Multivariate visualization II

C. Andrews

2014-04-03

Multivariate questions

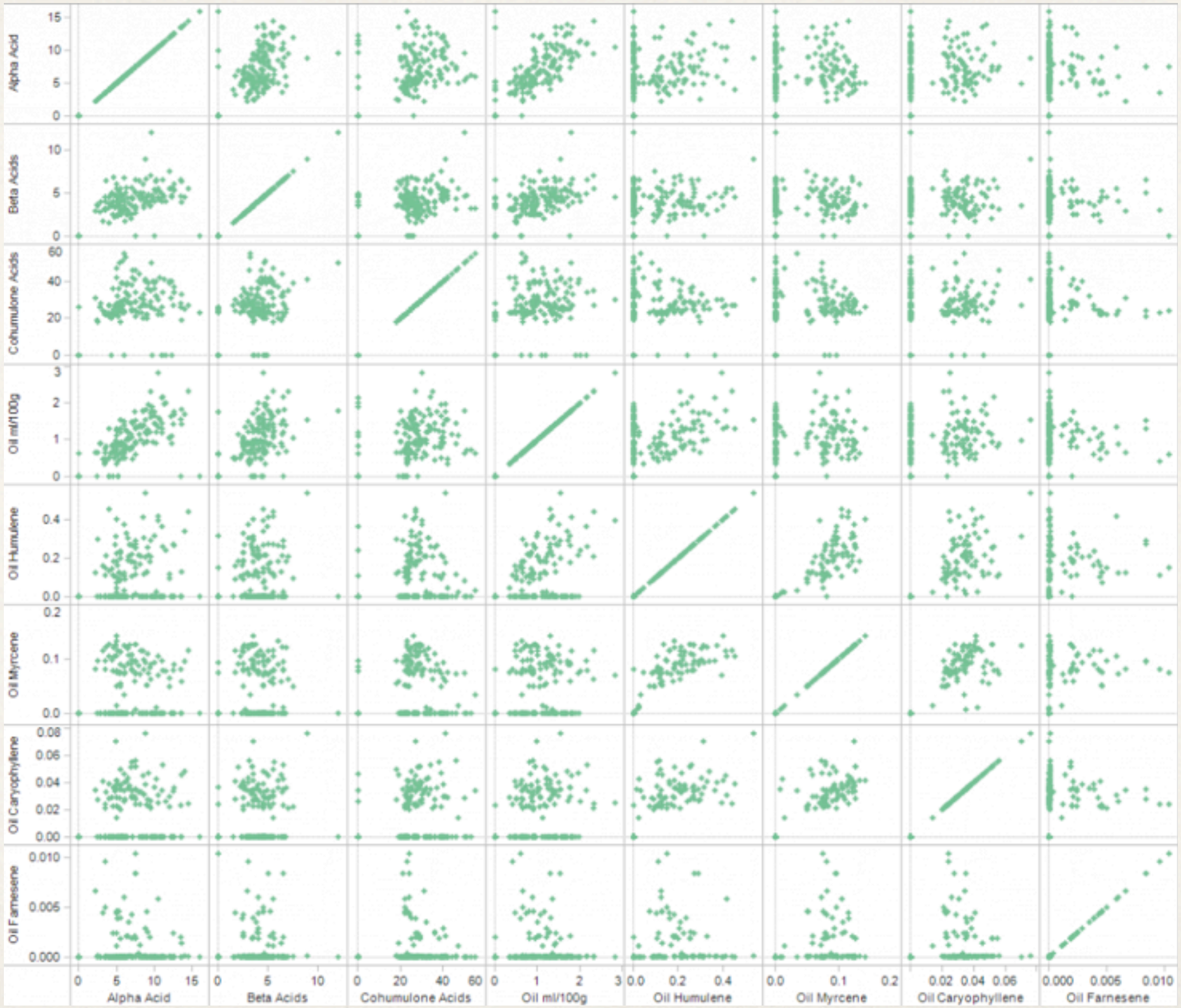
Which items are most alike?

Which items are most exceptional?

How can these items be combined into logical groups based on similarity?

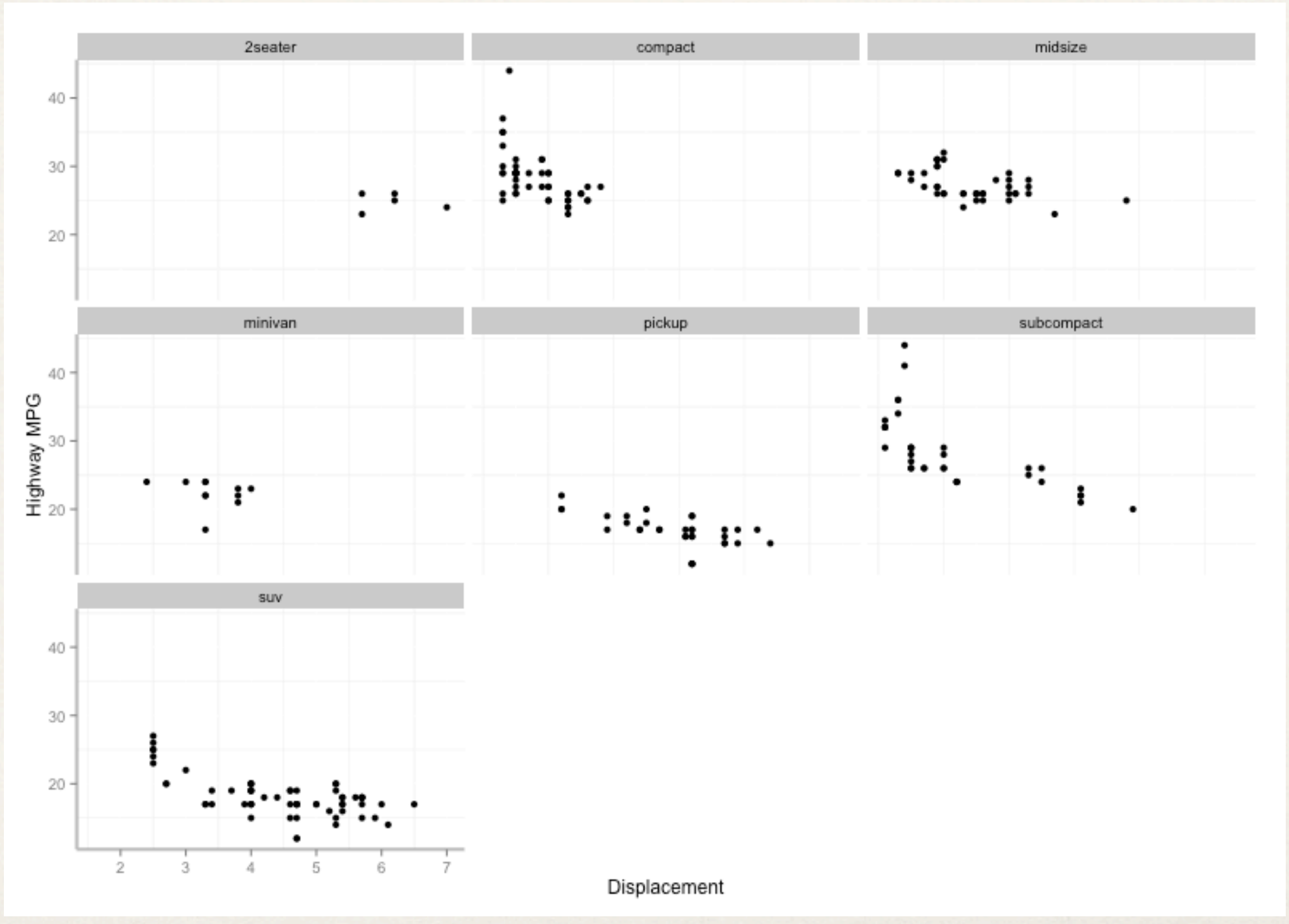
Few, “Now You See It”

Scatterplot matrix

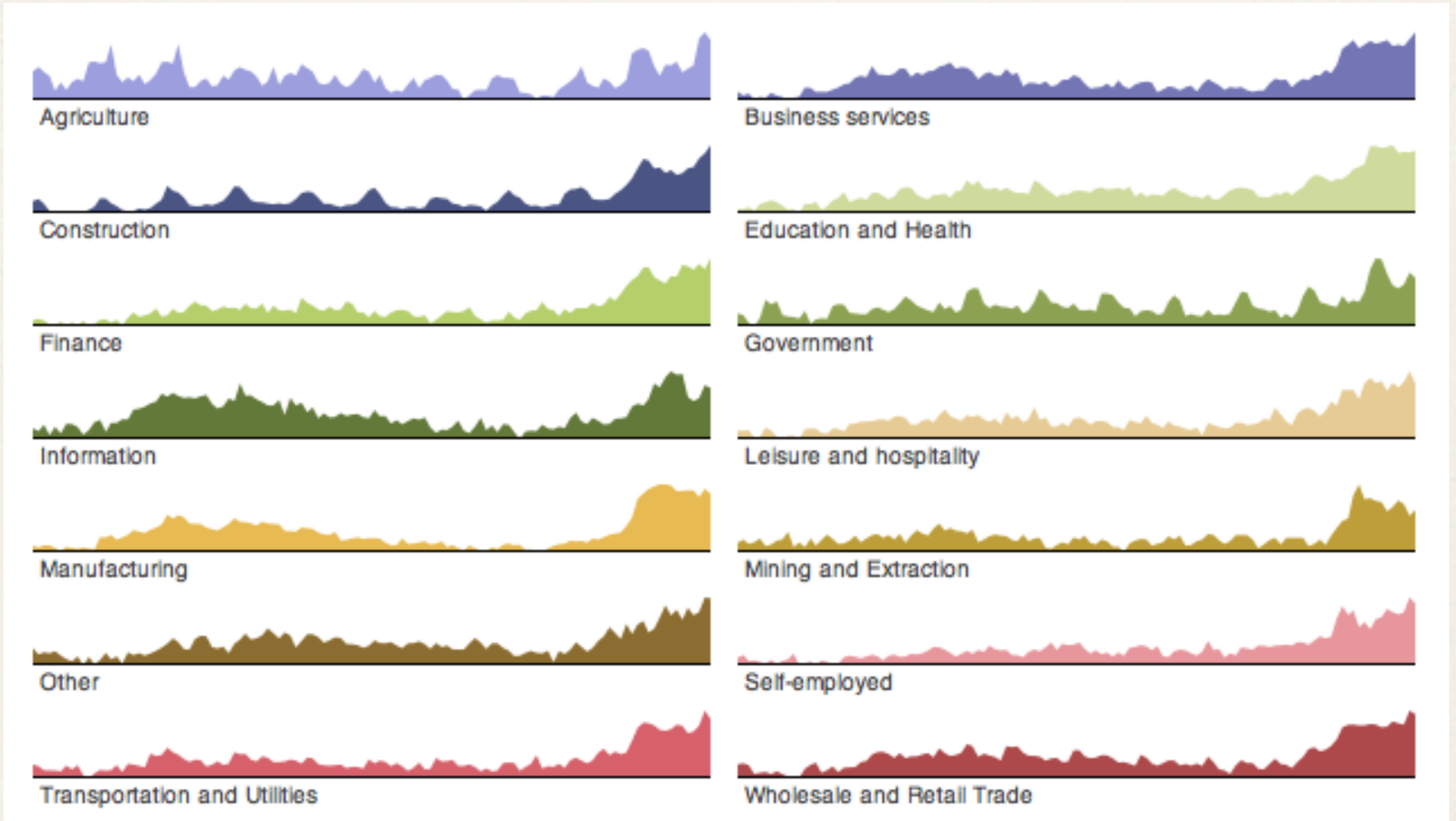


http://ericksondata.com/wp/2012/150-varieties-of-hops/

Trellis plot

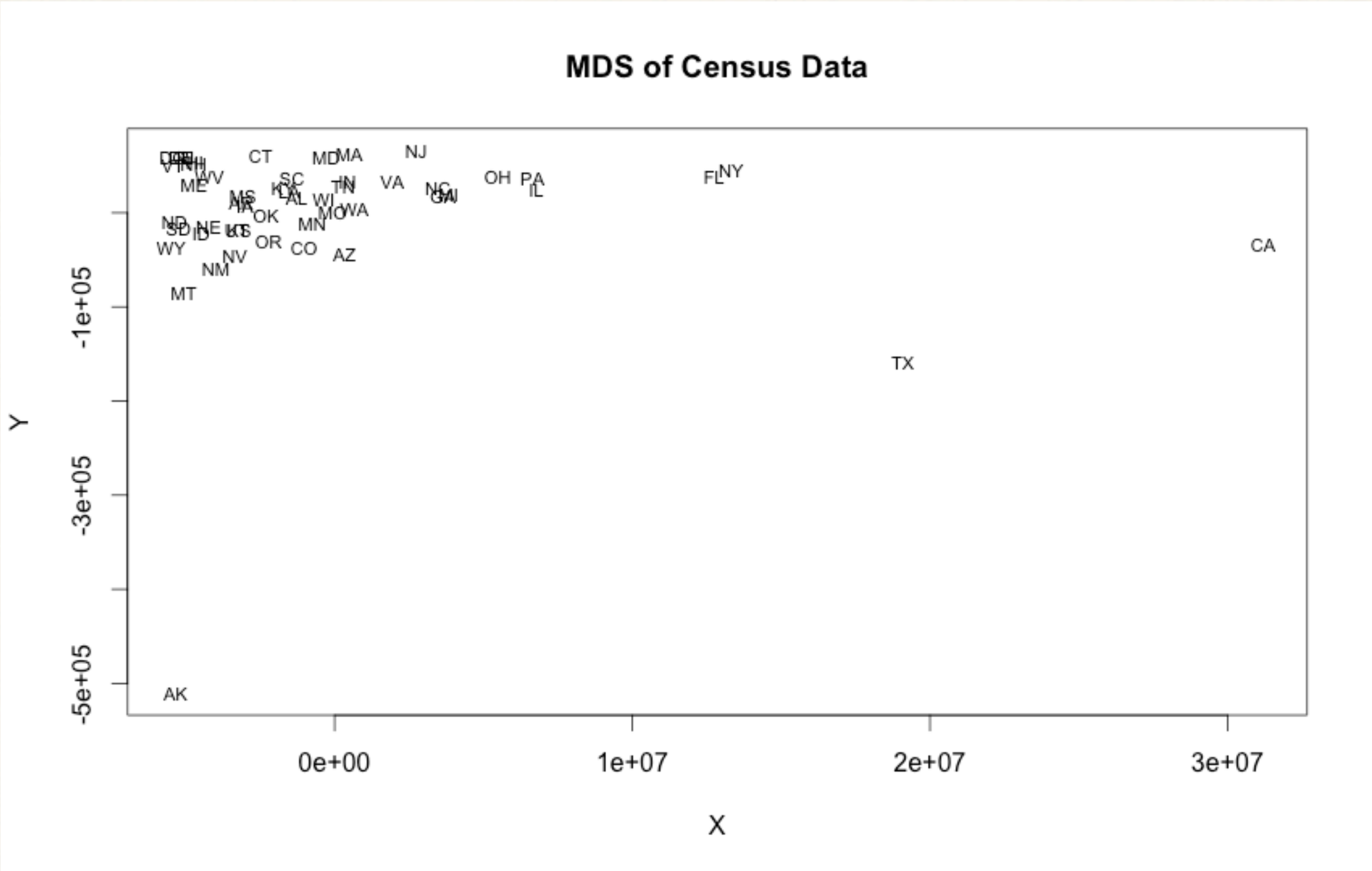


Small multiples

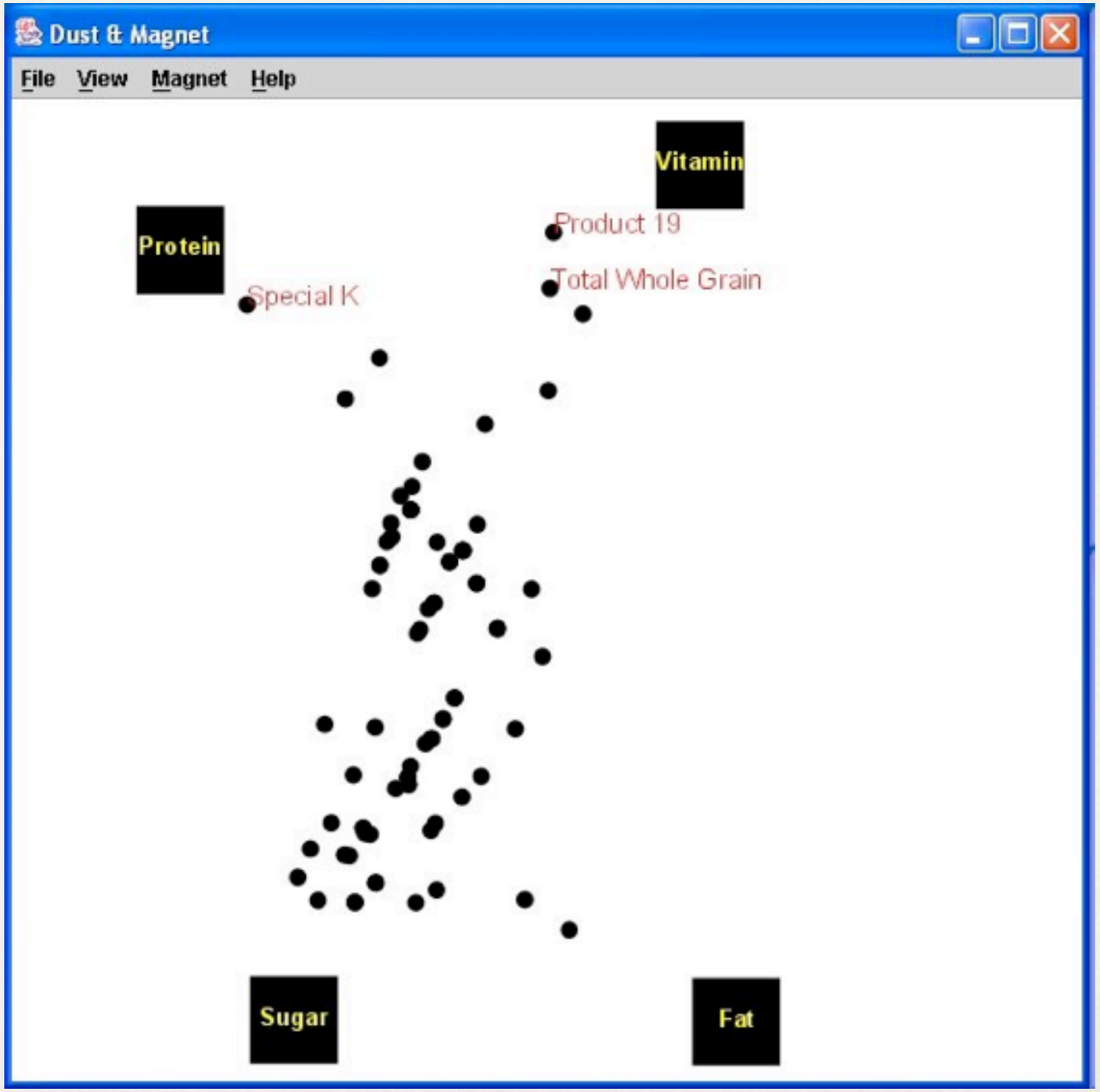


Heer et al., "A Tour Through the Visualization Zoo"

Multidimensional scaling

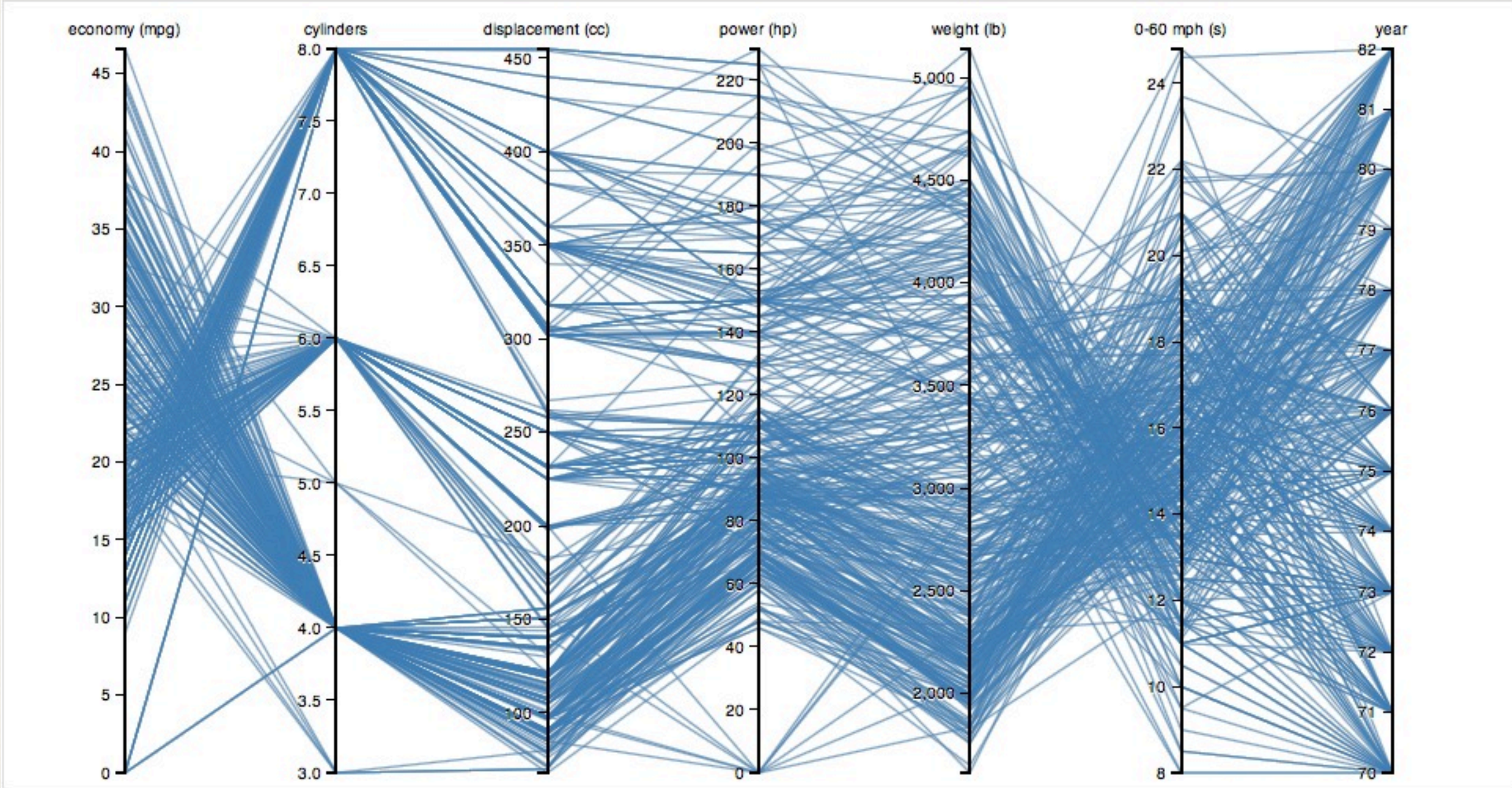


Dust & Magnet



Yi, Melton, Jacko, Stasko, "Dust & Magnet: Multivariate Information Visualization using a Magnet Metaphor"

Parallel Coordinates in D3

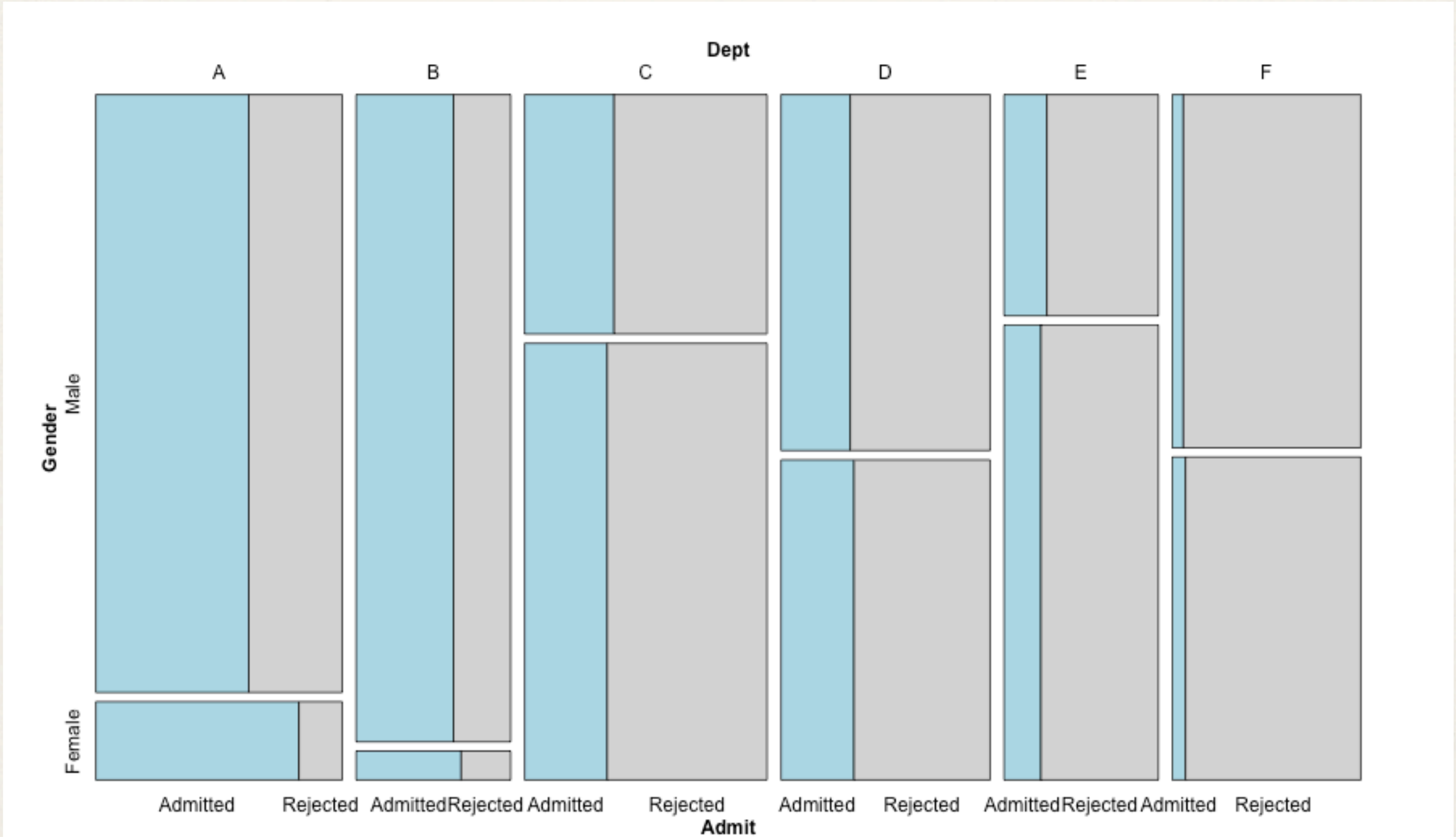


http://bl.ocks.org/jasondavies/1341281

Parallel Sets

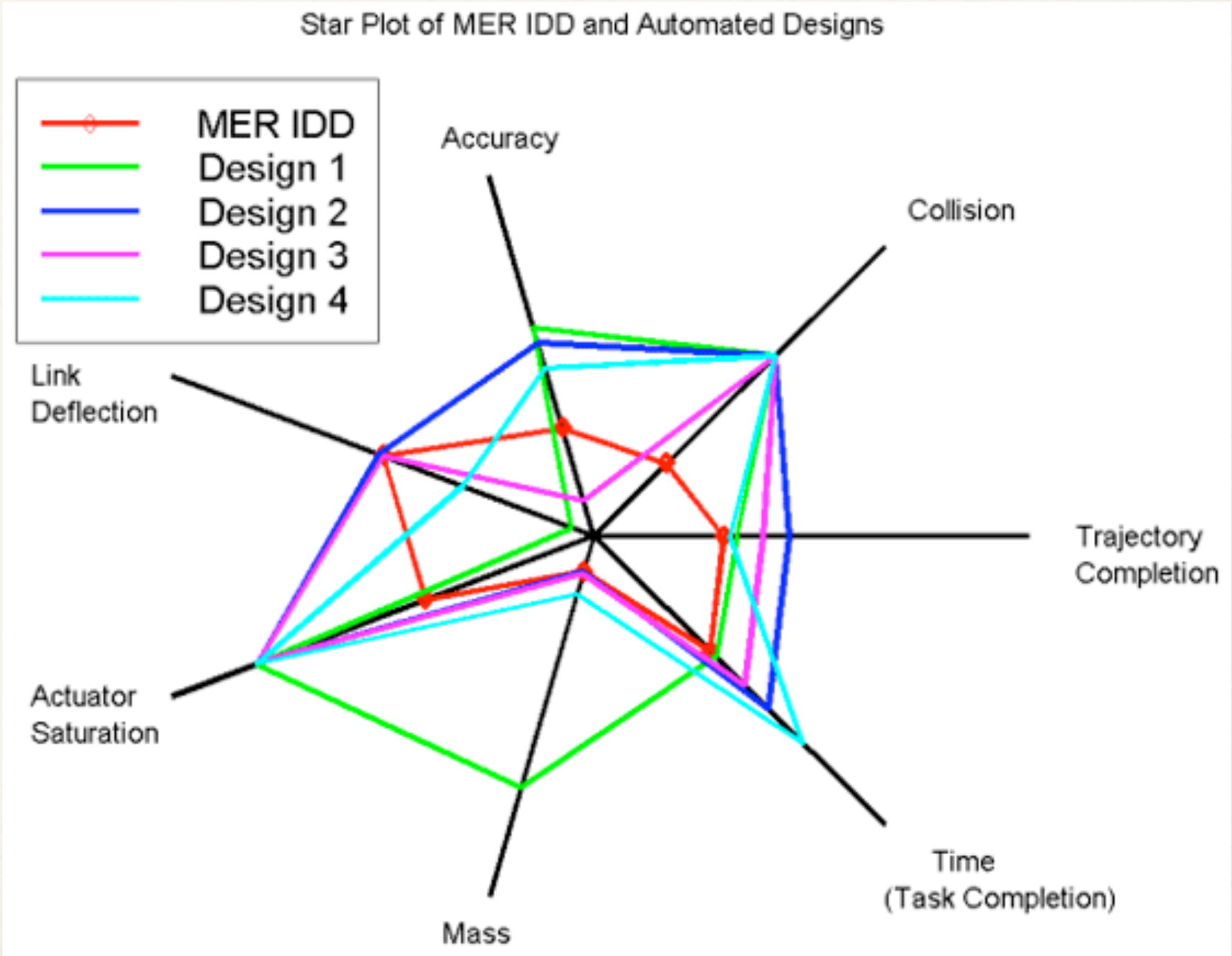
Kosara et al. “Parallel sets: Interactive exploration and visual analysis of categorical data”

Aside: Simpson's paradox



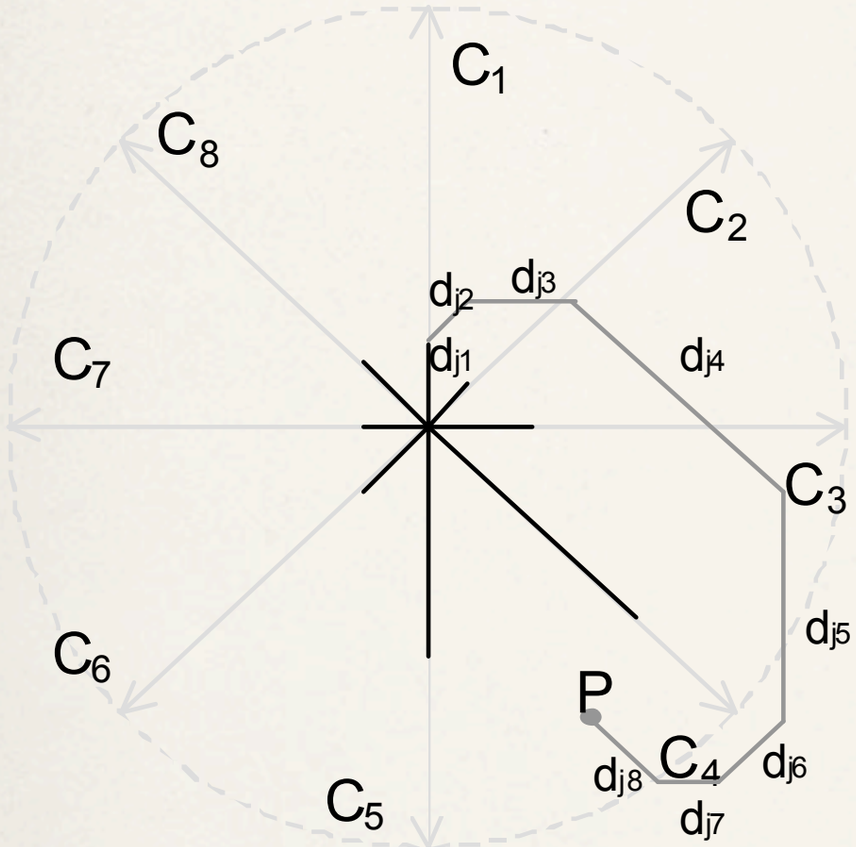
Radar chart

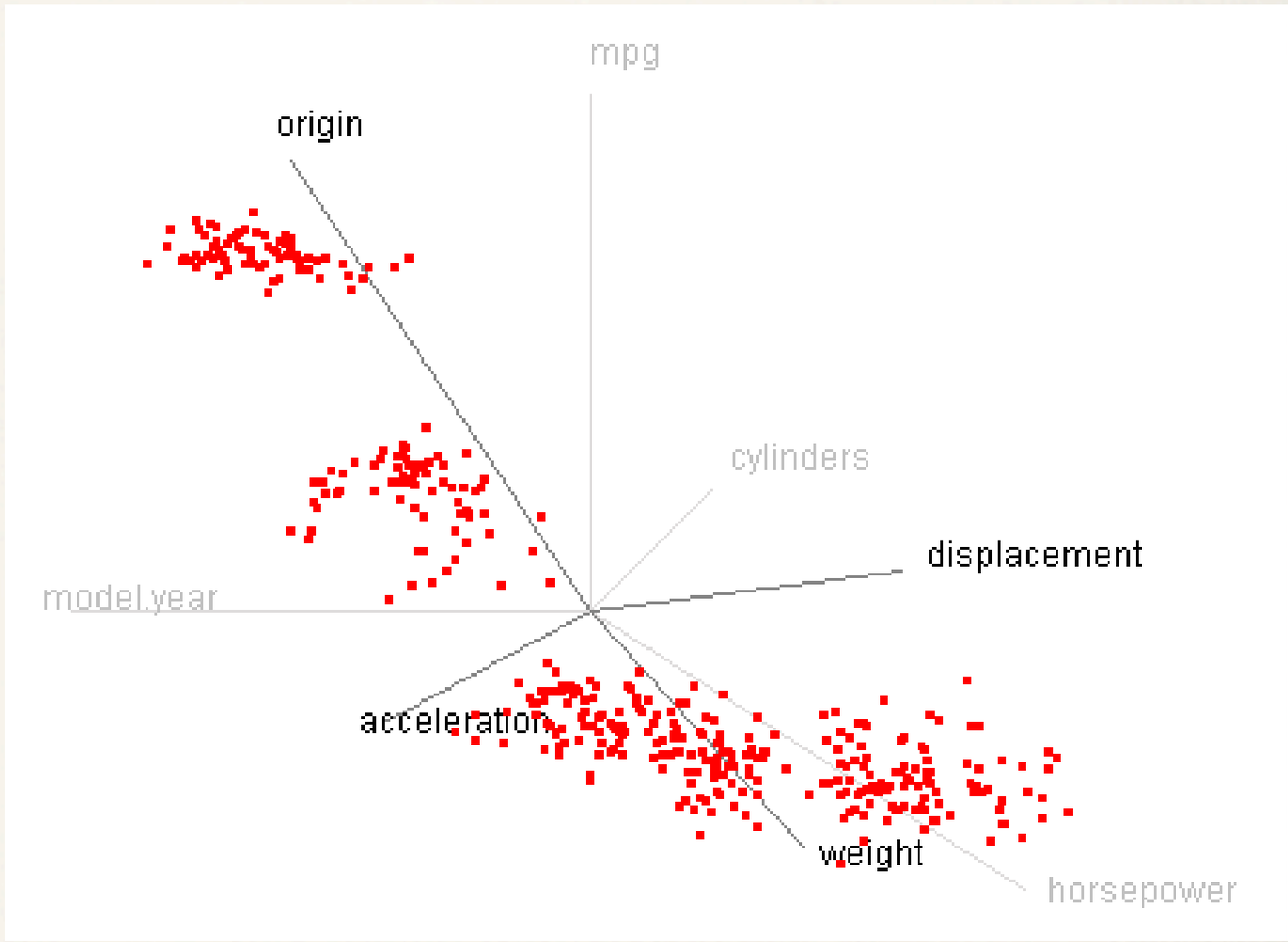
...or
star plot
polar chart
spider chart
cobweb chart
web chart...



Wikimedia Commons

Star Coordinates

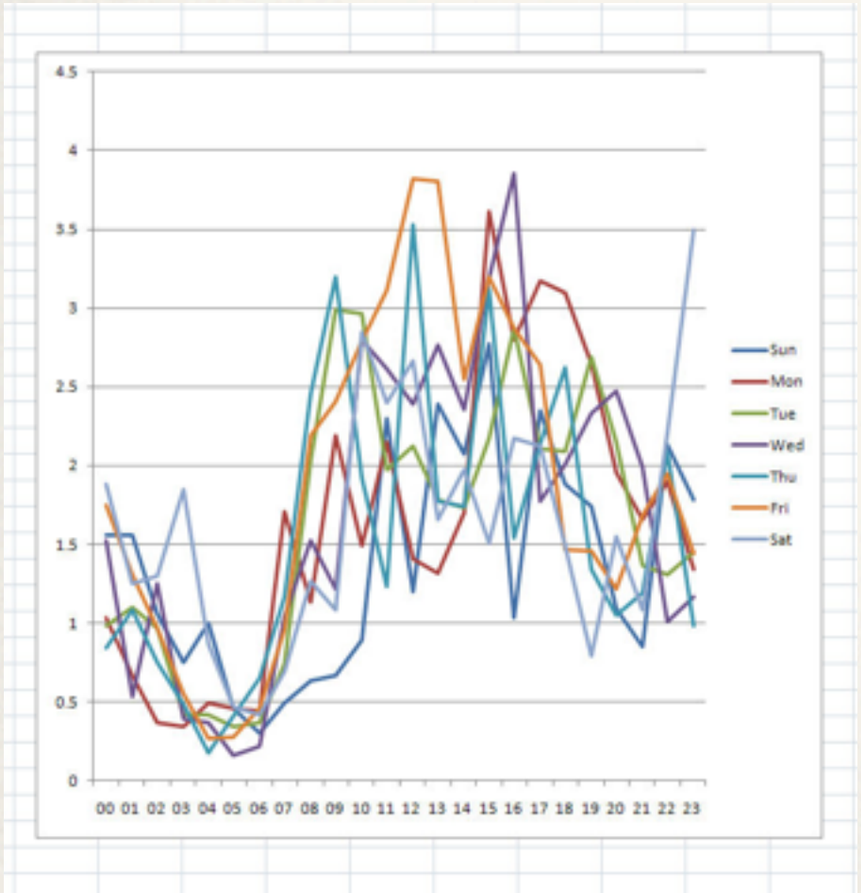




Kandogan, "Star Coordinates: A Multi-dimensional Visualization Technique with Uniform Treatment of Dimensions"

Heatmap

	Sun	Mon	Tue	Wed	Thu	Fri	Sat
0000	2.59	0.66	0.68	1.35	1.35	2.03	1.6
0100	1.39	0.7	0.95	1.22	1.08	1	2.12
0200	2.87	0.59	1.02	1.22	0.57	1.08	3
0300	0.99	0.25	0.5	0.48	0.5	0.99	1.7
0400	1.06	0.42	0.17	0.56	0.24	0.3	0.48
0500	0.32	0.23	0.39	0.22	0.47	0.47	0.44
0600	0.42	0.41	0.57	0.6	0.64	0.5	0.49
0700	0.38	1.29	0.77	0.86	1.42	1.14	1.22
0800	0.53	1.05	1.77	1.56	1.32	1.58	1.67
0900	0.62	2.04	2.97	1.45	2.96	1.92	2.32
1000	1.37	2.09	3.67	1.87	2.52	1.47	2.29
1100	0.98	3.27	1.6	3.32	2.89	2.09	1.27
1200	1.81	3.41	2.66	2.7	3.24	2.84	1.35
1300	2.38	1.79	2.15	1.91	1.64	1.43	2.49
1400	2.31	2.69	3.19	2.98	2.85	3.69	1.17
1500	1.44	1.46	1.44	3.46	1.55	3.55	2.35
1600	1.18	2.61	3.74	3.21	2.76	1.98	1.84
1700	1.52	3.45	1.4	1.99	1.79	3.33	2.1
1800	2.09	2.53	1.64	1.37	3.15	3.1	1.21
1900	2.67	1.2	1.44	2.04	2.58	1.16	2.34
2000	1.5	2.31	2.58	1.89	2.76	1.96	1.75
2100	0.81	1.7	1.97	1.76	0.99	3.16	1.92
2200	1.24	1.91	1.97	1.48	2.22	2.93	1.63
2300	1.69	1.55	1.74	1.29	2.01	1.97	3.87



Heatmap

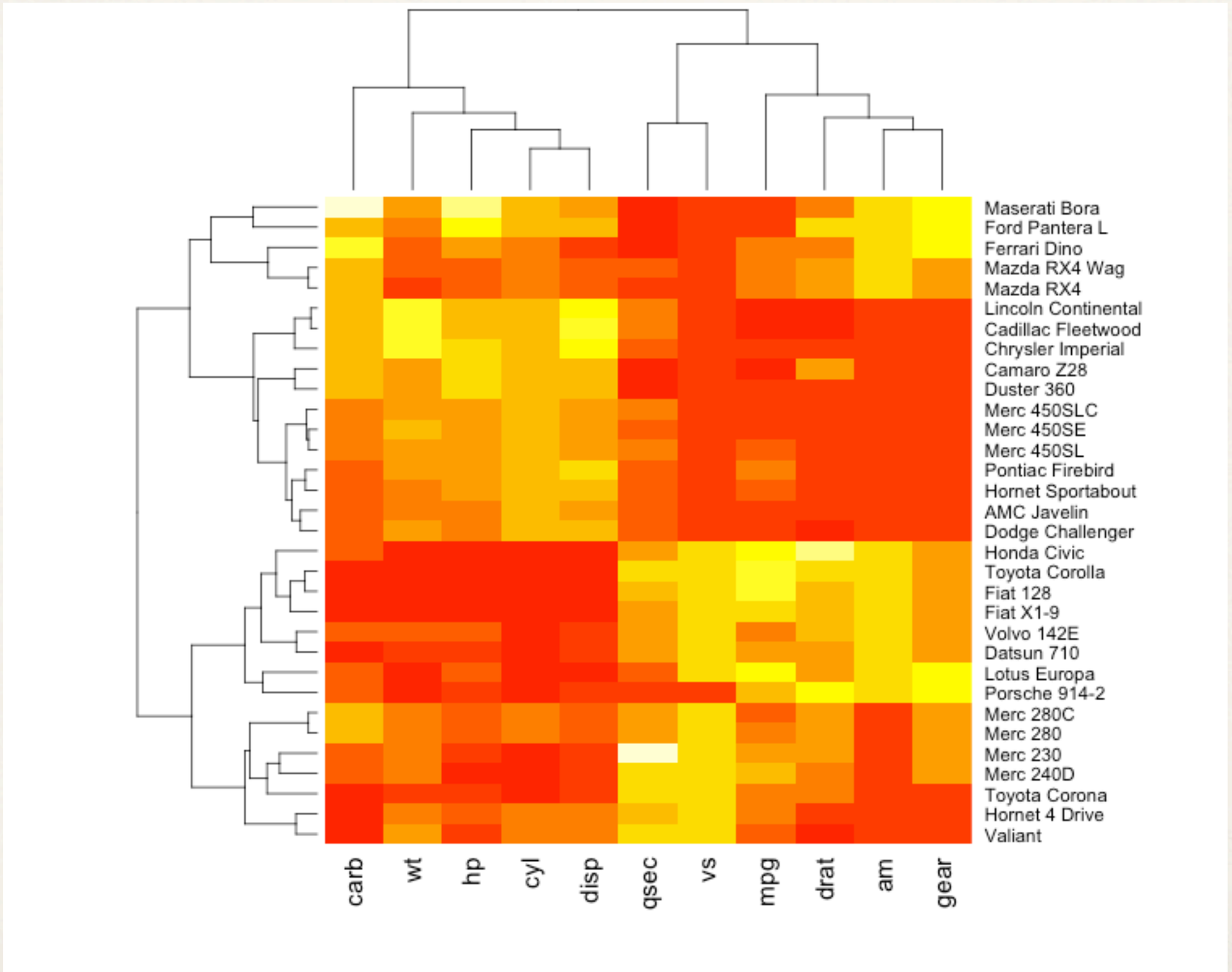
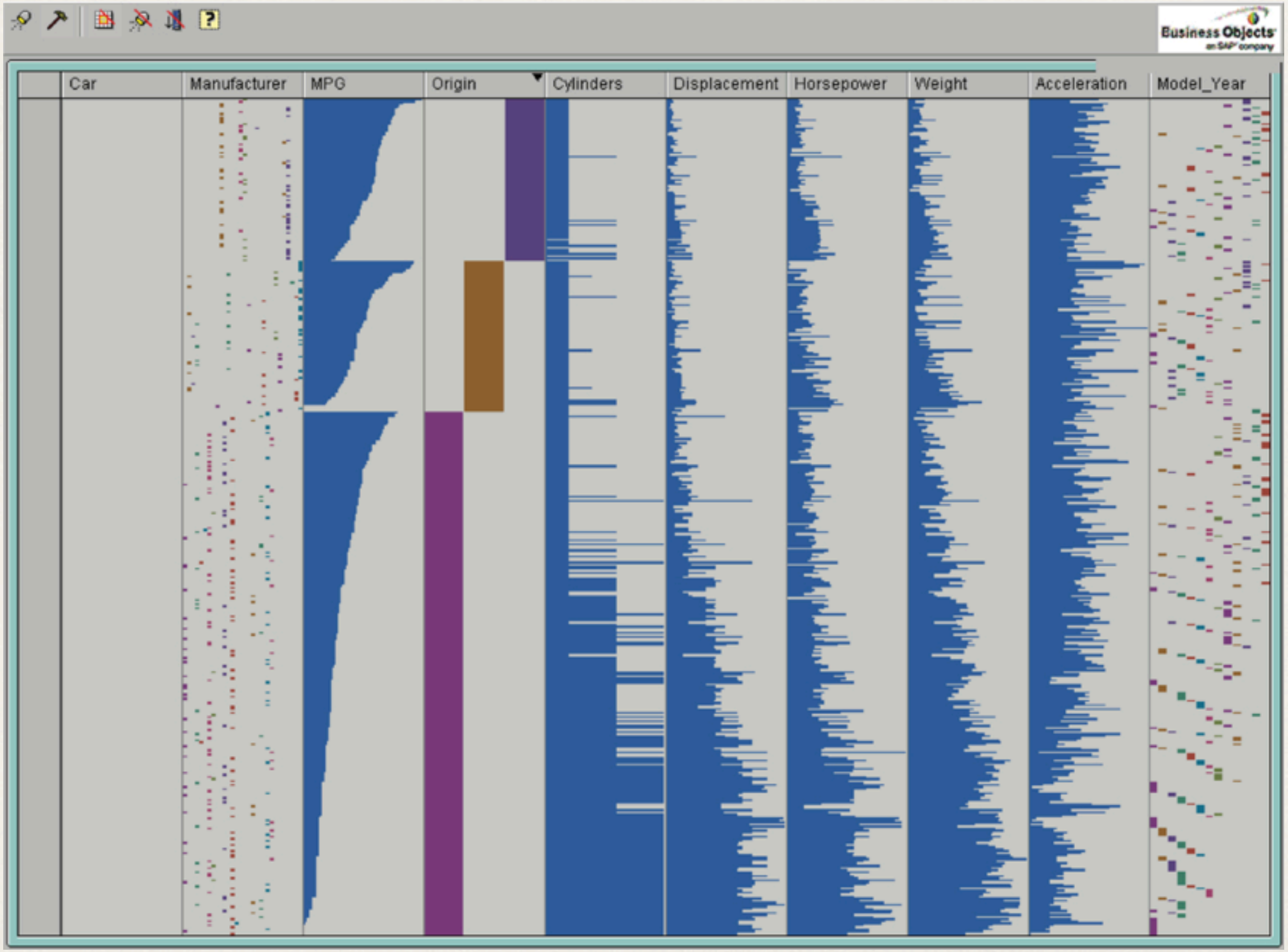
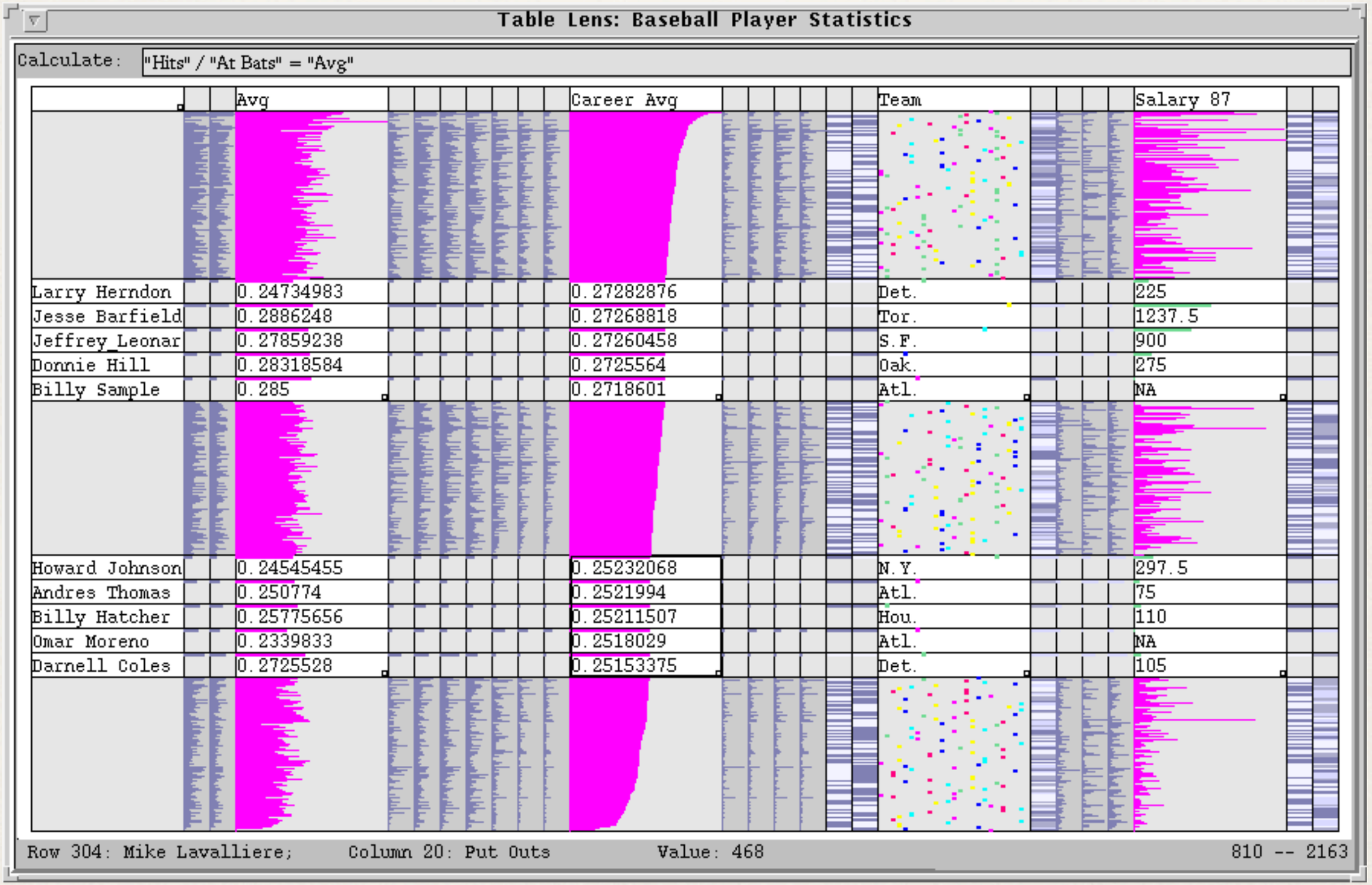

Maserati Bora
Ford Pantera L
Ferrari Dino
Mazda RX4 Wag
Mazda RX4
Lincoln Continental
Cadillac Fleetwood
Chrysler Imperial
Camaro Z28
Duster 360
Merc 450SLC
Merc 450SE
Merc 450SL
Pontiac Firebird
Hornet Sportabout
AMC Javelin
Dodge Challenger
Honda Civic
Toyota Corolla
Fiat 128
Fiat X1-9
Volvo 142E
Datsun 710
Lotus Europa
Porsche 914-2
Merc 280C
Merc 280
Merc 230
Merc 240D
Toyota Corona
Hornet 4 Drive
Valiant
carb
wt
hp
cyl
disp
qsec
vs
mpg
drat
am
gear

Table Lens



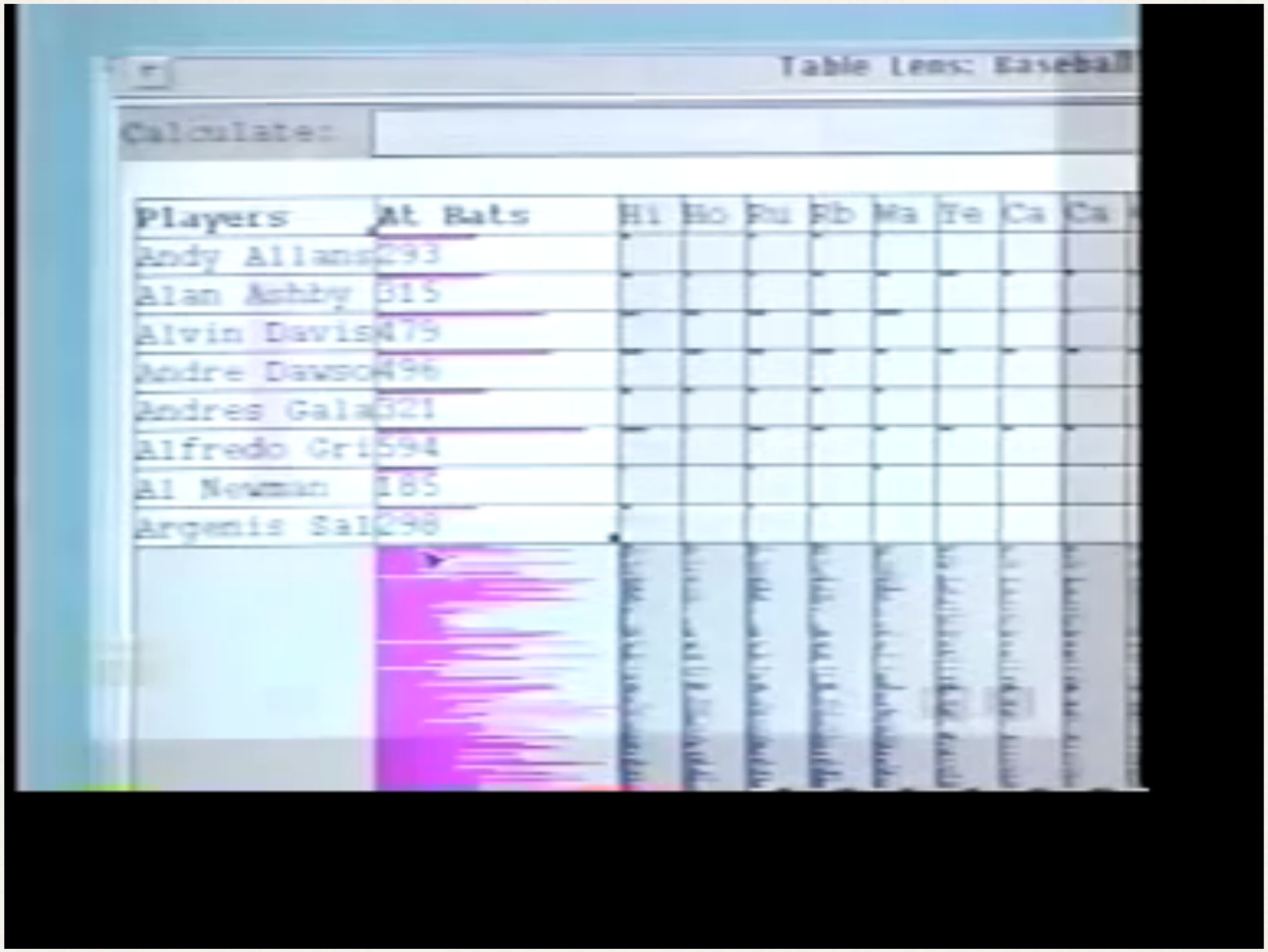
Rao and Card, "The Table Lens: merging Graphical and Symbolic Representations in and Interactive Focus + Context Visualization for Tabular Information"

Table Lens



Rao and Card, "The Table Lens: merging Graphical and Symbolic Representations in and Interactive Focus + Context Visualization for Tabular Information"

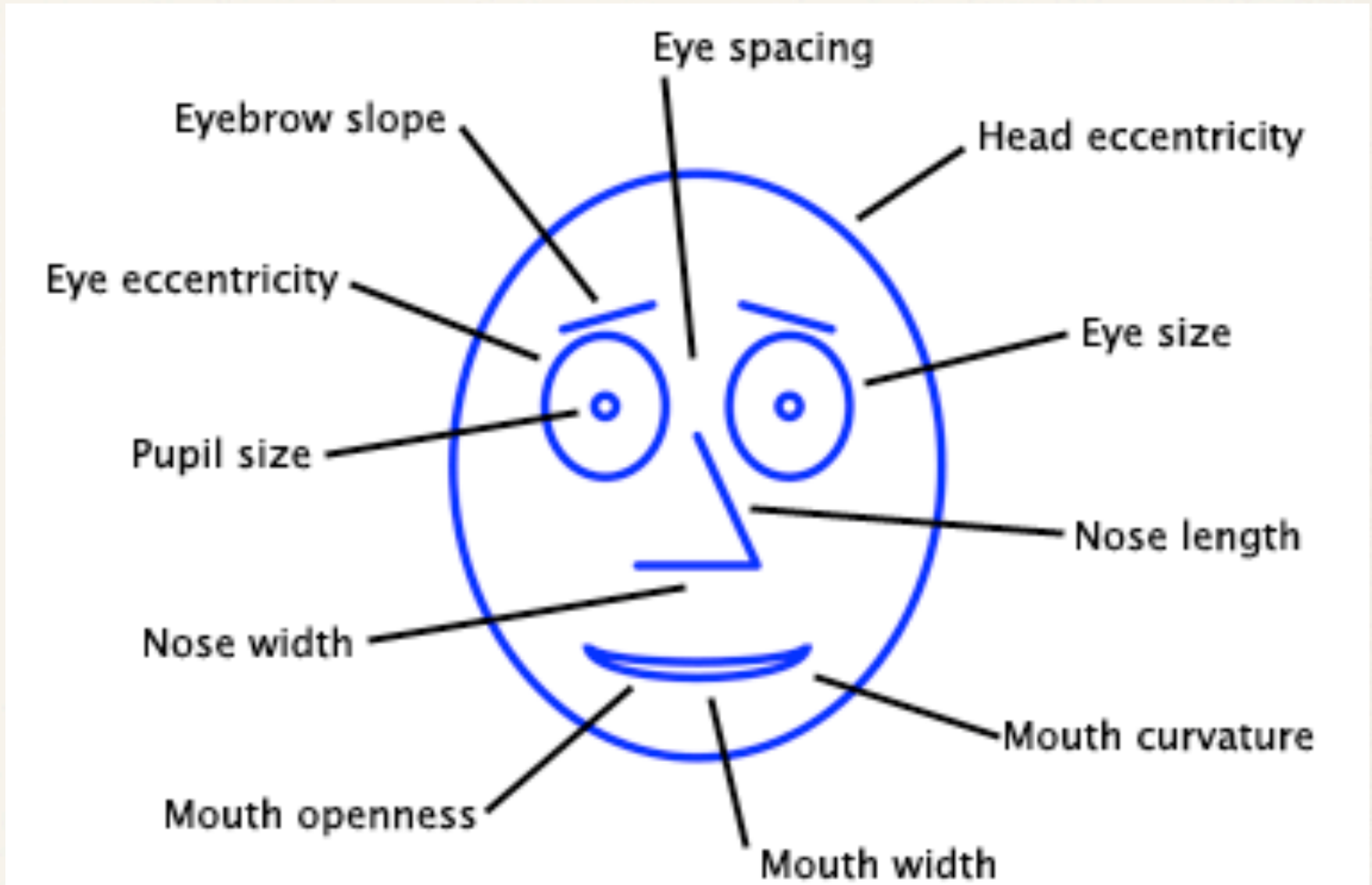
Table Lens



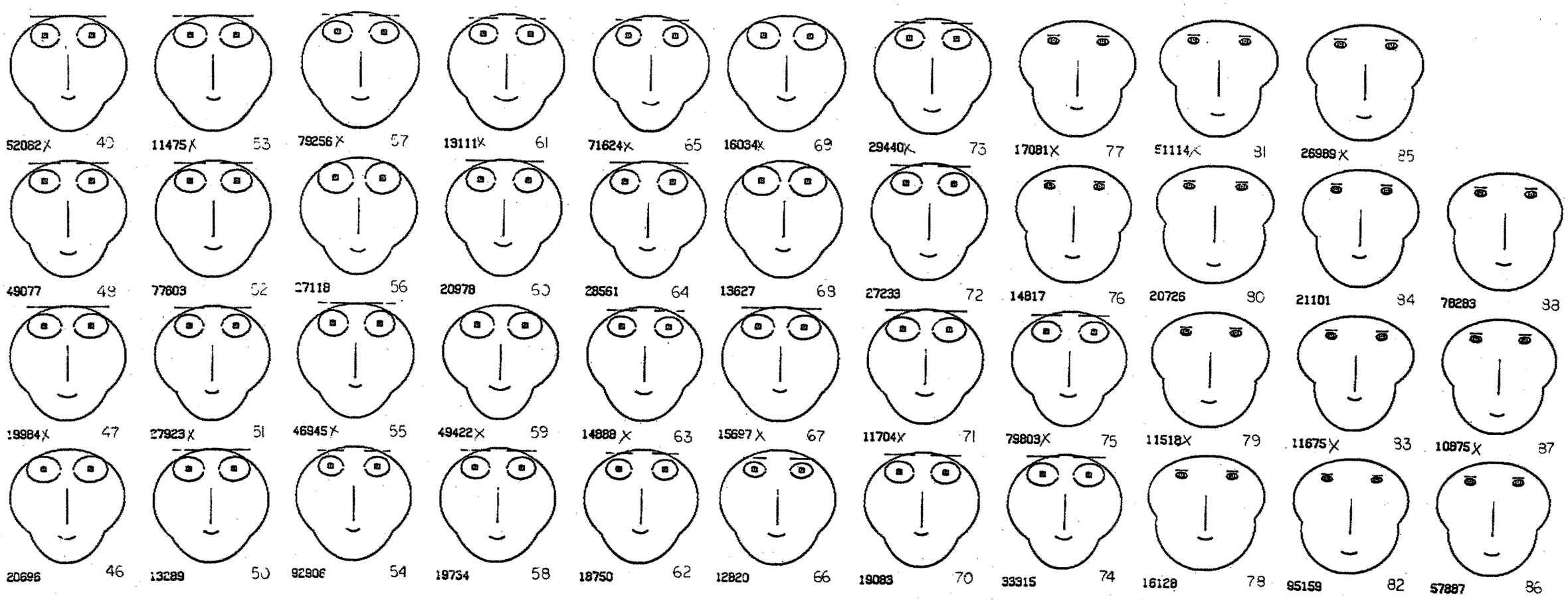
https://www.youtube.com/watch?v=qWqTrRAC52U

Chernoff Faces

Each attribute of the face can be mapped to a data value.



Chernoff Faces



Fossil data

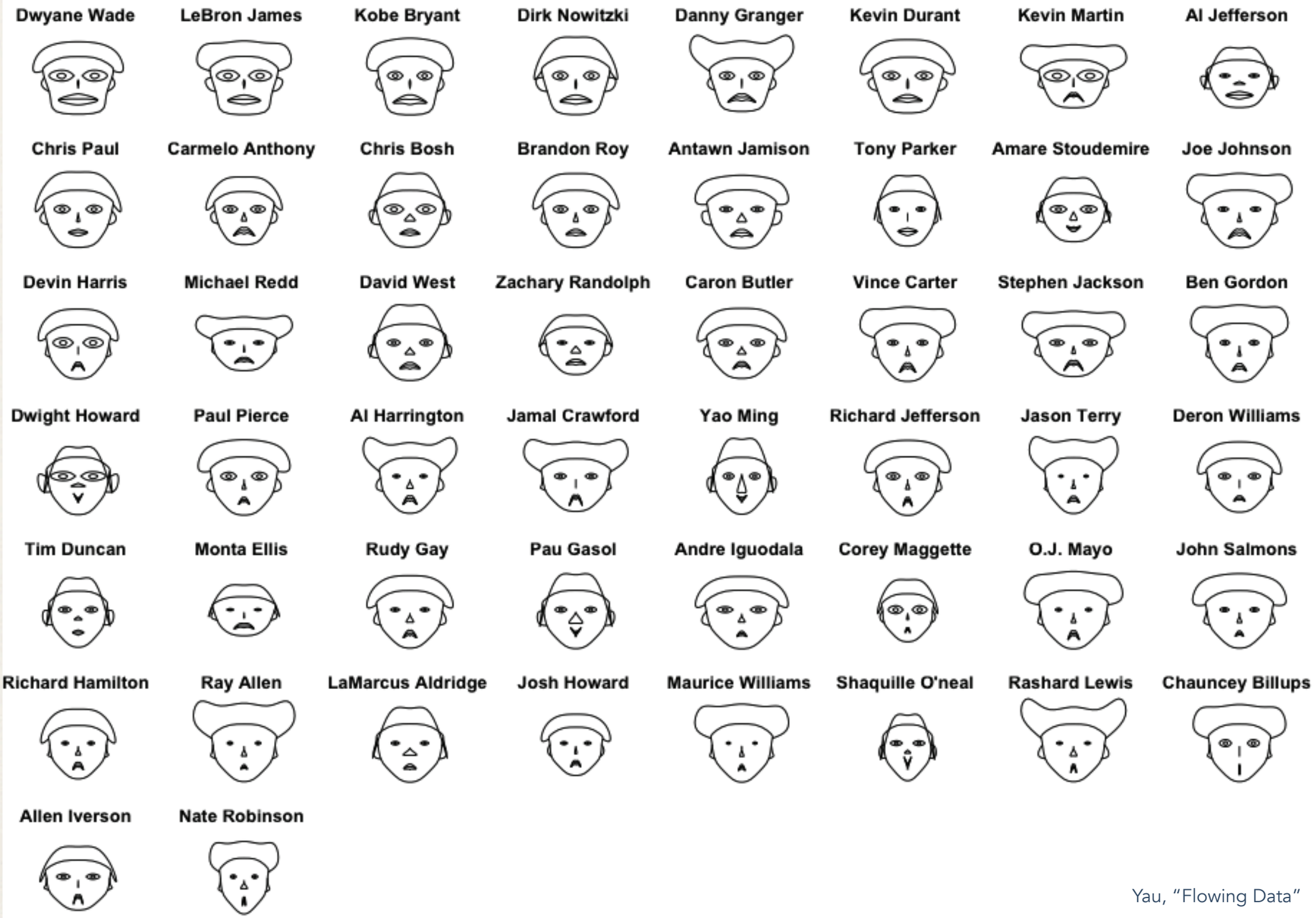
- inner diameter of embryonic chamber
- total number of whorls
- number of chambers in first whorl
- number of chambers in last whorl
- maximum height of chambers in first whorl
- maximum height of chambers in last whorl

Chernoff, "The Use of Faces to Represent Points in K-Dimensional Space Graphically"

Height of face – Games played
Width of face – Minutes per game
Shape of face – Points per game
Height of mouth – Field goals made
Width of mouth – Field goal attempts

Curve of smile – Field goal percentage
Height of eyes – Free throws made
Width of eyes – Free throw attempts
Height of hair – Free throw percentage
Width of hair – Three-pointers made

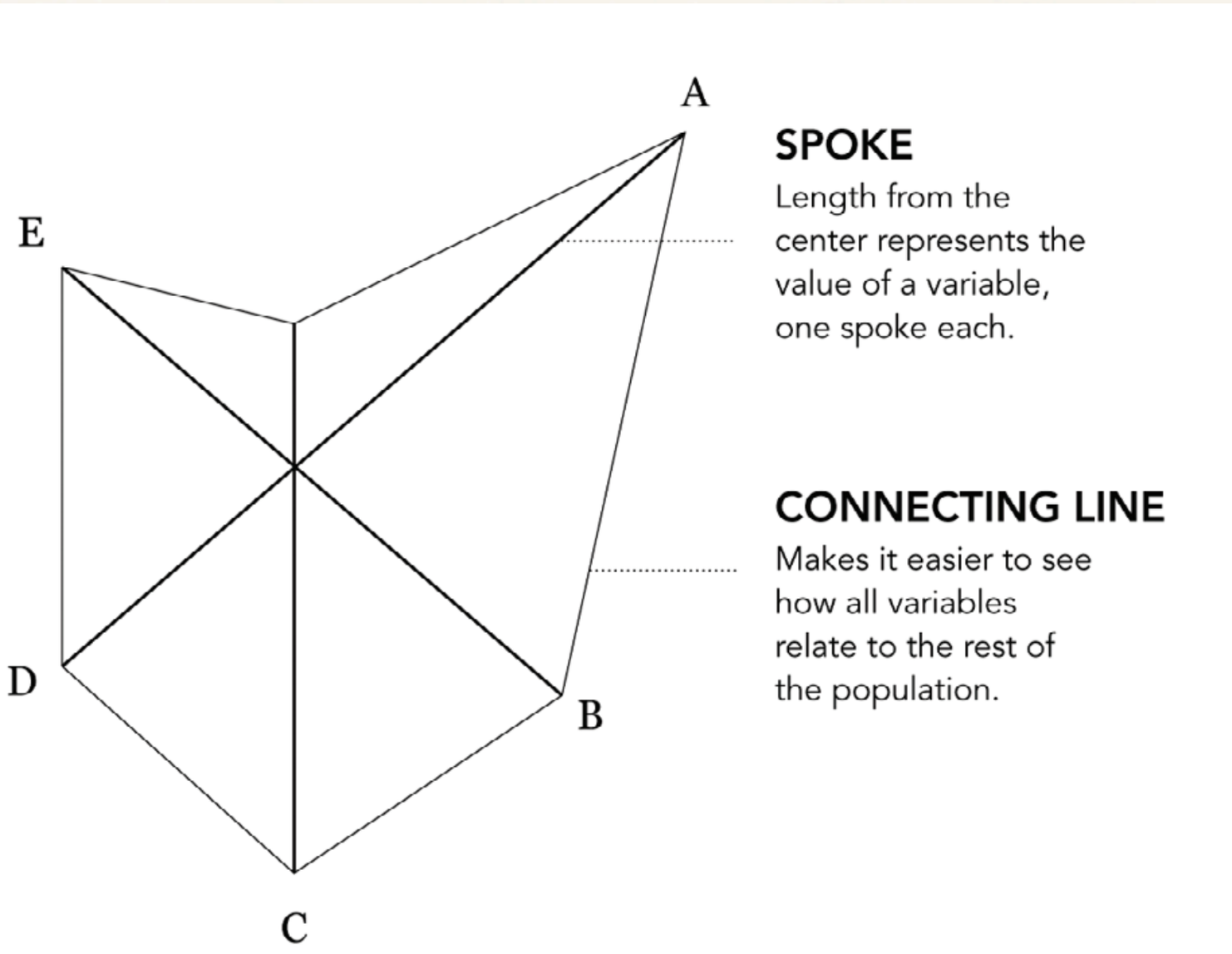
Styling of hair – Three-point attempts
Height of nose – Offensive rebounds
Width of nose – Defensive rebounds
Width of ears – Total rebounds
Height of ears – Assists



Yau, "Flowing Data"

Stars

These are essentially star charts with the axes snipped at the variable's value.



Yau, "Flowing Data"

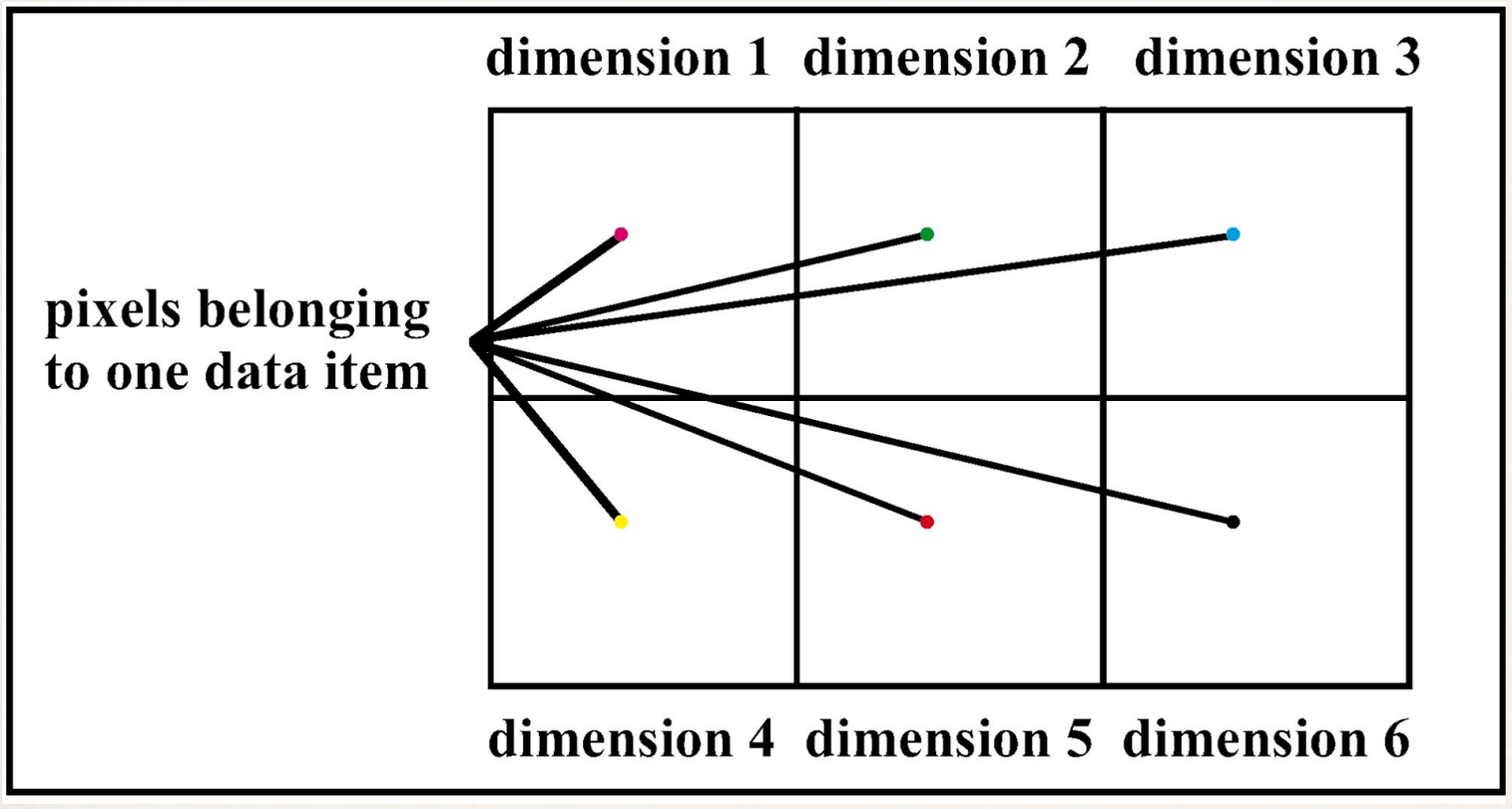
Stars

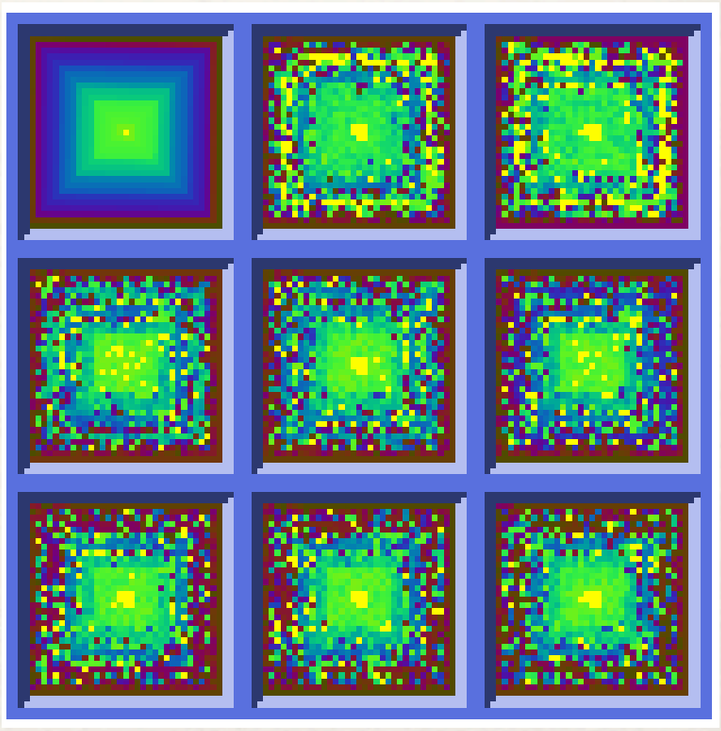
Yau, "Flowing Data"

Dense pixel displays

It's Hammer Time!

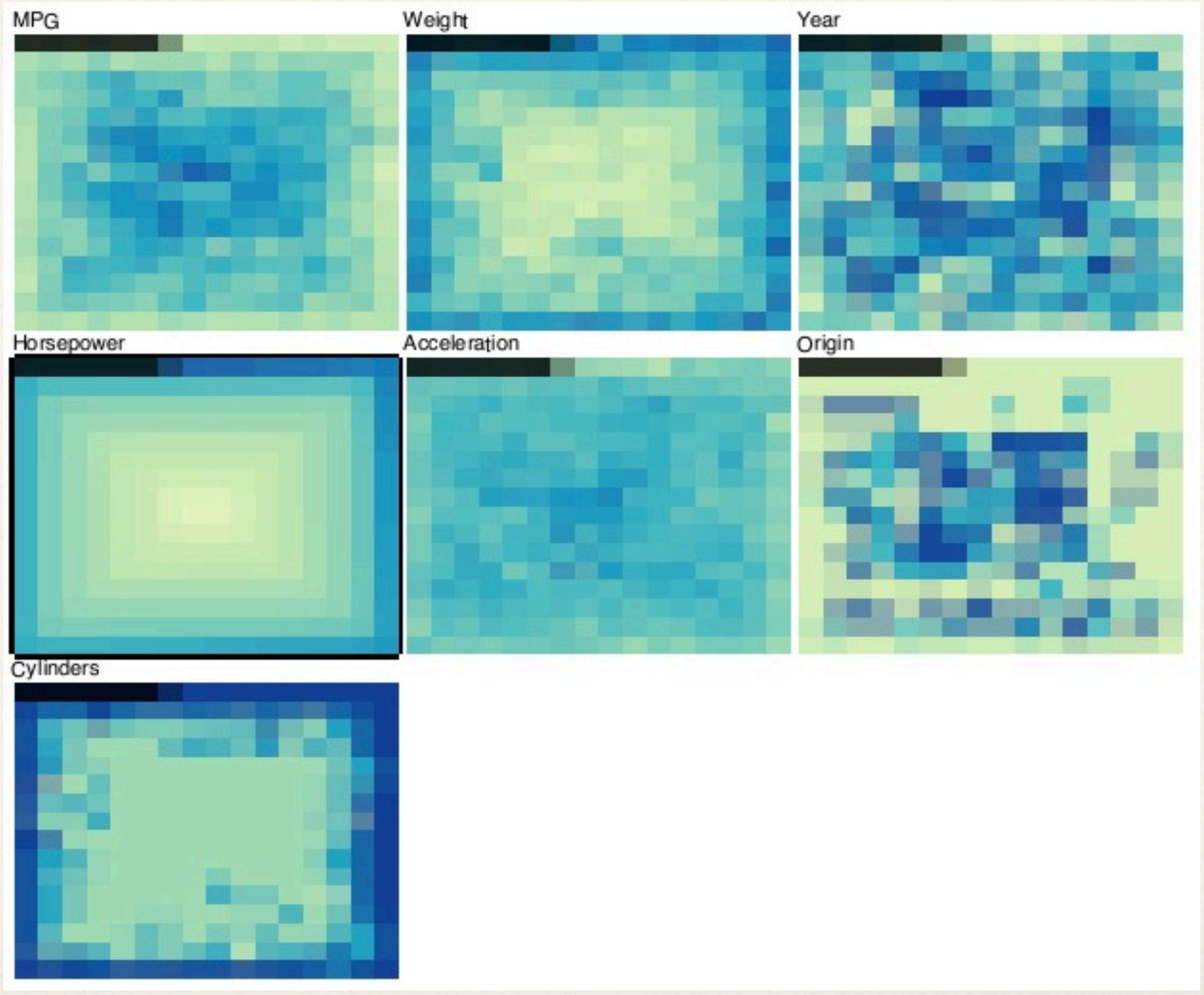
Concept: Condense values down to single pixel and then create a filled shape to represent a dimension of the data





Keim, "Designing Pixel-Oriented Visualization Techniques: Theory and Applications"

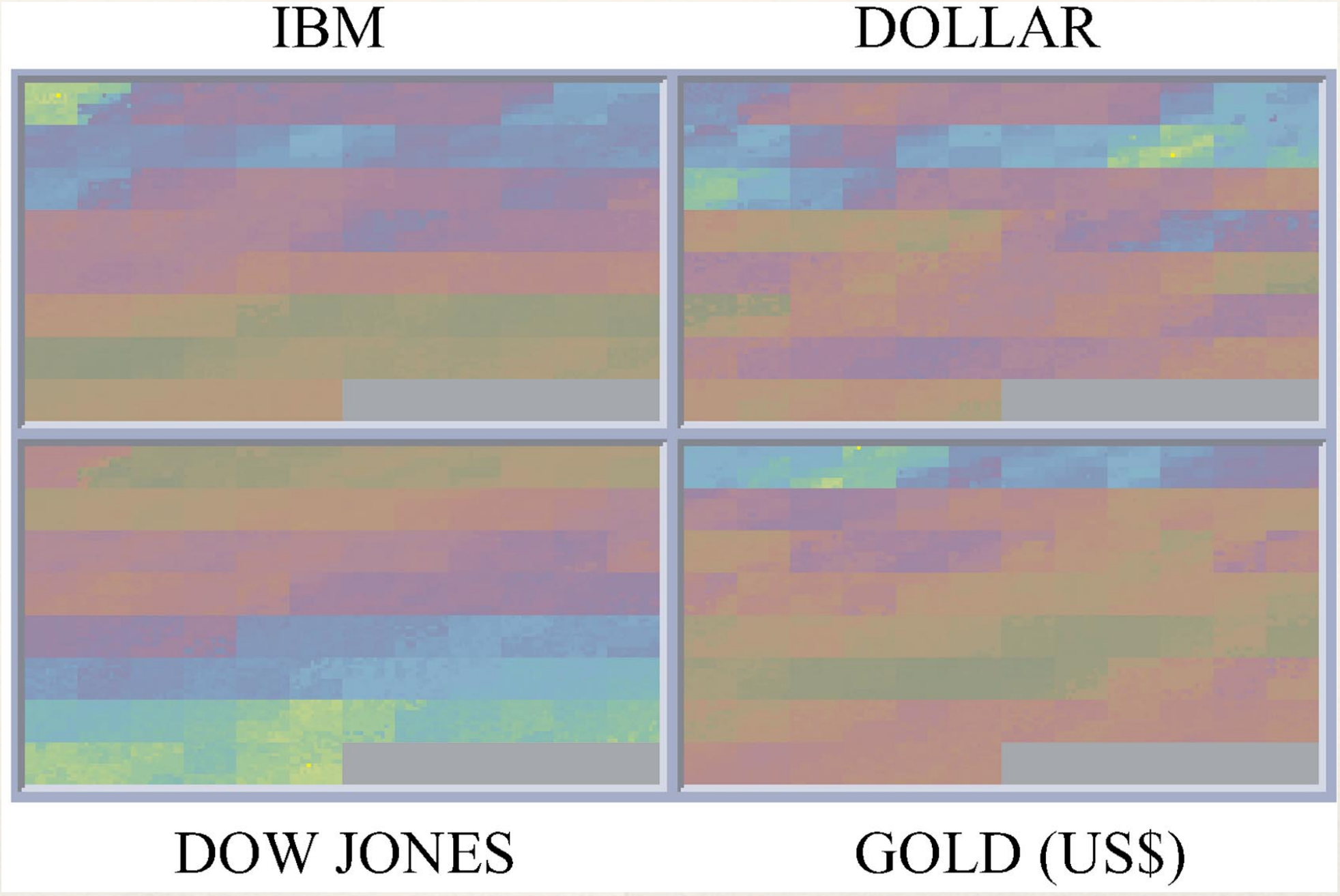
Dense pixel displays



Dense pixel displays

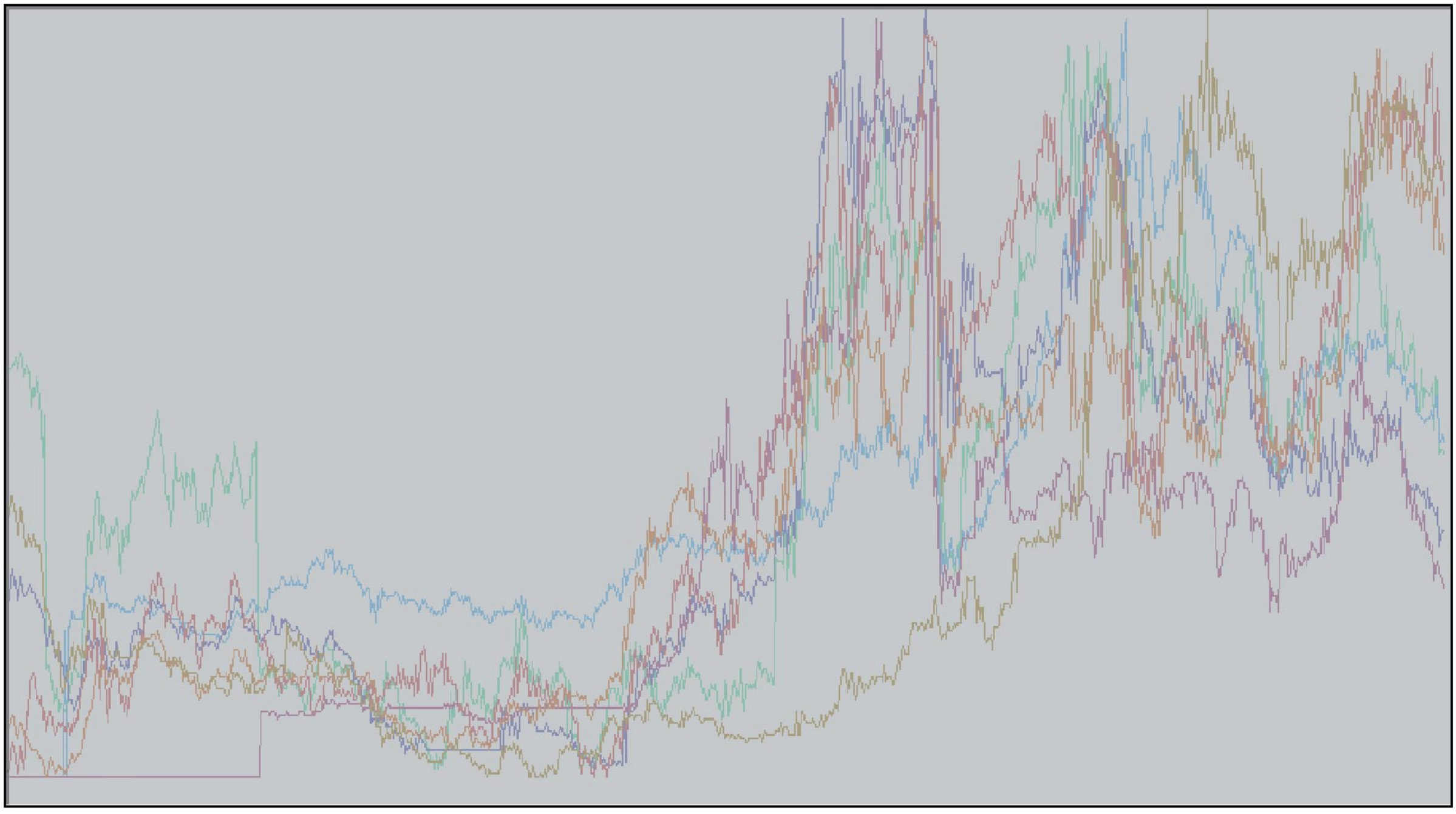
Five level recursive pattern

day / week / month / year / attribute



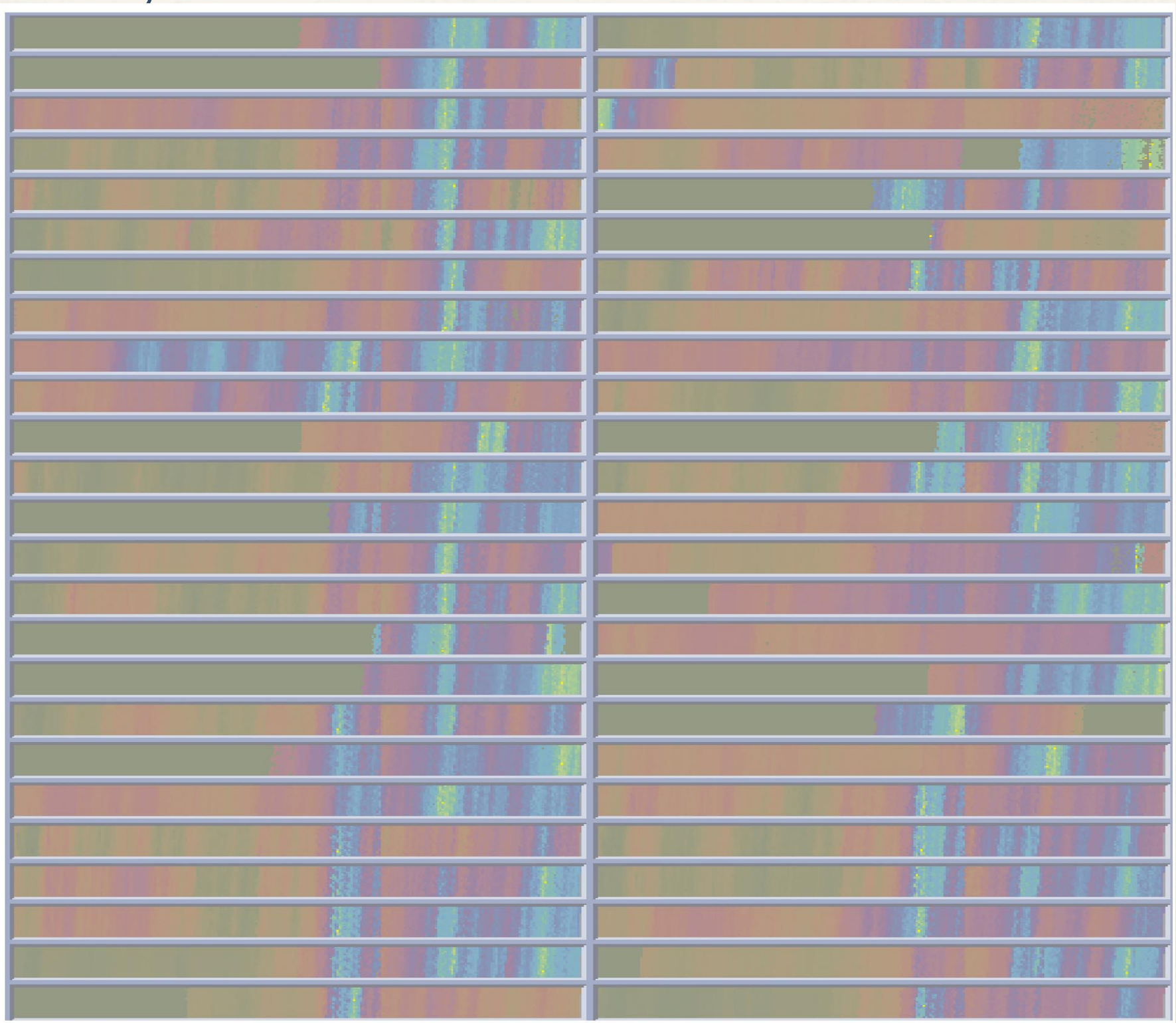
Dense pixel displays

20 years of daily stock data for 50 stocks



Dense pixel displays

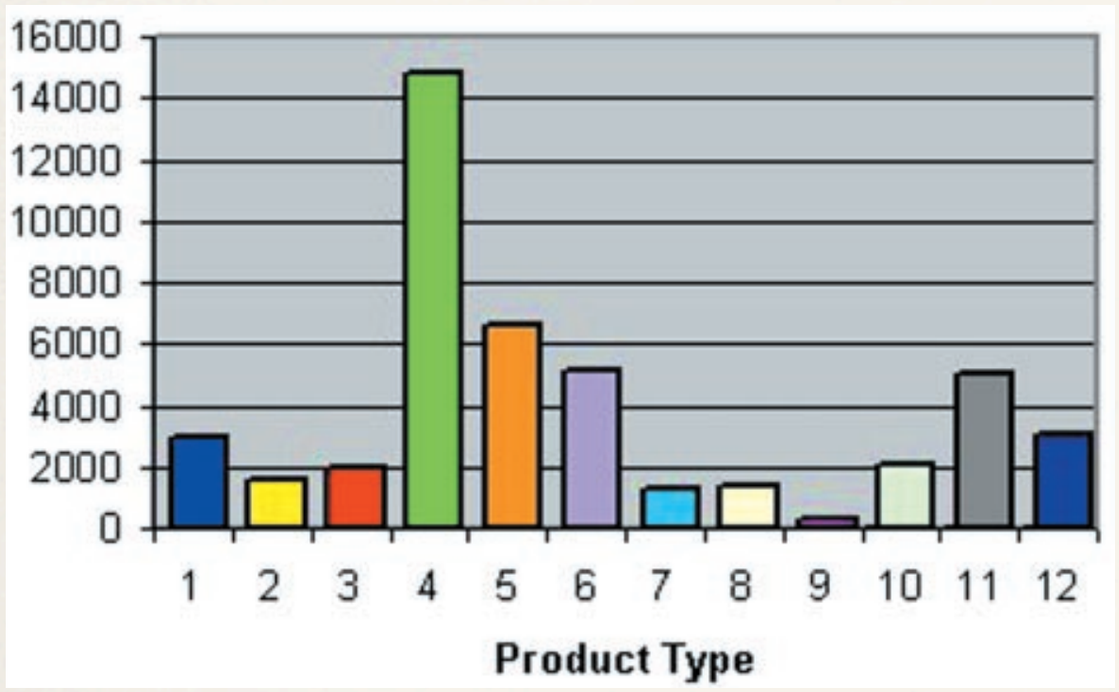
20 years of daily stock data for 50 stocks



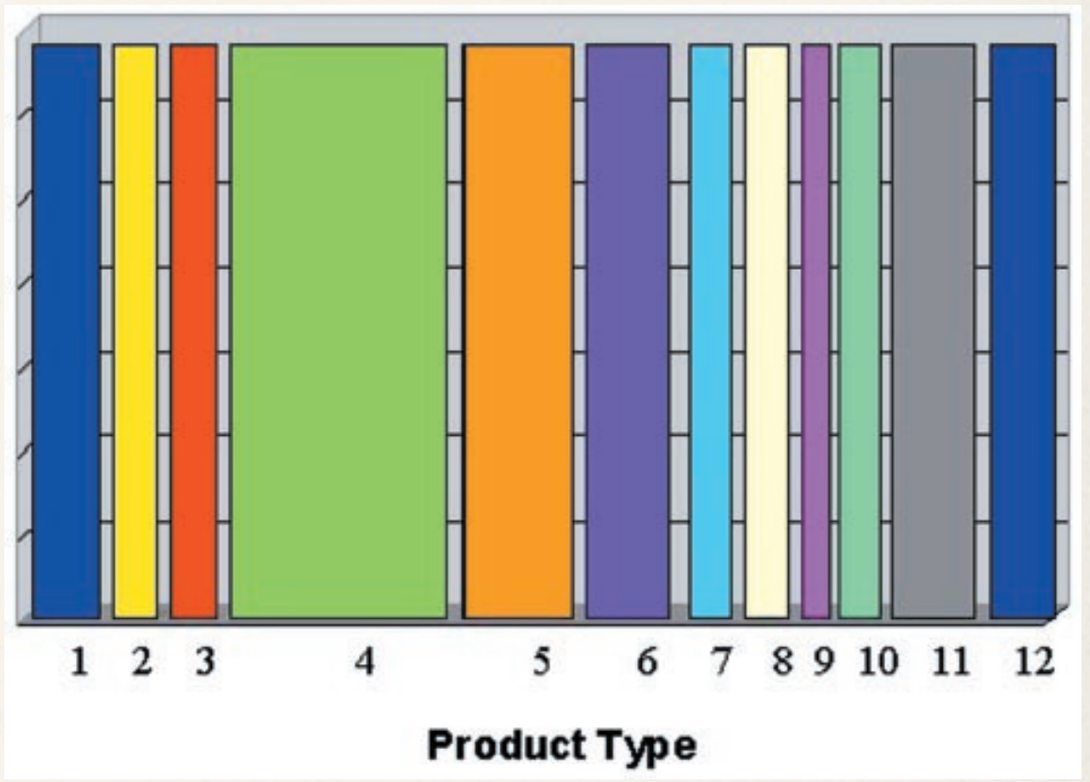
Pixel bar charts

Concept: Fill in bar charts with information about individual elements

Step one: Make more room by switching to width encoding



Height encoding



Width encoding

Keim et al. “Pixel bar charts: a visualization technique for very large multi-attributes data sets”

Pixel bar charts

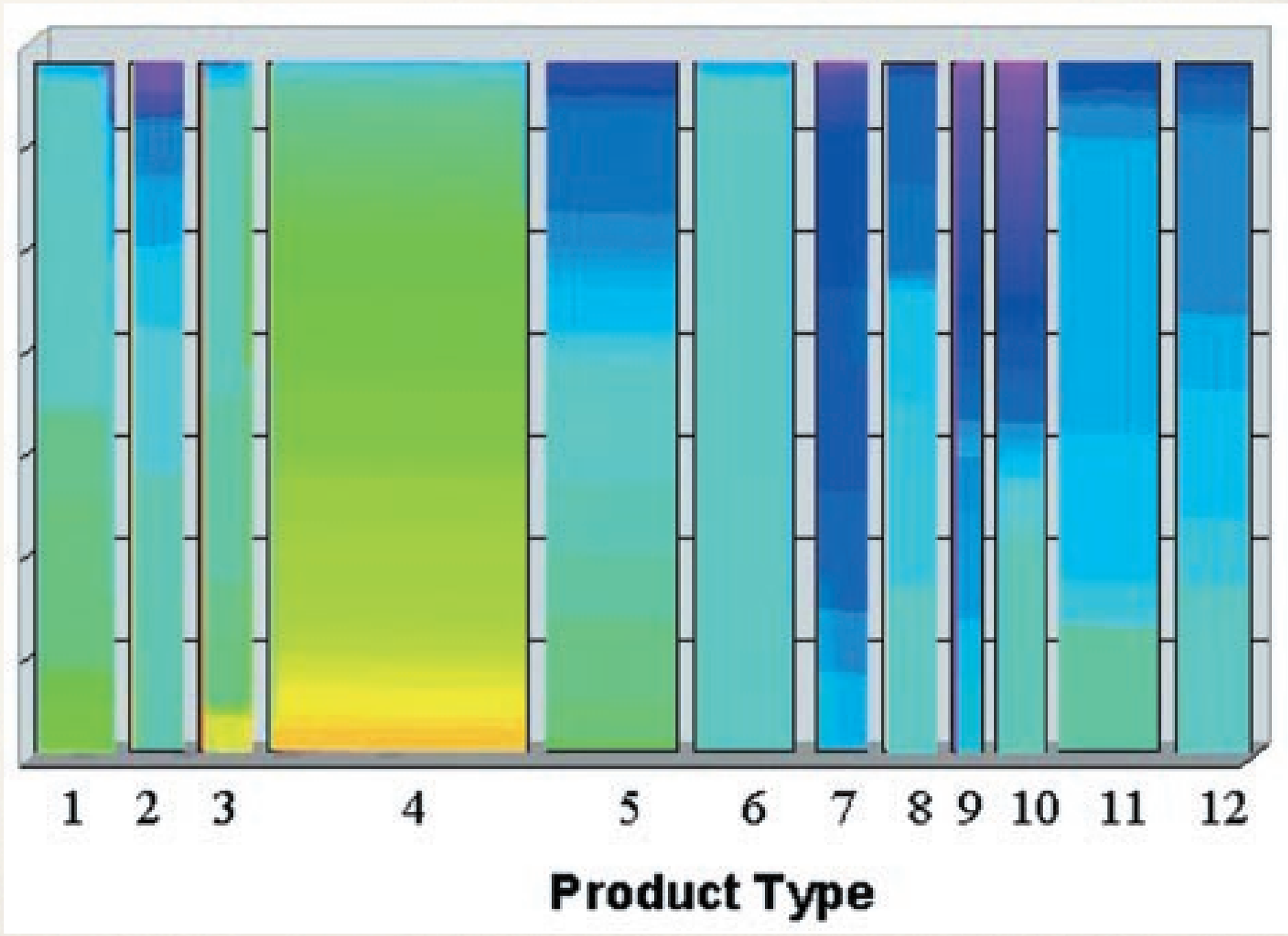
Concept: Fill in bar charts with information about individual elements

Step two: Color each pixel based on some attribute of the data point

Order the pixels to show patterns

Each pixel is a customer

Color is amount spent by that customer

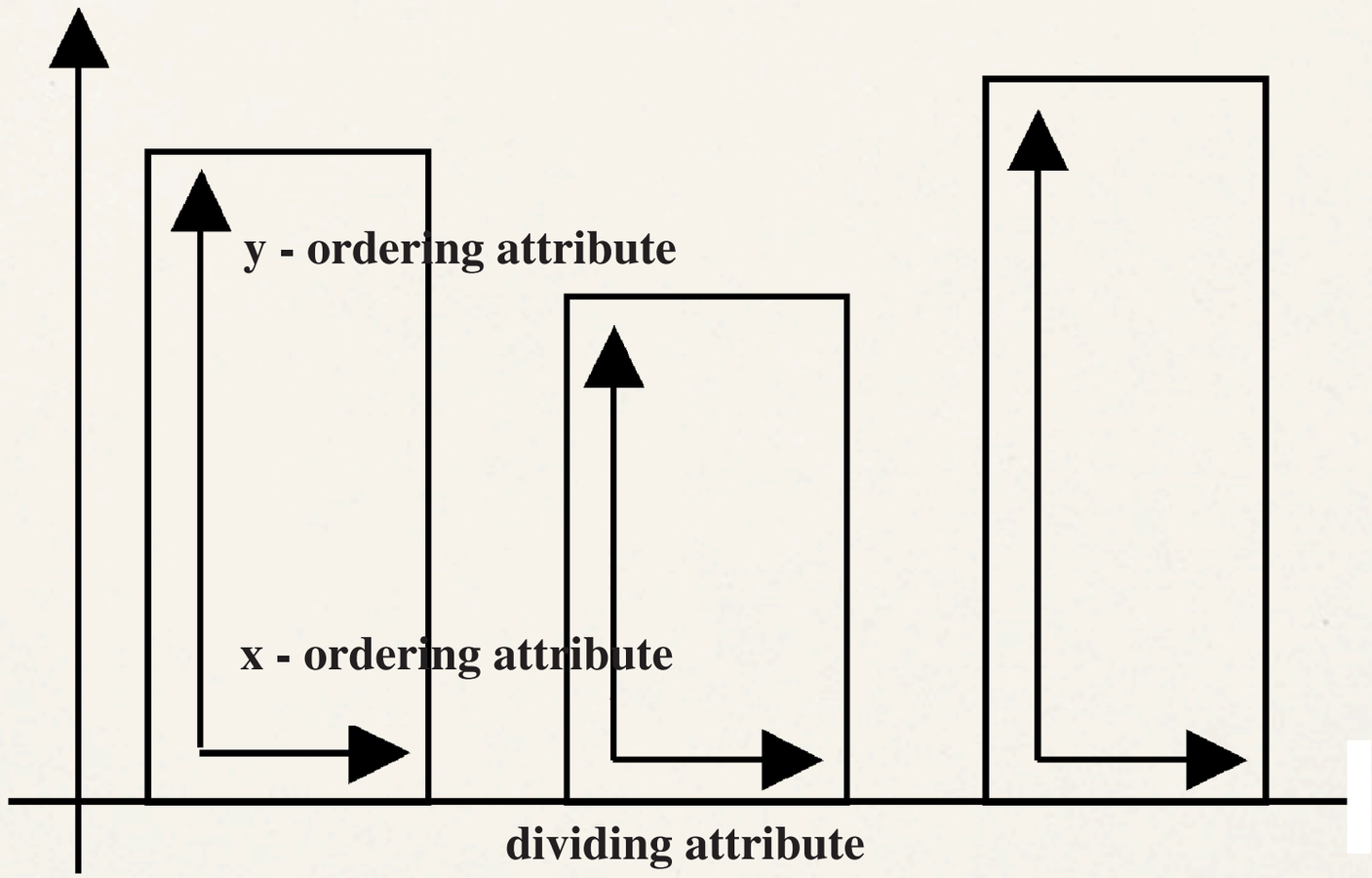


Keim et al. “Pixel bar charts: a visualization technique for very large multi-attributes data sets”

Pixel bar charts

Concept: Fill in bar charts with information about individual elements

Step three: Extend this by making it a 2D space



Keim et al. “Pixel bar charts: a visualization technique for very large multi-attributes data sets”

Pixel bar charts

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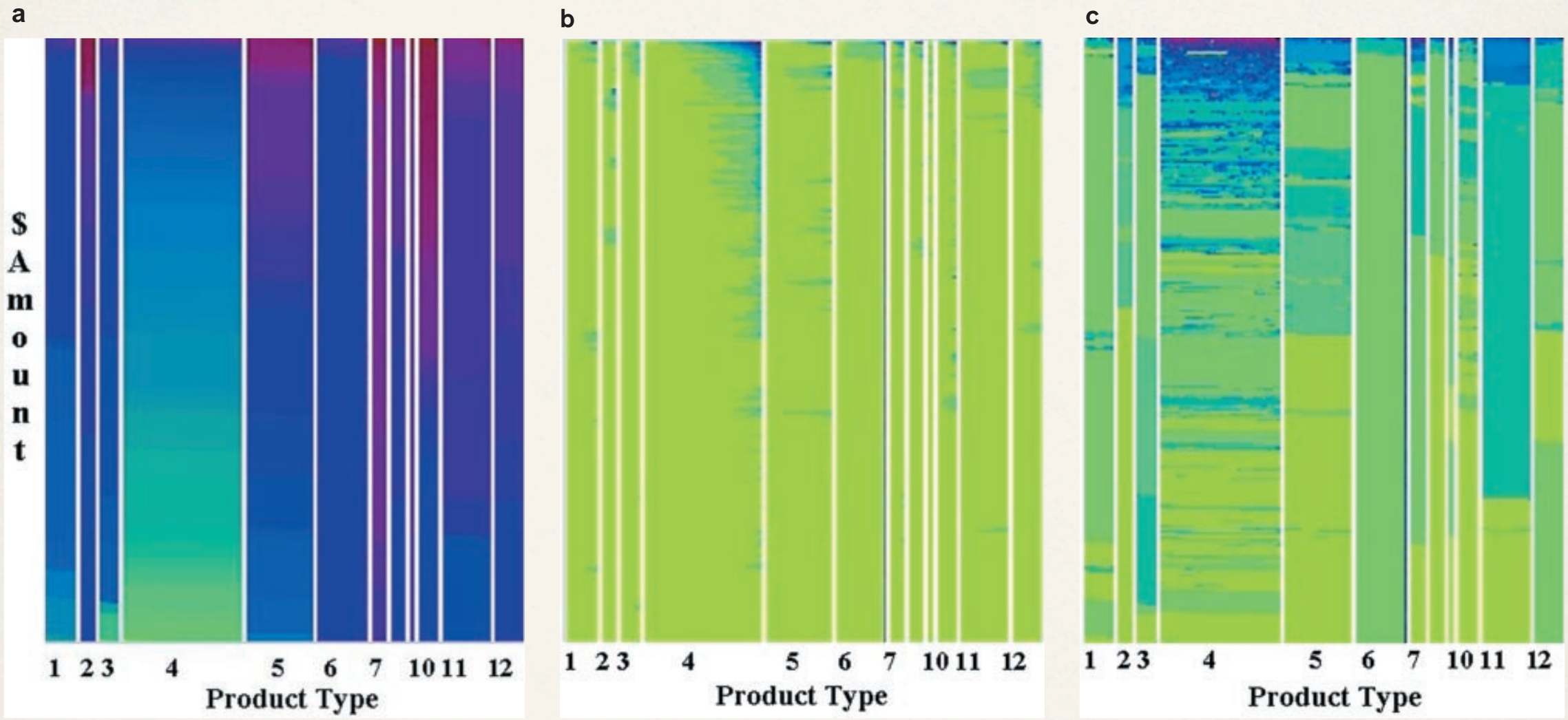


Color

(a) dollar amount spent

(b) number of visits

(c) sales quantity

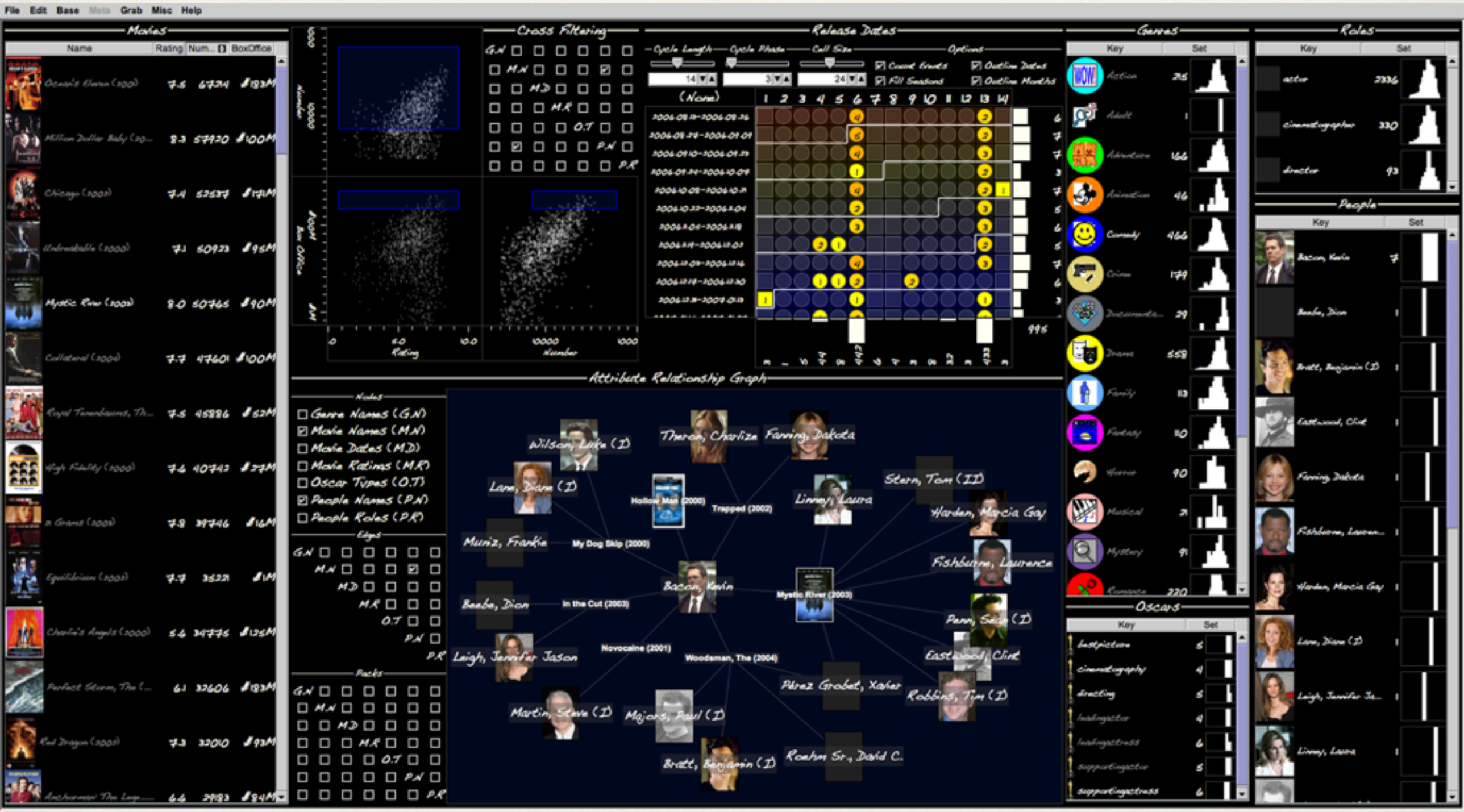
Ordering

y-axis dollar amount spent

x-axis number of visits

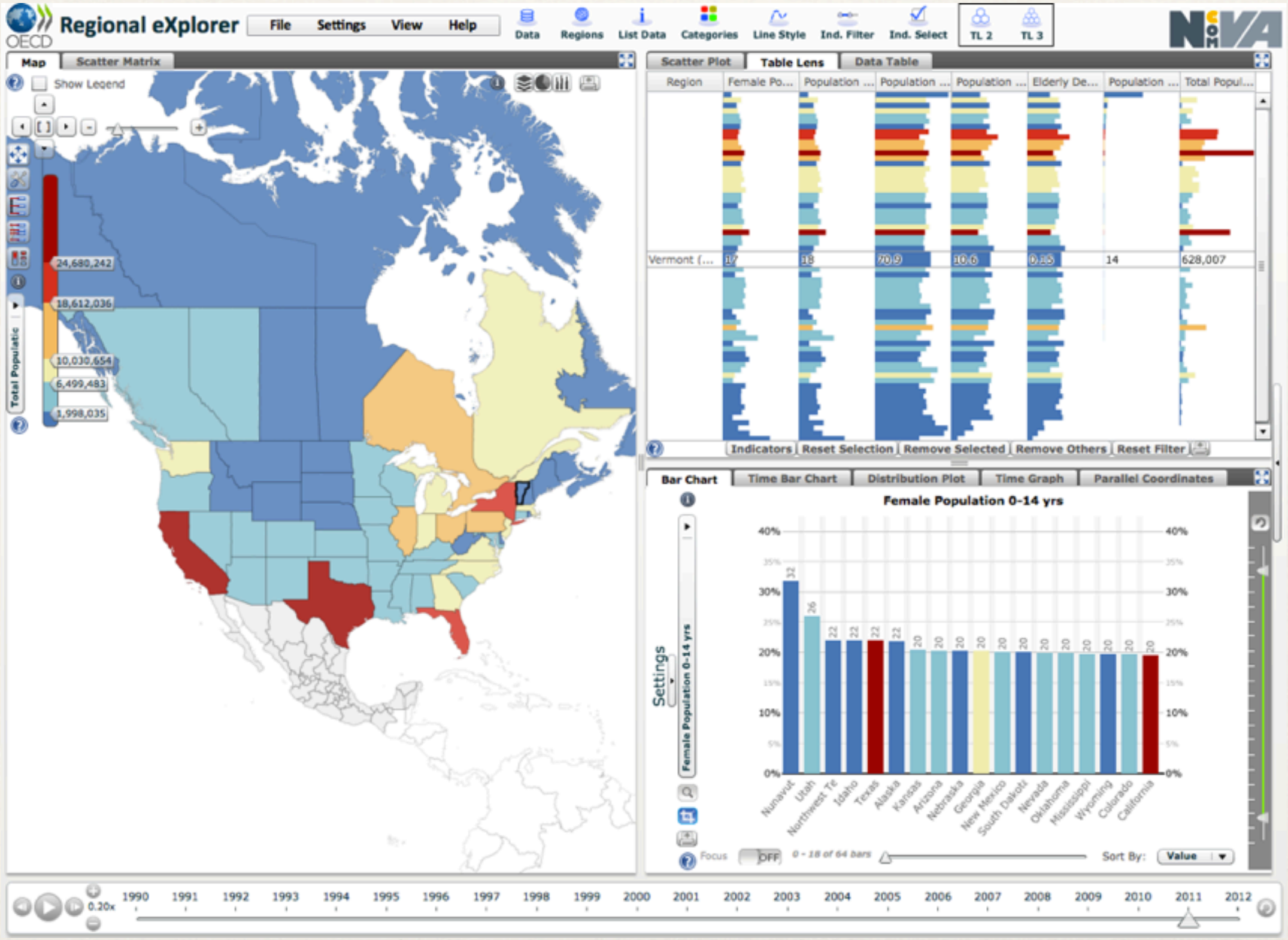
Keim et al. "Pixel bar charts: a visualization technique for very large multi-attributes data sets"

Linked views



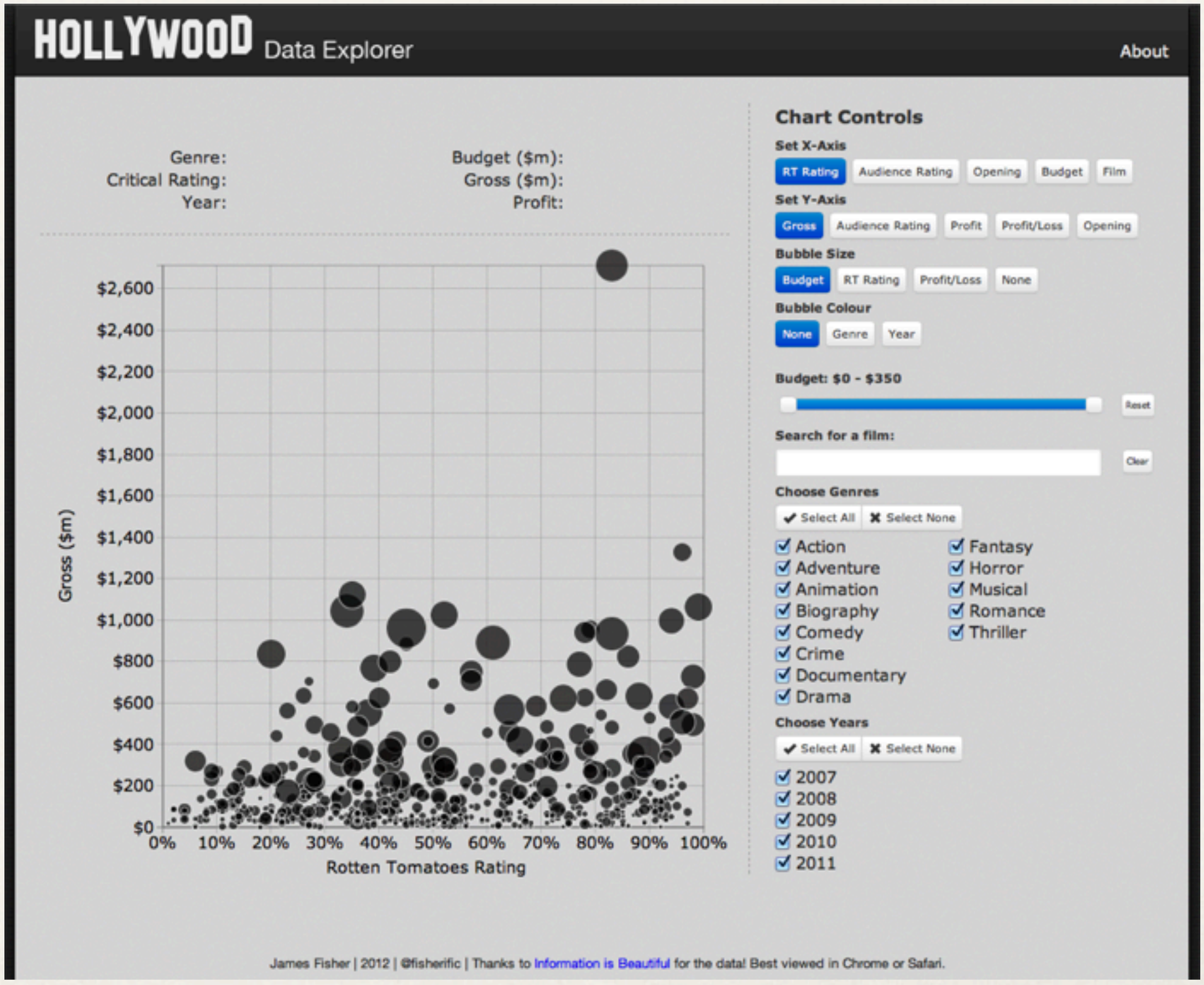
[Improvise]

Linked views



http://stats.oecd.org/OECDregionalstatistics/

Dynamic Queries



http://indexity.net/vis/hw/

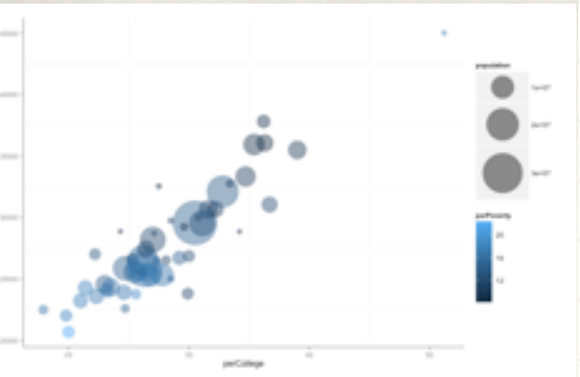
Multivariate questions

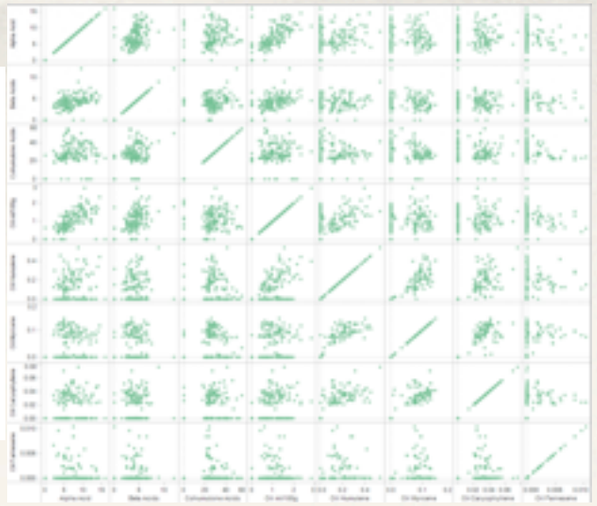
Which items are most alike?

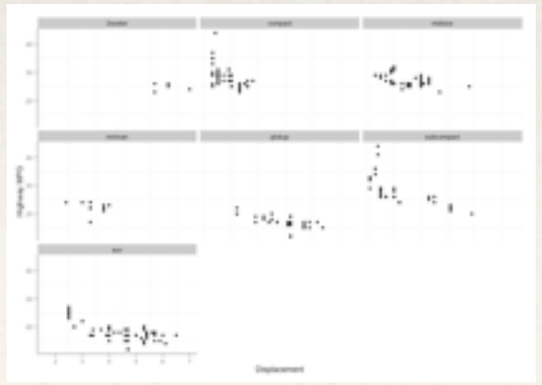
Which items are most exceptional?

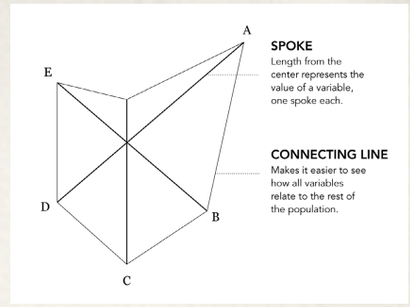
How can these items be combined into logical groups based on similarity?

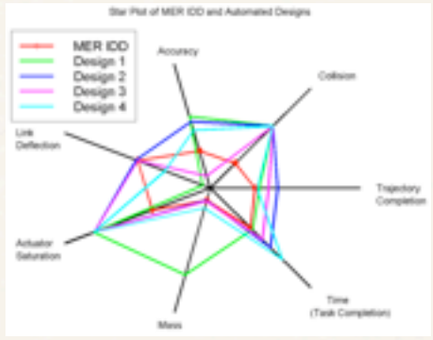
Few, “Now You See It”

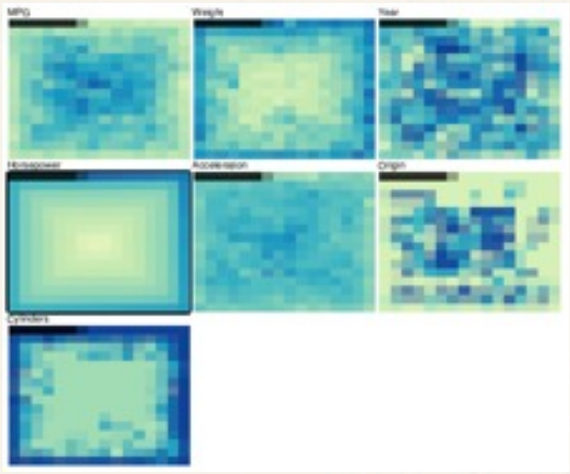

population
avPoverty
perCollege

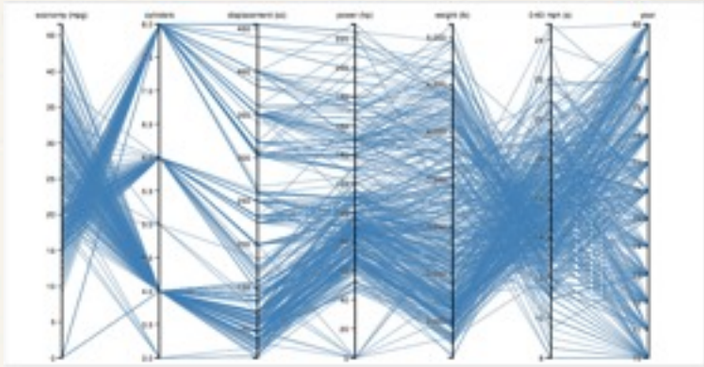



Displacement

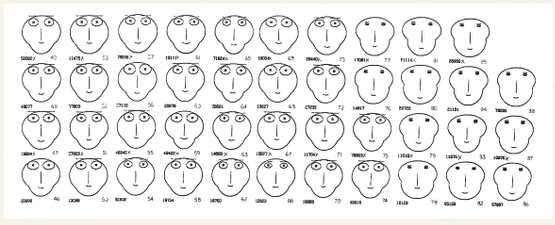

A
B
C
D
E
SPOKE
Length from the center represents the value of a variable, one spoke each.
CONNECTING LINE
Makes it easier to see how all variables relate to the rest of the population.

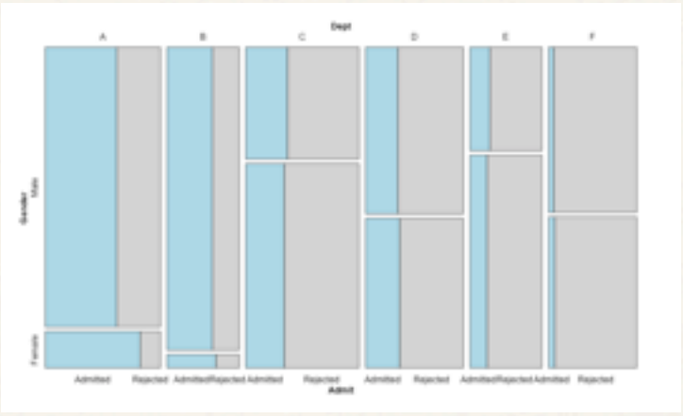

Star Plot of MER IDD and Automated Designs
MER IDD
Design 1
Design 2
Design 3
Design 4
Accuracy
Collision
Trajectory Completion
Time (Task Completion)
Mass
Actuator Saturation
Link Deflection

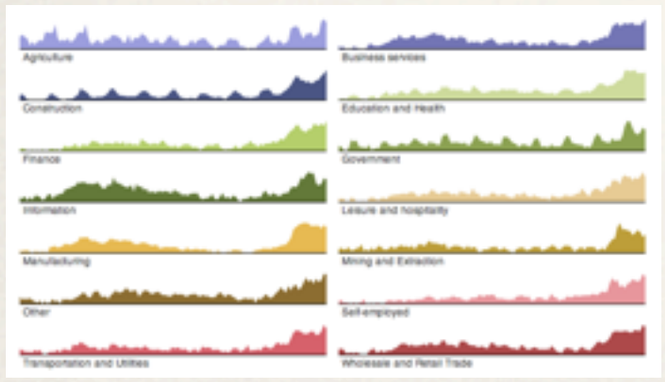

MPG
Weight
Year
Horsepower
Acceleration
Origin
Cylinders

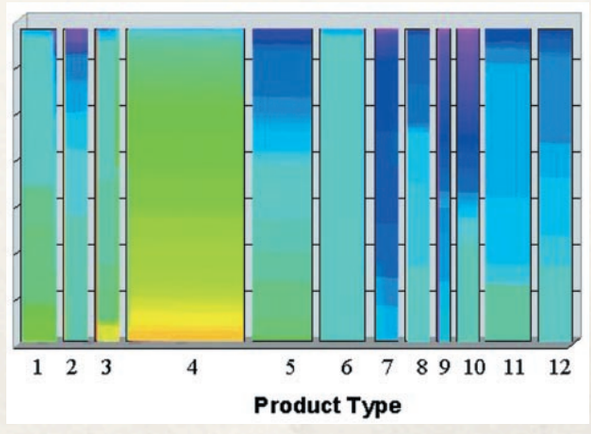



Dust & Magnet
File View Magnet Help
Vitamin
Protein
Product 19
Fiber
Special K
Total Whole Grain
Sugar
Fat




Dept
Gender
Male
Female
A
B
C
D
E
F
Admitted
Rejected
Admit


Agriculture
Business services
Construction
Education and Health
Finance
Government
Information
Leisure and hospitality
Manufacturing
Mining and Extraction
Other
Self-employed
Transportation and Utilities
Wholesale and Retail Trade


1 2 3 4 5 6 7 8 9 10 11 12
Product Type