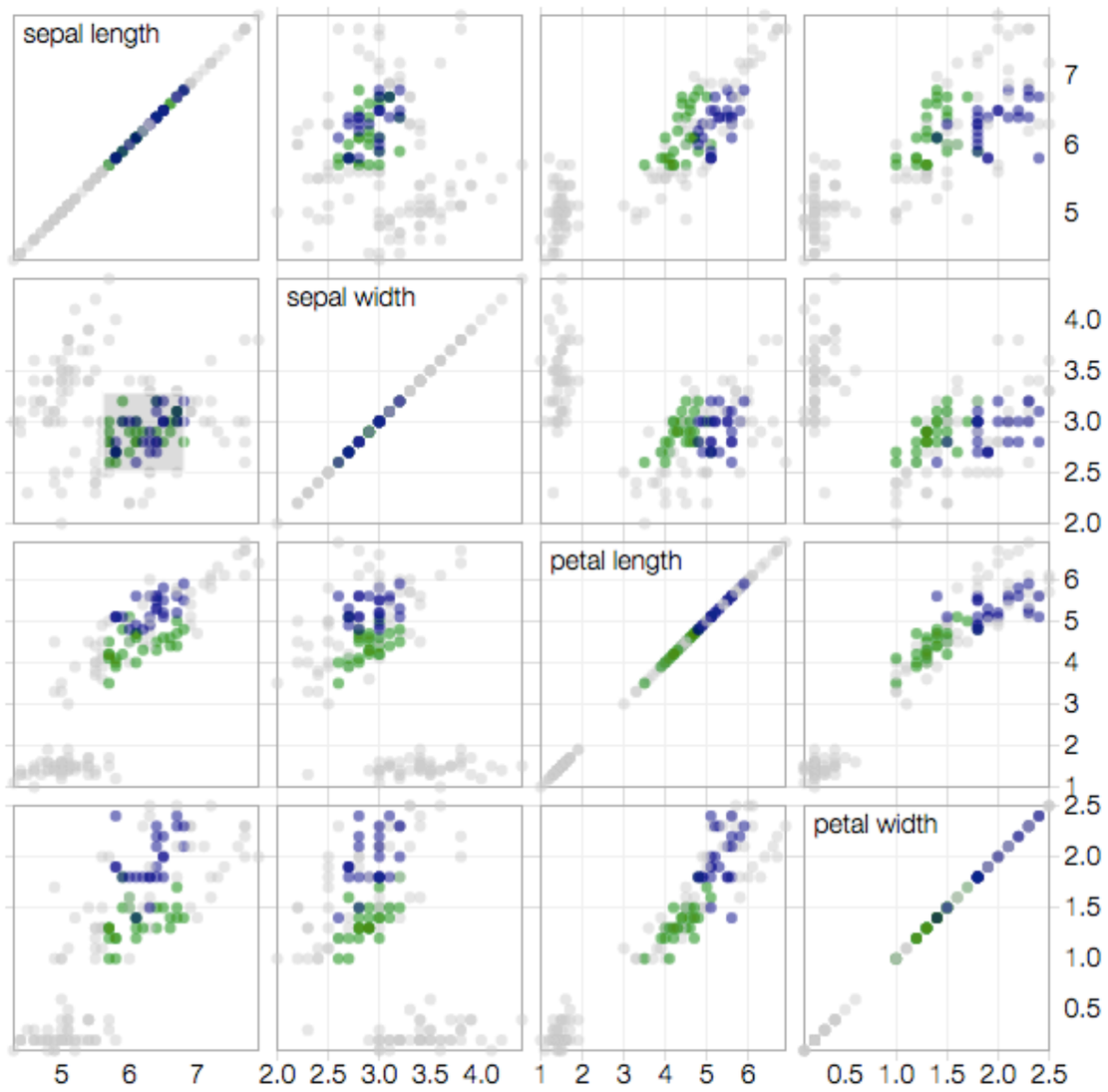
dataset: share all, subset, or none

How to interact

highlighting: to link, or not

navigation: to share, or not

LINKED HIGHLIGHTING



What to show

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How to interact

highlighting: to link, or not

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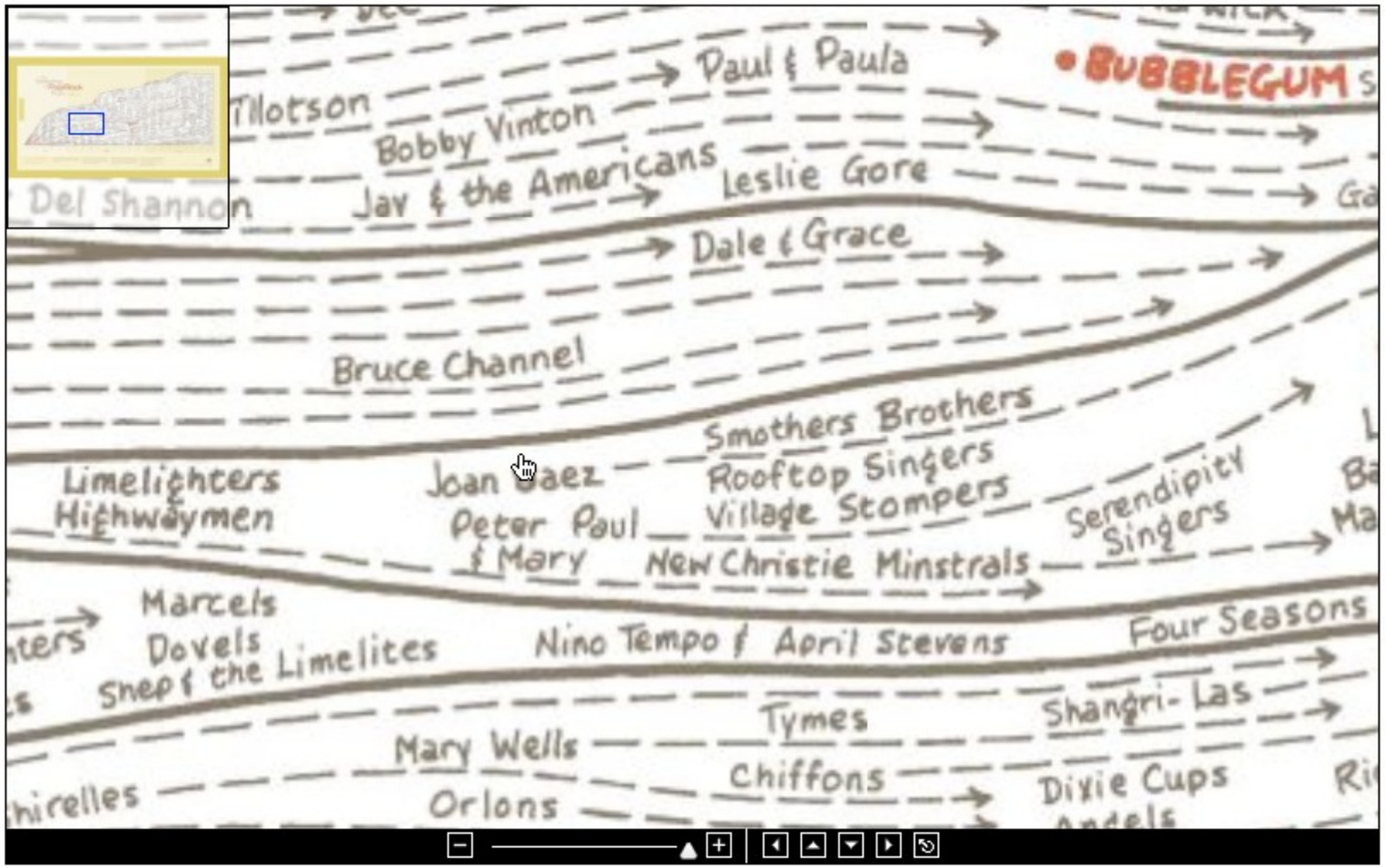
LINKED NAVIGATION



http://www.historyshots.com/rockmusic/

A VARIETY OF OPTIONS…

PARTITIONING

action on the dataset that separates the data into groups

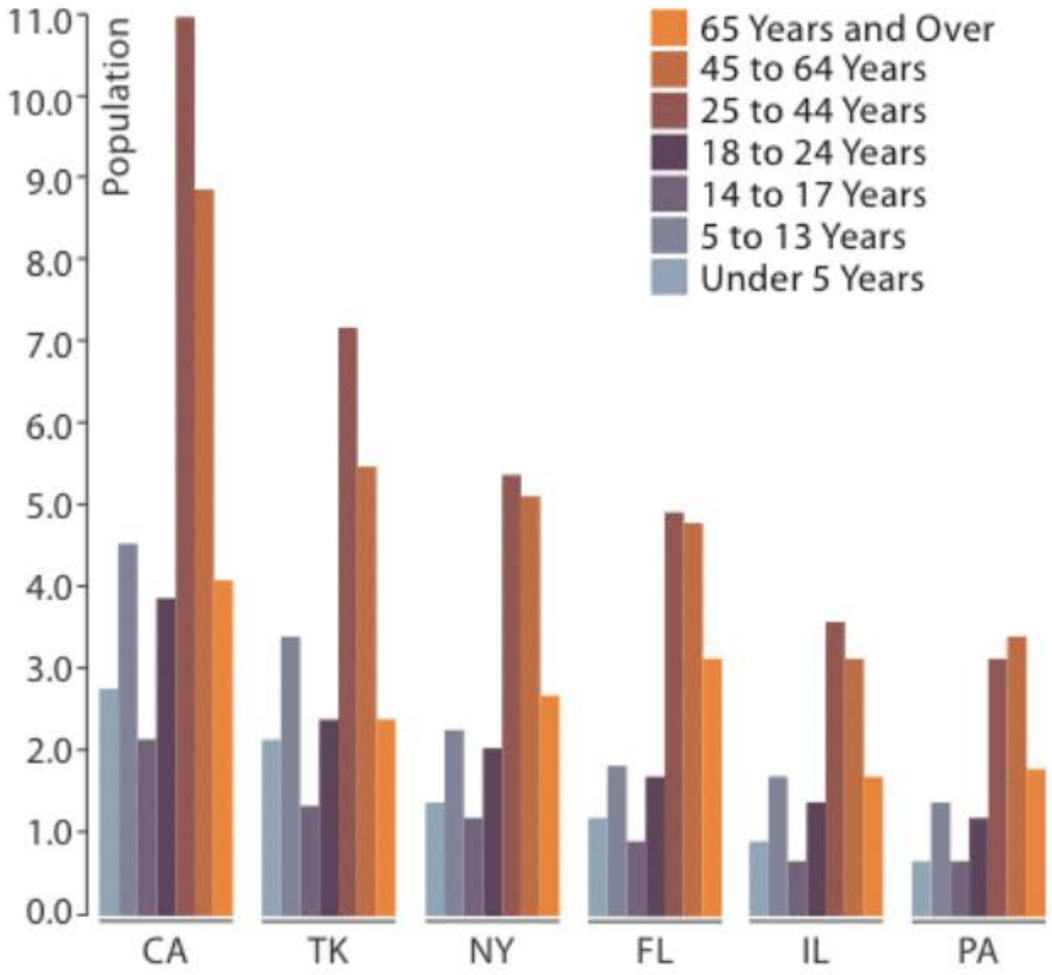
main design choices

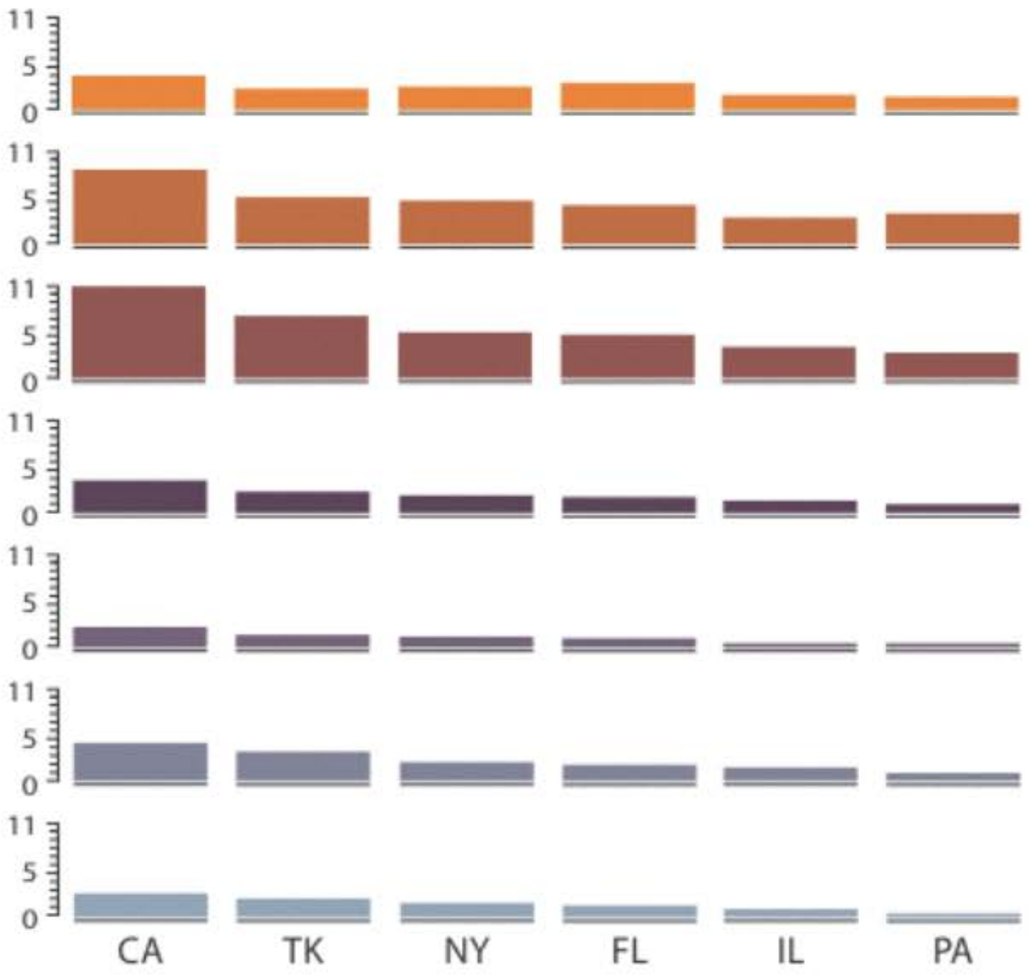
how to divide data up between views, given a hierarchy of attributes

how many splits, and order of splits how many views (usually data driven)

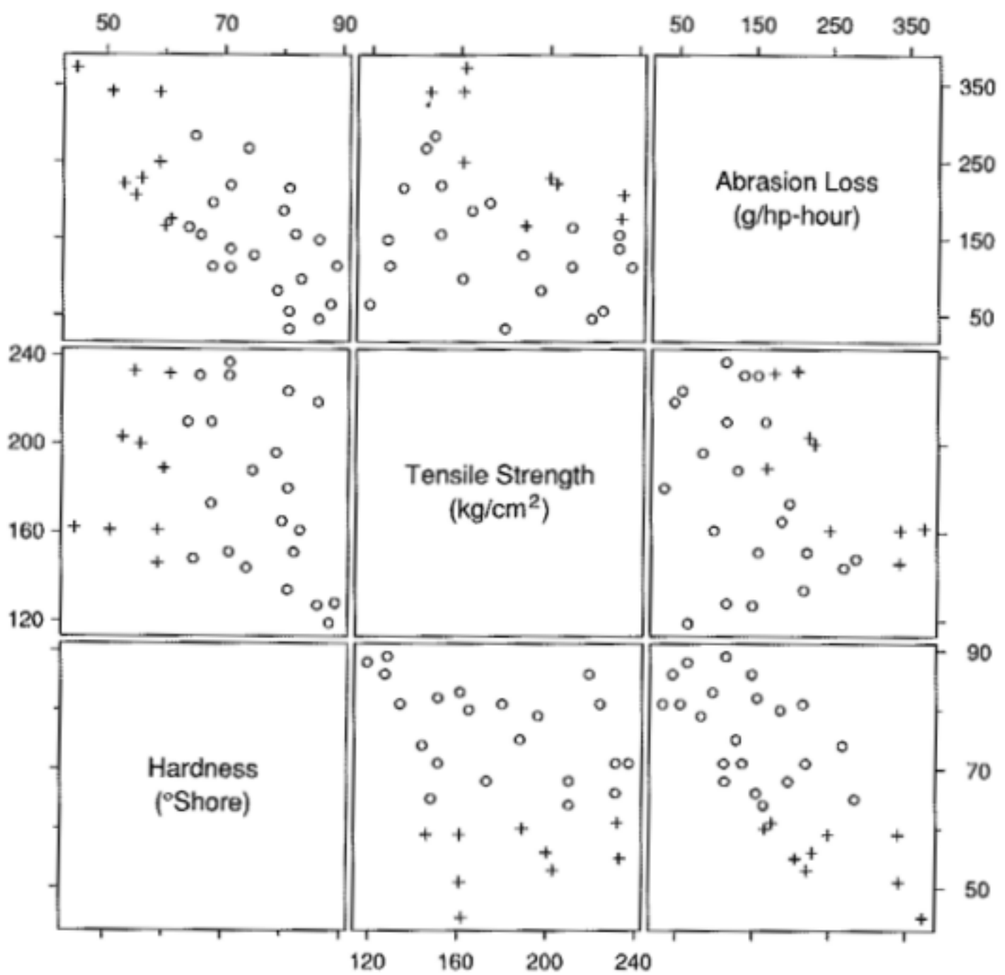
partition attribute(s)

typically categorical


Population
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
65 Years and Over
45 to 64 Years
25 to 44 Years
18 to 24 Years
14 to 17 Years
5 to 13 Years
Under 5 Years
CA
TK
NY
FL
IL
PA


11
5
0
CA
TK
NY
FL
IL
PA

SCATTERPLOT MATRIX (SPLOM)



3.65 CONDITIONING. A scatterplot matrix displays trivariate data: measurements of abrasion loss, hardness, and tensile strength for 30 rubber specimens. The "+" plotting symbols encode the data for those specimens with hardness less than 62 °Shore.

Cleveland 1994

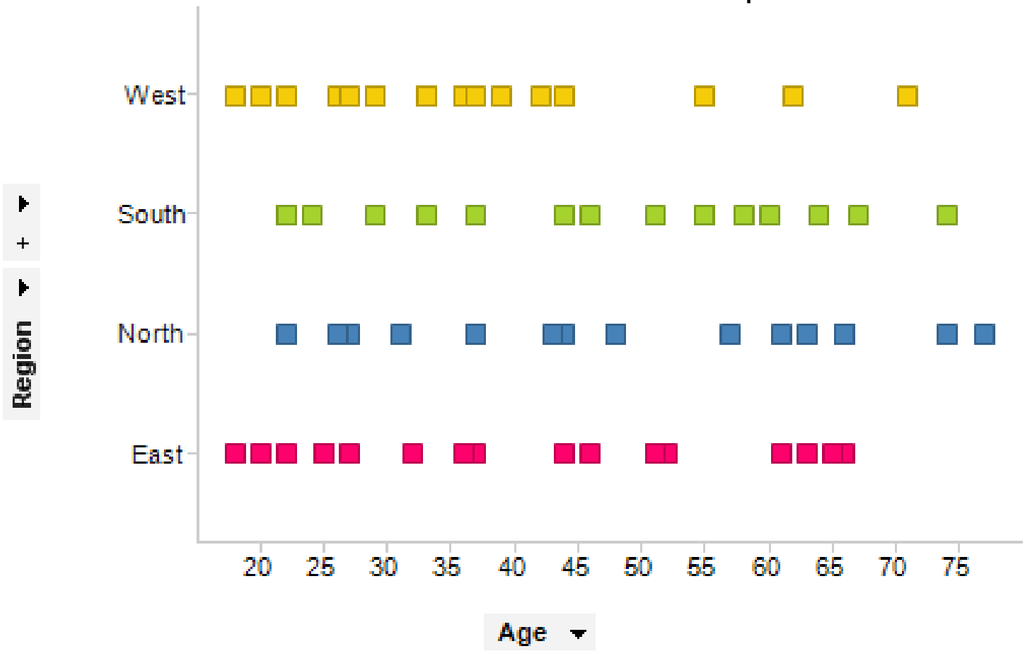
Becker 1996

TRELLISED VIEWS

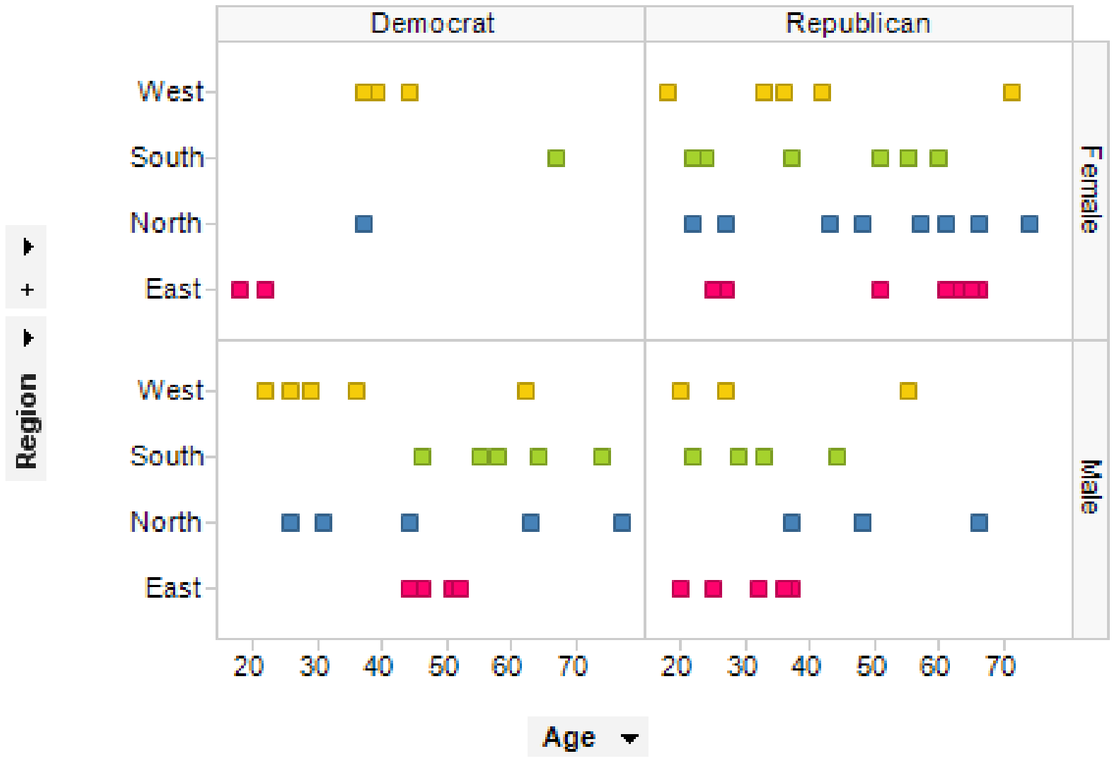
panel variables: attributes encoded in individual views

partitioning variables: partitioning attributes assigned to columns, rows, and pages

non-trellised scatter plot



trellising this visualization based on
Gender and Political affiliation



From https://docs.tibco.com/pub/spotfire/5.5.0-march-2013/UsersGuide/vis/vis_trellis_visualizations.htm

Hierarchical Visual Expression

HIVE

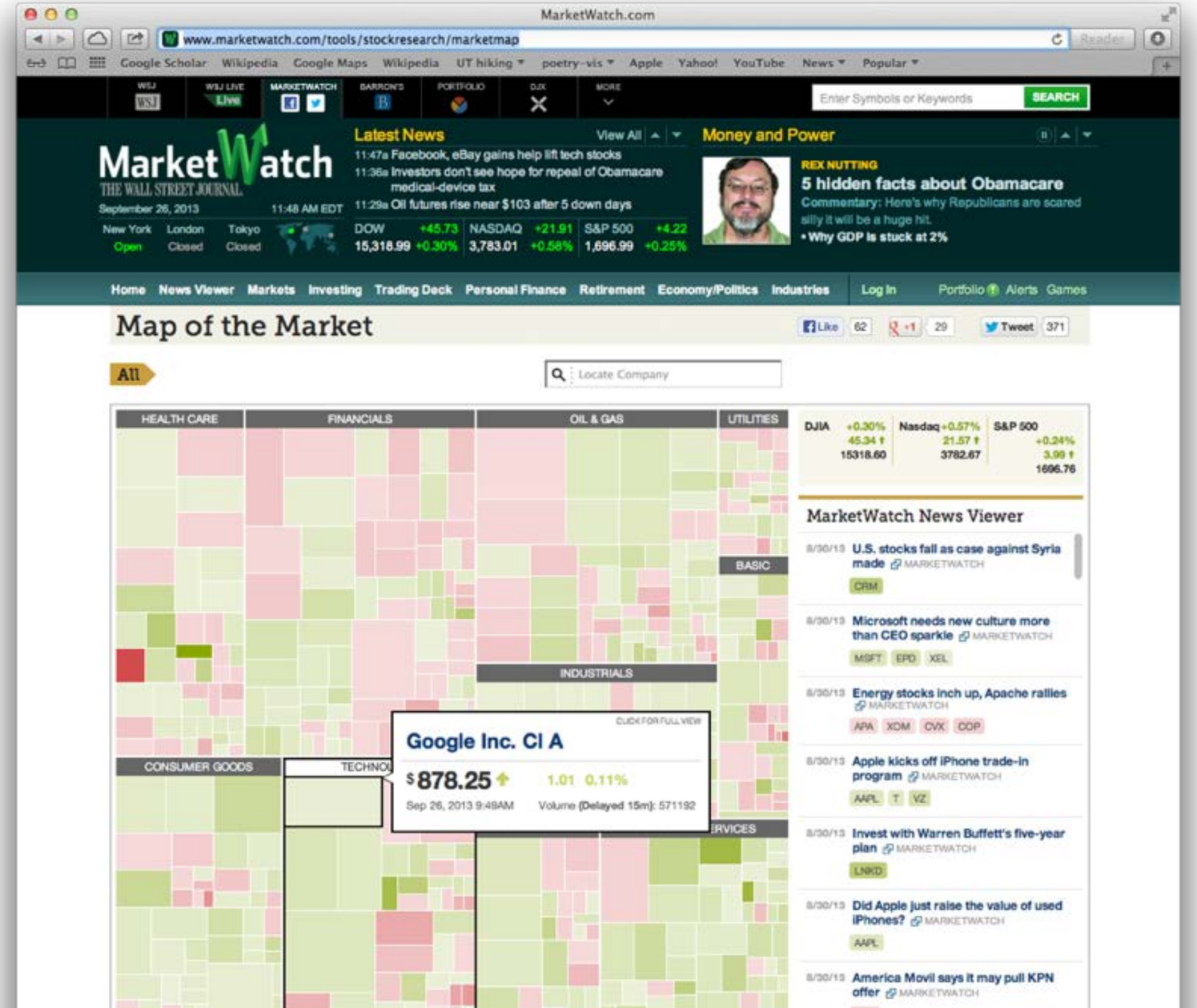
partitioning: transform data attributes into a hierarchy

reconfigure hierarchies to explore data space

treemaps used as spacefilling layouts

Slingsby 2009

TREEMAP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NASDAQ +21.91 3,783.01 +0.58%
S&P 500 +4.22 1,696.99 +0.25%
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Commentary: Here's why Republicans are scared silly it will be a huge hit.
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Map of the Market
Like 62 +1 29 Tweet 371
All
Locate Company
HEALTH CARE
FINANCIALS
OIL & GAS
UTILITIES
BASIC
INDUSTRIALS
CONSUMER GOODS
TECHNOL
ERVICES
CLICK FOR FULL VIEW
Google Inc. Cl A
$878.25 1.01 0.11%
Sep 26, 2013 9:49AM Volume (Delayed 15m): 571192
DJIA +0.30% 45.34 15318.60
Nasdaq +0.57% 21.57 3782.67
S&P 500 +0.24% 3.99 1696.76
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Hierarchical Visual Expression

HIVE

partitioning: transform data attributes into a hierarchy

reconfigure hierarchies to explore data space

treemaps used as spacefilling layouts

each rectangle is a partitioned subset

nested graphical summaries

size, shape, color used to show subset properties

containment ordering by partition variables

Slingsby 2009

Configuring Hierarchical Layouts to Address Research Questions

CITY UNIVERSITY LONDON

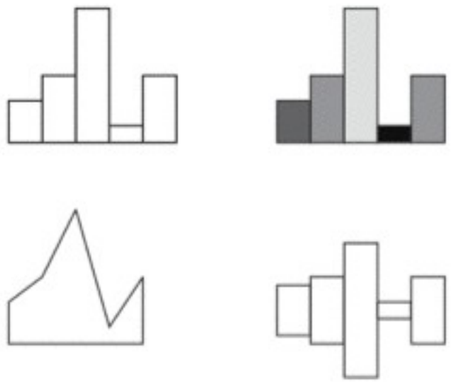
Aidan Slingsby, Jason Dykes and Jo Wood
giCentre, Department of Information Science, City University London
http://www.gicentre.org/hierarchical_layouts/

CITY UNIVERSITY LONDON

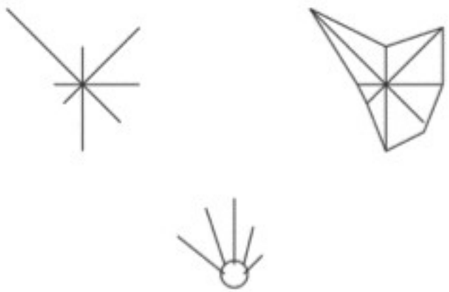
GLYPHS

a graphical object with internal structure
that arises from multiple marks

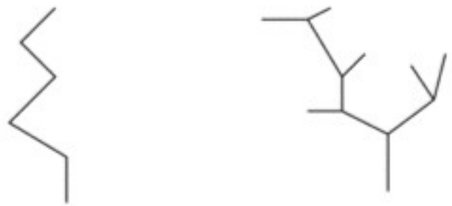
ambiguity: little distinct line between glyph and view!



Variations on Profile glyphs

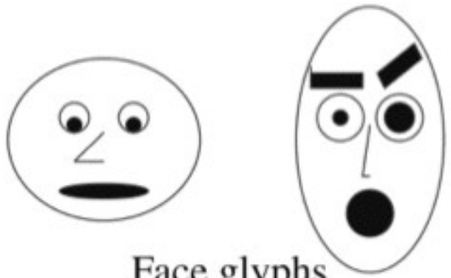


Stars and Anderson/metroglyphs



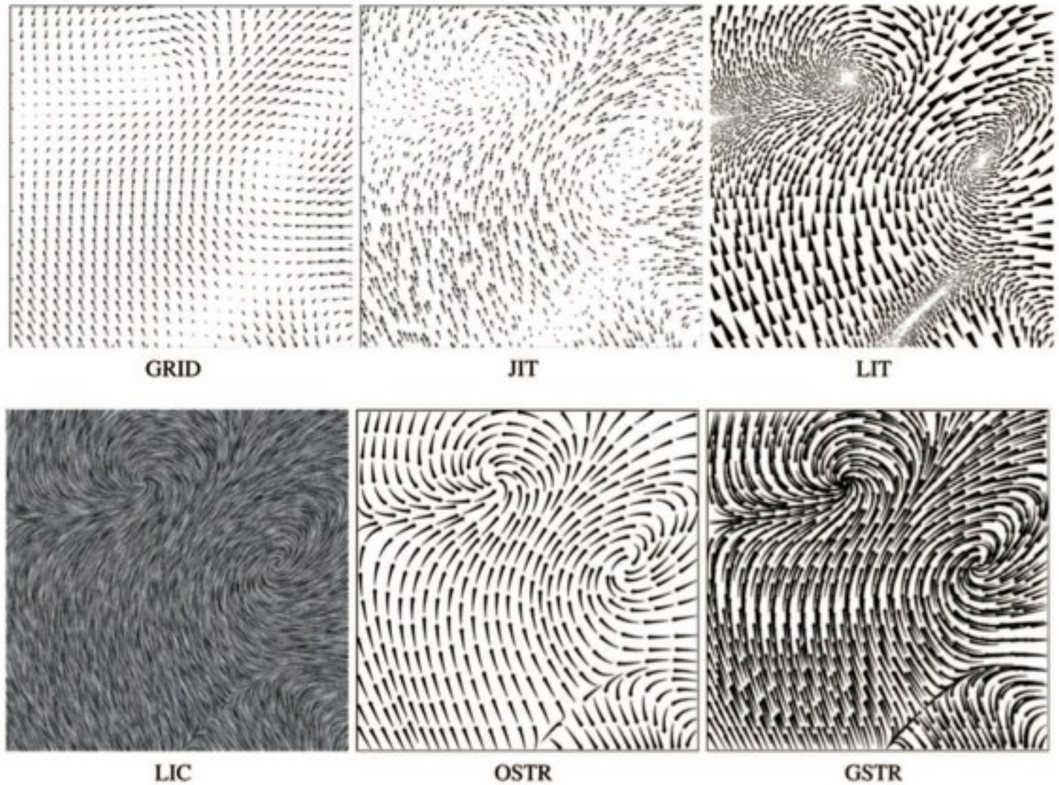
Sticks and Trees

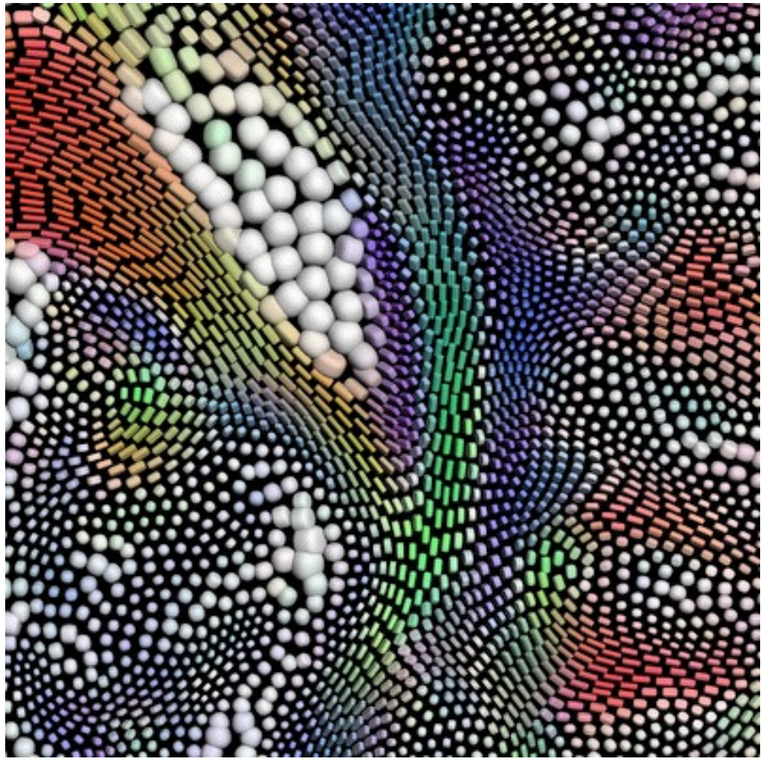
Autoglyph and box glyph



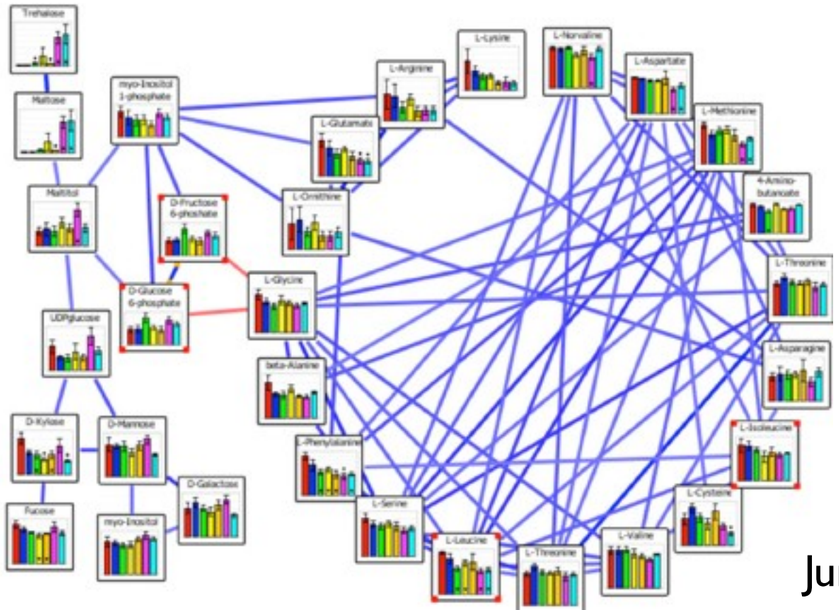
Face glyphs

Arrows and Weathervanes





Kindlmann 2006



Junker 2006

PROCESS

gather metadata for obtaining a set of names

or, things you want to represent

build a taxonomy

propose several categorization schemes

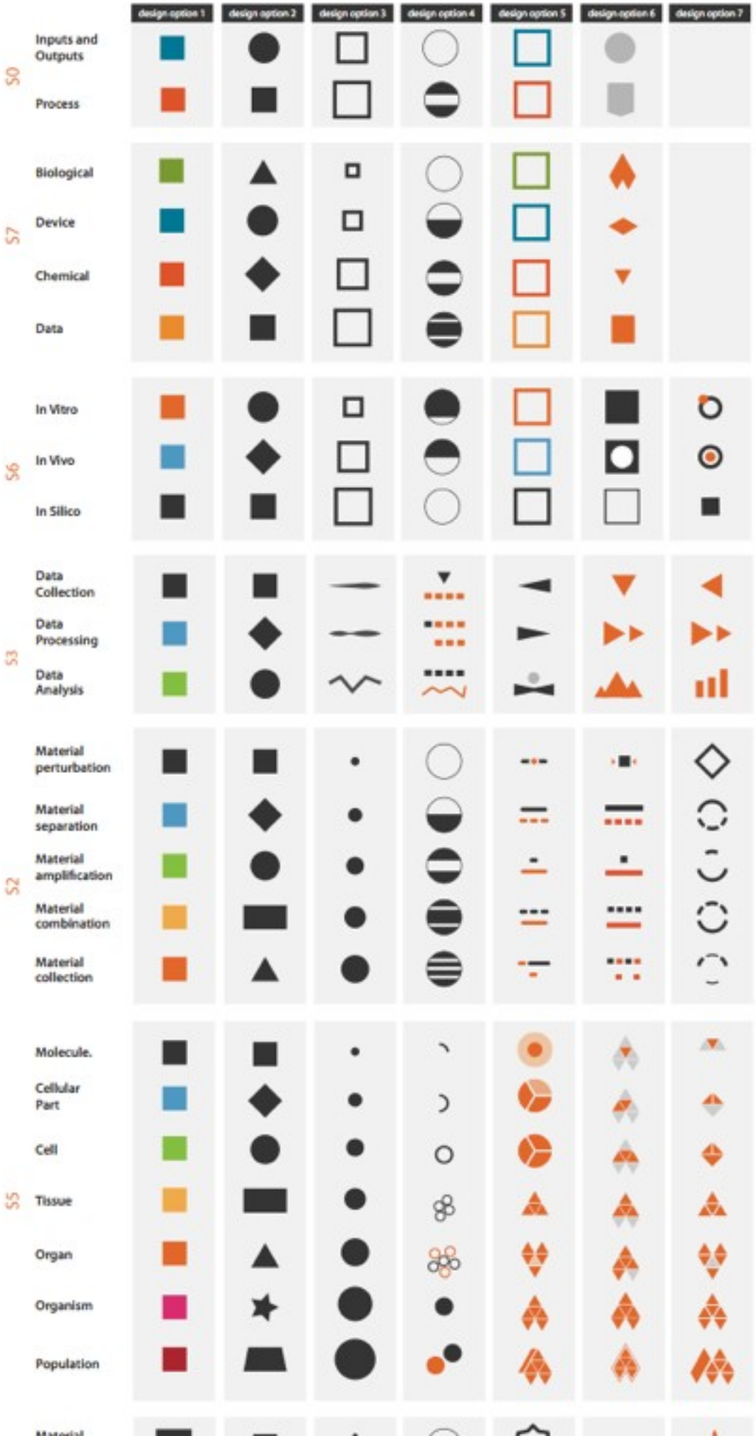
develop visual design

determine order of visual channels

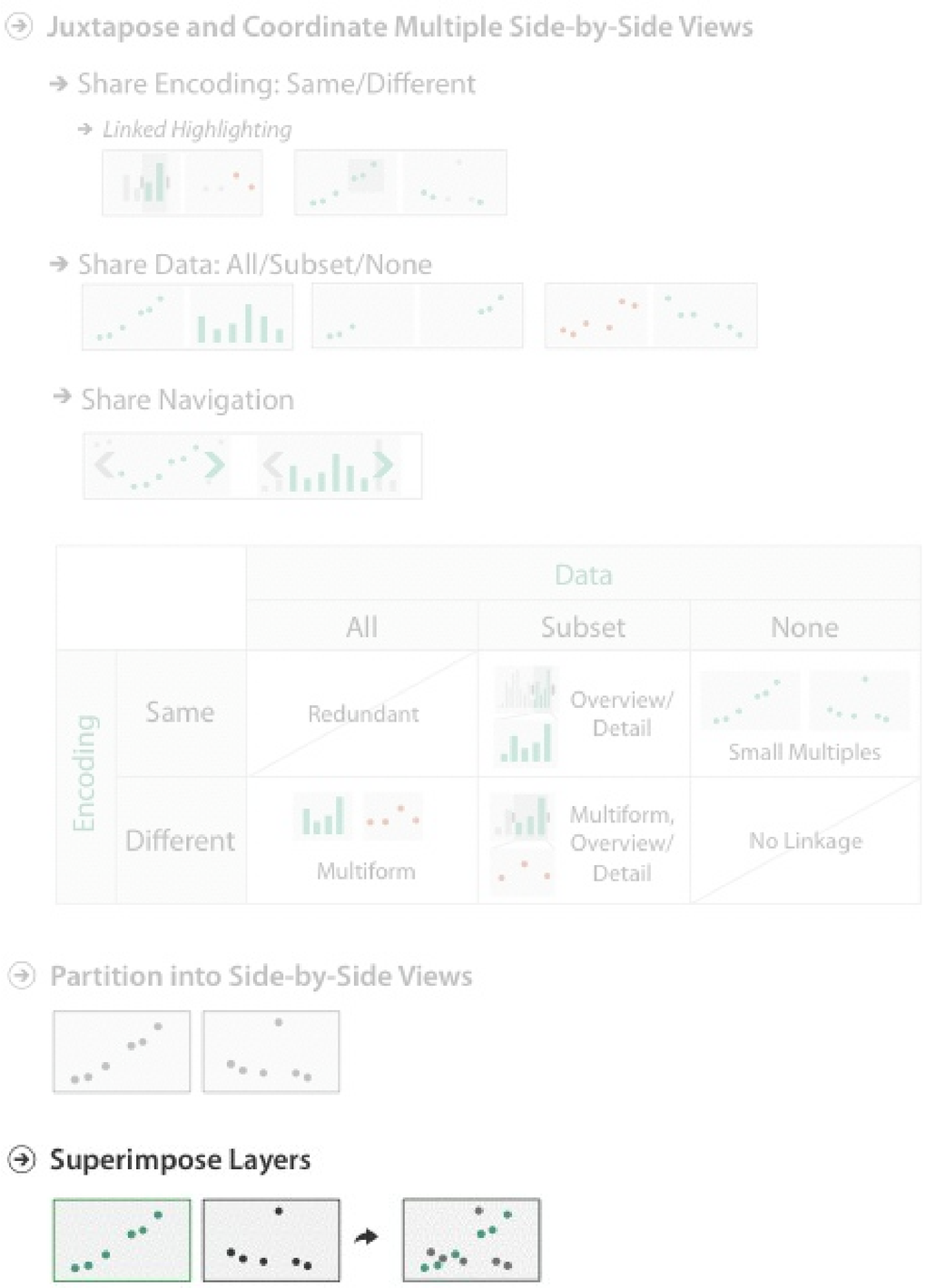
propose optional mappings

identify metaphoric abstractions

implement a glyph-based system


design option 1
design option 2
design option 3
design option 4
design option 5
design option 6
design option 7
S0
Inputs and Outputs
Process
S7
Biological
Device
Chemical
Data
S6
In Vitro
In Vivo
In Silico
S3
Data Collection
Data Processing
Data Analysis
S2
Material perturbation
Material separation
Material amplification
Material combination
Material collection
S5
Molecule.
Cellular Part
Cell
Tissue
Organ
Organism
Population

A variety of options…



LAYERING

combining multiple views on top of one another to form a composite view

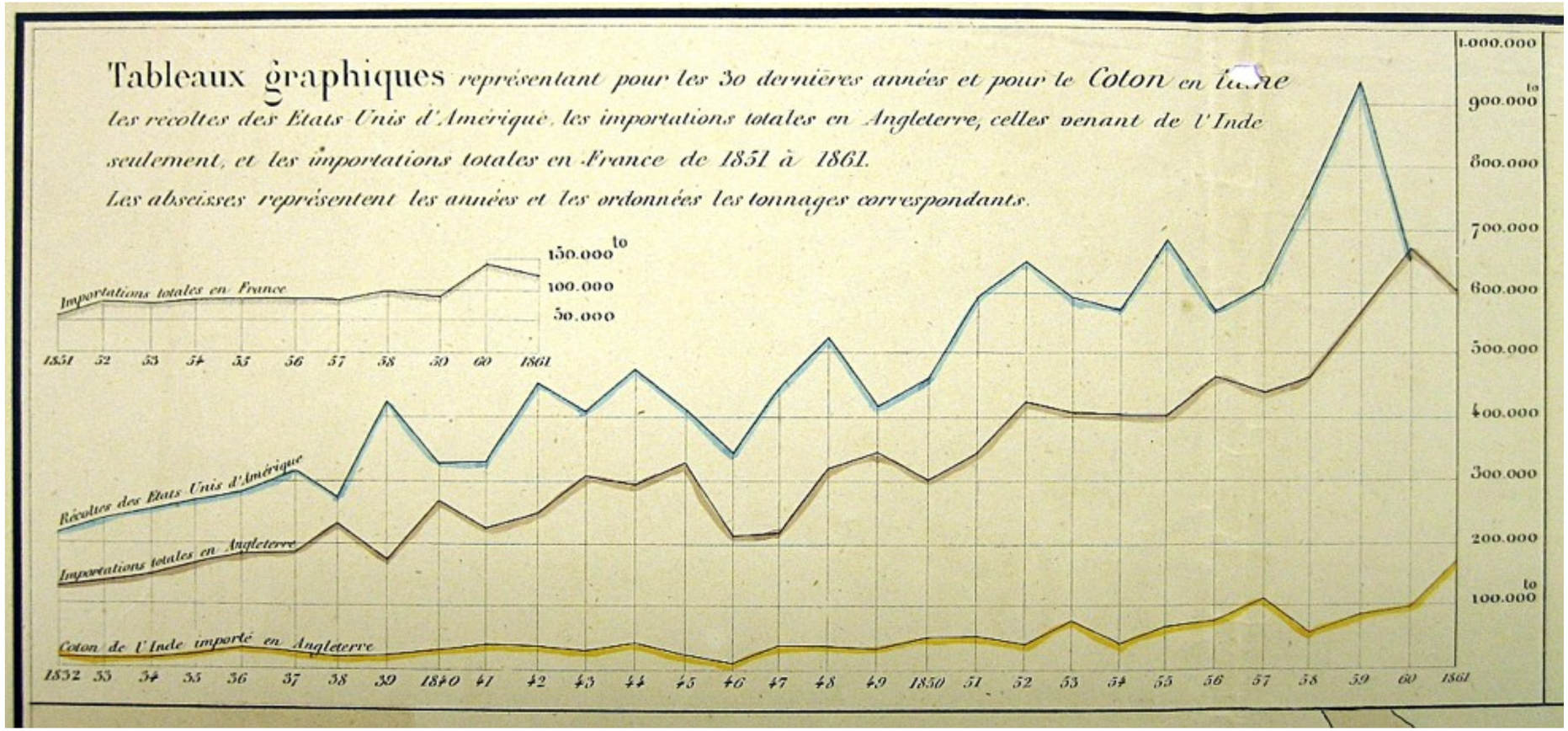
rational: supports a larger, more detailed view than using multiple views

trade-off: layering imposes constraints on visual encoding choice as well as number of layers that can be shown

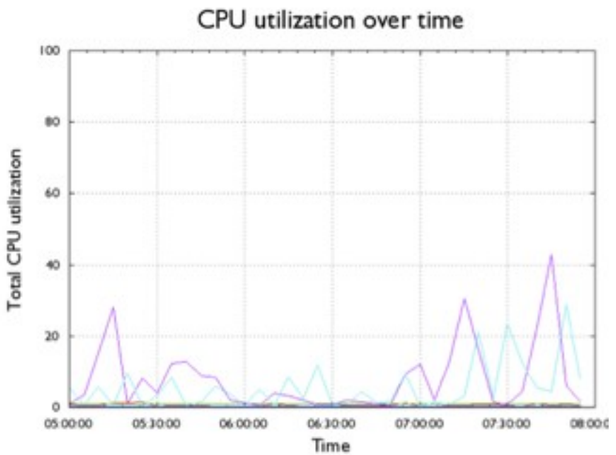
GLOBAL COMPOSITING

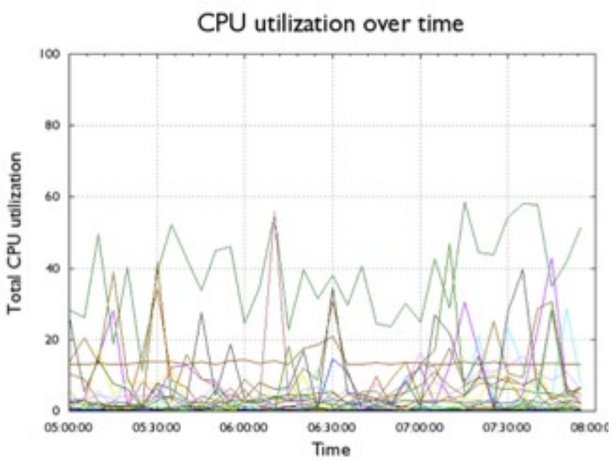
JOSEPH MINARD

1781-1870



OVERLAYS


CPU utilization over time
Total CPU utilization
Time
100
80
60
40
20
0
05:00:00
05:30:00
06:00:00
06:30:00
07:00:00
07:30:00


CPU utilization over time
Total CPU utilization
Time
100
80
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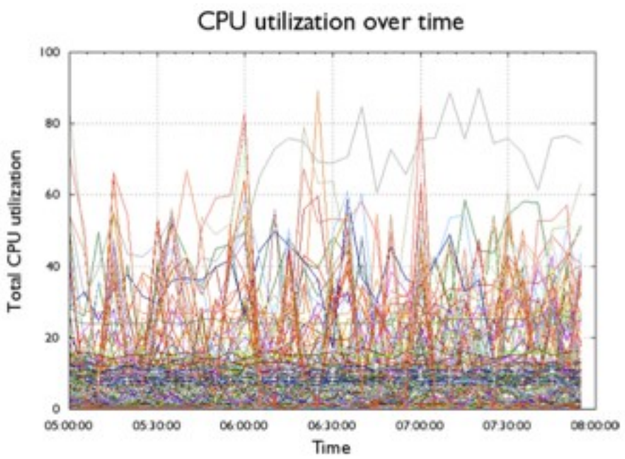
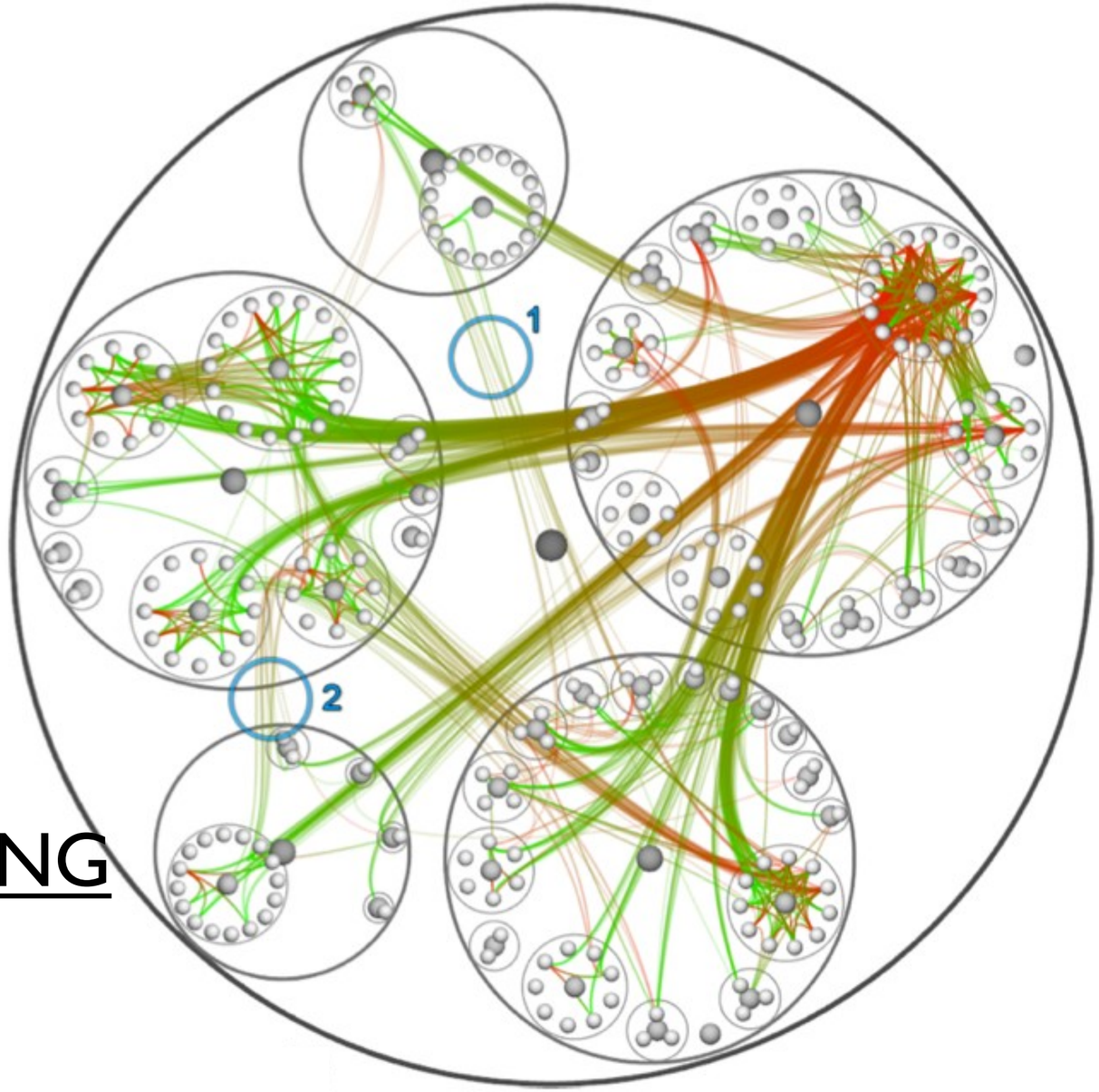
05:00:00
05:30:00
06:00:00
06:30:00
07:00:00
07:30:00

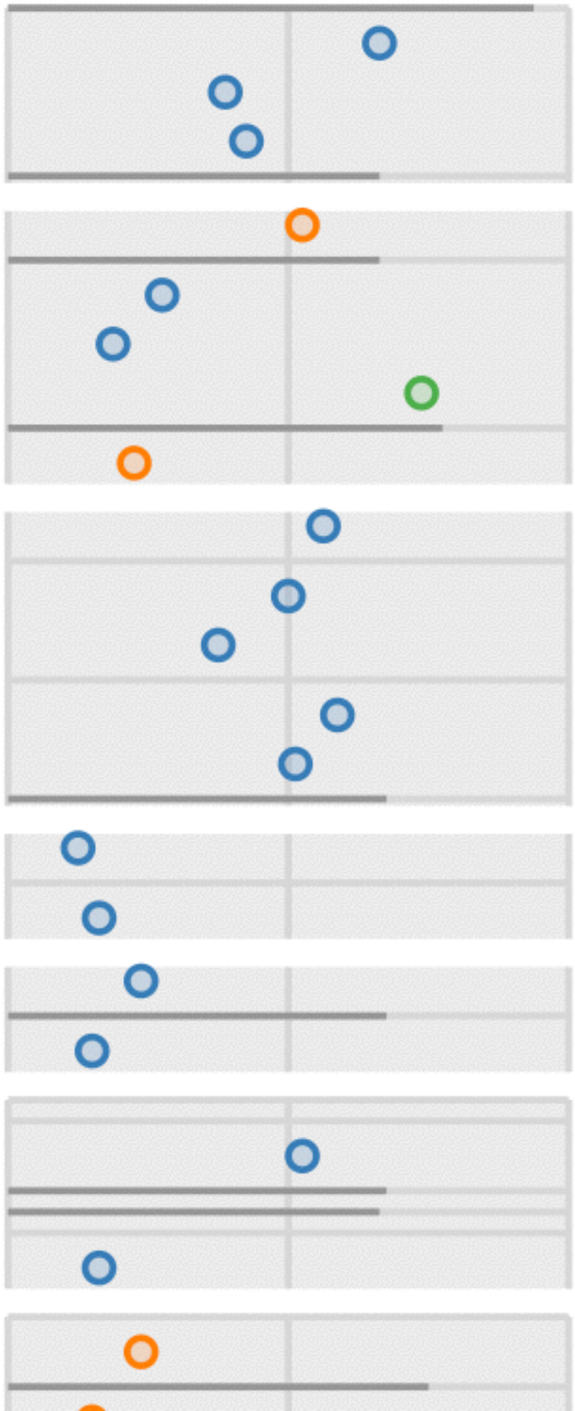

CPU utilization over time
Total CPU utilization
Time
100
80
60
40
20
0
05:00:00
05:30:00
06:00:00
06:30:00
07:00:00
07:30:00
08:00:00

EDGE BUNDLING



Holton 2006

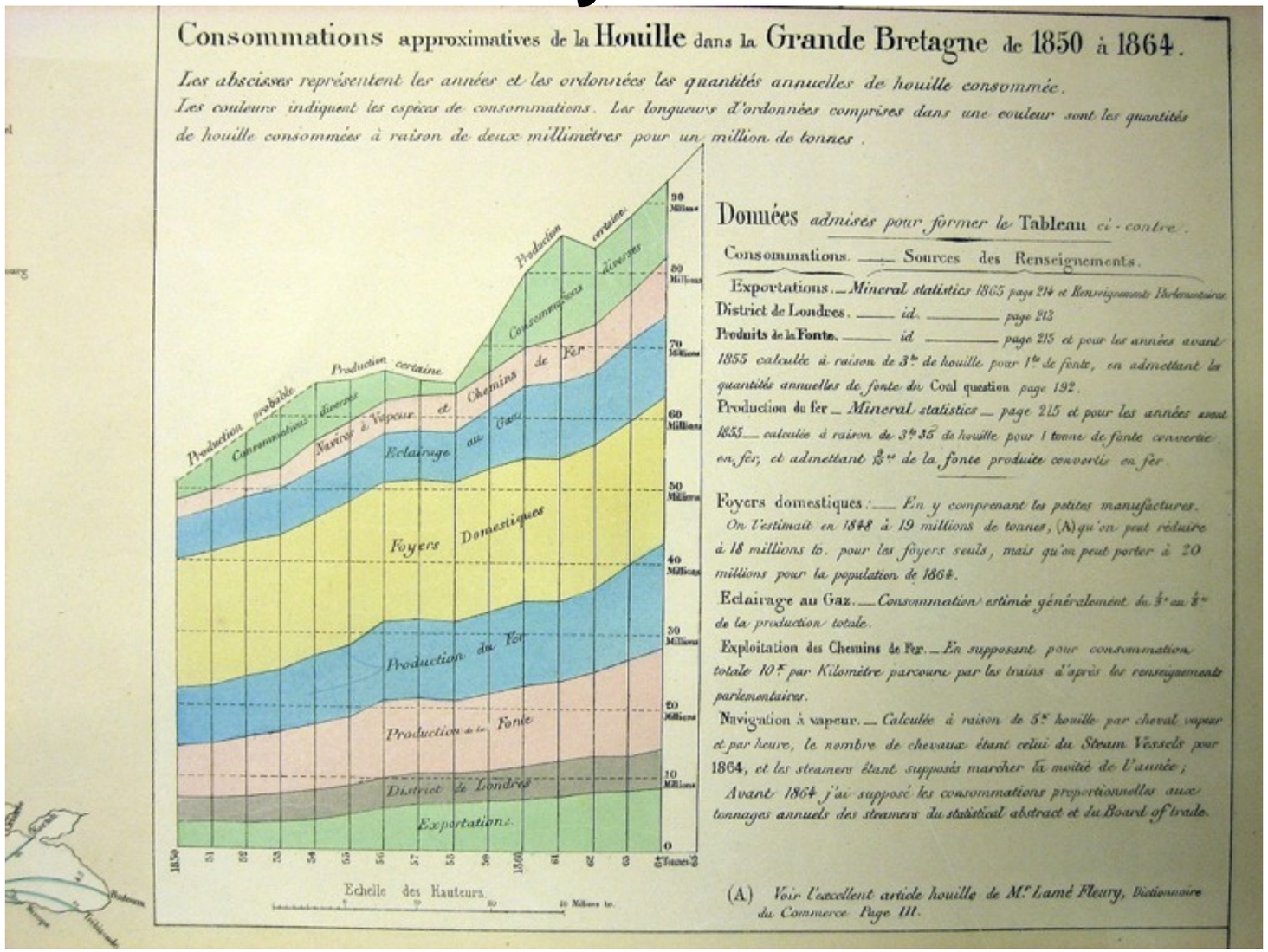
MULTIPLE ENCODINGS



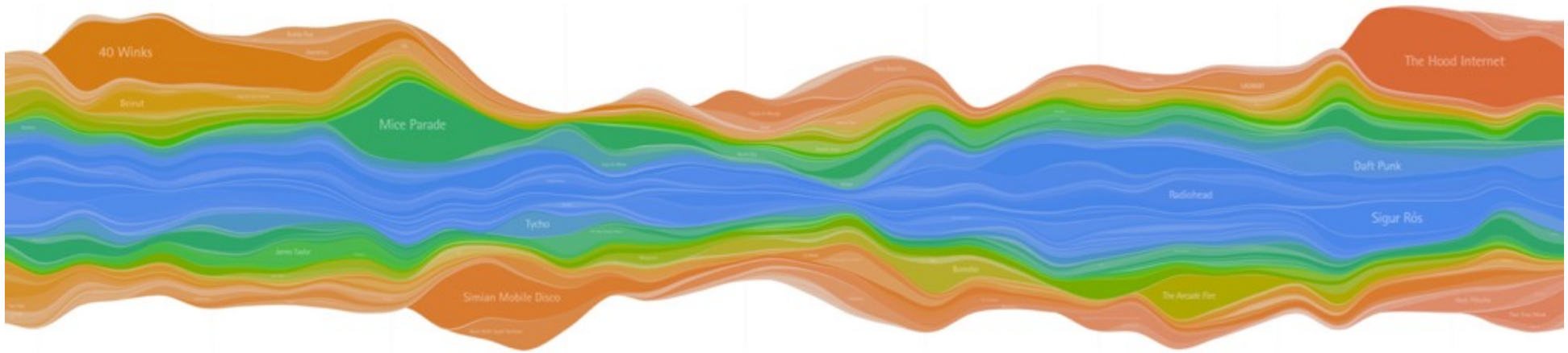
ITEM-LEVEL STACKING

1781-1870

JOSEPH MINARD



STREAMGRAPH



Byron 2008

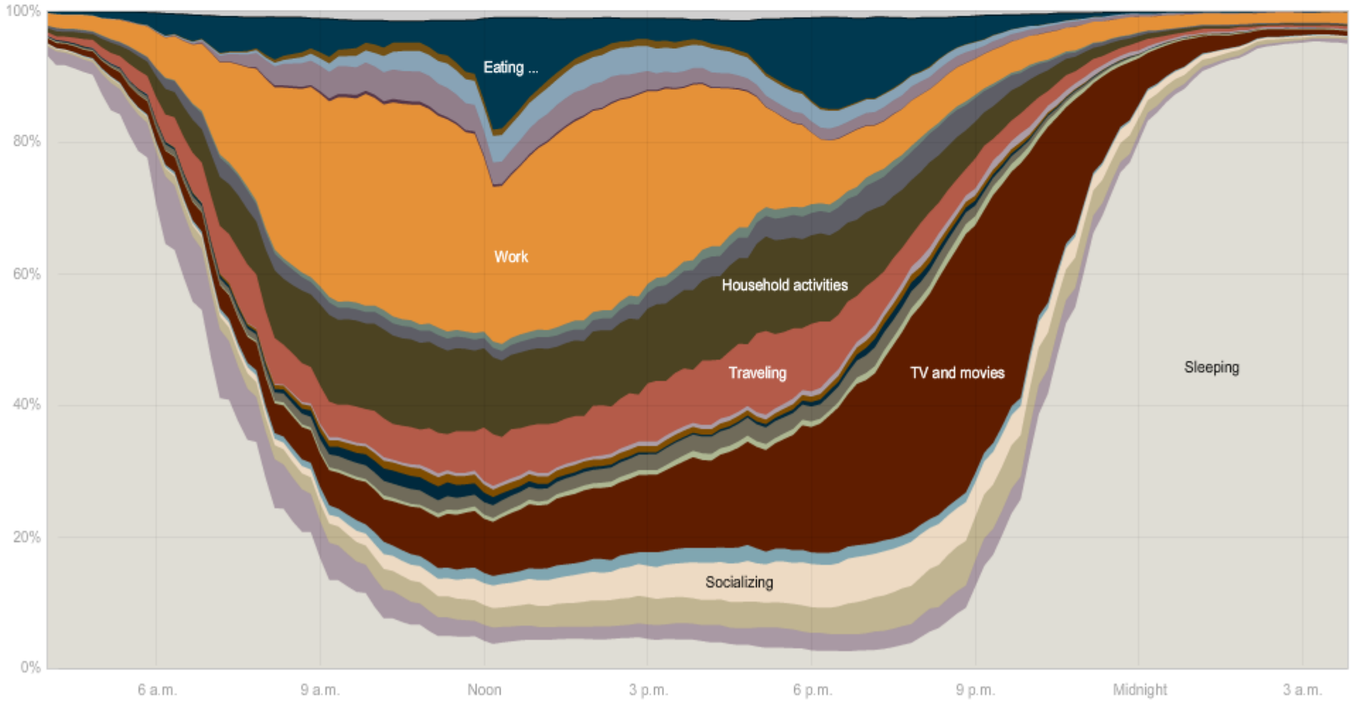
How Different Groups Spend Their Day

The American Time Use Survey asks thousands of American residents to recall every minute of a day. Here is how people over age 15 spent their time in 2008. Related article

Everyone

Sleeping, eating, working and watching television take up about two-thirds of the average day.

Everyone	Employed	White	Age 15-24	H.S. grads	No children
Men	Unemployed	Black	Age 25-64	Bachelor's	One child
Women	Not in lab...	Hispanic	Age 65+	Advanced	Two+ children



By SHAN CARTER, AMANDA COX, KEVIN QUEALY and AMY SCHOENFELD | Send Feedback

TWITTER LINKEDIN SHARE

FOCUS + CONTEXT

techniques to show detail (focus) and overview (context) simultaneously

requires: carefully pick what to show and hinting at what you are not showing

FOCUS + CONTEXT

synthesis of visual encoding and interaction

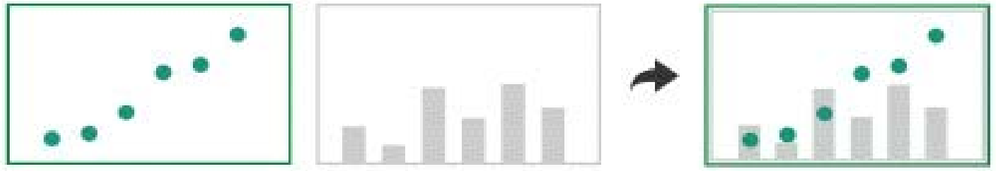
user selects region of interest (focus) through navigation or selection

provide context through aggregation, reduction, or layering

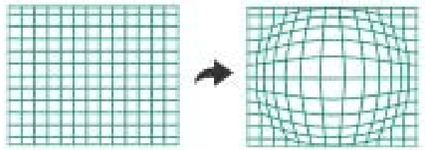
FOCUS+CONTEXT

- **Embed**
  - Elide Data

  - Superimpose Layer



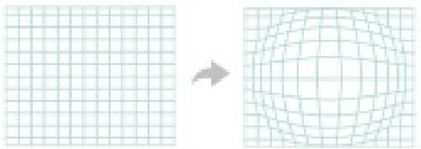
  - Distort Geometry



- Embed
  - Elide Data

  - Superimpose Layer

  - Distort Geometry



<u>ELISION</u>

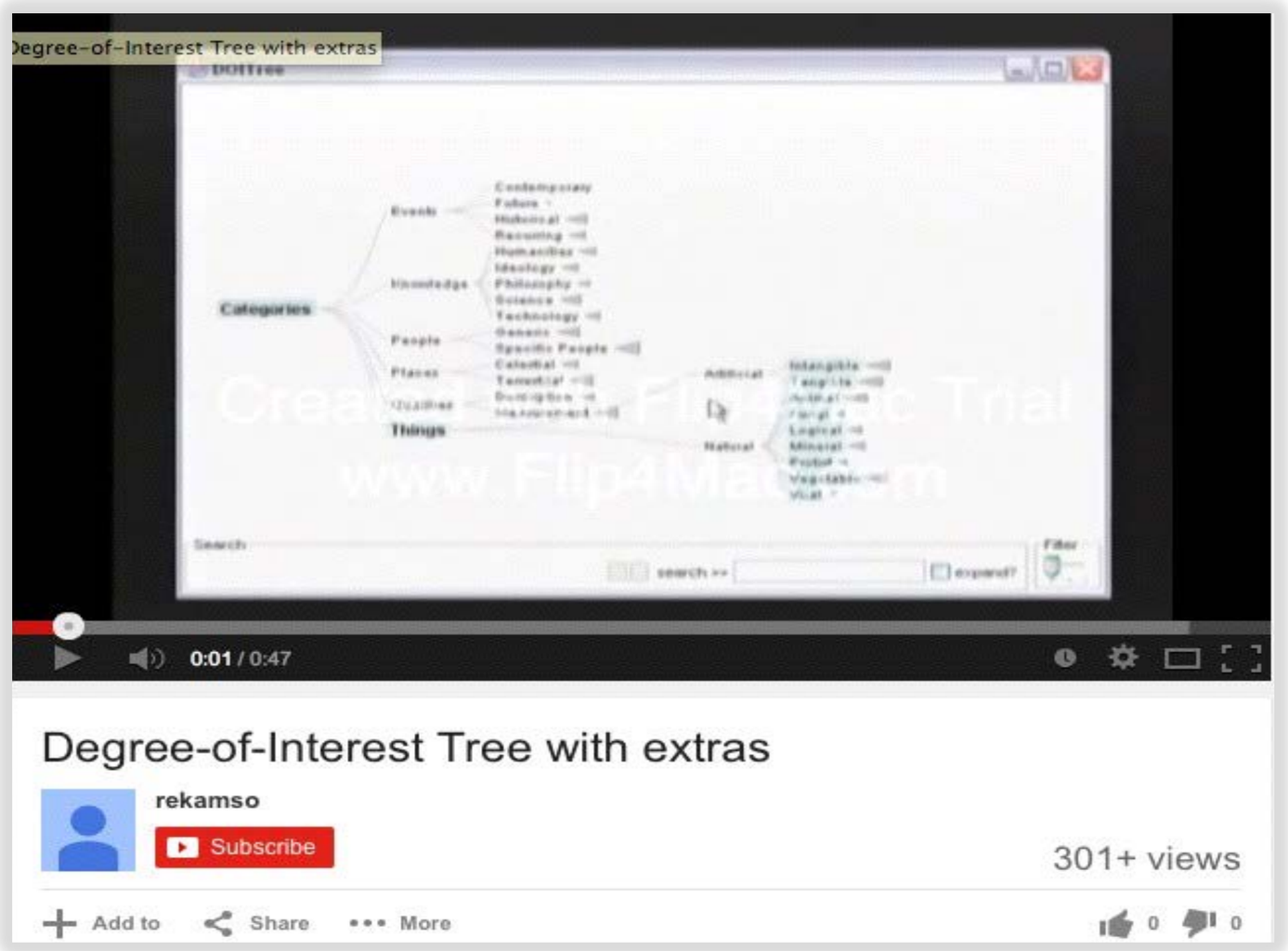
means "suppression"

focus items shown in detail, other items summarized (suppressed) for context

SPACETREE

Grosjean 2002

DOITREE



Heer 2004

DOI

degree of interest

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

Furnas 1986

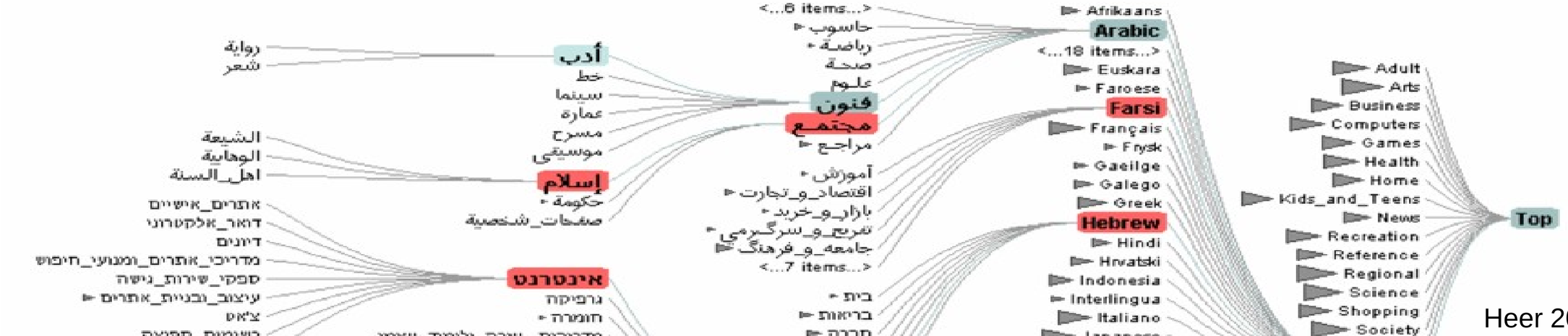
DOITREE

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

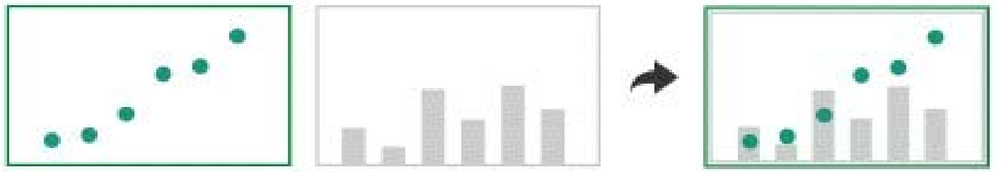


Heer 2004

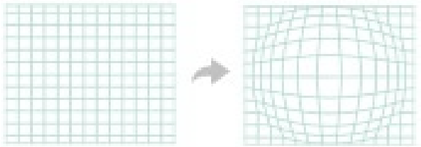
Embed

- Elide Data

- Superimpose Layer



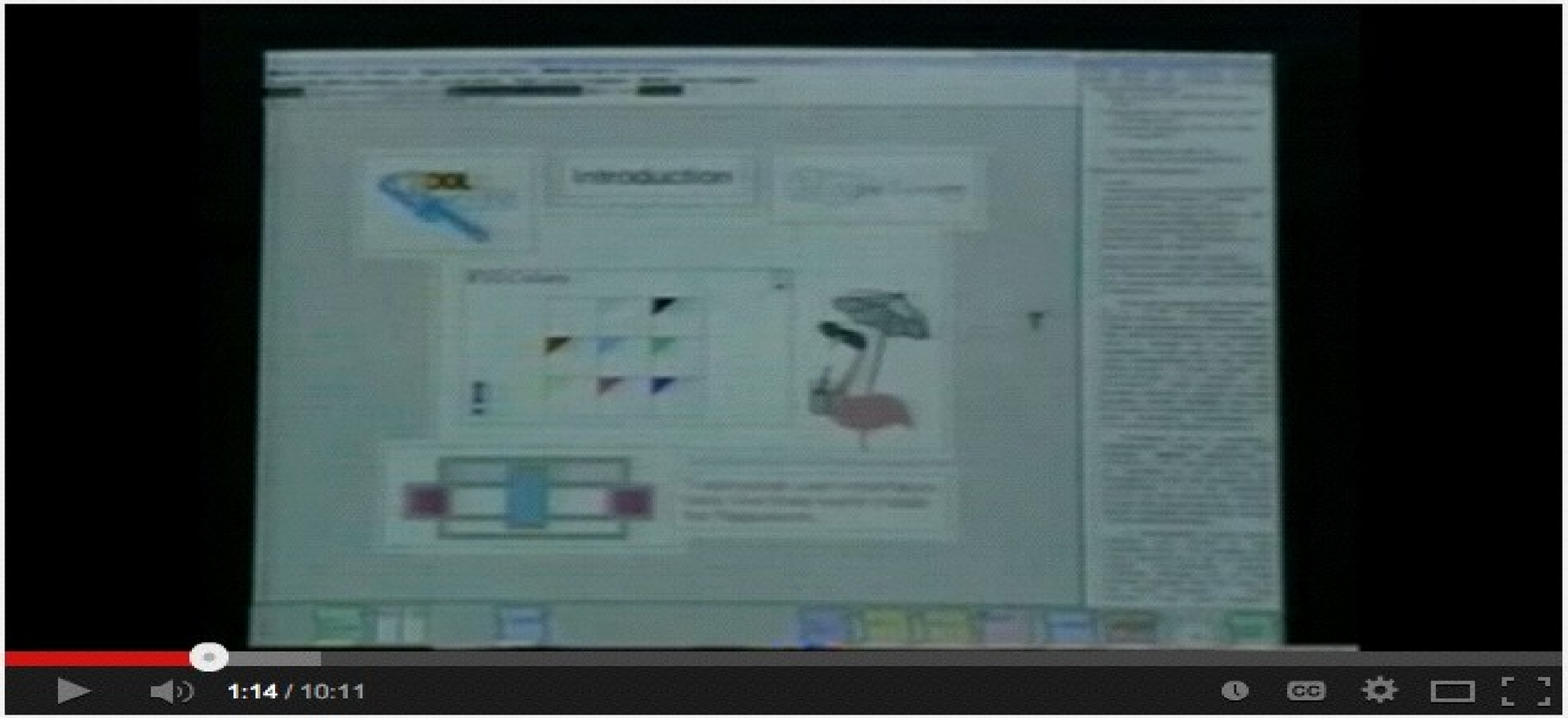
- Distort Geometry



SUPERIMPOSE

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

Toolglass & Magic Lenses



Toolglass & Magic Lenses: The See-Through Interface

tabletopresearch201

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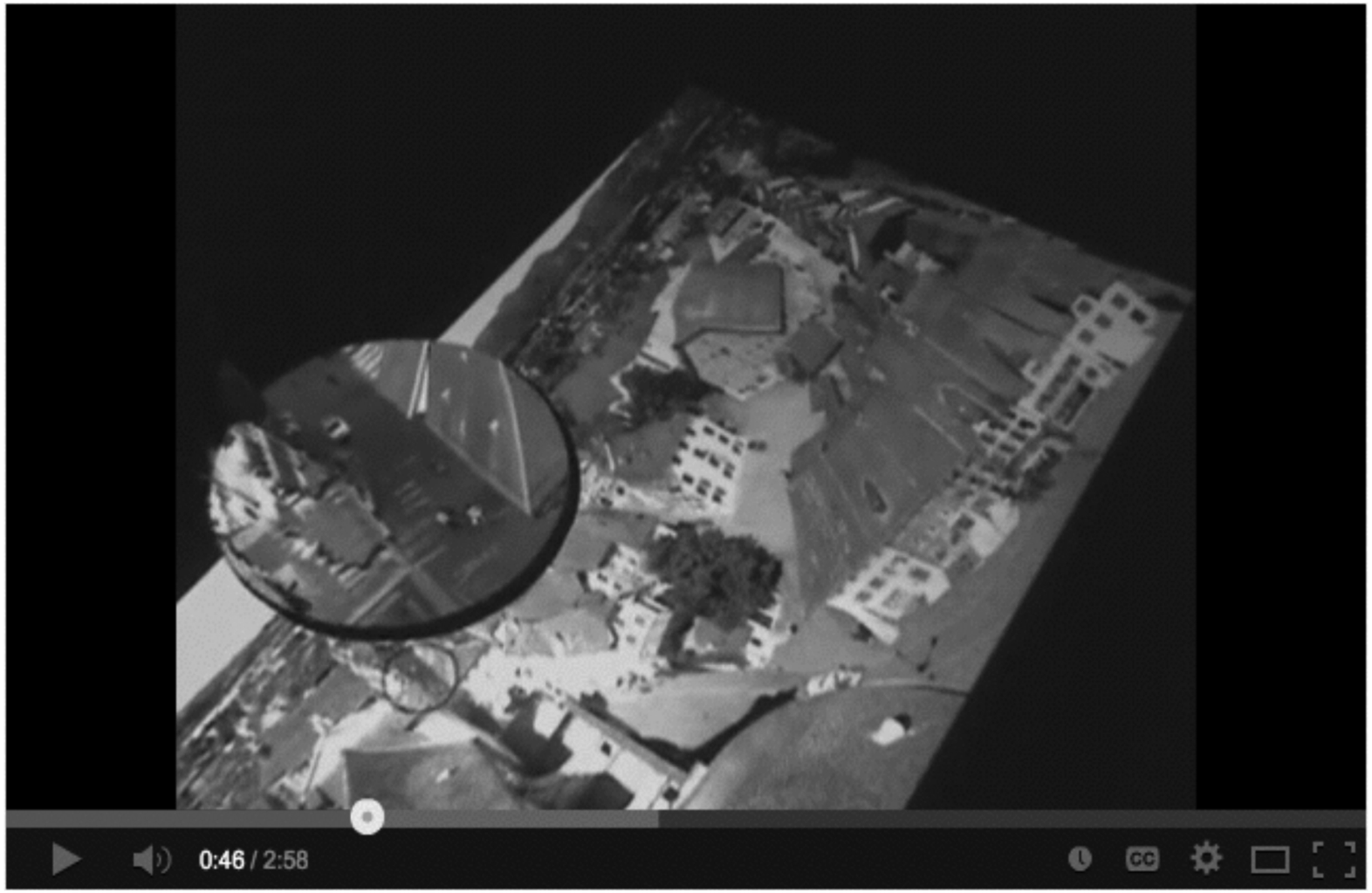
Exploring Information Spaces by Using Tangible IMagic Lenses in a Tabletop Environment



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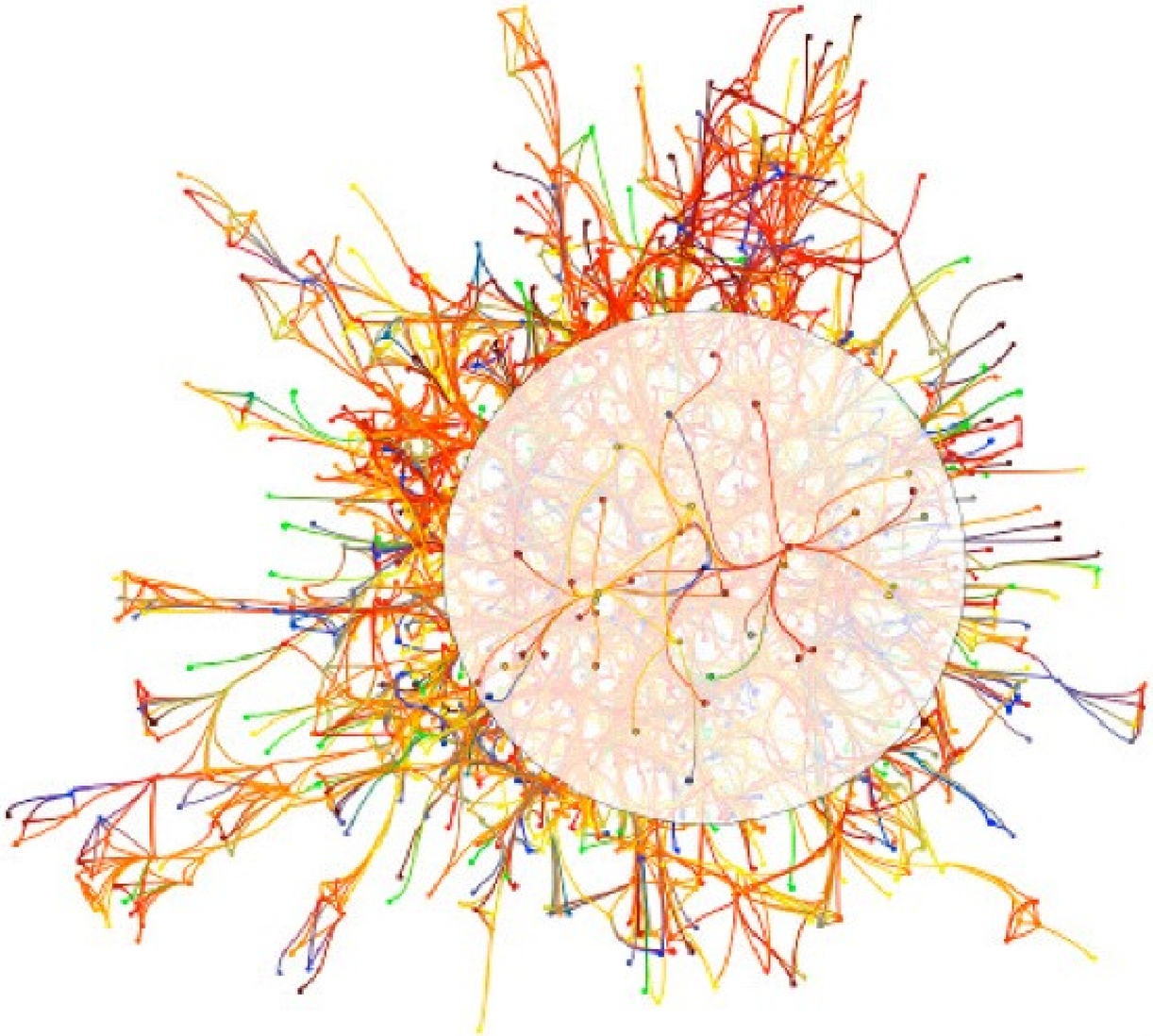
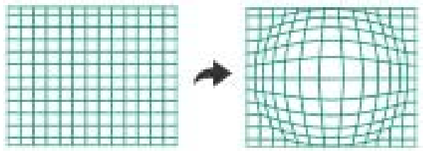


highlight | suppress

- Embed
  - Elide Data

  - Superimpose Layer

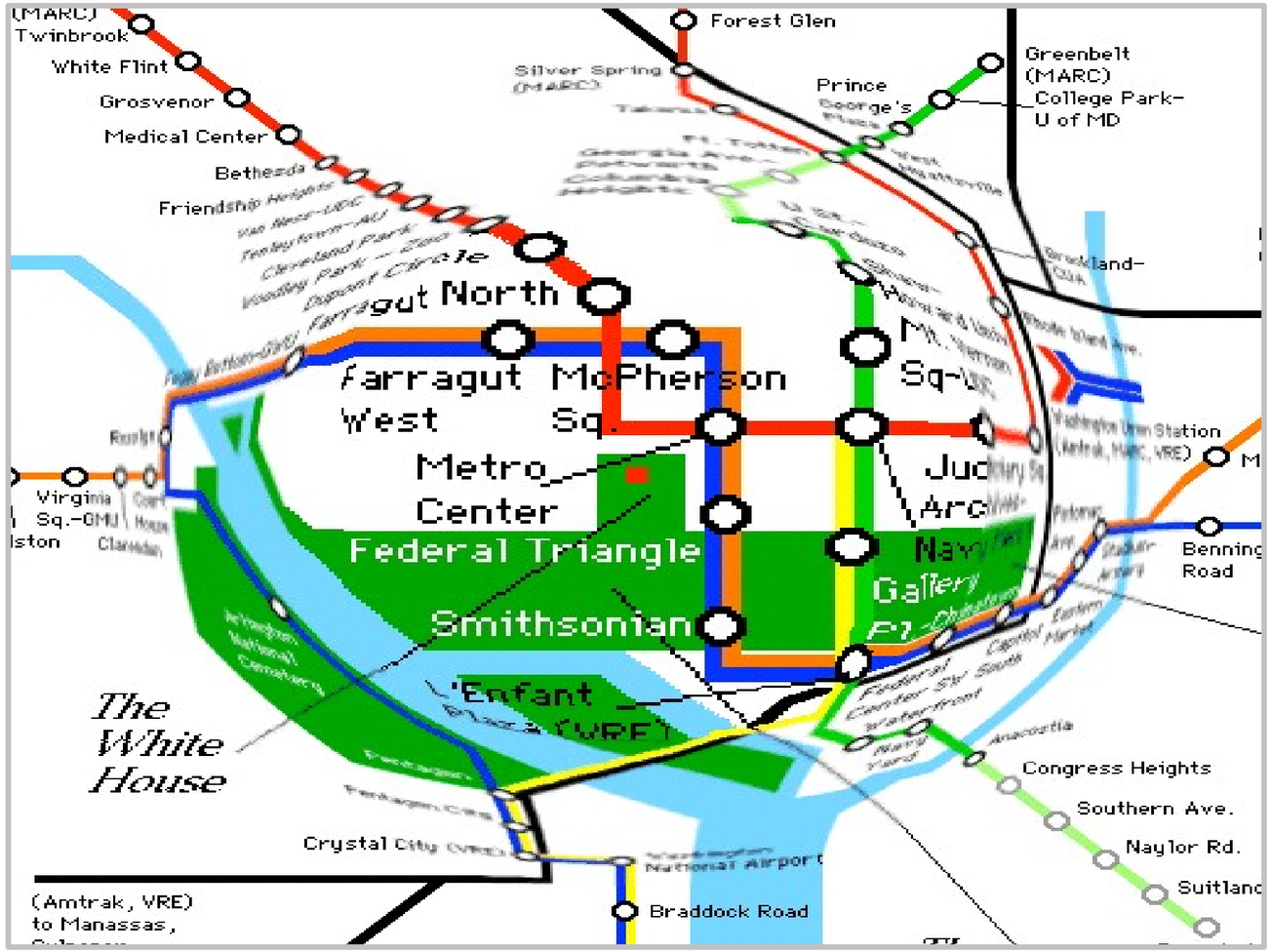
  - Distort Geometry



DISTORT

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

FISHEYE



http://www.cs.umd.edu/class/fall2002/cmsc838s/tichi/fisheye.html

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– VIDEOS

Unfolding - Fisheye and Zoom lens example

Fisheye Tree View

ctominski

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HYPERBOLIC GEOMETRY

DISTORTION CONCERNS

unsuitable for relative spatial judgments

overhead of tracking distortion

visual communication of distortion

gridlines, shading

DISTORTION CONCERNS (CONT.)

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

REMINDERS

project 2 due Tuesday

reading for Tuesday

A. Cockburn, et al. "A review of overview+detail, zooming, and focus+context interfaces."