



Data Illustrator

Augmenting Vector Design Tools with Lazy Data Binding
for Expressive Visualization Authoring

Leo Zhicheng Liu

Adobe Research

John Thompson

Georgia Tech



Mira Dontcheva

Adobe Research



Alan Wilson



James Delorey



Sam Grigg



Bernard Kerr



John Stasko

Georgia Tech

Adobe Systems, Inc

Data Journalism



Emily Badger
Writer



Claire Cain Miller
Writer

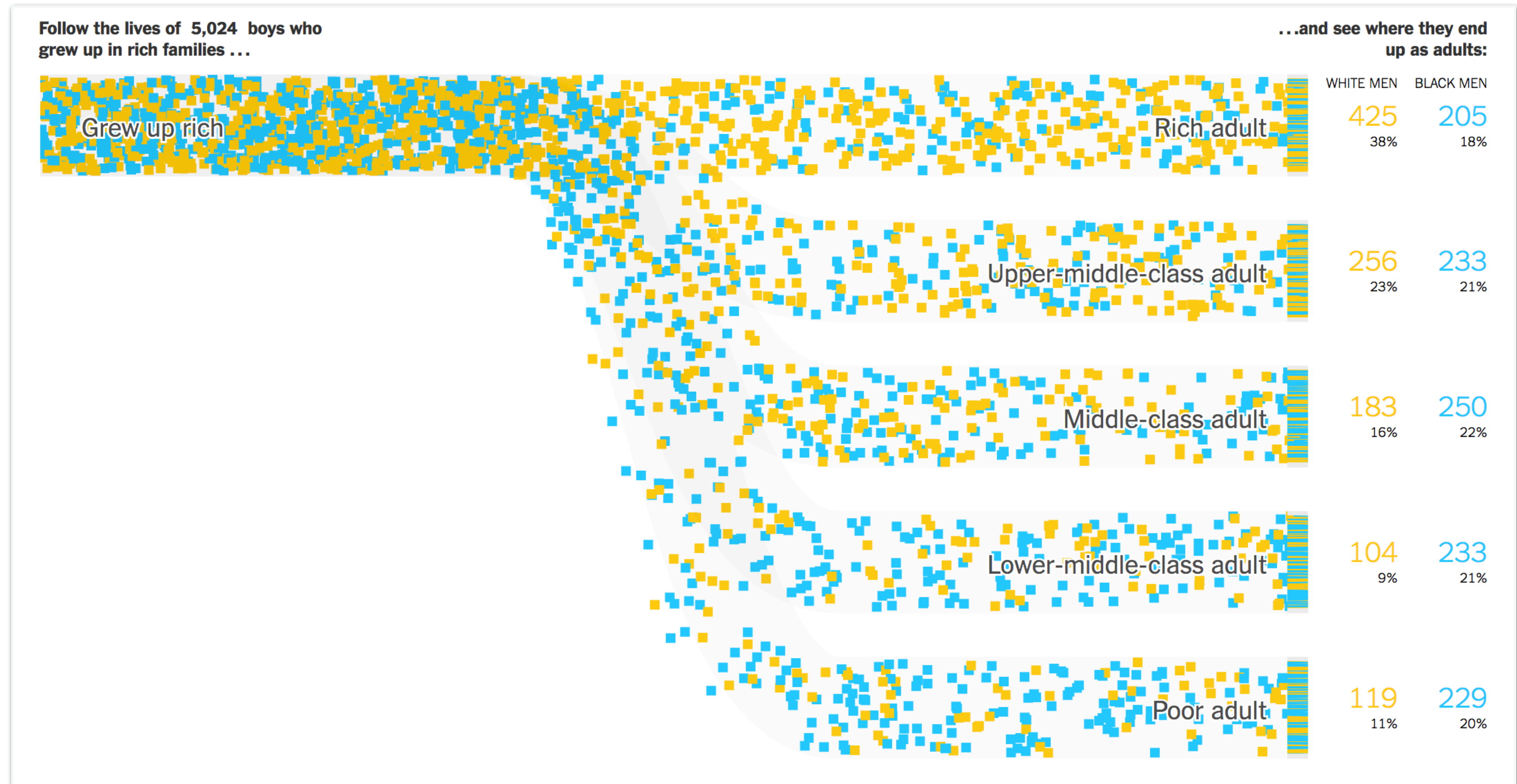


Adam Pearce
Graphics Editor



Kevin Quealy
Graphics Editor

The New York Times



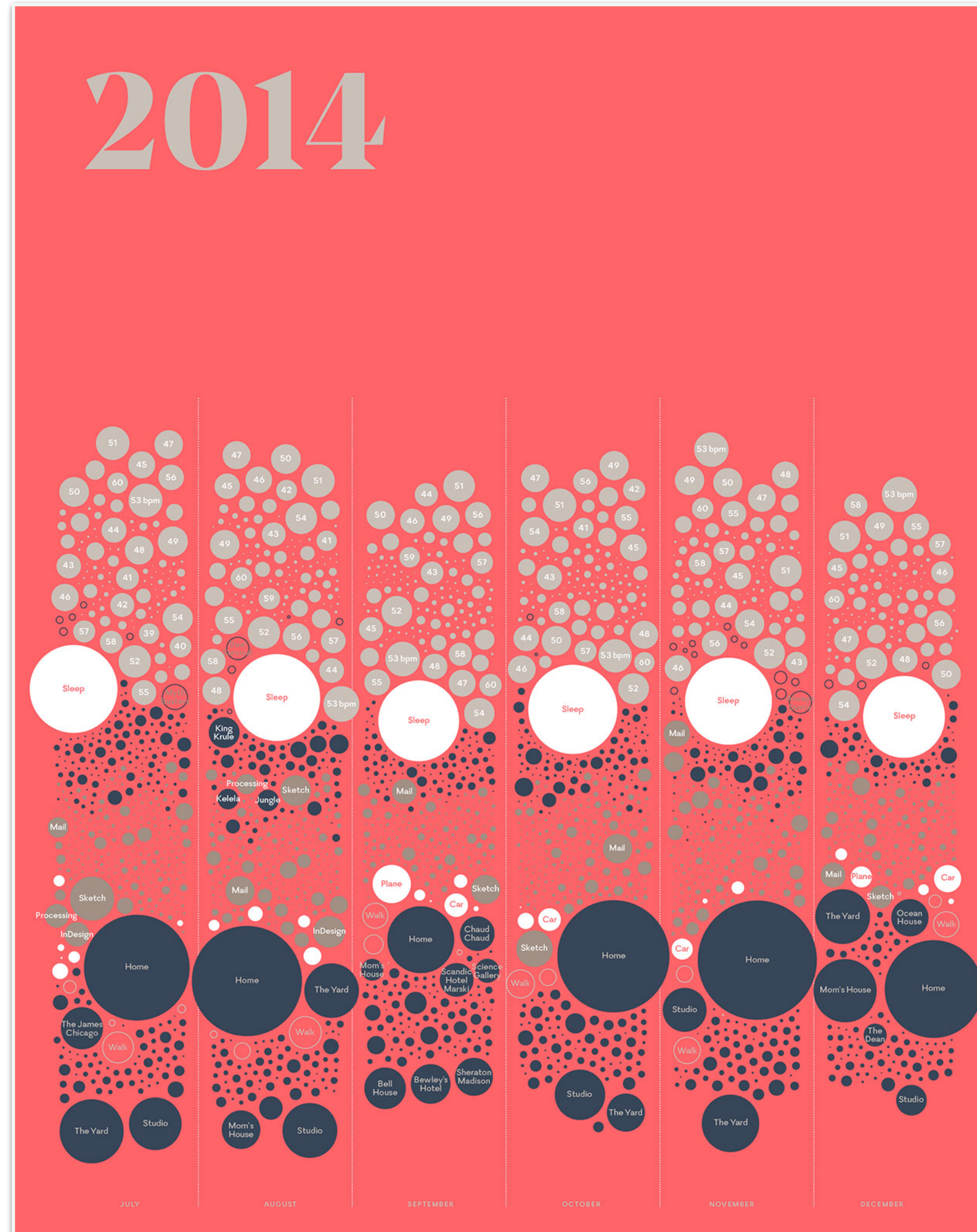
Extensive Data Shows Punishing Reach of Racism for Black Boys

<https://www.nytimes.com/interactive/2018/03/19/upshot/race-class-white-and-black-men.html>

Personal Informatics

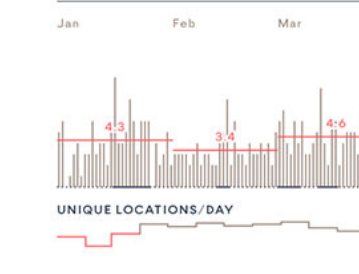


Nicholas Felton
Information Designer



Q1

Locations



134

76 FEWER LOCATIONS THAN PREVIOUS QUARTER

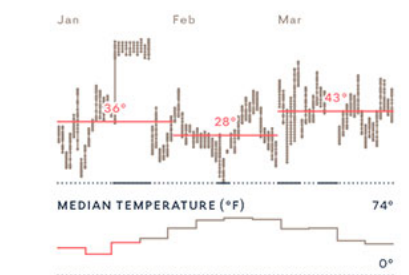
TOP CATEGORIES	DAYS AT HOME
Airport Gates: 9	Sixty-Seven
Airport Terminals: 7	23 days away
Airports: 6	
American Restaurants: 4	TOP CUISINE TYPE
Coffee Shops: 4	Japanese
	7 visits to 2 restaurants

MOST LOCATIONS: Jan. 16 (10 unique locations)
LONGEST VISIT: Home (Jan 25 for 47h 35m)

Travel



Weather

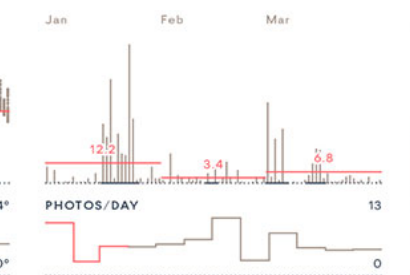


37°

NO DATA FOR PREVIOUS QUARTER

TOP CONDITIONS	VARIAION IN TEMP
Clear: 38d	84°F
Overcast: 20d	Range: 0°-84°F
Partly Cloudy: 8d	
Scattered Clouds: 8d	PRECIPITATION
Mostly Cloudy: 5d	5h 32m
	Snow for 2h 39m

Photos

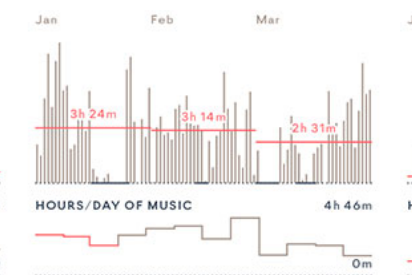


685

246 LESS THAN PREVIOUS QUARTER

TOP REGIONS	MOST PHOTOS
Virgin Gorda: 291	Jan. 23
Brooklyn: 141	84 photos in Virgin Gorda
Mammoth Lakes: 32	
Amsterdam: 30	INSTAGRAM POSTS
Zeist: 21	Twenty-two
	3% of photos

Music

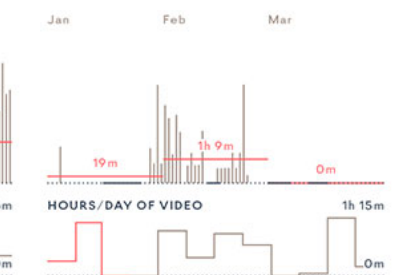


11.5

2.7 DAYS MORE THAN PREVIOUS QUARTER

TOP ARTISTS	SONGS PLAYED
Lorde: 25h	3,982
Suans: 24h	Max: 138 on Jan 4
Drake: 23h	UNIQUE ALBUMS
Interpol: 16h	231
Breadford Cox: 12h	1,293 unique songs

Videos

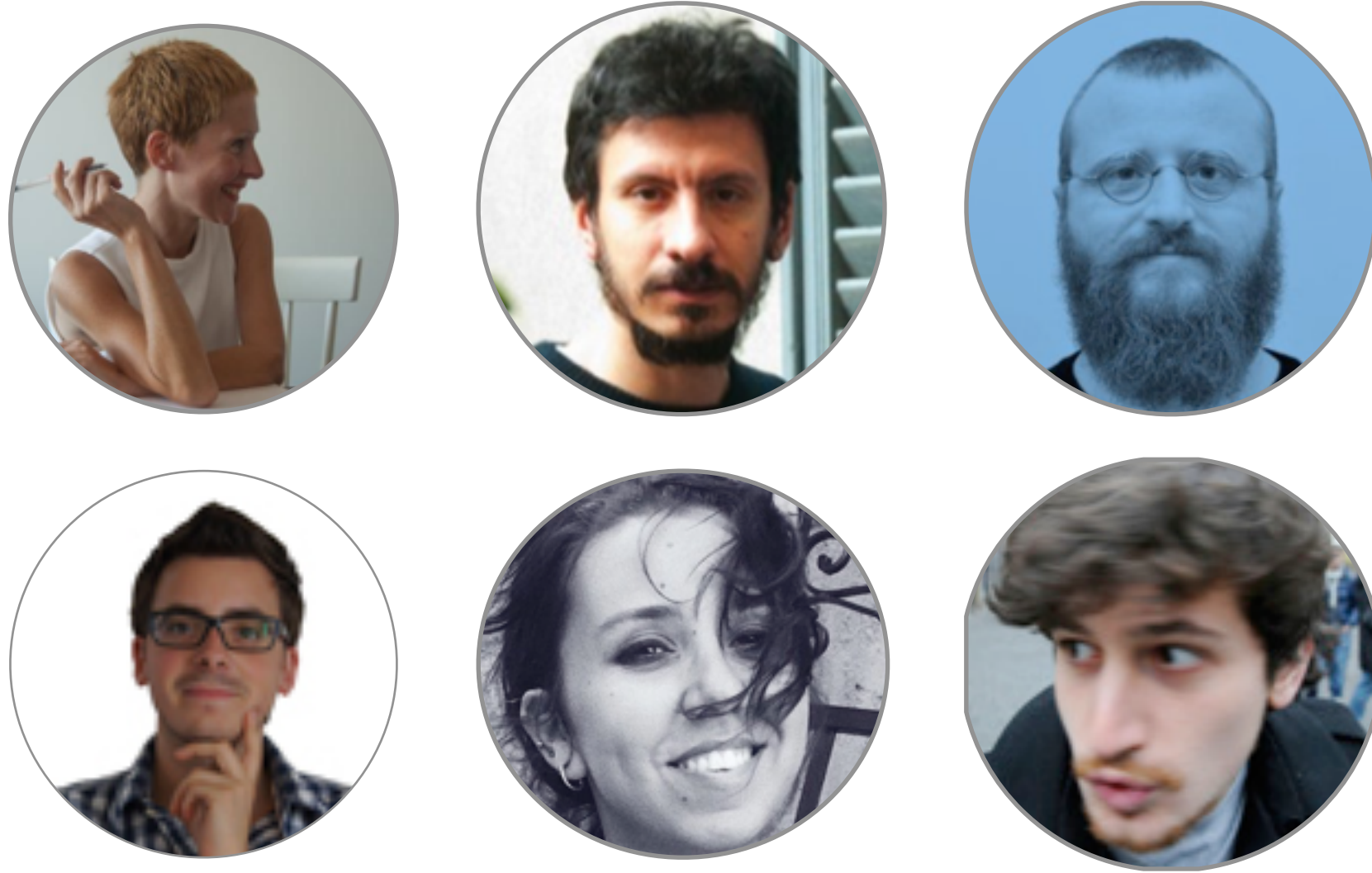


1.6

1 DAY LESS THAN PREVIOUS QUARTER

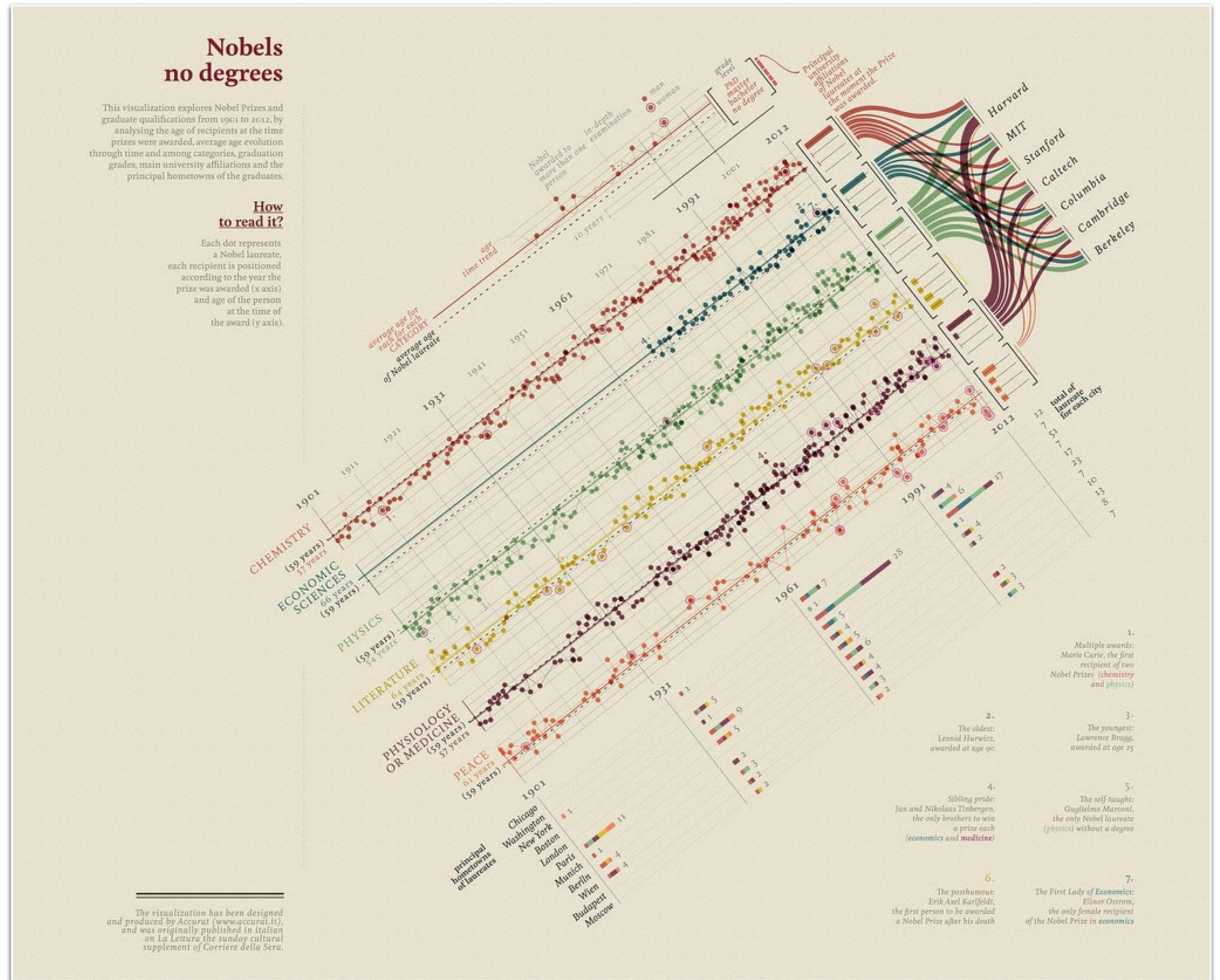
TOP GENRES	VIDEOS WATCHED
Drama: 17h	Sixty-two
Reality TV: 12h	58 TV episodes, 4 movies
Sitcom: 7h	
Action & Adventure: 2h	TOP MOVIE RATING
Documentary: 1h	90%
	Deceptive Practice

Data Art



Giorgia Lupi, Simone Quadri, Gabriele Rossi,
Davide Ciuffi, Federica Fragapane, Francesco Majno.

Information Designer, Artist



Nobels, no degrees

<https://www.behance.net/gallery/14159439/Nobel-no-degrees>

Pre-baked Charts



- ✓ quick to create
- ✓ easy to learn/use
- ✗ hard to customize

Programming Toolkits



- ✗ slow to create
- ✗ hard to learn/use
- ✓ powerful and expressive

Design Tools



- ✗ tedious & error-prone
- ✓ familiar & widely used
- ✓ powerful and expressive



Data Illustrator

Drawing-based, resembles existing design tools

Automatic data encoding support

Power & expressivity comparable to toolkits, **without programming**

Improved learnability and usability

DonorsChoose.org Project Funding

odds of school projects

7 subject areas

4 resource types

(books, supplies, technology, other)

Source:

Column5Media

Row ID	Subject Area	Resource Type	Chance
R1	Special Needs	Books	0.01
R2	Special Needs	Supplies	-0.12
R3	Special Needs	Technology	-0.115
R4	Special Needs	Other	-0.05
...
R27	Applied Learning	Technology	-0.225
R28	Applied Learning	Other	-0.27

DonorsChoose.org Project Funding

odds of school projects

7 subject areas

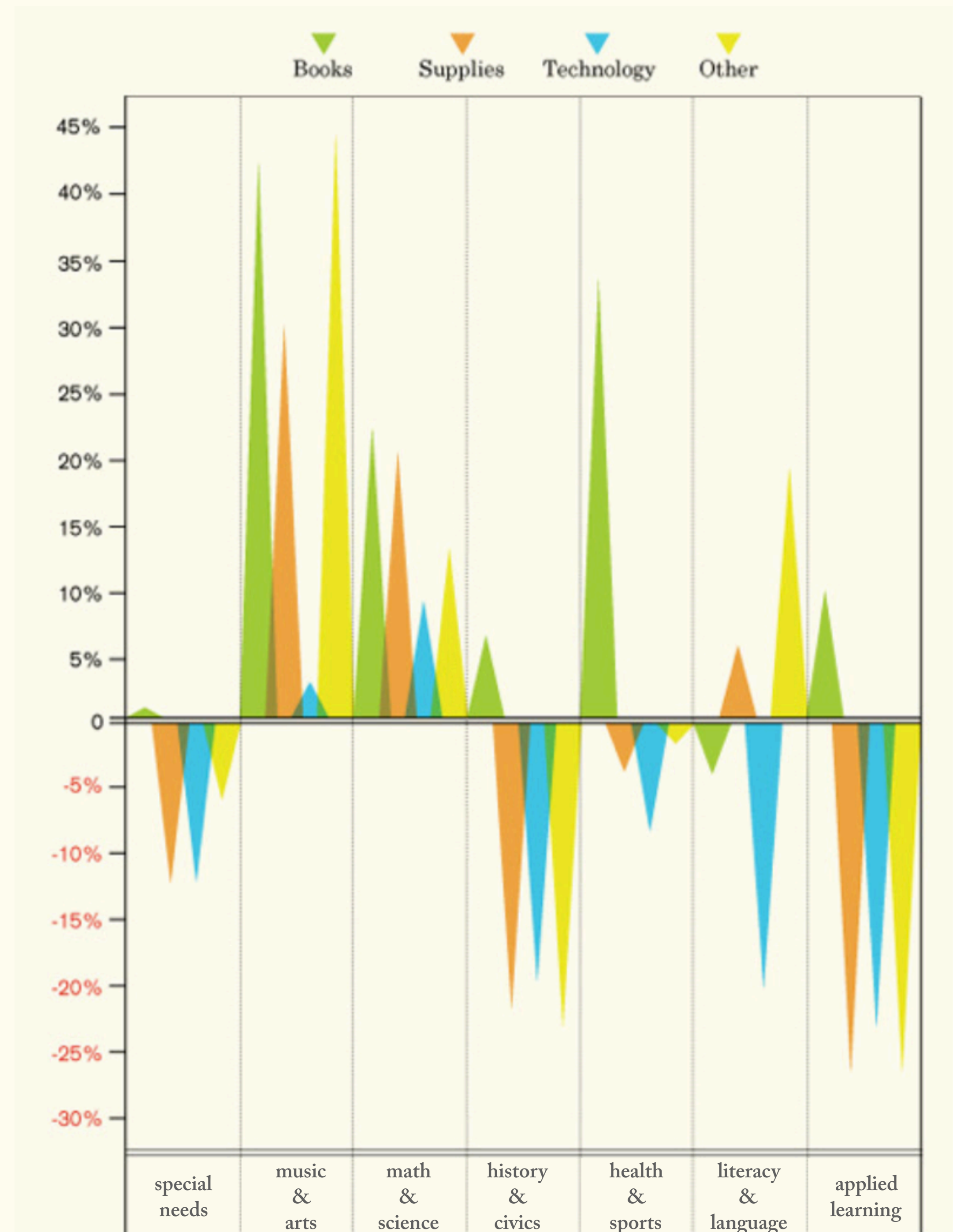
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DonorsChoose.org Project Funding

odds of school projects

7 subject areas

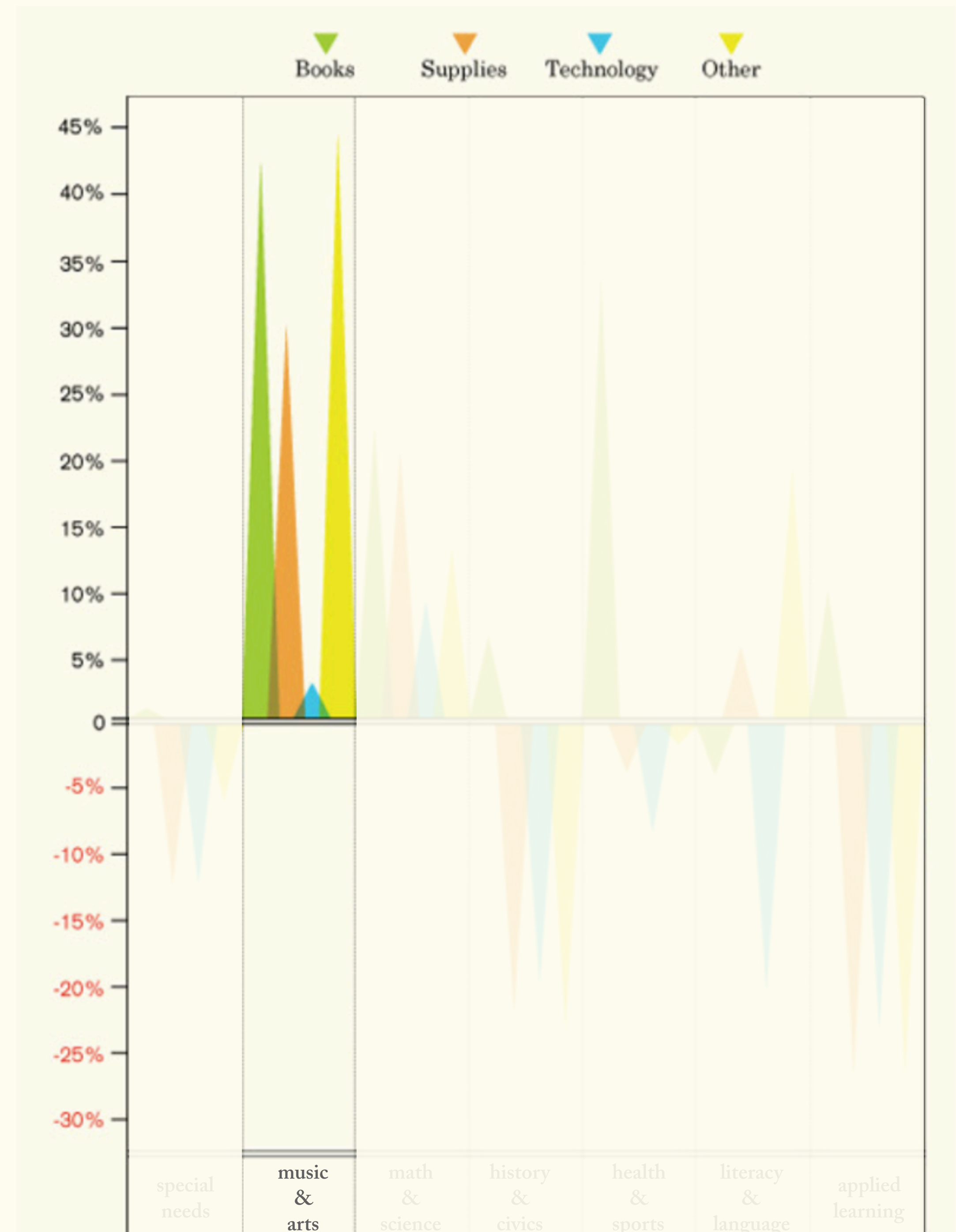
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Column5Media

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DonorsChoose.org Project Funding

odds of school projects

7 subject areas

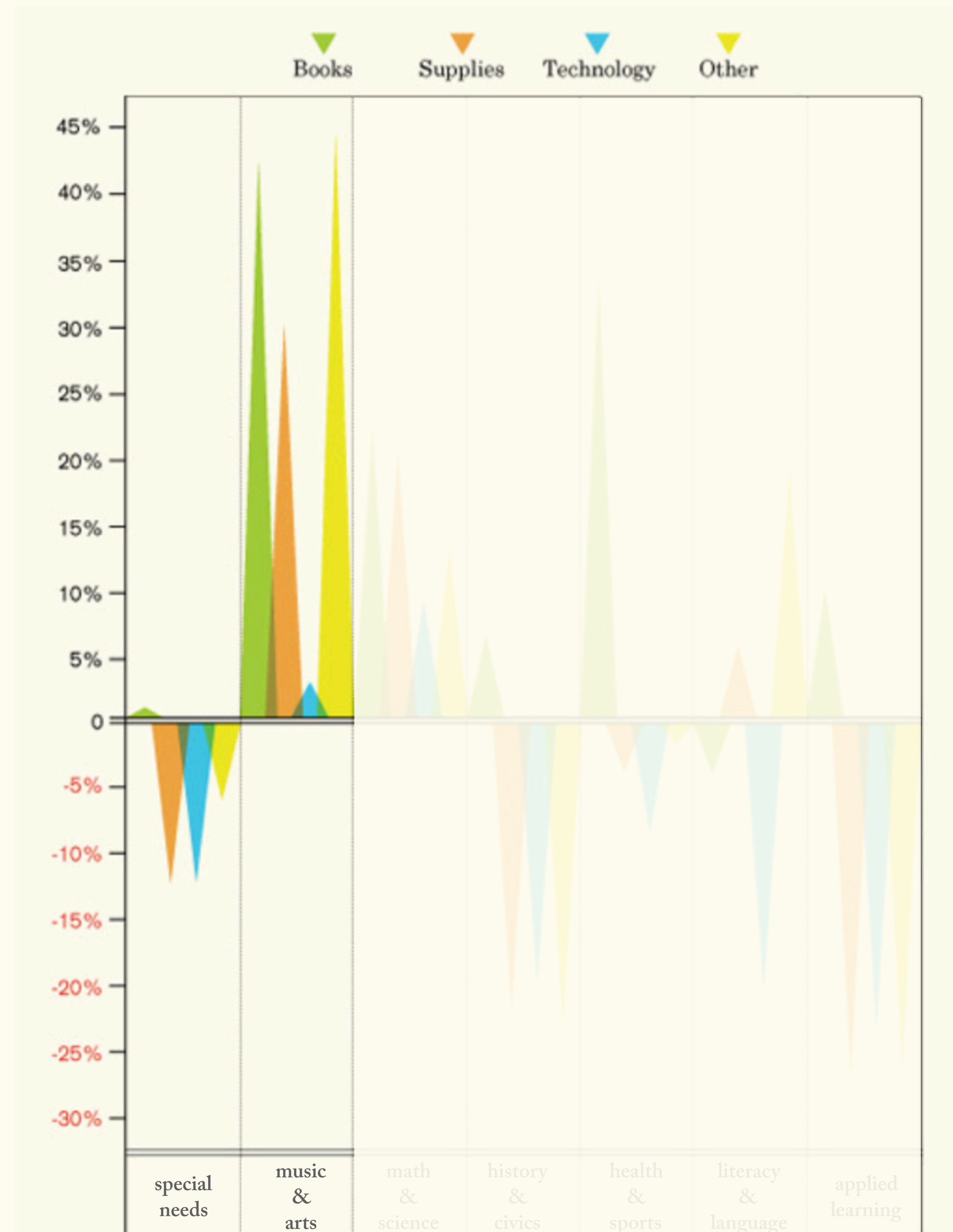
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...
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R28	Applied Learning	Other	-0.27



project funding.csv Change

28 rows in total

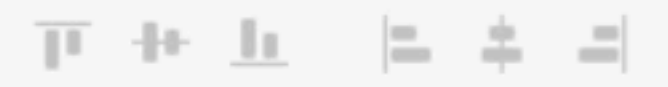
Abc **Subject** ⓘ 7 values

Abc **Resource Type** ⓘ 4 values

Chance ⓘ -0.40 - 0.43

Abc **Row_ID** ⓘ 28 values

LAYERS

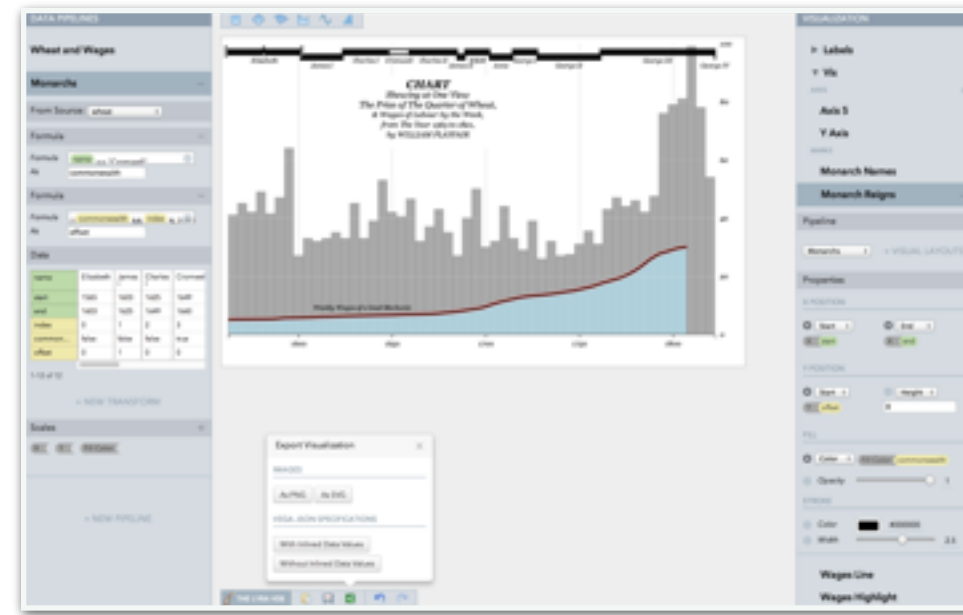


- Repeat
- Partition
- Break
- Group

Data for Artboard 1: all rows ⌵

Abc Row_ID	Abc Subject	Abc Resource Type	# Chance
1	Special Needs	Books	0.01
2	Special Needs	Supplies	-0.12
3	Special Needs	Technology	-0.115
4	Special Needs	Other	-0.05
5	Music & The Arts	Books	0.42
6	Music & The Arts	Supplies	0.29

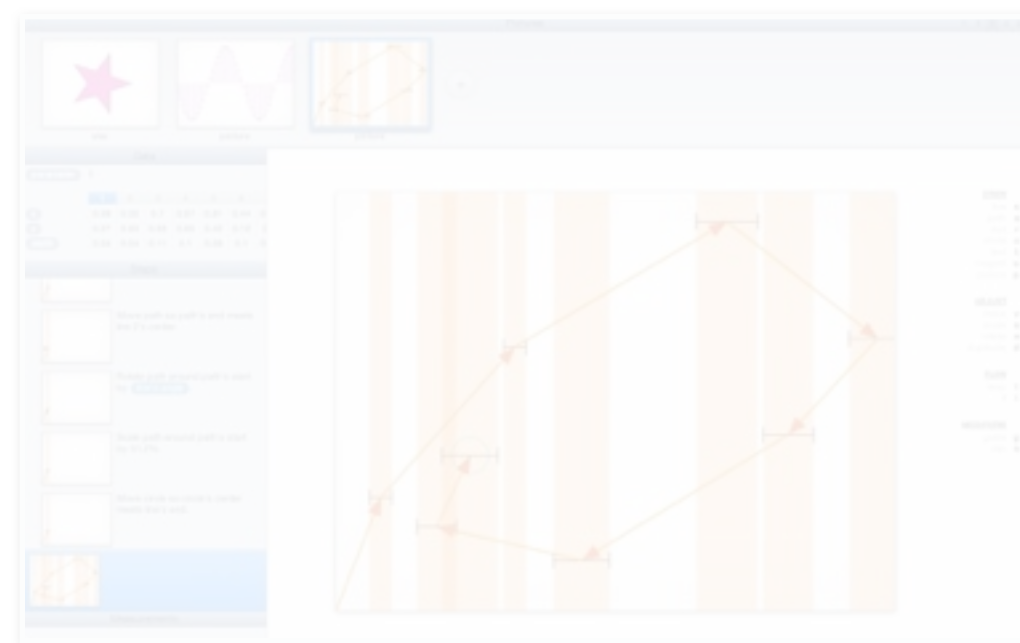
Yet Another Visualization Authoring Tool?



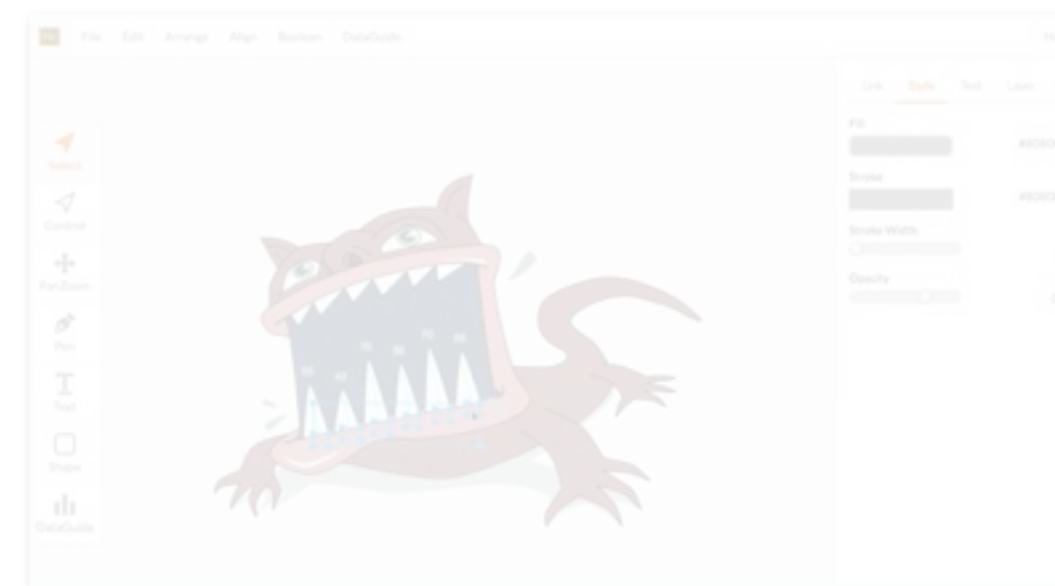
Satyanarayan and Heer (2014)
Lyra



Ren et. al. (2014)
iVisDesigner



Bret Victor (2013)
Drawing Dynamic Visualizations



Kim et. al. (2016)
Data-driven Guides



Xia et. al. (2018)
DataInk

Grammar/Template based Approach

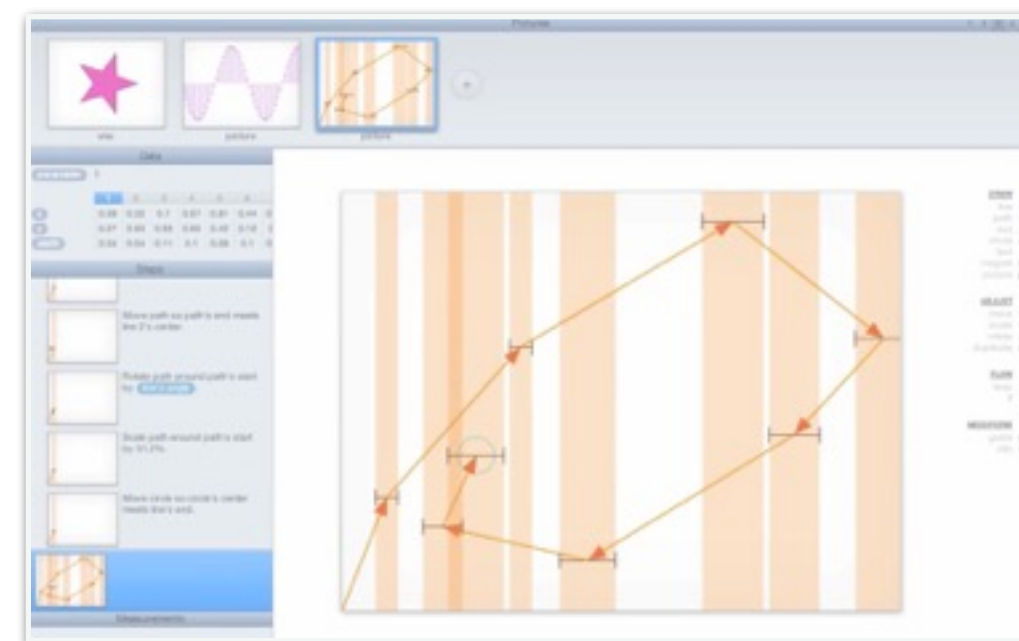
Yet Another Visualization Authoring Tool?



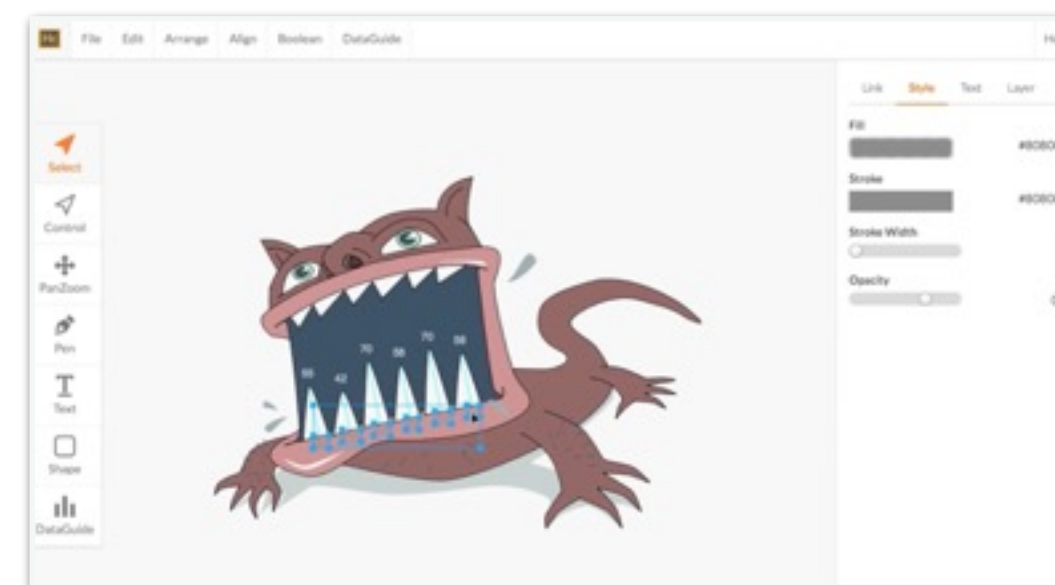
Satyanarayan and Heer (2014)
Lyra



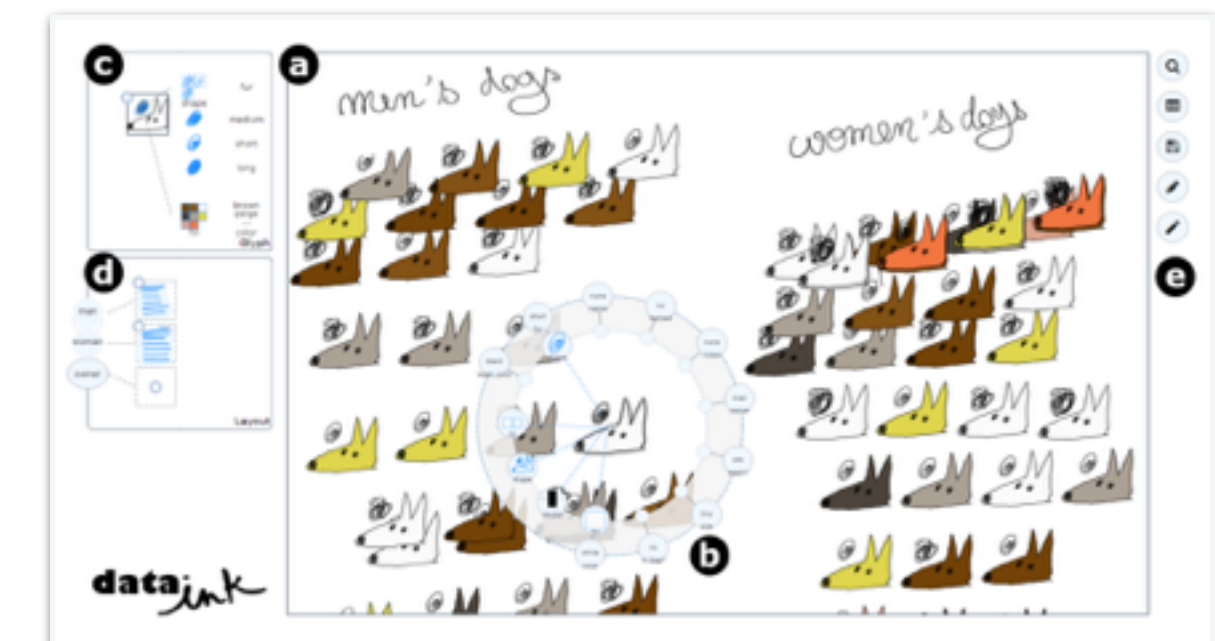
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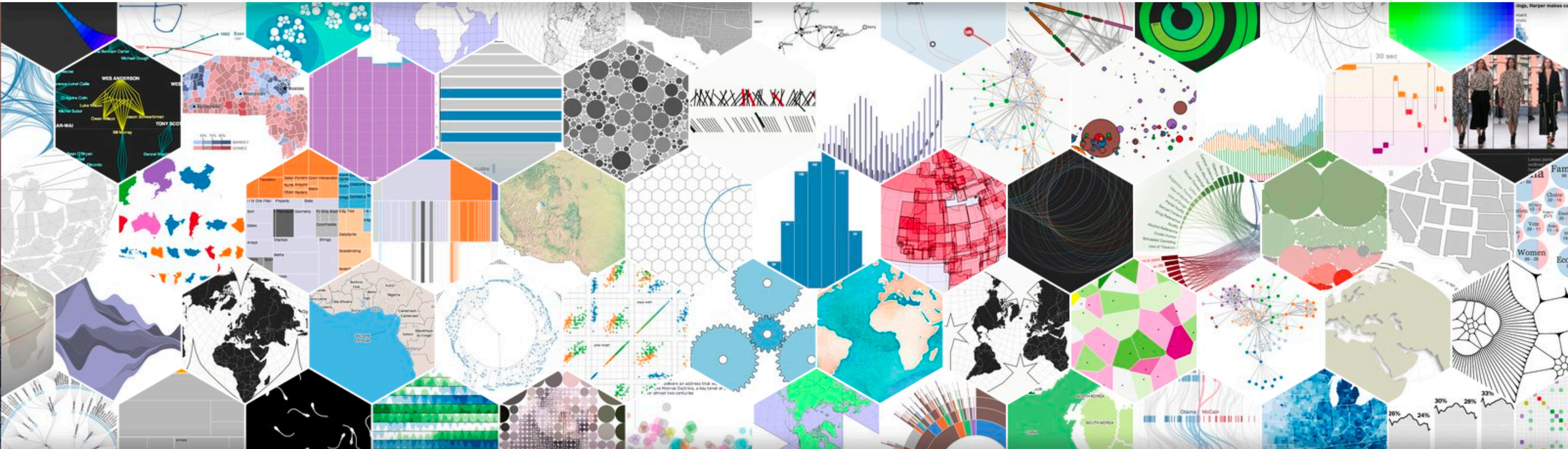


Xia et. al. (2018)
DataInk

Lazy Data Binding Approach

Sketch first, apply data binding when necessary

The Quest for Expressivity



How do we scale the lazy data binding approach to describe a wide variety of visualizations?

A set of building blocks that describe
the *structure* and *generation* of diverse visualizations.



The Grammar of Graphics

CaseID	Response
1	Frequently
2	Not Sure
3	Frequently
...	...
3834	Rarely
3835	Infrequently

CaseID	Gender
1	Male
2	Female
3	Male
...	...
3834	Male
3835	Female

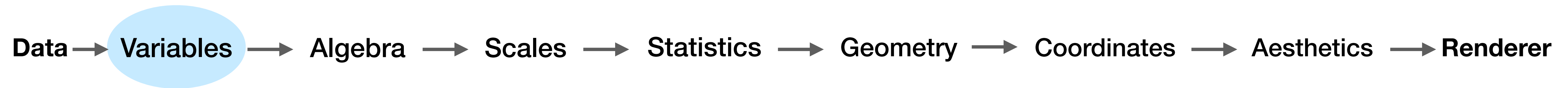


The Grammar of Graphics

CaseID	Response
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3835	Female

response = Response
gender = Gender



The Grammar of Graphics

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1	Frequently
2	Not Sure
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...	...
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3835	Infrequently

CaseID	Gender
1	Male
2	Female
3	Male
...	...
3834	Male
3835	Female

```
response = Response  
gender = Gender  
cross(response, gender)
```



The Grammar of Graphics

CaseID	Response
1	Frequently
2	Not Sure
3	Frequently
...	...
3834	Rarely
3835	Infrequently

CaseID	Gender
1	Male
2	Female
3	Male
...	...
3834	Male
3835	Female

```
response = Response  
gender = Gender  
cross(response, gender)  
cat(dim(1), values("Rarely", "Infrequently",  
  "Occasionally", "Frequently", "Not Sure"))  
cat(dim(2), values("Female", "Male"))
```

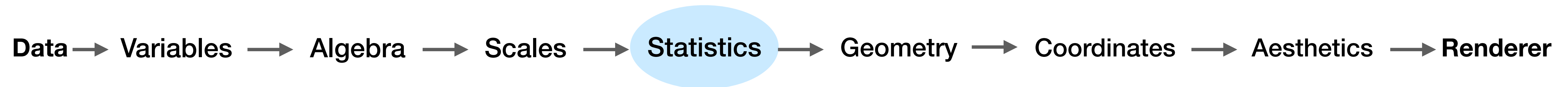


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```
response = Response  
gender = Gender  
cross(response, gender)  
cat(dim(1), values("Rarely", "Infrequently",  
  "Occasionally", "Frequently", "Not Sure"))  
cat(dim(2), values("Female", "Male"))  
summary.proportion(Response*Gender)
```

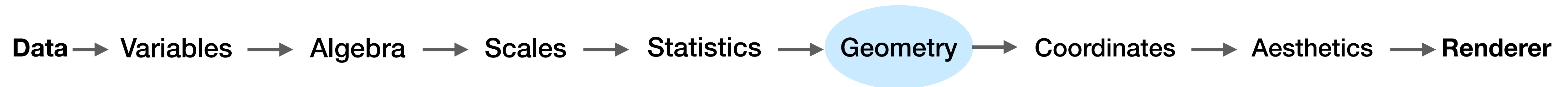


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cross(response, gender)
cat(dim(1), values("Rarely", "Infrequently",
  "Occasionally", "Frequently", "Not Sure"))
cat(dim(2), values("Female", "Male"))
summary.proportion(Response*Gender)
interval.stack(summary.proportion(response*gender))
```



The Grammar of Graphics

CaseID	Response
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2	Not Sure
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cat(dim(2), values("Female", "Male"))
summary.proportion(Response*Gender)
rect(dim(2), polar.theta(dim(1)))
interval.stack(position(summary.proportion(response*gender)))
```



The Grammar of Graphics

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2	Not Sure
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3835	Infrequently

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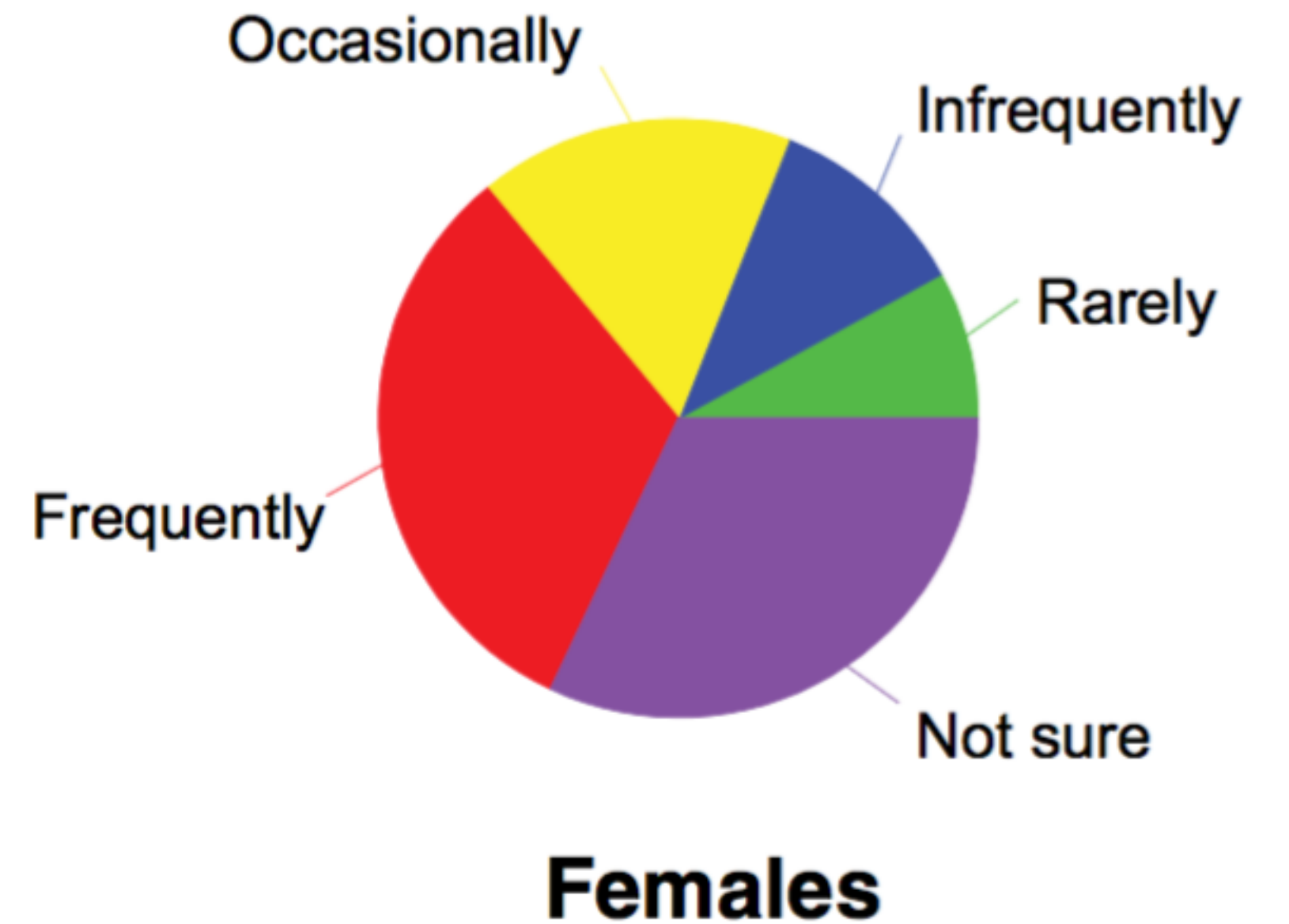
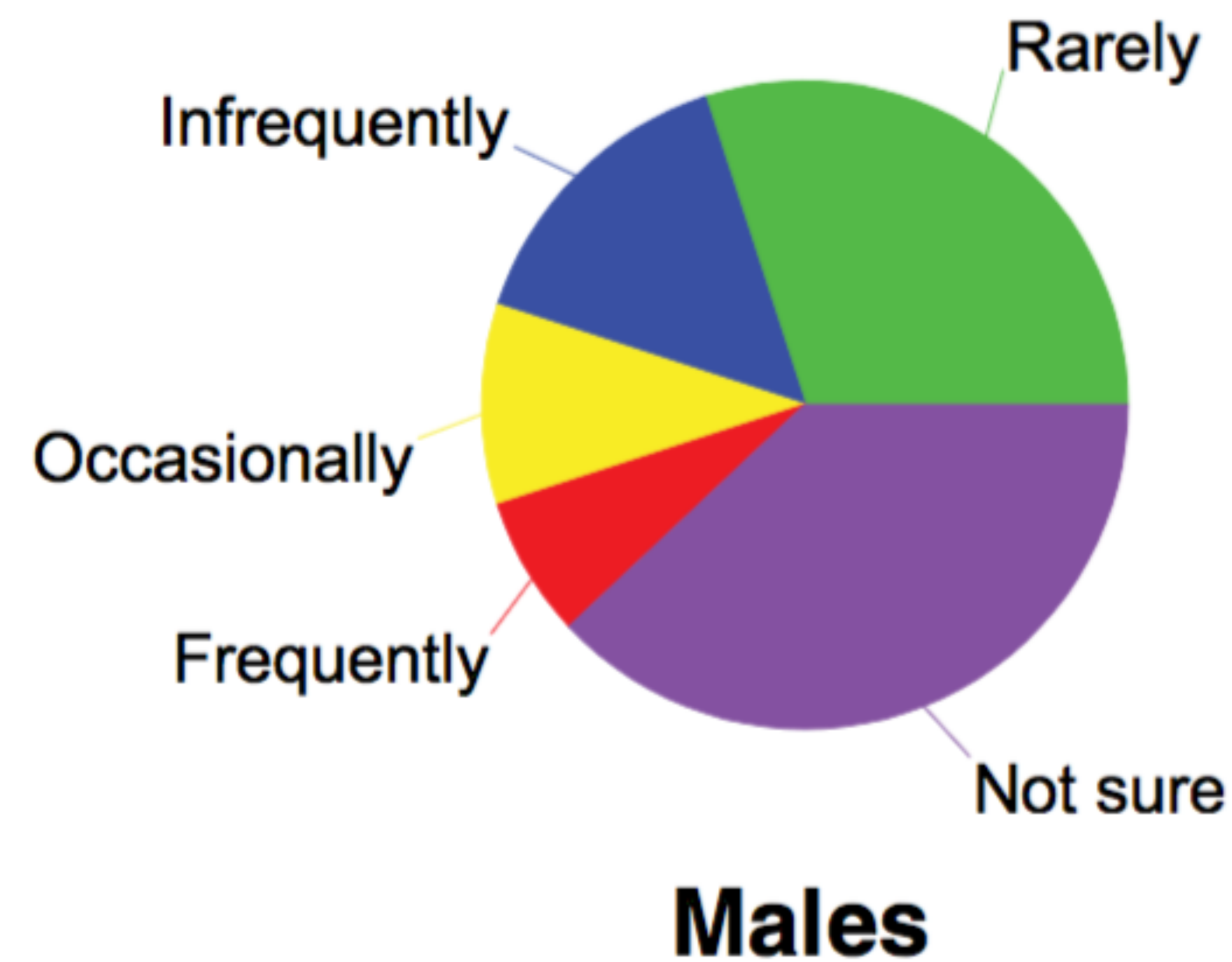
```
response = Response
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cross(response, gender)
cat(dim(1), values("Rarely", "Infrequently",
  "Occasionally", "Frequently", "Not Sure"))
cat(dim(2), values("Female", "Male"))
summary.proportion(Response*Gender)
rect(dim(2), polar.theta(dim(1)))
interval.stack(position(summary.proportion(response*gender)),
label(response), color(response))
```

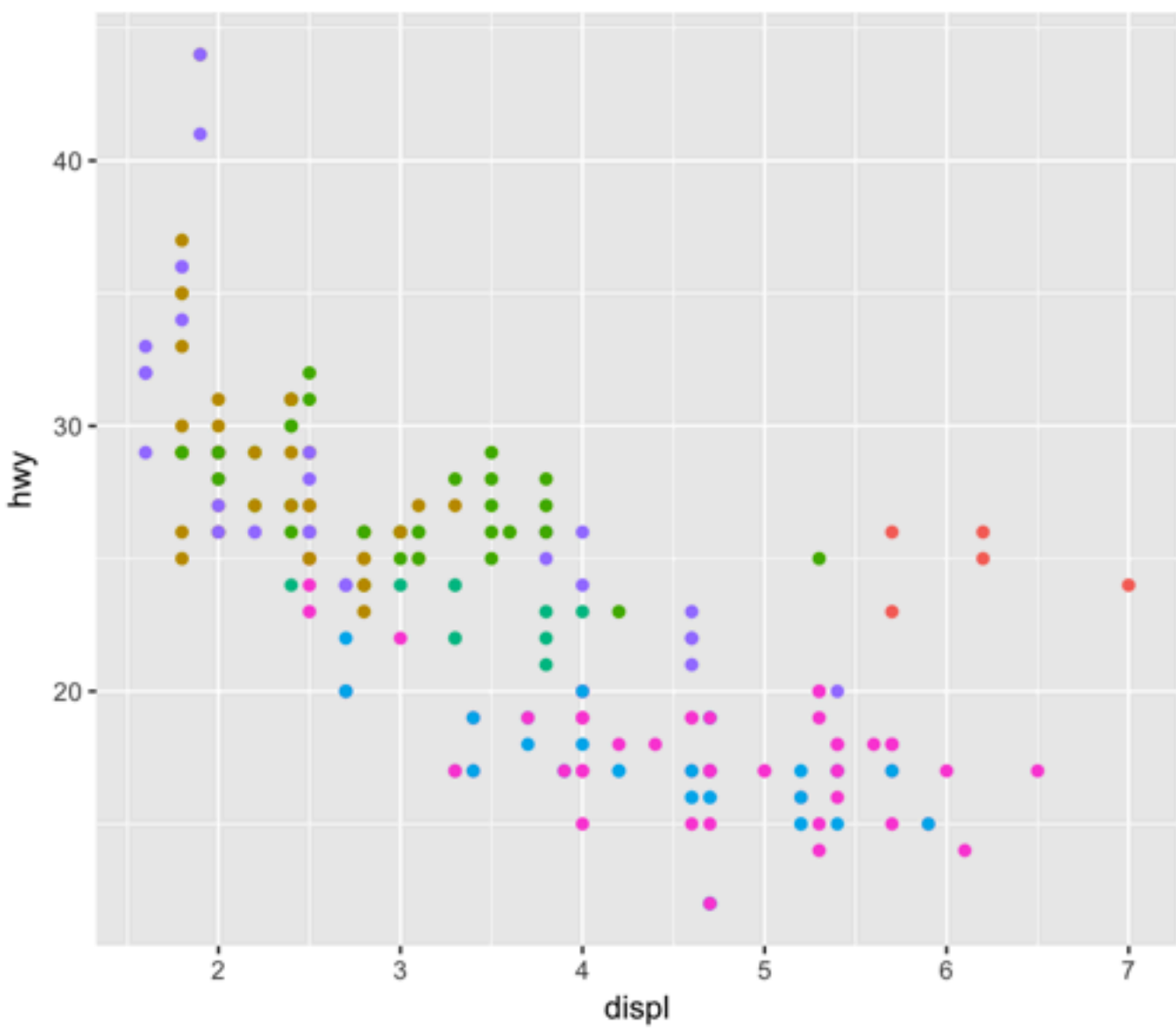


The Grammar of Graphics

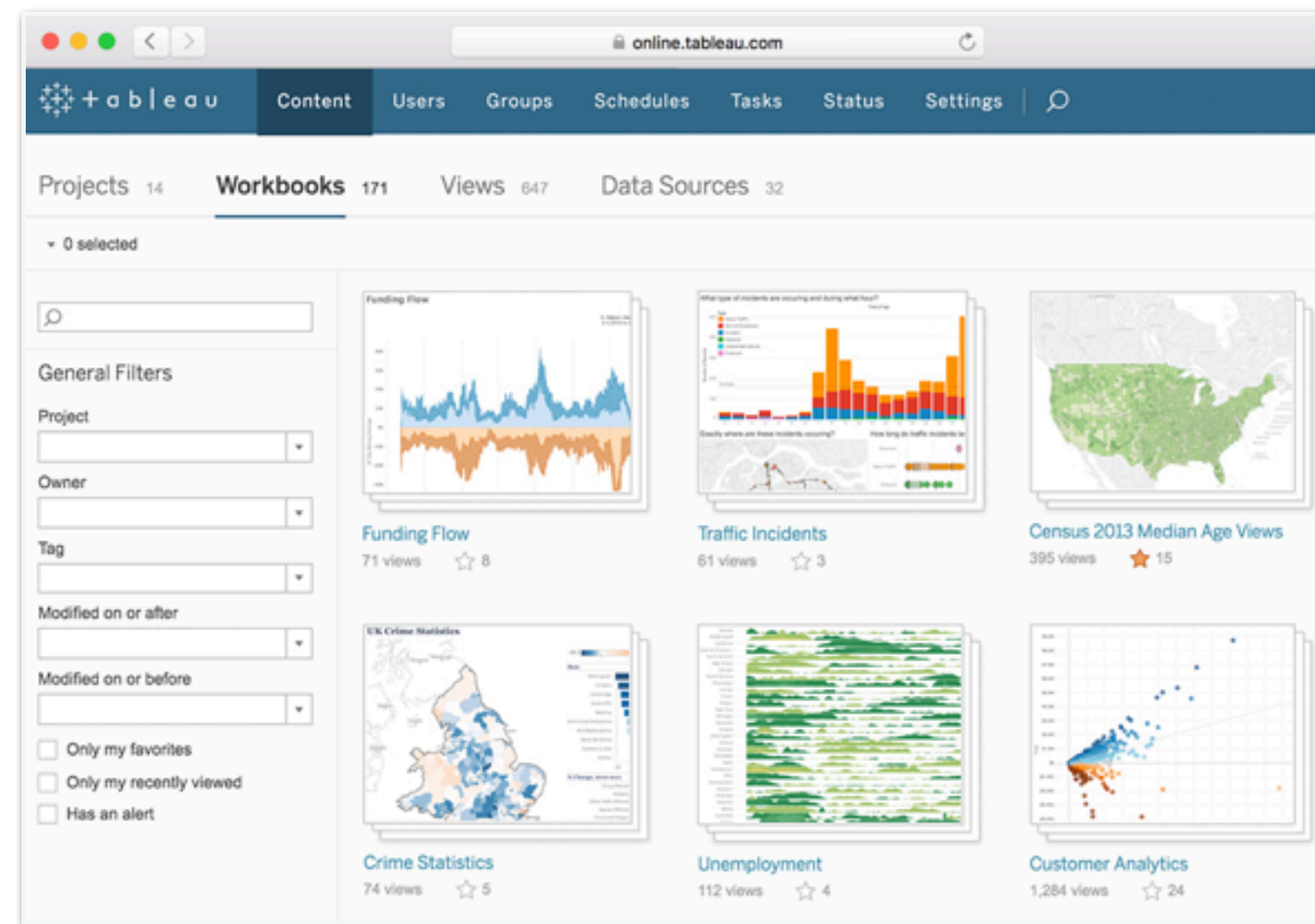
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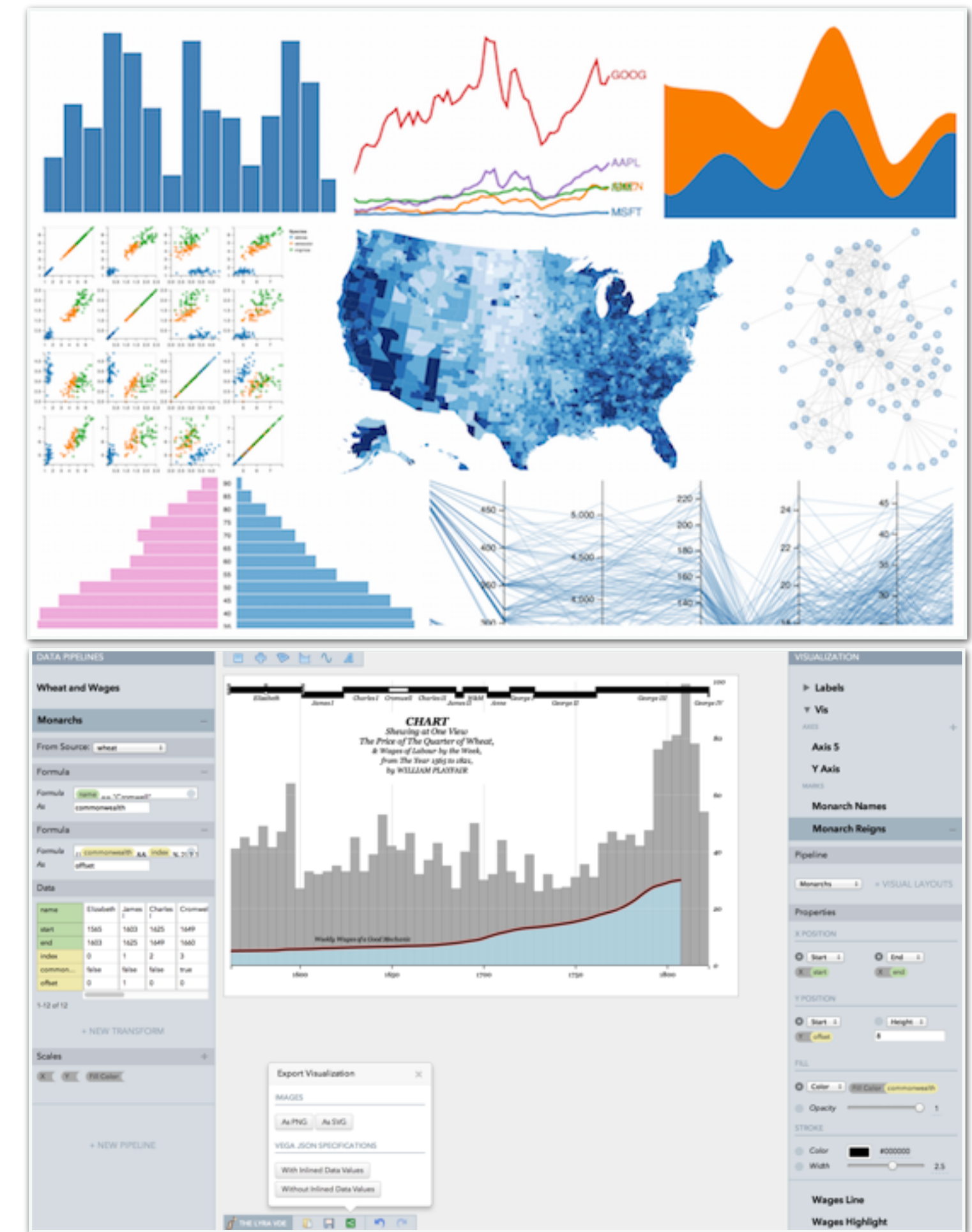




Wickham, 2010



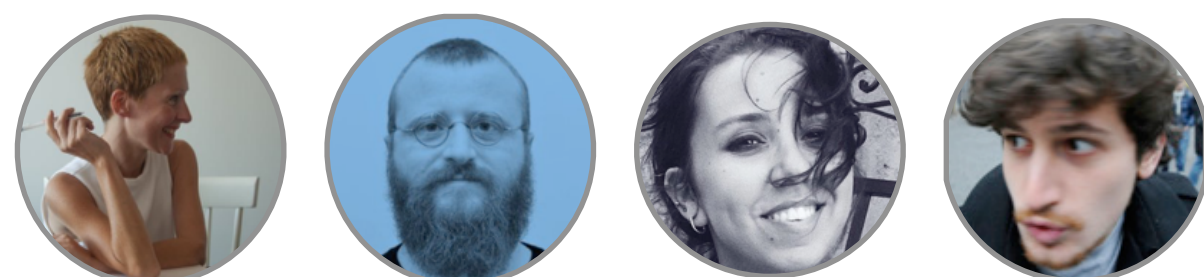
Stolte and Hanrahan, 2002



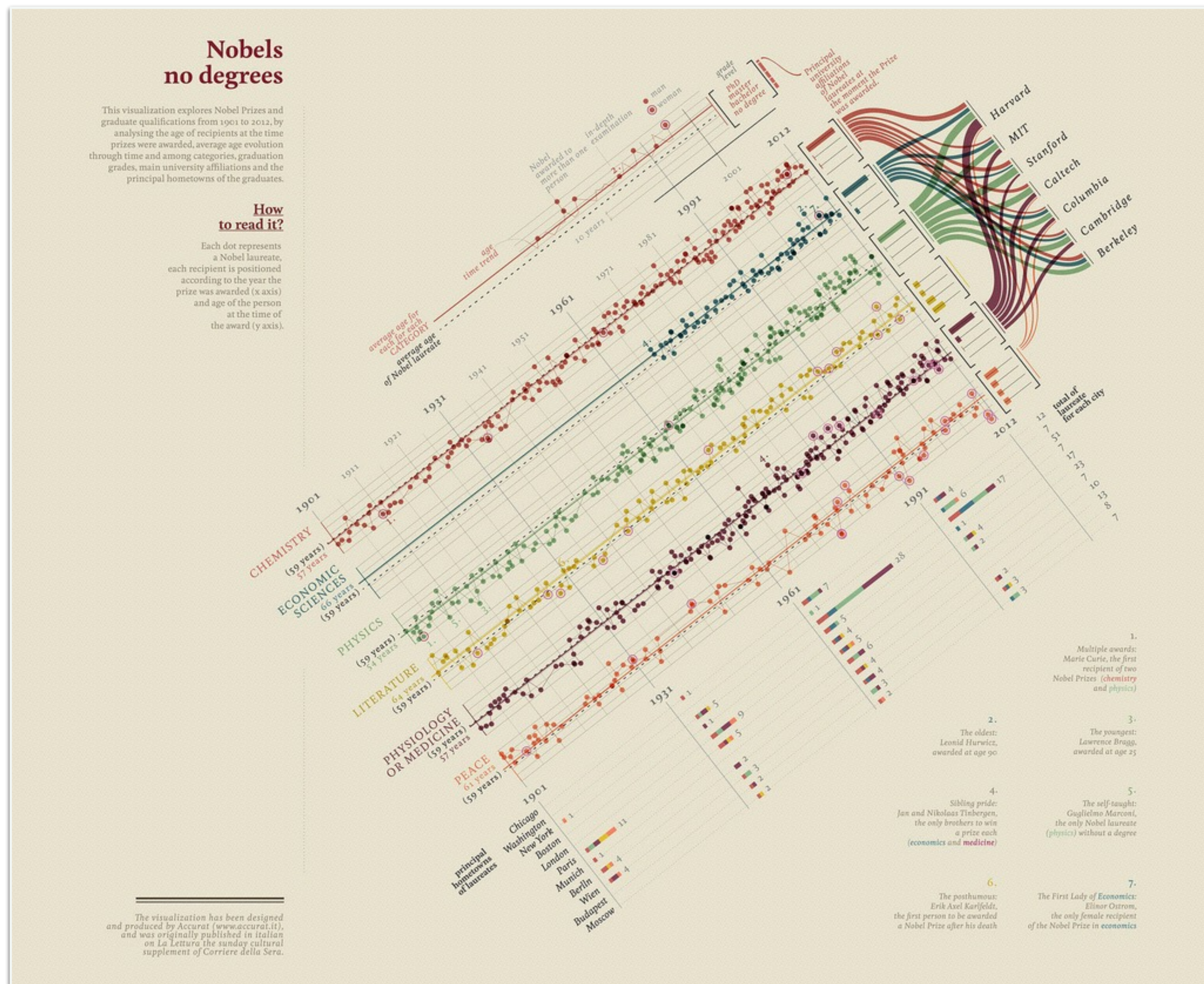
Satyanarayan and Heer, 2014

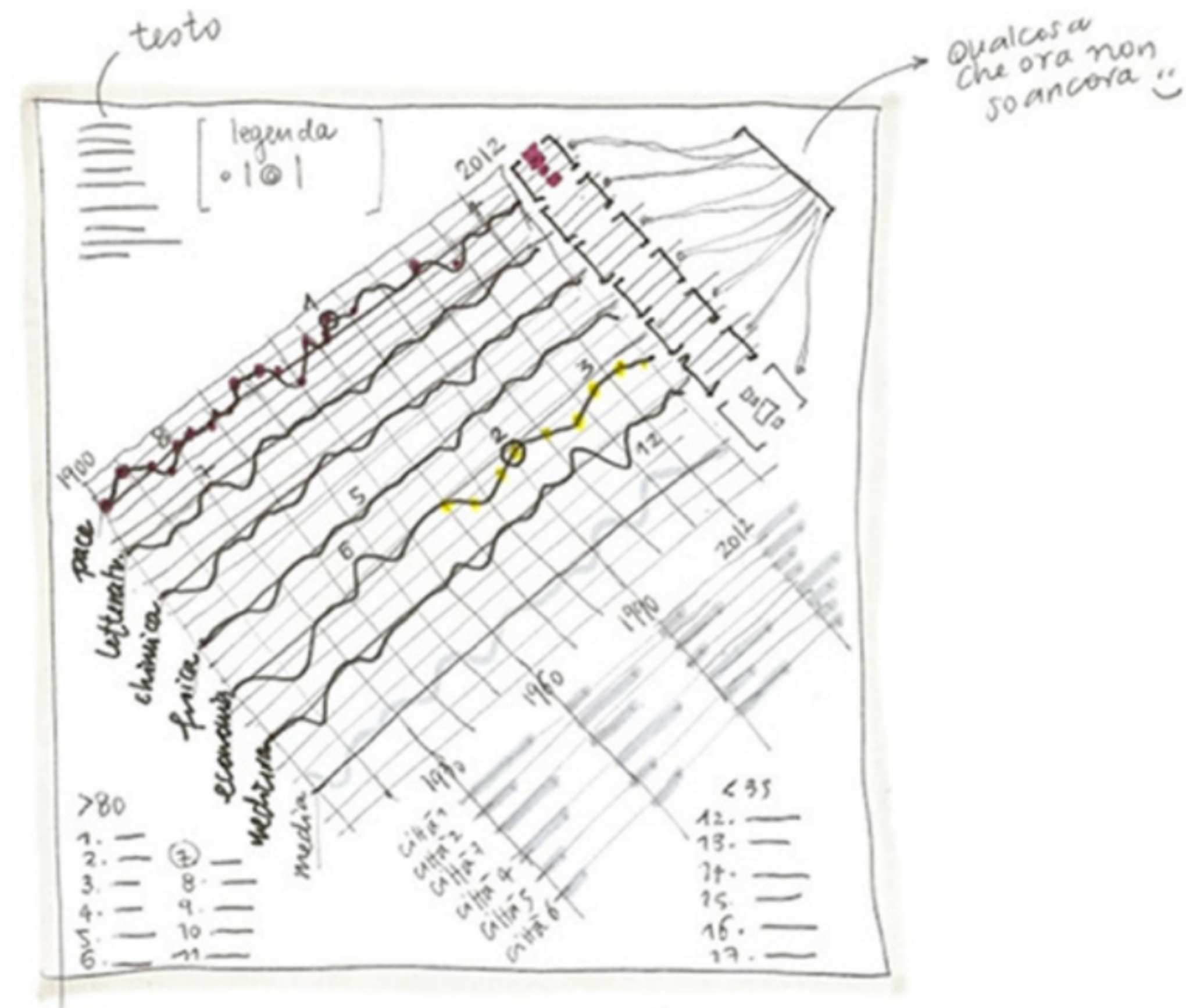
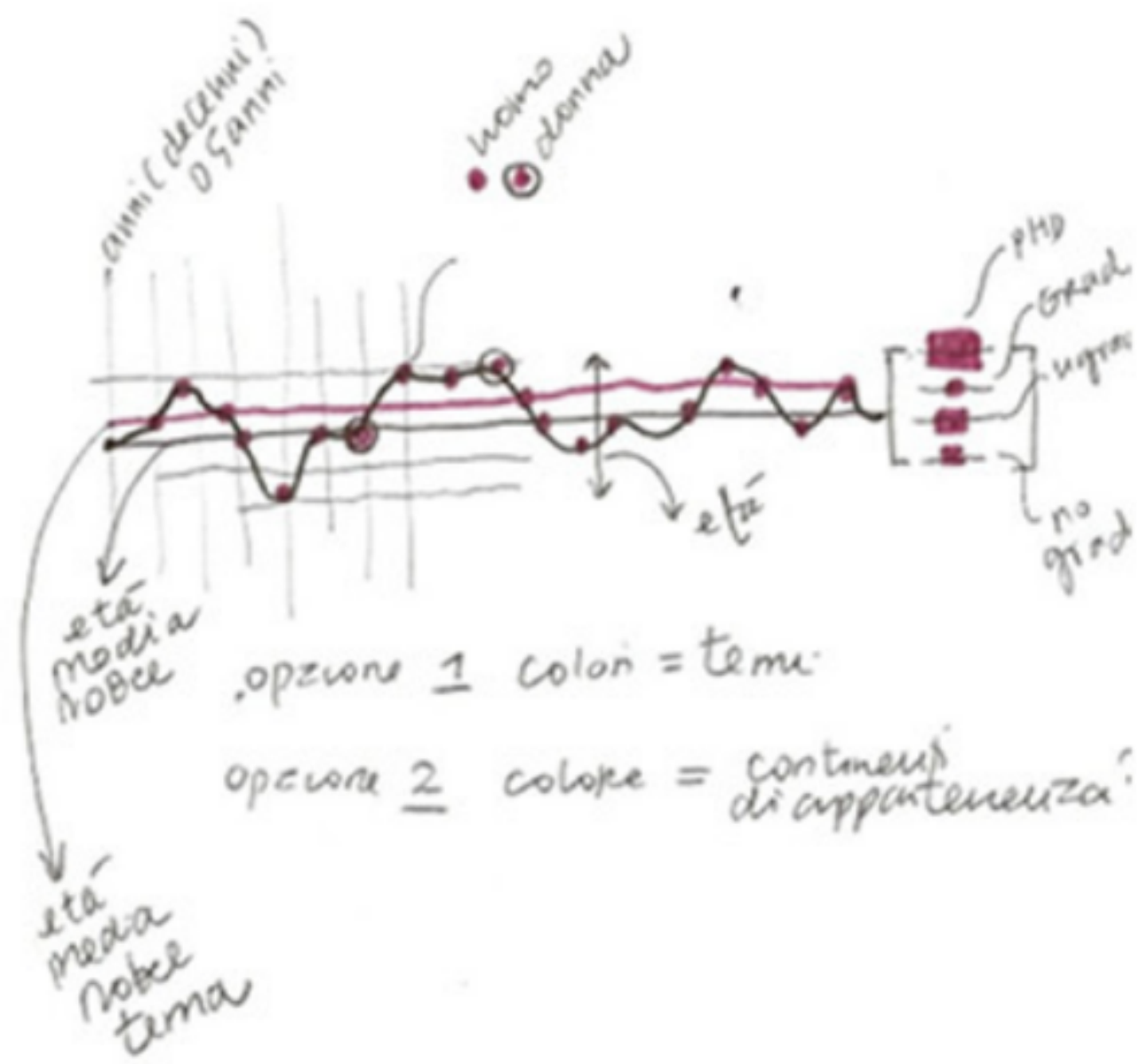
“For this visualization, we took a lot of inspiration from musical scores and their elegant aesthetics.

Particularly, John Cage, a famous contemporary composer, was a true source of fascination.”



Giorgia Lupi, Gabriele Rossi,
Federica Fragapane, Francesco Majno.



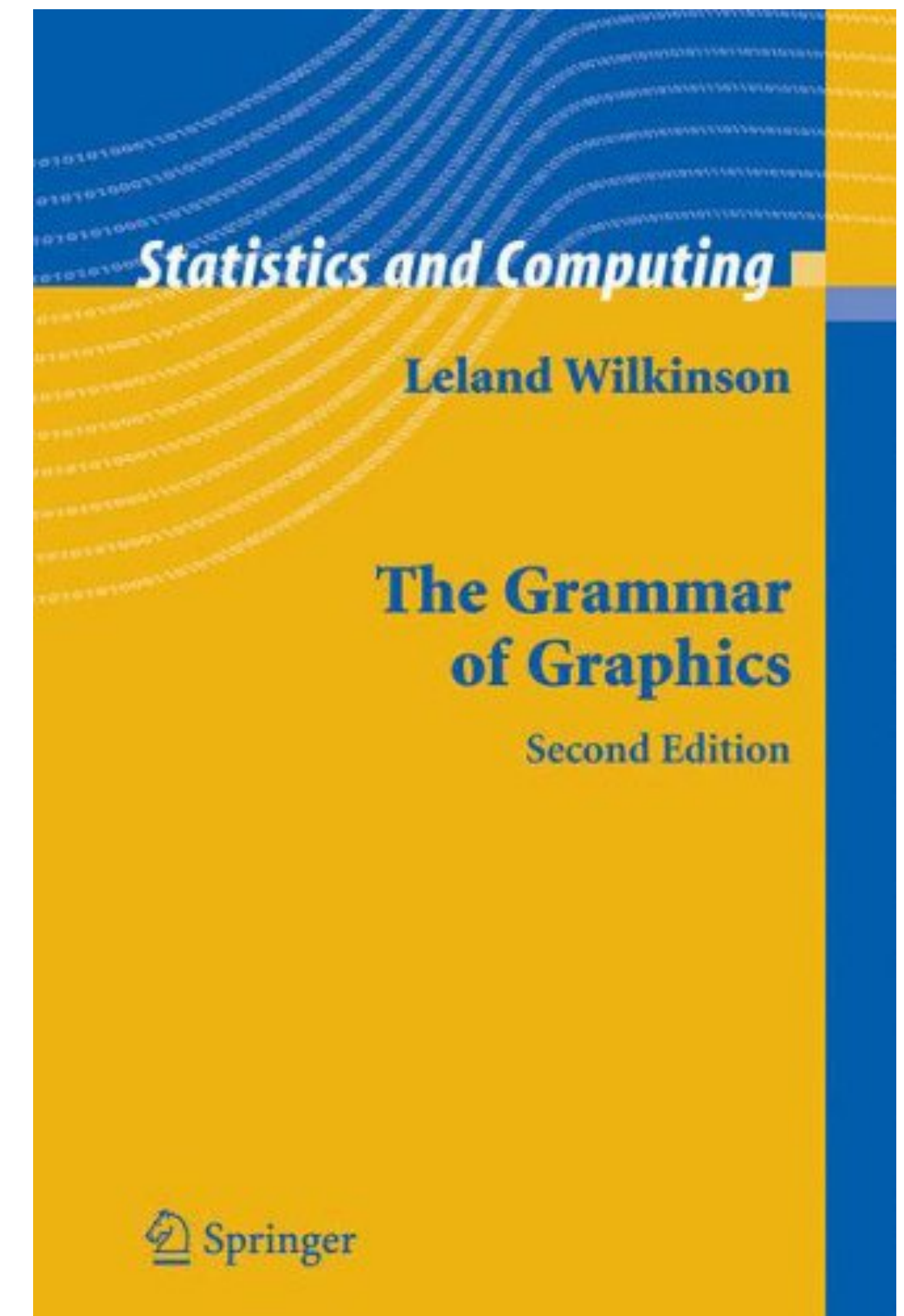


Giorgia Lupi, Gabriele Rossi,
Federica Fragapane, Francesco Majno.

A Model for Computer Scientists/Programmers

Start from data, visualization rendered in the end

Intermediate abstraction such as specifications



A Model for Graphical Designers

~~Start from data, visualization rendered in the end~~

Start with drawing, apply data binding when necessary

~~Intermediate abstraction such as specifications~~

Direct interaction with visual items on canvas



2 Years 3 Designers 1-hour Weekly Meetings ~40 Storyboards and Mockups



Consistent with existing design applications

Interpretable by designers and non-programmers

Composable to create novel visualizations



- ◆ **Graphical Primitives**
Shapes, Anchor Points, Segments
- ◆ **Generative Operators**
Repeat & Partition
- ◆ **Structural Descriptors**
Group & Collection, Layout, Nesting
- ◆ **Data Binding Concepts**
Data Scope, Peer, Scale

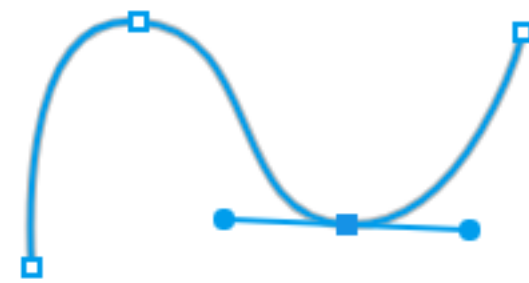


Line



2 anchor points
1 line segment
open path

Path



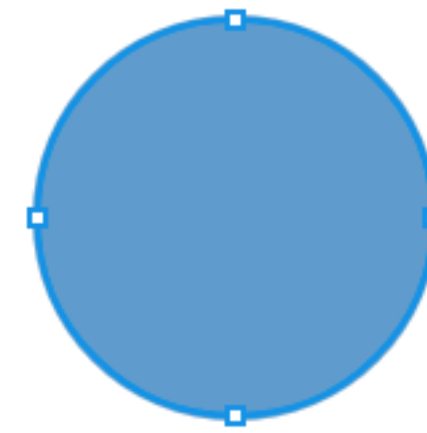
2+ anchor points
1+ line segments
open/closed path

Rectangle



4 anchor points
3 line segment
closed path

Circle



4 anchor points
3 line segments
closed path

Text



point text
non-deformable

Graphical Primitives



Row ID	Country	Medal Type	Count
R1	United States	Gold	46
R2	United States	Silver	29
R3	United States	Bronze	29
R4	China	Gold	38
R5	China	Silver	27
R6	China	Bronze	23
...
R58	Grenada	Gold	1
R59	Grenada	Silver	0
R60	Grenada	Bronze	0

Repeat Operator

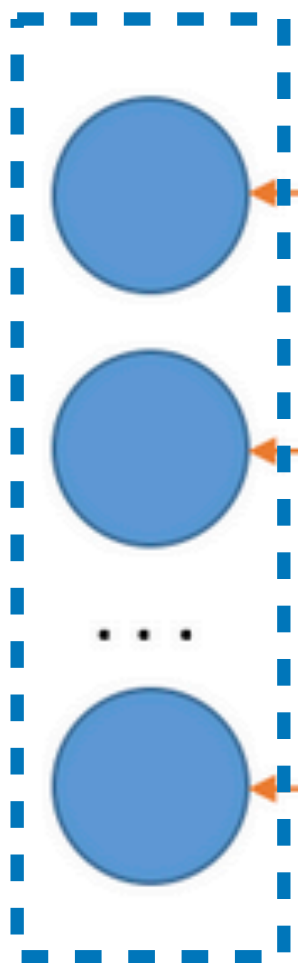


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R5	China	Silver	27
R6	China	Bronze	23
...
R58	Grenada	Gold	1
R59	Grenada	Silver	0
R60	Grenada	Bronze	0



Repeat by "Country"

Collection



Row ID	Country	Medal Type	Count
R1	United States	Gold	46
R2	United States	Silver	29
R3	United States	Bronze	29
R4	China	Gold	38
R5	China	Silver	27
R6	China	Bronze	23
...
R58	Grenada	Gold	1
R59	Grenada	Silver	0
R60	Grenada	Bronze	0

data scope of circle 1

data scope of circle 2

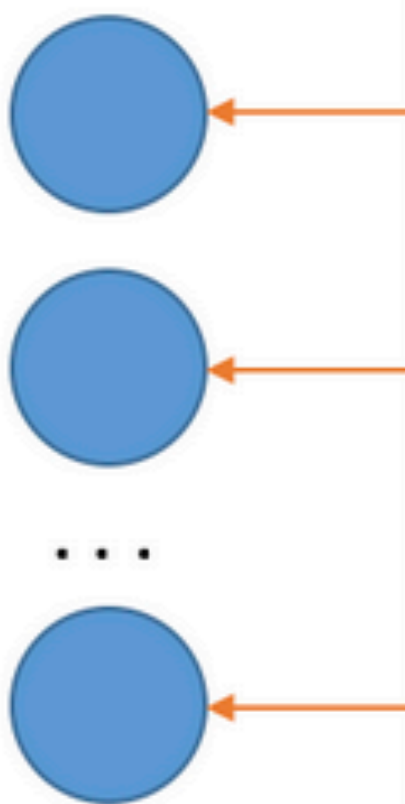
data scope of circle 3

Repeat Operator



Row ID	Country	Medal Type	Count
R1	United States	Gold	46
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R3	United States	Bronze	29
R4	China	Gold	38
R5	China	Silver	27
R6	China	Bronze	23
...
R58	Grenada	Gold	1
R59	Grenada	Silver	0
R60	Grenada	Bronze	0

Repeat by "Country"



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R5	China	Silver	27
R6	China	Bronze	23
...
R58	Grenada	Gold	1
R59	Grenada	Silver	0
R60	Grenada	Bronze	0

File View Help

Olympic Medals Change

60 rows in total

Abc Country_Code 20 values

Abc Country_Name 20 values

Abc Medal_Type 3 values

Count 0 - 46

Abc Row_ID 60 values

LAYERS

● Ellipse 1



+

Repeat

Partition

Break

Group

SHAPE POSITION

X 400.5

Y 115.5

SIZE

Width 31.0

Height 31.0

Area 755.0

STYLE

Fill Color #ffffff

Stroke Color #bbbbbb


Stroke Width 1.5

Opacity 0% 100%

Data represented by Ellipse 1: 0/60 rows

Abc Row_ID	Abc Country_Code	Abc Country_Name	Abc Medal_Type	# Count
------------	------------------	------------------	----------------	---------

Repeat and Lay out in Grid



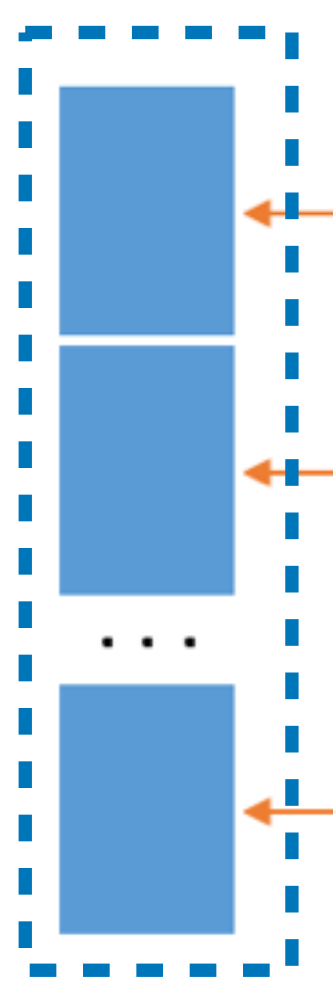
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...
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Partition Operator

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R5	China	Silver	27
R6	China	Bronze	23
...
R58	Grenada	Gold	1
R59	Grenada	Silver	0
R60	Grenada	Bronze	0

↓ Partition by "Country"

Collection



Row ID	Country	Medal Type	Count
R1	United States	Gold	46
R2	United States	Silver	29
R3	United States	Bronze	29
R4	China	Gold	38
R5	China	Silver	27
R6	China	Bronze	23
...
R58	Grenada	Gold	1
R59	Grenada	Silver	0
R60	Grenada	Bronze	0

data scope of rect 1

data scope of rect 2

data scope of rect 3

Partition Operator

Row ID	Country	Medal Type	Count
R1	United States	Gold	46
R2	United States	Silver	29
R3	United States	Bronze	29
R4	China	Gold	38
R5	China	Silver	27
R6	China	Bronze	23
...
R58	Grenada	Gold	1
R59	Grenada	Silver	0
R60	Grenada	Bronze	0

↓ Partition by "Country"

Row ID	Country	Medal Type	Count
R1	United States	Gold	46
R2	United States	Silver	29
R3	United States	Bronze	29
R4	China	Gold	38
R5	China	Silver	27
R6	China	Bronze	23
...
R58	Grenada	Gold	1
R59	Grenada	Silver	0
R60	Grenada	Bronze	0

File View Help

Olympic Medals Change

60 rows in total

Abc Country_Code (20 values)

Abc Country_Name (20 values)

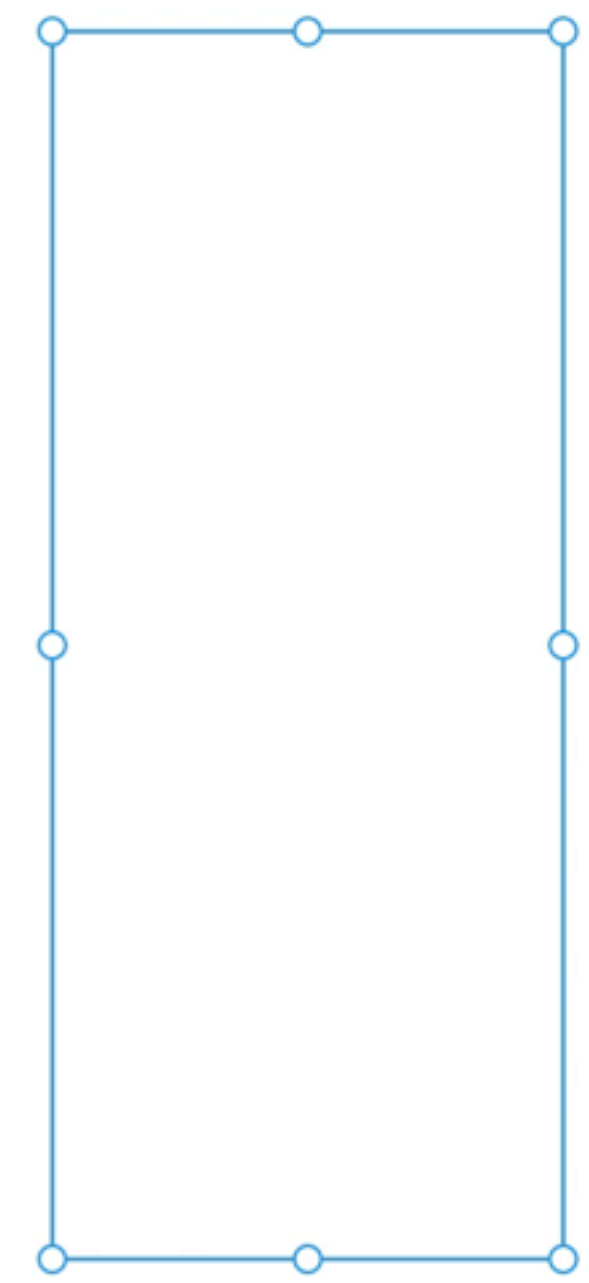
Abc Medal_Type (3 values)

Count (0 - 46)

Abc Row_ID (60 values)

LAYERS

- Rectangle 1



Repeat

Partition

Break

Group

SHAPE POSITION

X 441.0

Y 205.5

SIZE

Width 152.0

Height 365.0

Area 55480.0

STYLE

Fill Color #ffffff

Stroke Color #bbbbbb

Stroke Width 1.5

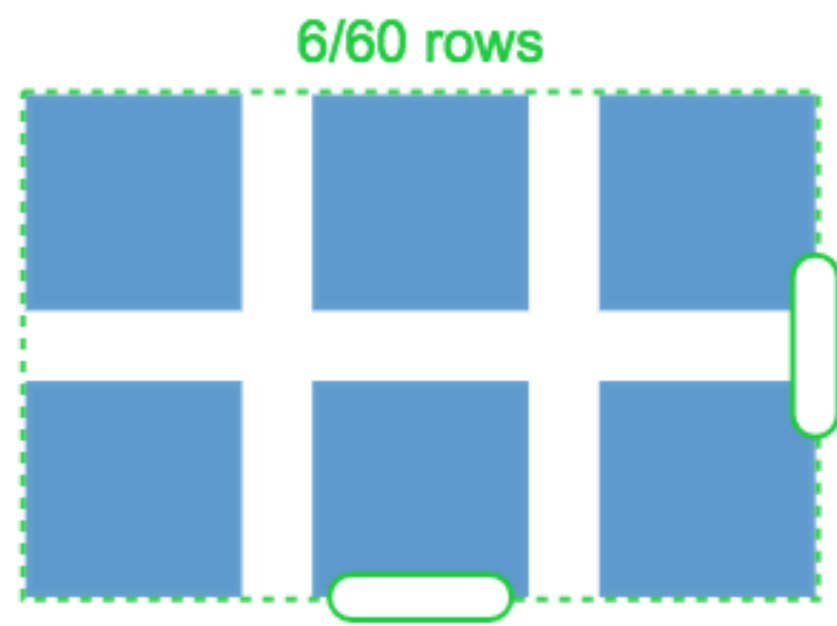
Opacity 0% 100%

Data represented by Rectangle 1: 0/60 rows

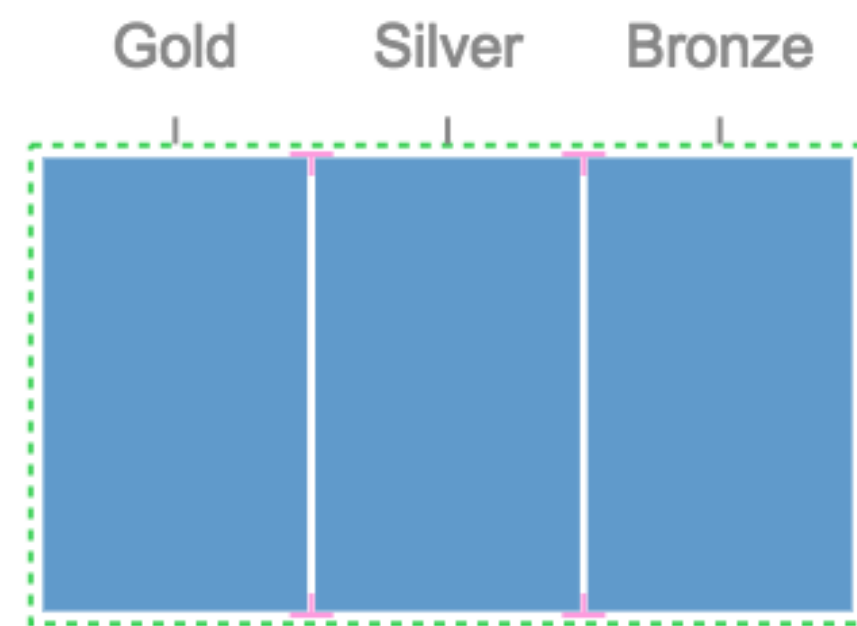
Abc Row_ID	Abc Country_...	Abc Country...	Abc Medal_...	# Count

Partition Operator

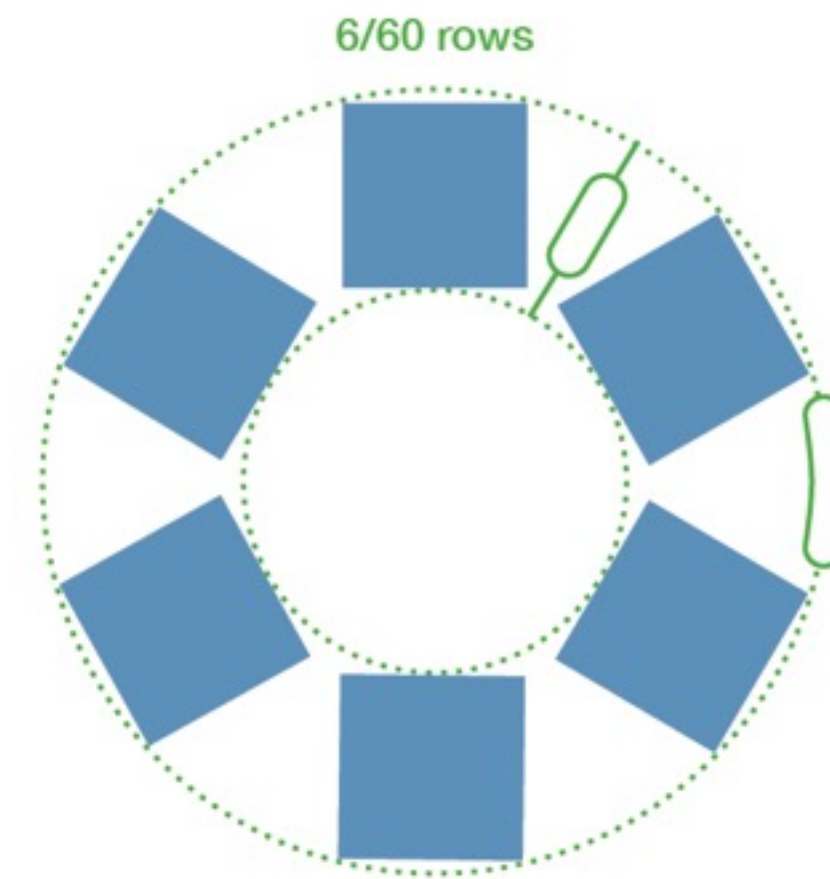
Grid



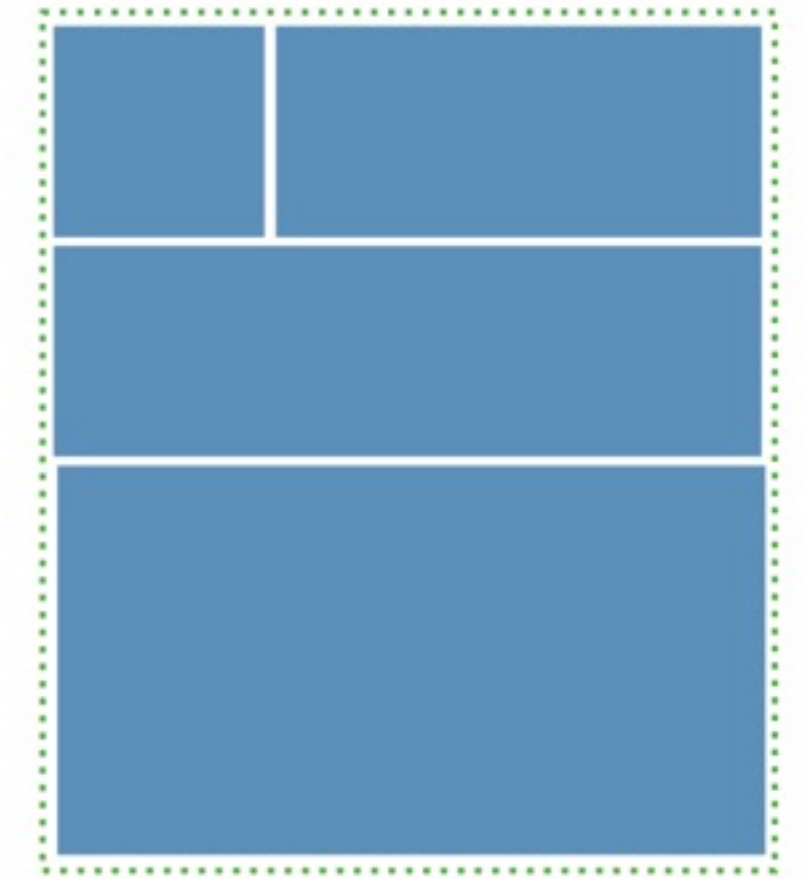
Stack



Radial

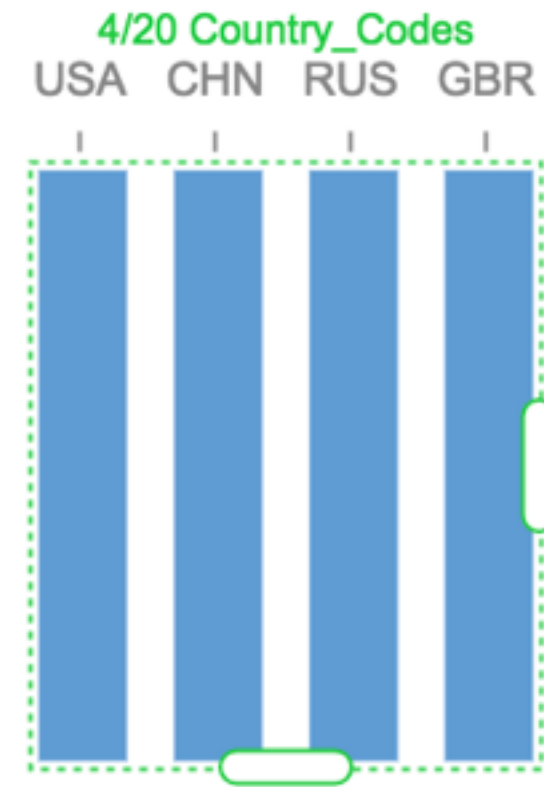


Packing

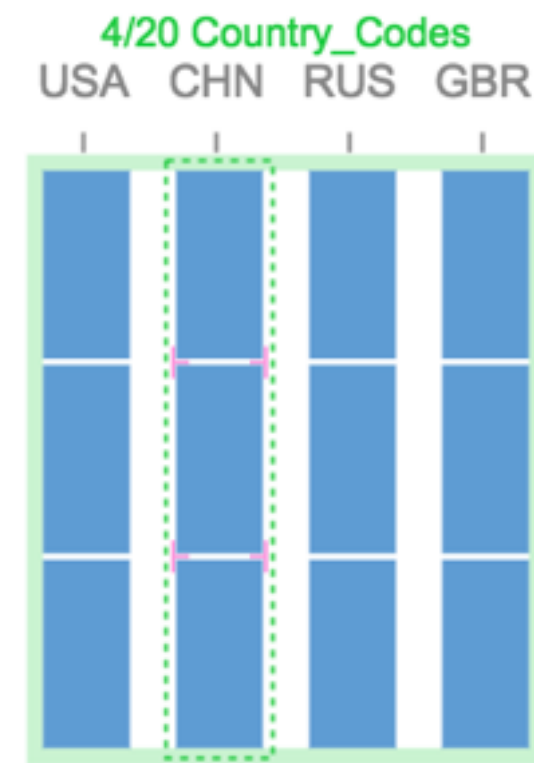


Repeat + Partition

Repeat(rect)

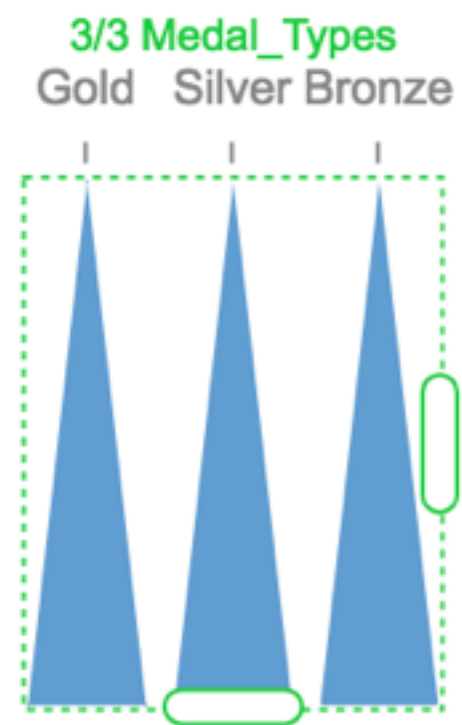


Partition(rect)

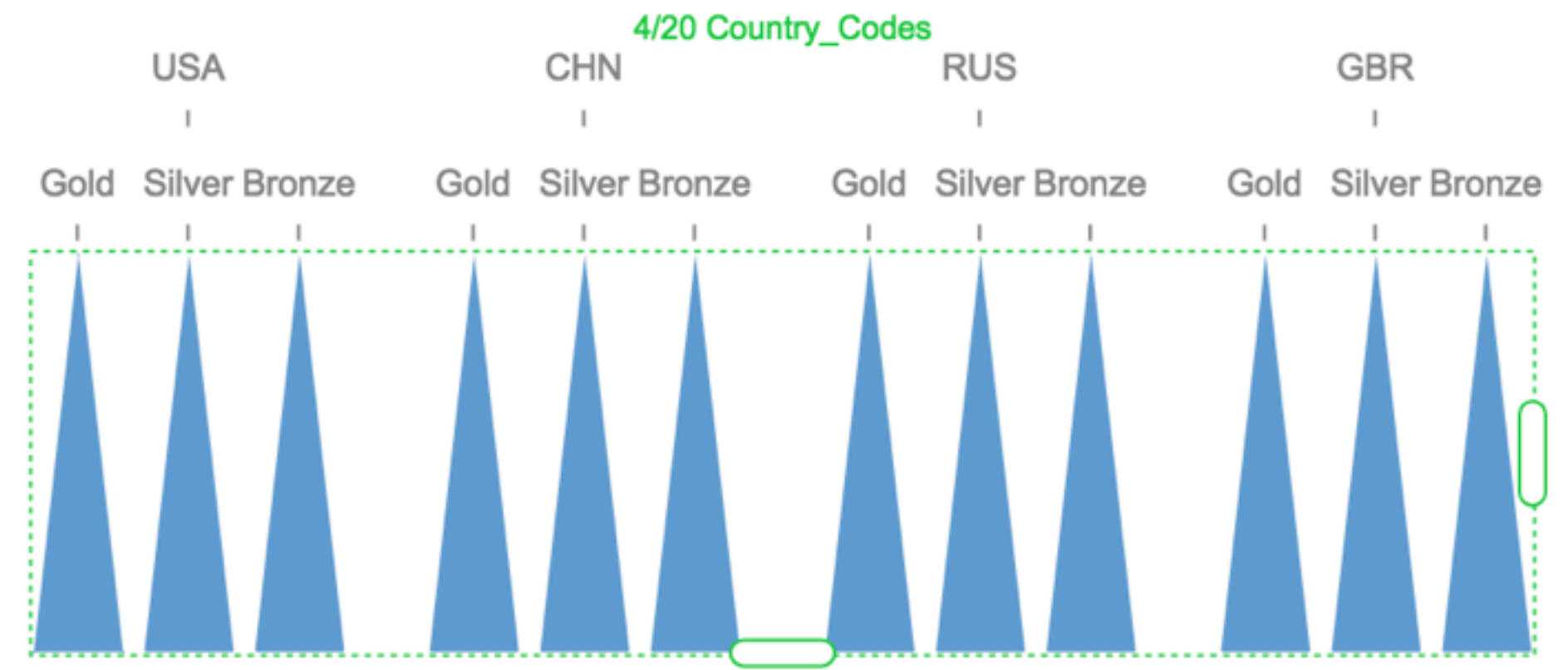


Repeat + Repeat

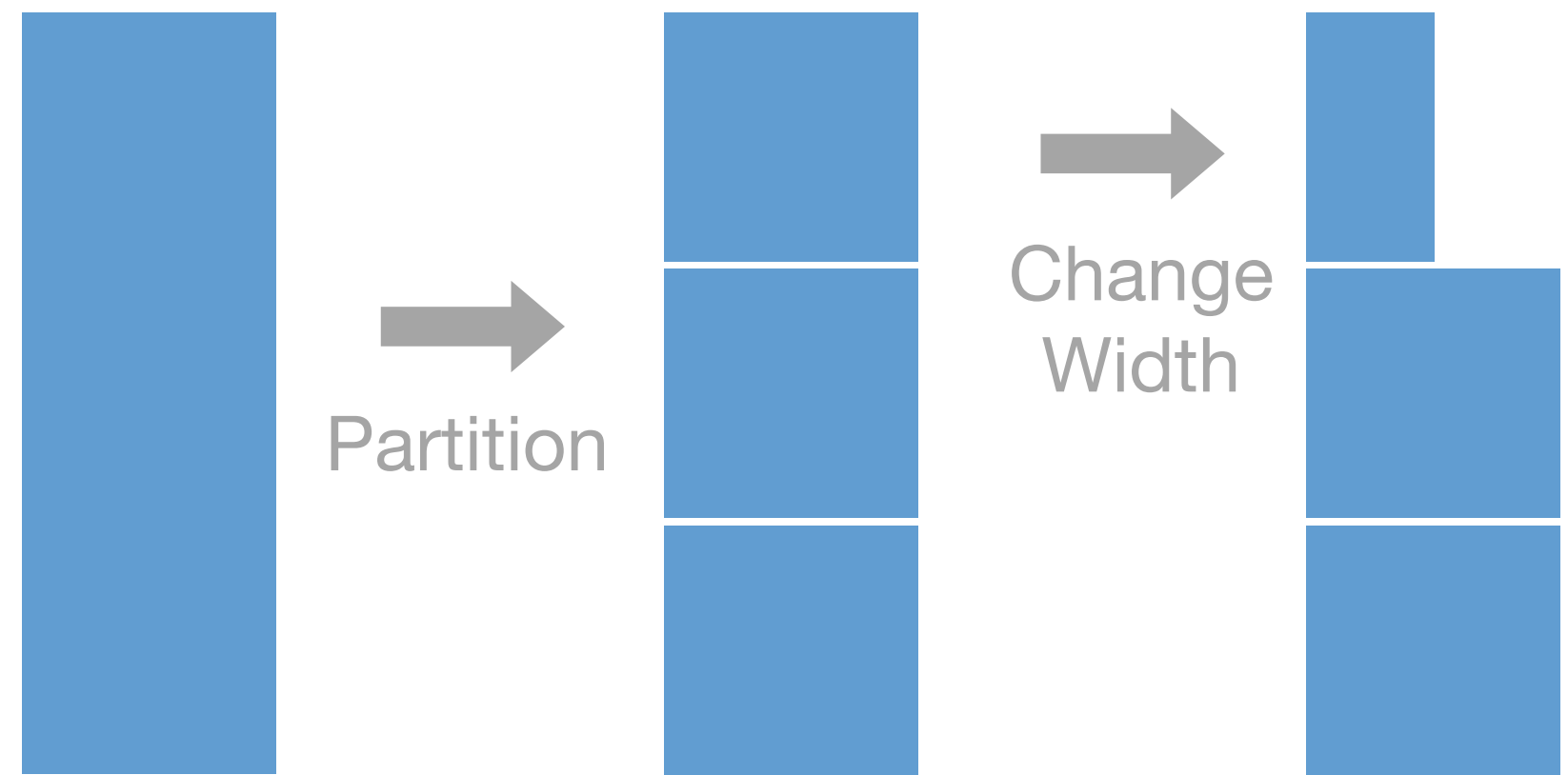
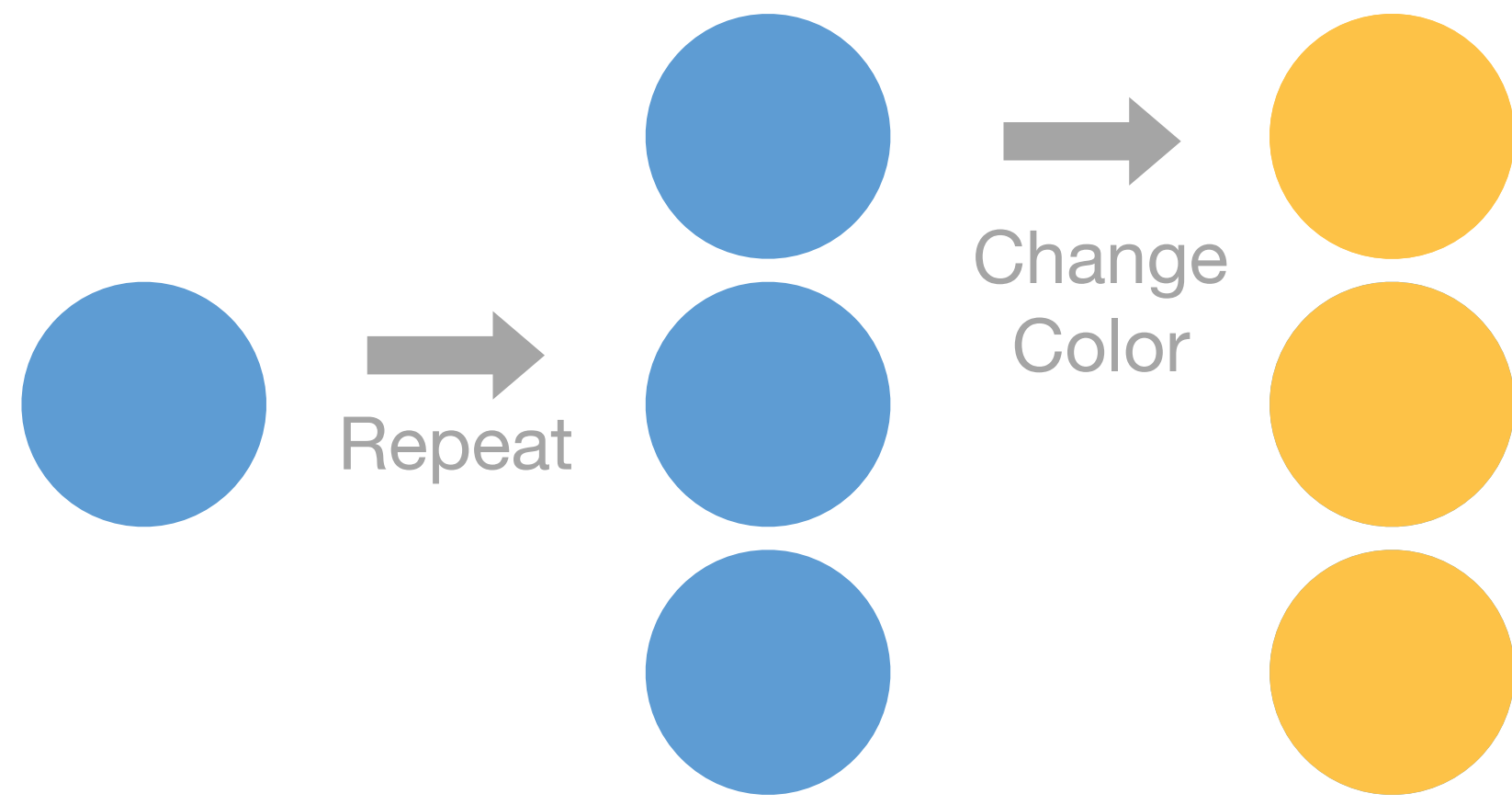
Repeat(path)



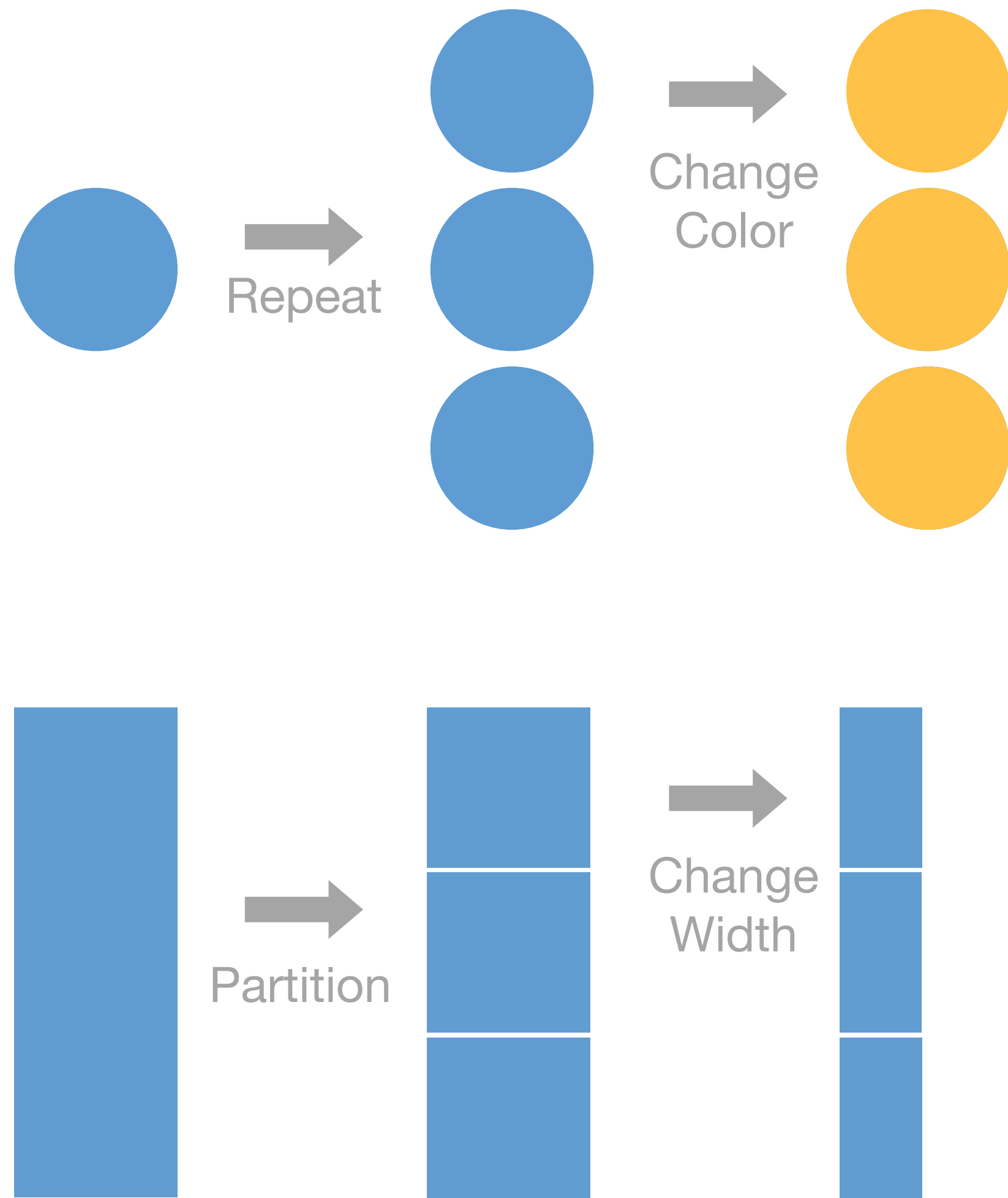
Repeat(grid)



Nested Collections



Peer Shapes



File View Help

Olympic Medals Change

60 rows in total

Country_Code 20 values

Country_Name 20 values

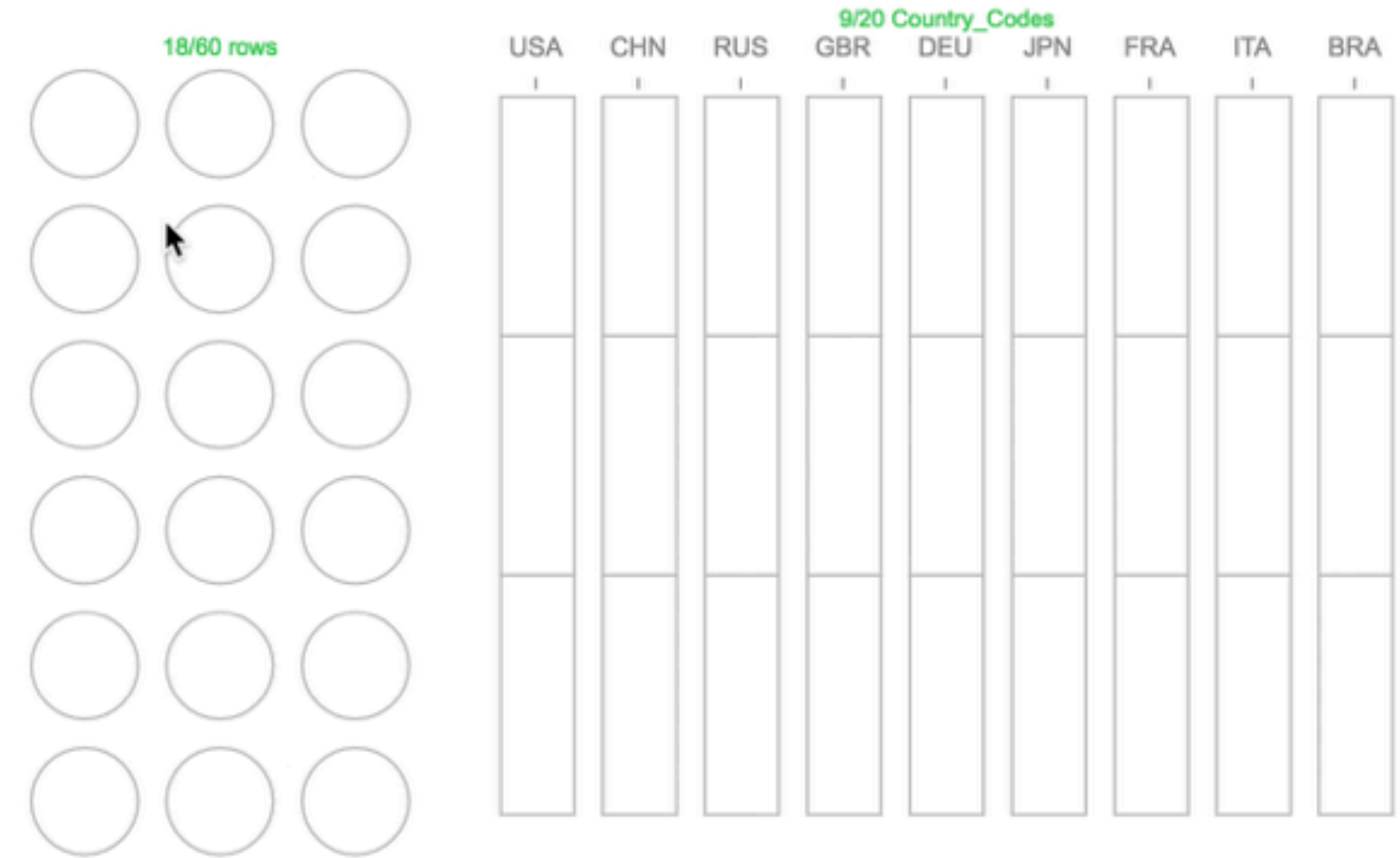
Medal_Type 3 values

Count 0 - 46

Row_ID 60 values

LAYERS

- Repeat Grid 1
 - Ellipse 1: row 1
 - Ellipse 2: row 2
 - Ellipse 3: row 3
 - Ellipse 4: row 4
 - Ellipse 5: row 5
 - Ellipse 6: row 6
 - Ellipse 7: row 7
 - Ellipse 8: row 8
 - Ellipse 9: row 9
 - Ellipse 10: row 10
 - Ellipse 11: row 11
 - Ellipse 12: row 12
 - Ellipse 13: row 13
 - Ellipse 14: row 14
 - Ellipse 15: row 15
 - Ellipse 16: row 16
 - Ellipse 17: row 17
 - Ellipse 18: row 18
- Repeat Grid 23



Data: all 60 rows

Row_ID	Country_C...	Country_N...	Medal_Type	Count
1	USA	United States	Gold	46
2	USA	United States	Silver	29
3	USA	United States	Bronze	29
4	CHN	China	Gold	38
5	CHN	China	Silver	27
6	CHN	China	Bronze	23
7	RUS	Russia	Gold	24

Repeat

Partition

Break Grid

Group

CANVAS

Background #ffffff

Peer Shapes



Row ID	Country	Medal Type	Count
R1	United States	Gold	46
R2	United States	Silver	29
R3	United States	Bronze	29
R4	China	Gold	38
R5	China	Silver	27
R6	China	Bronze	23
...
R58	Grenada	Gold	1
R59	Grenada	Silver	0
R60	Grenada	Bronze	0



Repeat by "Country"

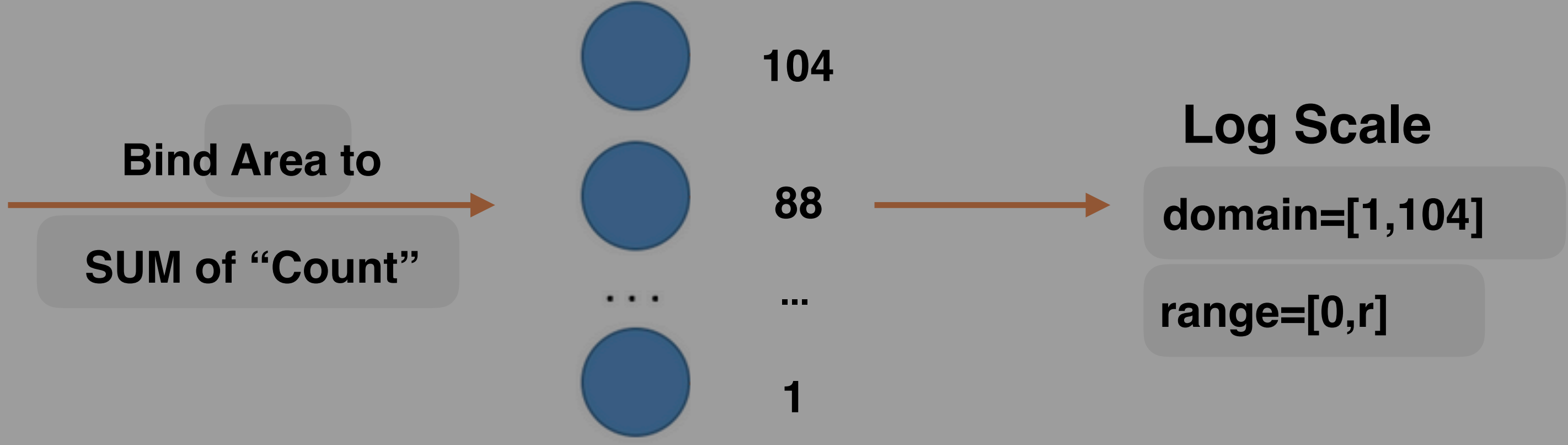


...



Row ID	Country	Medal Type	Count
R1	United States	Gold	46
R2	United States	Silver	29
R3	United States	Bronze	29
R4	China	Gold	38
R5	China	Silver	27
R6	China	Bronze	23
...
R58	Grenada	Gold	1
R59	Grenada	Silver	0
R60	Grenada	Bronze	0

Data Type	Visual Property	Scale
Numerical	x-,y- position height, width, area fill, stroke color	linear linear, log linear
Nominal	x-,y- position fill, stroke color	ordinal point categorical
Date	x-,y- position	linear



Lazy Data Binding: Create Scale

http://data-illustrator.com/app/

File View Help

Olympic Medals Change

60 rows in total

Country_Code (20 values)

Country_Name (20 values)

Medal_Type (3 values)

Count (0 - 46)

Row_ID (60 values)

LAYERS

Repeat Grid 1

- Ellipse 1: row 1
- Ellipse 2: row 2
- Ellipse 3: row 3
- Ellipse 4: row 4
- Ellipse 5: row 5
- Ellipse 6: row 6
- Ellipse 7: row 7
- Ellipse 8: row 8
- Ellipse 9: row 9
- Ellipse 10: row 10
- Ellipse 11: row 11
- Ellipse 12: row 12
- Ellipse 13: row 13
- Ellipse 14: row 14
- Ellipse 15: row 15
- Ellipse 16: row 16
- Ellipse 17: row 17
- Ellipse 18: row 18

Repeat Grid 44

18/60 rows

10/20 Country_Codes

USA CHN RUS GBR DEU JPN FRA ITA BRA IND

Count 1 60

Ordered By Data Source Order

SHAPE POSITION

X 159.5

Y 325.0

SIZE

Width 55.0

Height 55.0

Area 2372.4

STYLE

Fill Color #ffc337

Stroke Color #bbbbbb

Stroke Width 1.5

Opacity 0% 100%

Data represented by Ellipse 1: 1/60 rows Row_ID = 1

Row_ID	Country_Code	Country_Name	Medal_Type	Count
1	USA	United States	Gold	46

Lazy Data Binding

http://data-illustrator.com/app/

File View Help

Olympic Medals Change

60 rows in total

Country_Code (20 values)

Country_Name (20 values)

Medal_Type (3 values)

Count (0 - 46)

Row_ID (60 values)

LAYERS

- Repeat Grid 1
 - Ellipse 1: row 1
 - Ellipse 2: row 2
 - Ellipse 3: row 3
 - Ellipse 4: row 4
 - Ellipse 5: row 5
 - Ellipse 6: row 6
 - Ellipse 7: row 7
 - Ellipse 8: row 8
 - Ellipse 9: row 9
 - Ellipse 10: row 10
 - Ellipse 11: row 11
 - Ellipse 12: row 12
 - Ellipse 13: row 13
 - Ellipse 14: row 14
 - Ellipse 15: row 15
 - Ellipse 16: row 16
 - Ellipse 17: row 17
 - Ellipse 18: row 18
- Repeat Grid 44

Count

0 20 40

USA CHN RUS GBR DEU JPN FRA ITA BRA IND

Medal_Type

- Gold
- Silver
- Bronze

Count

0 10 20 30 40 50 60 70 80 90 100

Row_ID	Country_Code	Country_Name	Medal_Type	Count
1	USA	United States	Gold	46
2	USA	United States	Silver	29
3	USA	United States	Bronze	29
4	CHN	China	Gold	38
5	CHN	China	Silver	27
6	CHN	China	Bronze	23
7	RUS	Russia	Gold	24

Repeat

Partition

Break Grid

Group

CANVAS

Background #ffffff

Scales & Legends

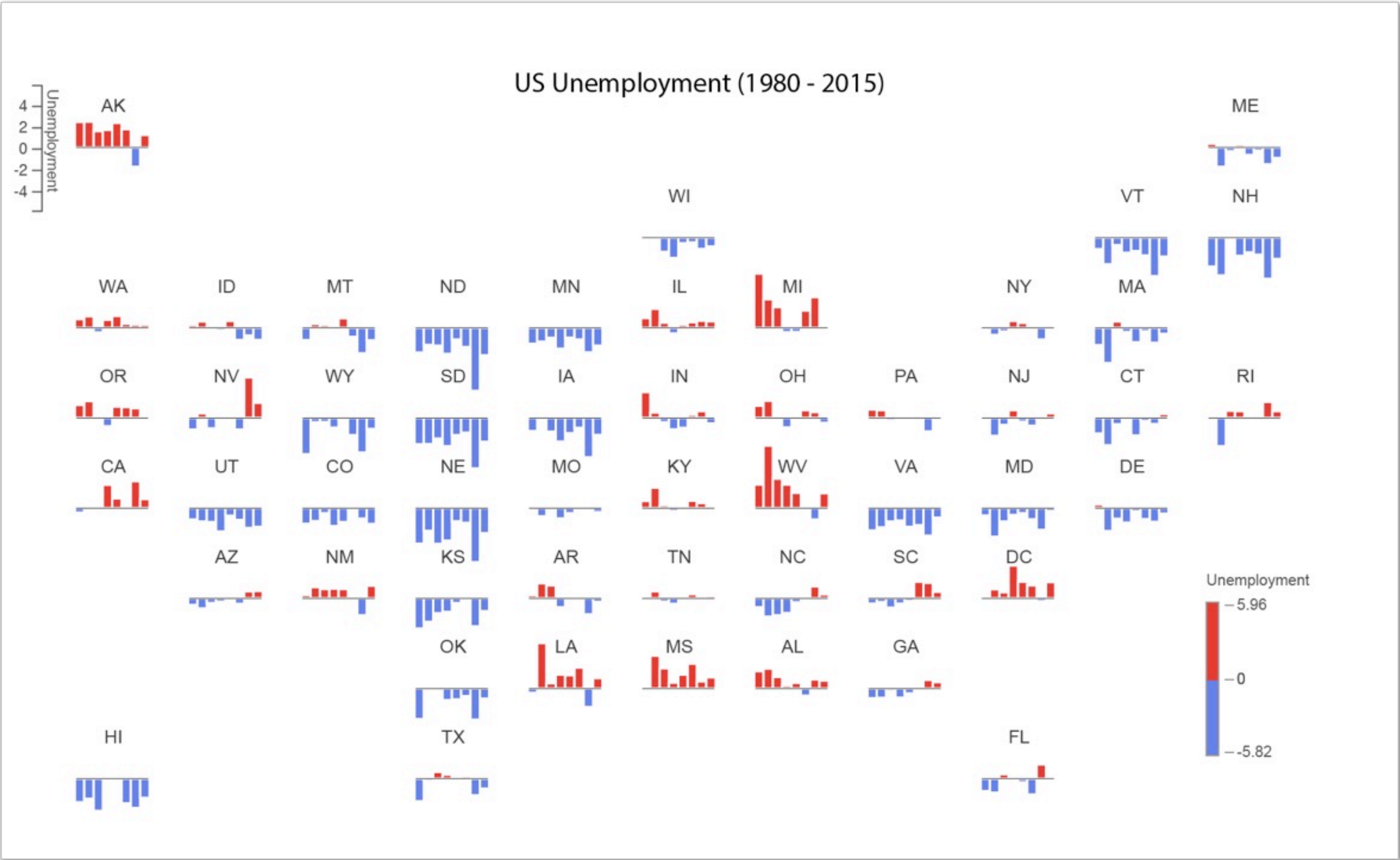
An Example with Data Illustrator

Unemployment rate for U.S. States (difference from national average)

1950 to 2015
(5 year intervals)

Source:
Economic Research, Federal Reserve Bank of St. Louis

Row ID	State	Unemployment	Year	MapX	MapY
R1	Alaska	2.475	'80	0	7
R2	Alabama	1.708	'80	6	1
R3	Arkansas	0.383	'80	4	2
R4	Arizona	-0.525	'80	1	2
...
R407	W. Virginia	1.483	'15	6	3
R408	Wyoming	-0.95	'15	2	4





us_state_unemployme Change

408 rows in total

Abc **State** ⓘ 51 values

Abc **Year** ⓘ 8 values

Unemployment ⓘ -5.83 - 5.96

Abc **State Name** ⓘ 51 values

MapX ⓘ 0 - 10

LAYERS

Repeat

Partition

Break

Group

Data for Artboard 1: all rows

Abc Row_ID	Abc State	Abc Year	# Unemploy...	Abc State Name	# MapX	# MapY	Abc US Avg
1	AK	'80	2.475	Alaska	0	7	Above Average
2	AL	'80	1.708	Alabama	6	1	Above Average
3	AR	'80	0.383	Arkansas	4	2	Above Average
4	AZ	'80	-0.525	Arizona	1	2	Below Average
5	CA	'80	-0.325	California	0	3	Below Average
6	CO	'80	-1.367	Colorado	2	3	Below Average
7	CT	'80	-1.367	Connecticut	9	4	Below Average
8	DC	'80	0.192	District of Columbia	8	2	Above Average



us_state_unemployme Change

408 rows in total

Abc **State** (51 values)

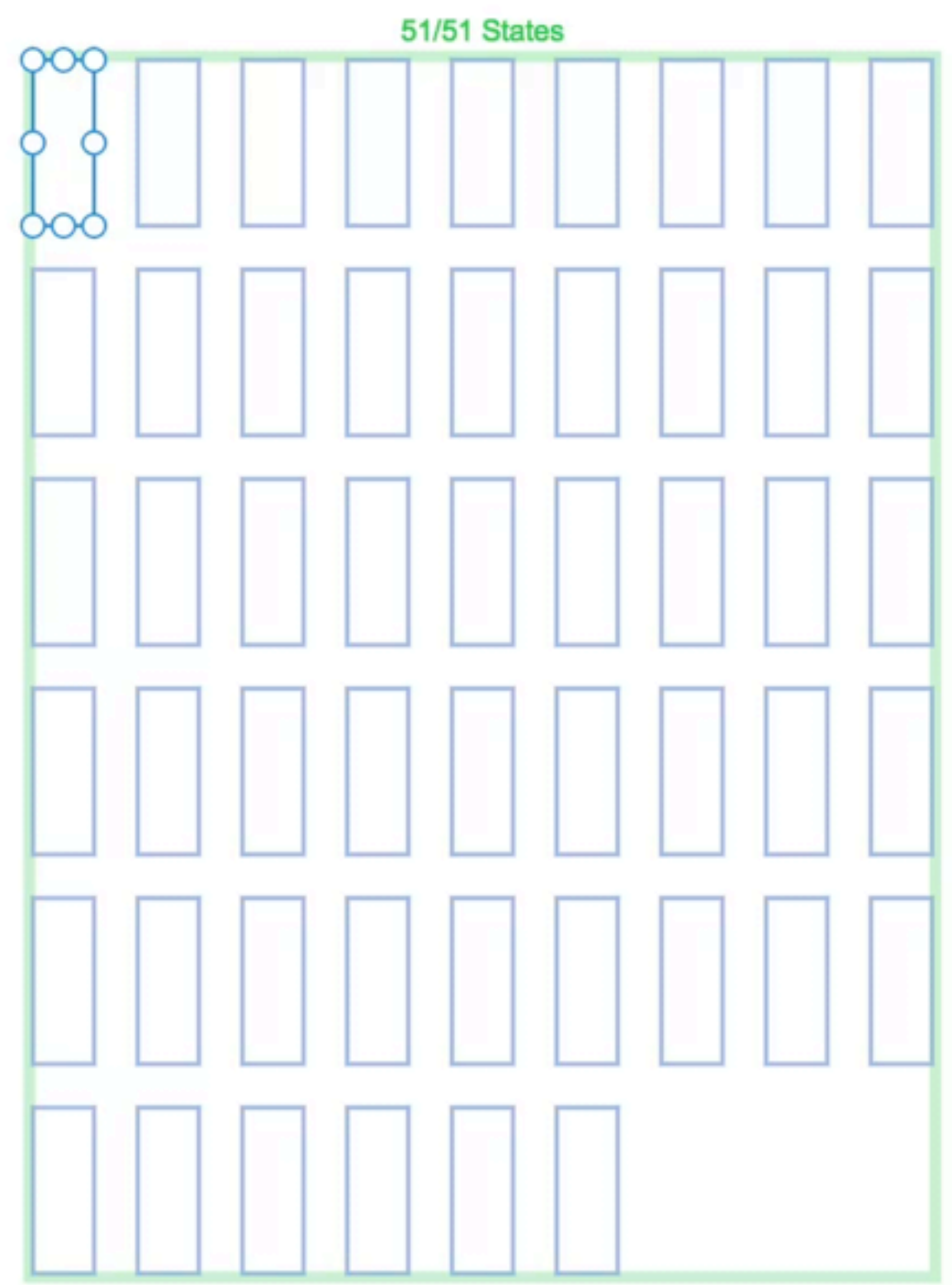
Abc **Year** (8 values)

Unemployment (-5.83 - 5.96)

Abc **State Name** (51 values)

MapX (0 - 10)

- LAYERS**
- Repeat Grid 1
 - Rectangle 1: AK
 - Rectangle 2: AL
 - Rectangle 3: AR
 - Rectangle 4: AZ
 - Rectangle 5: CA
 - Rectangle 6: CO
 - Rectangle 7: CT
 - Rectangle 8: DC
 - Rectangle 9: DE
 - Rectangle 10: FL
 - Rectangle 11: GA
 - Rectangle 12: HI
 - Rectangle 13: IA
 - Rectangle 14: ID
 - Rectangle 15: IL
 - Rectangle 16: IN
 - Rectangle 17: KS
 - Rectangle 18: KY
 - Rectangle 19: LA



Data represented by Rectangle 1: 8/408 rows State = AK

Abc Row_ID	Abc State	Abc Year	# Unemploy...	Abc State Name	# MapX	# MapY	Abc US Avg
1	AK	'80	2.475	Alaska	0	7	Above Average
52	AK	'85	2.5	Alaska	0	7	Above Average
103	AK	'90	1.617	Alaska	0	7	Above Average
154	AK	'95	1.725	Alaska	0	7	Above Average
205	AK	'00	2.392	Alaska	0	7	Above Average
256	AK	'05	1.8	Alaska	0	7	Above Average
307	AK	'10	-1.733	Alaska	0	7	Below Average
358	AK	'15	1.266	Alaska	0	7	Above Average



Repeat

Partition

Break Grid

Group

PEERS

Count 1 51

Ordered By

SHAPE POSITION

X

Y

SIZE

Width

Height

Area

STYLE

Fill Color

Stroke Color

Stroke Width

Opacity 0% 100%

ALIGNMENT IN CELL



us_state_unemployme Change

408 rows in total

Abc **State** (51 values)

Abc **Year** (8 values)

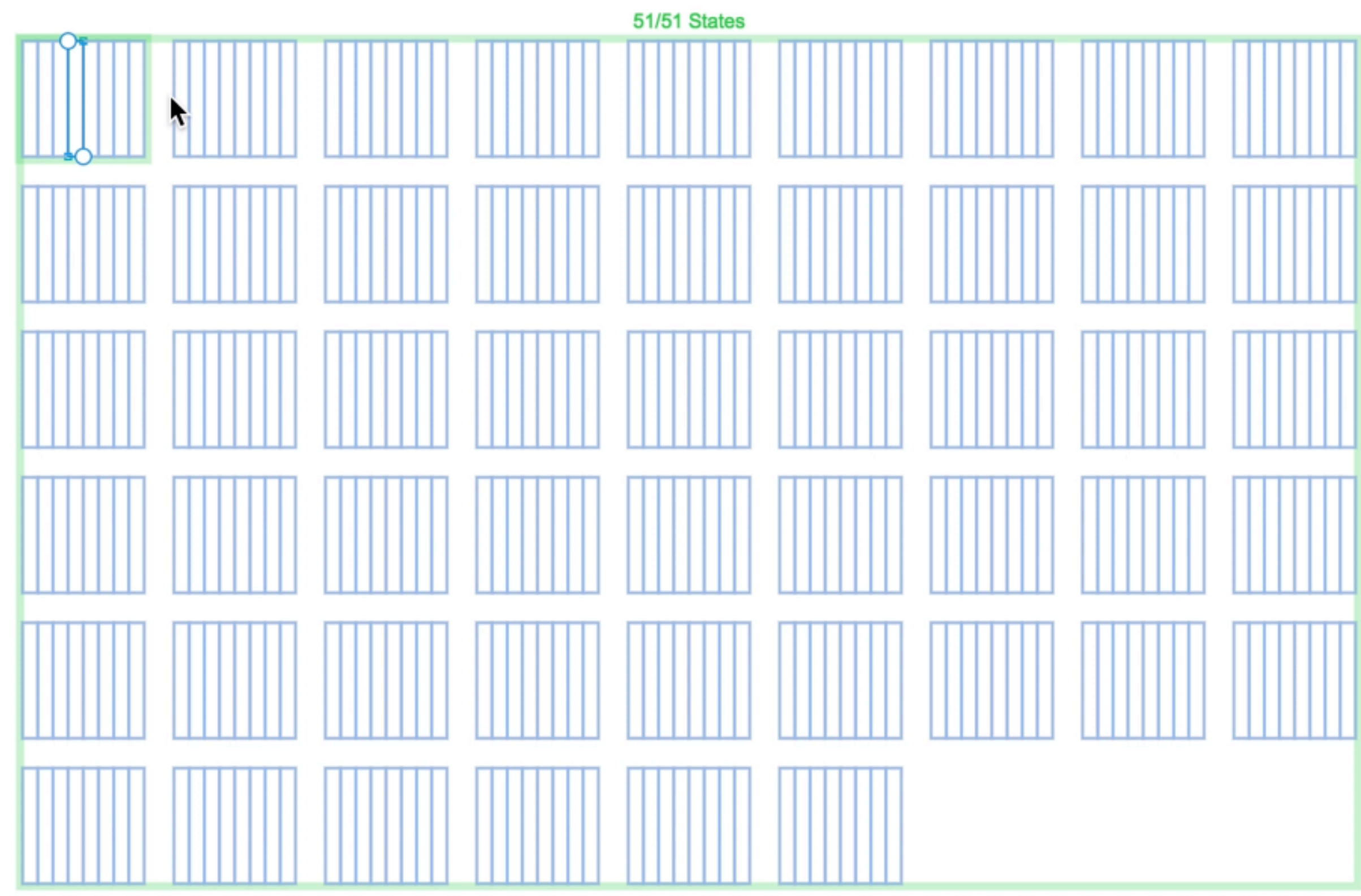
Unemployment (-5.83 - 5.96)

Abc **State Name** (51 values)

MapX (0 - 10)

LAYERS

- Repeat Grid 1
 - Partition 2: AK
 - Rectangle 409: '80
 - Rectangle 410: '85
 - Rectangle 411: '90
 - Rectangle 412: '95**
 - Rectangle 413: '00
 - Rectangle 414: '05
 - Rectangle 415: '10
 - Rectangle 416: '15
 - Partition 3: AL
 - Partition 4: AR
 - Partition 5: AZ
 - Partition 6: CA
 - Partition 7: CO
 - Partition 8: CT
 - Partition 9: DC
 - Partition 10: DE
 - Partition 11: FL
 - Partition 12: GA



Data represented by Rectangle 412: 1/408 rows

Year = '95 State = AK

Abc Row_ID	Abc State	Abc Year	# Unemploy...	Abc State Name	# MapX	# MapY	Abc US Avg
154	AK	'95	1.725	Alaska	0	7	Above Average

Repeat

Partition

Break Grid

Group

PEERS

Ordered By Data Source Orde

SIZE

Width 7.6

Height 58.0

Area 442.2

STYLE

Fill Color #ffffff

Stroke Color #bbbbbb

Stroke Width 1.5

Opacity 0% 100%

ALIGNMENT IN CELL

Horizontal Off

Vertical Off

us_state_unemployem Change

408 rows in total

Abc **State** (51 values)

Abc **Year** (8 values)

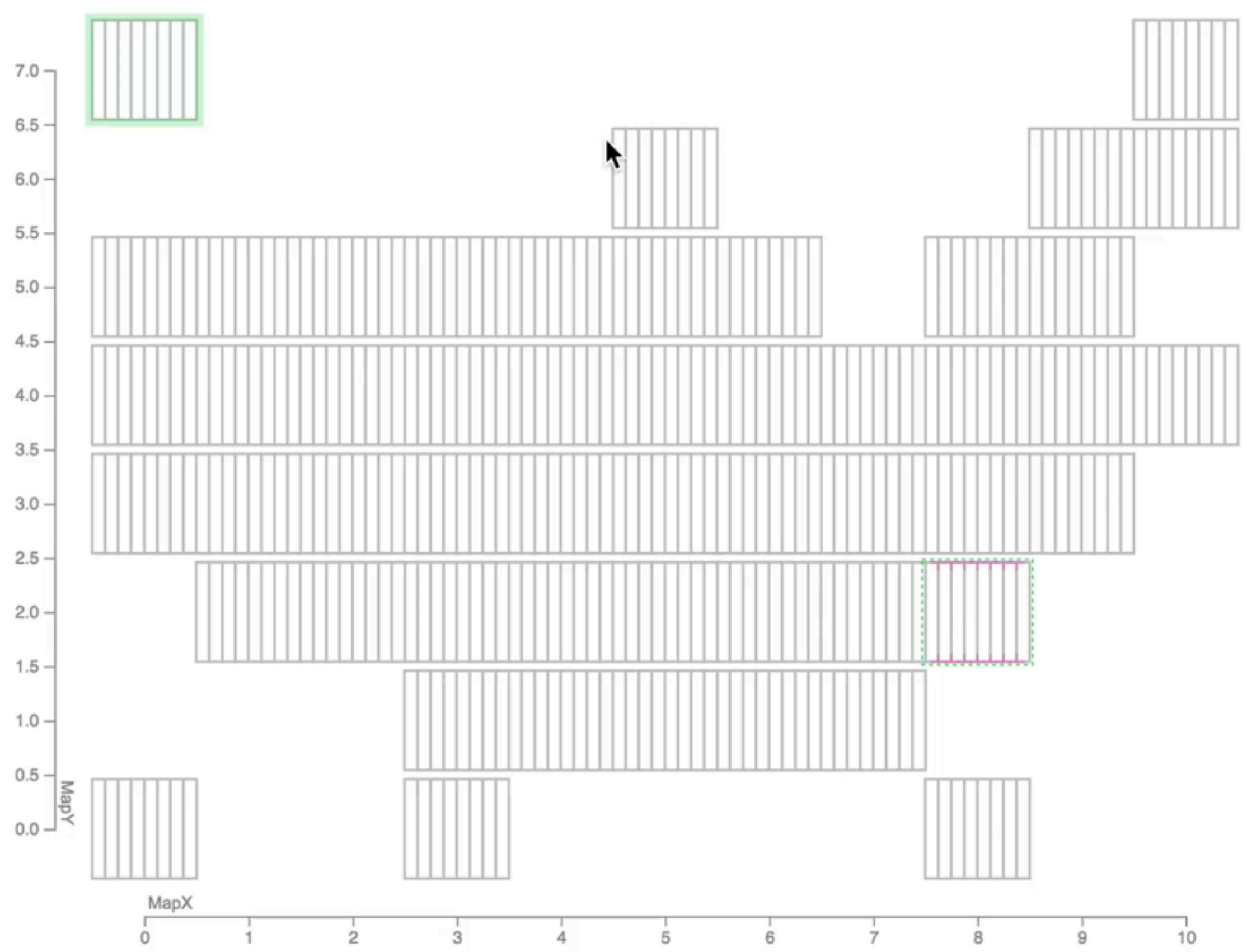
Unemployment (-5.83 - 5.96)

Abc **State Name** (51 values)

MapX (0 - 10)

LAYERS

- Partition 2: AK
 - Rectangle 409: '80
 - Rectangle 410: '85
 - Rectangle 411: '90
 - Rectangle 412: '95
 - Rectangle 413: '00
 - Rectangle 414: '05
 - Rectangle 415: '10
 - Rectangle 416: '15
- Partition 3: AL
- Partition 4: AR
- Partition 5: AZ
- Partition 6: CA
- Partition 7: CO
- Partition 8: CT
- Partition 9: DC**
- Partition 10: DE
- Partition 11: FL
- Partition 12: GA
- Partition 13: HI



Data represented by Partition 9: 8/408 rows State = DC

Abc Row_ID	Abc State	Abc Year	# Unemploy...	Abc State Name	# MapX	# MapY	Abc US Avg
8	DC	'80	0.192	District of Columbia	8	2	Above Average
59	DC	'85	0.942	District of Columbia	8	2	Above Average
110	DC	'90	0.65	District of Columbia	8	2	Above Average
161	DC	'95	3.158	District of Columbia	8	2	Above Average
212	DC	'00	1.633	District of Columbia	8	2	Above Average
263	DC	'05	1.3	District of Columbia	8	2	Above Average
314	DC	'10	-0.2	District of Columbia	8	2	Below Average
365	DC	'15	1.608	District of Columbia	8	2	Above Average

Repeat

Partition

Break Stack

Group

PEERS

Count 1 51

COLLECTION POSITION

X MEAN MapX

Y MEAN MapY

LAYOUT

Type Stack

us_state_unemployme Change

408 rows in total

Abc **State** (51 values)

Abc **Year** (8 values)

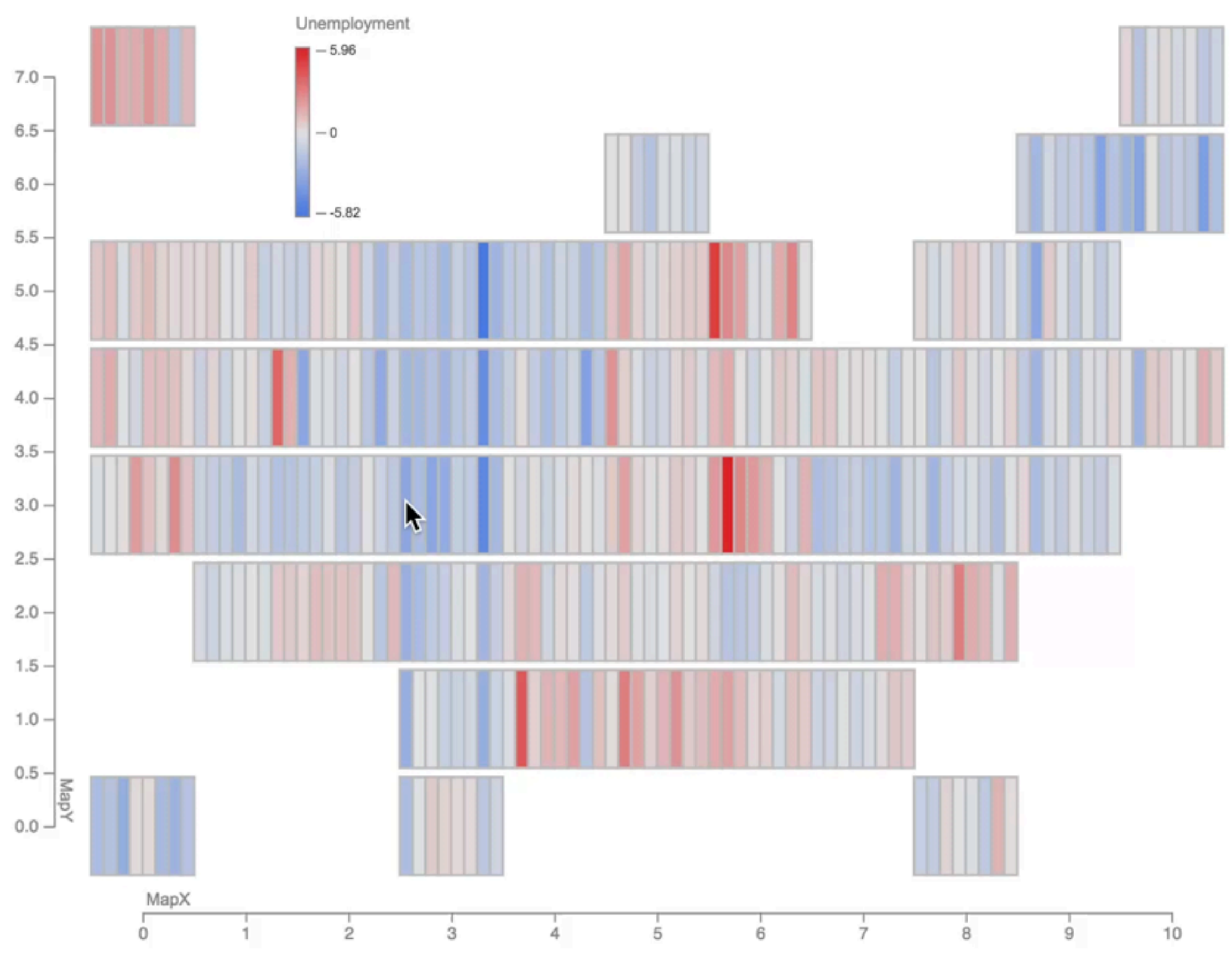
Unemployment (-5.83 - 5.96)

Abc **State Name** (51 values)

MapX (0 - 10)

LAYERS

- Partition 2: AK
 - Rectangle 409: '80
 - Rectangle 410: '85
 - Rectangle 411: '90
 - Rectangle 412: '95
 - Rectangle 413: '00
 - Rectangle 414: '05
 - Rectangle 415: '10
 - Rectangle 416: '15
- Partition 3: AL
- Partition 4: AR
- Partition 5: AZ
- Partition 6: CA
- Partition 7: CO
- Partition 8: CT
- Partition 9: DC
- Partition 10: DE
- Partition 11: FL
- Partition 12: GA
- Partition 13: HI



Data: all 408 rows

Abc	Row_ID	Abc	State	Abc	Year	#	Unemploy...	Abc	State Name	#	MapX	#	MapY	Abc	US Avg
	1		AK		'80		2.475		Alaska		0		7		Above Average
	2		AL		'80		1.708		Alabama		6		1		Above Average
	3		AR		'80		0.383		Arkansas		4		2		Above Average
	4		AZ		'80		-0.525		Arizona		1		2		Below Average
	5		CA		'80		-0.325		California		0		3		Below Average
	6		CO		'80		-1.367		Colorado		2		3		Below Average
	7		CT		'80		-1.367		Connecticut		9		4		Below Average
	8		DC		'80		0.192		District of Columbia		8		2		Above Average
	9		DE		'80		0.433		Delaware		9		3		Above Average
	10		FL		'80		1.082		Florida		8		0		Below Average

Repeat

Partition

Break Stack

Group

CANVAS

Background

us_state_unemployme Change

408 rows in total

Abc **State** (51 values)

Abc **Year** (8 values)

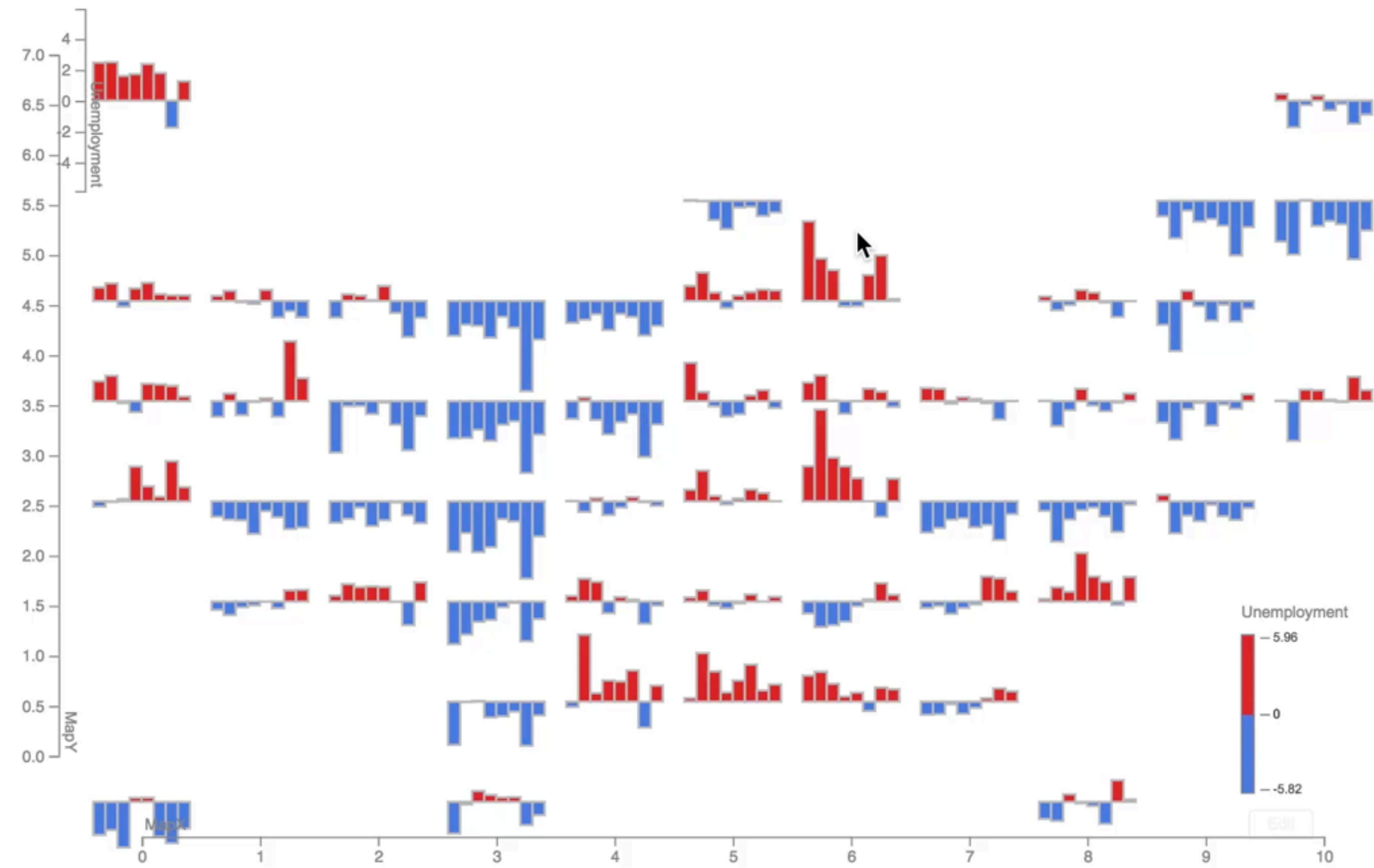
Unemployment (-5.83 - 5.96)

Abc **State Name** (51 values)

MapX (0 - 10)

LAYERS

- Partition 2: AK
 - Rectangle 409: '80
 - Rectangle 410: '85
 - Rectangle 411: '90
 - Rectangle 412: '95
 - Rectangle 413: '00
 - Rectangle 414: '05
 - Rectangle 415: '10
 - Rectangle 416: '15
- Partition 3: AL
- Partition 4: AR
- Partition 5: AZ
- Partition 6: CA
- Partition 7: CO
- Partition 8: CT
- Partition 9: DC
- Partition 10: DE
- Partition 11: FL
- Partition 12: GA
- Partition 13: HI



Repeat

Partition

Break Stack

Group

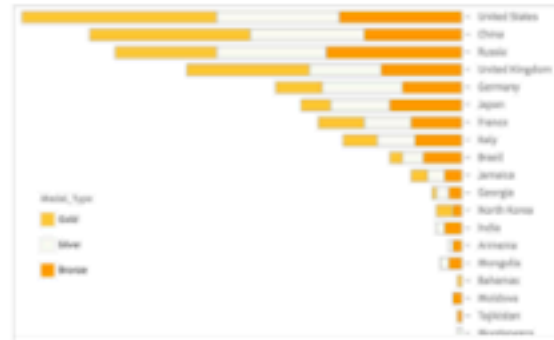
CANVAS

Background

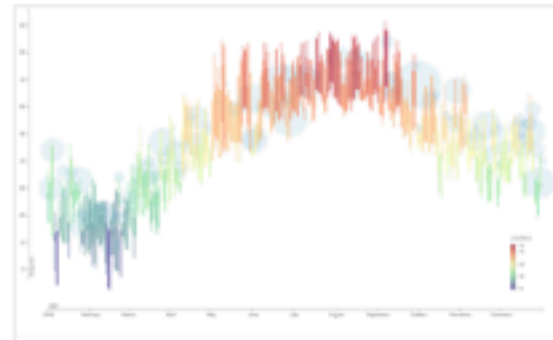
Data: all 408 rows

Abc	Row_ID	Abc	State	Abc	Year	#	Unemploy...	Abc	State Name	#	MapX	#	MapY	Abc	US Avg
	1		AK		'80		2.475		Alaska		0		7		Above Average
	2		AL		'80		1.708		Alabama		6		1		Above Average
	3		AR		'80		0.383		Arkansas		4		2		Above Average
	4		AZ		'80		-0.525		Arizona		1		2		Below Average
	5		CA		'80		-0.325		California		0		3		Below Average
	6		CO		'80		-1.367		Colorado		2		3		Below Average
	7		CT		'80		-1.367		Connecticut		9		4		Below Average
	8		DC		'80		0.192		District of Columbia		8		2		Above Average
	9		DE		'80		0.433		Delaware		9		3		Above Average
	10		FL		'80		1.082		Florida		8		0		Below Average

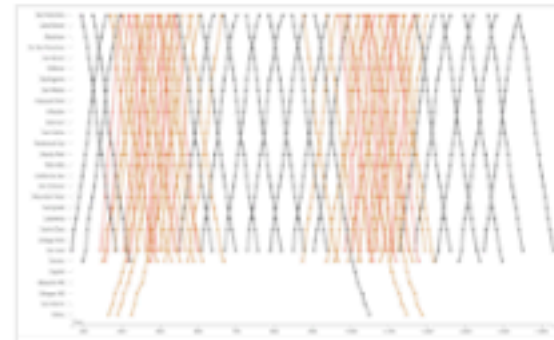
Click on each example to open it in Data Illustrator and to watch demo video. For best viewing experience, please use [Google Chrome](#).



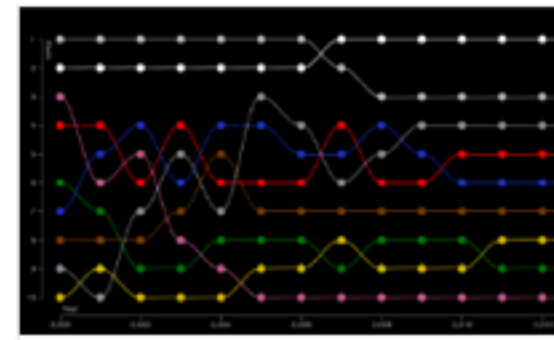
2012 Summer Olympic Medals
Stacked bar chart on the number of gold, silver and bronze medals by country
[Open Example](#) | [Watch Demo](#)



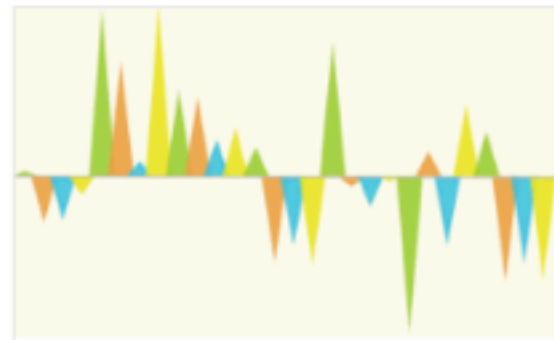
Boston Weather
Daily max and min temperatures and precipitation in Boston for year 2015
[Open Example](#) | [Watch Demo](#)



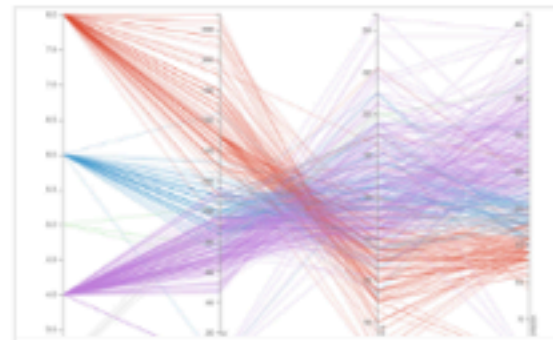
Caltrain Schedule
Stations and arrival time information for the Caltrains
[Open Example](#) | [Watch Demo](#)



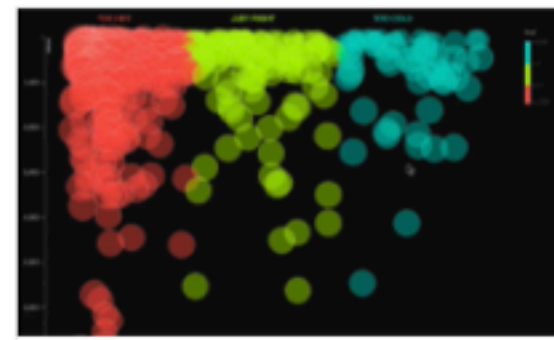
Color Popularity in New Cars
The untangling of color popularity among new cars in North America
[Open Example](#) | [Watch Demo](#)



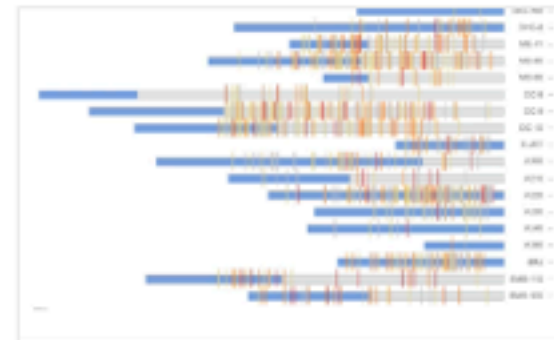
Donors Choose
The chances of completion for projects on DonorsChoose.org
[Open Example](#) | [Watch Demo](#)



Features of Cars
Parallel coordinates plot of features of 406 cars
[Open Example](#) | [Watch Demo](#)



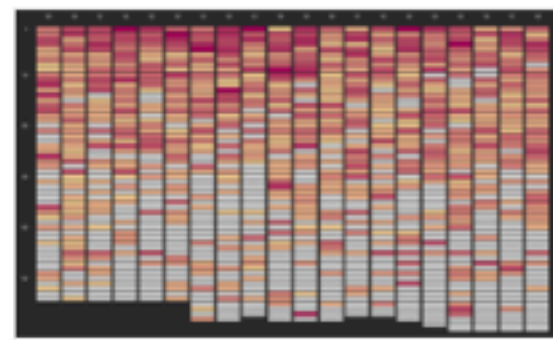
Goldilocks Worlds
1780 confirmed planets beyond our solar system, which are habitable?
[Open Example](#) | [Watch Demo](#)



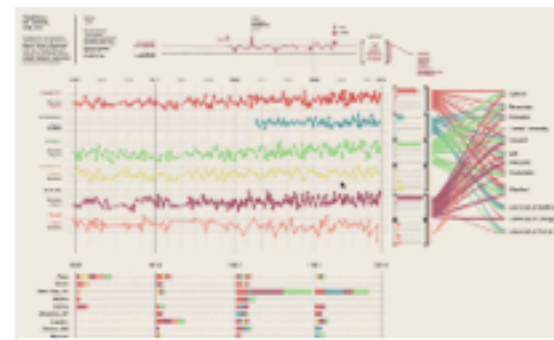
Life of a Plane
The life span of plane models, with information on incidents and fatal injuries
[Open Example](#) | [Watch Demo](#)



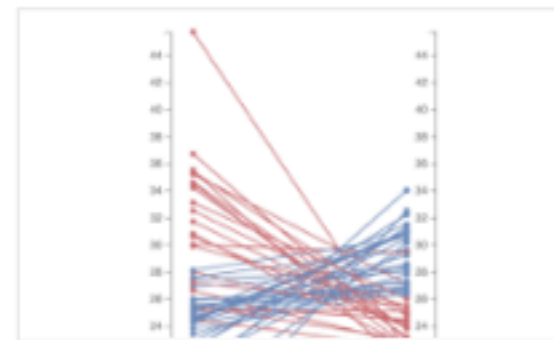
Mobile OS Usage
Mobile operating system usage from 2008 to 2014
[Open Example](#) | [Watch Demo](#)



NBA Redraft
Twenty years of NBA draft picks from 1989 to 2008
[Open Example](#) | [Watch Demo](#)



Nobel Prizes and Laureates
All Nobel laureates in a data-rich and complex graphics
[Watch Demo](#)



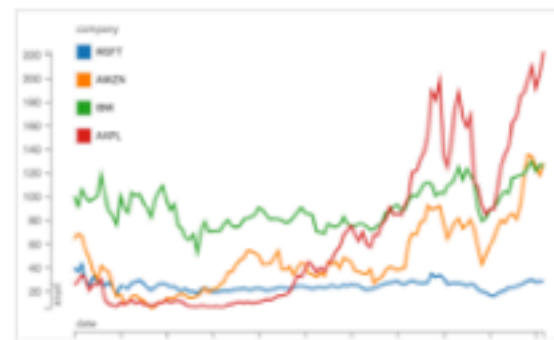
Obesity and Education
Slope graph on percentages of obesity and higher education in US states
[Open Example](#) | [Watch Demo](#)



Red and Blue America
Partisan Voter Index (PVI) for each US state over the years
[Open Example](#) | [Watch Demo](#)



Share of Women across Job Levels
The proportion of women declines in higher job titles.
[Open Example](#) | [Watch Demo](#)



Stock Market
Monthly stock prices for four companies from 2000 to 2010
[Open Example](#) | [Watch Demo](#)



US Unemployment
Unemployment rate by race, education level, and gender from 2009 to 2016
[Open Example](#) | [Watch Demo](#)

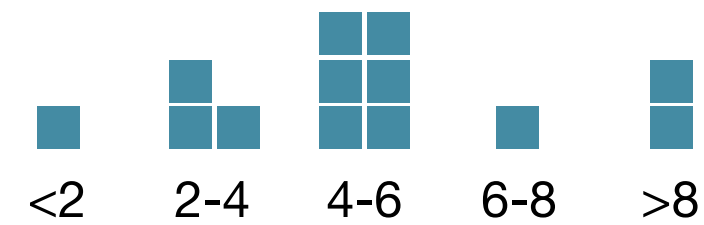
- stacked bar chart
- range chart
- strangling chart
- bump chart
- triangle bar chart
- parallel coordinates plot
- bubble plot
- gantt chart
- (connected) scatterplot
- stacked column chart
- heat map
- alluvial diagram
- small multiples
- slope chart
- multi-series line charts
- composite scatter plot
- mosaic plot

Evaluation - User Study

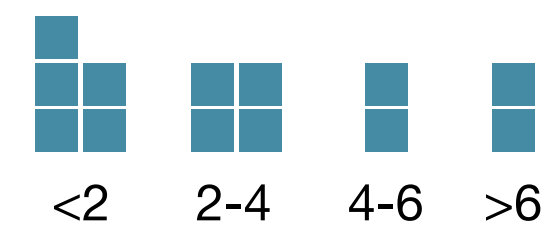
13 designers

(7 male, 6 female)

Design experience (years):



Visualization experience (years):

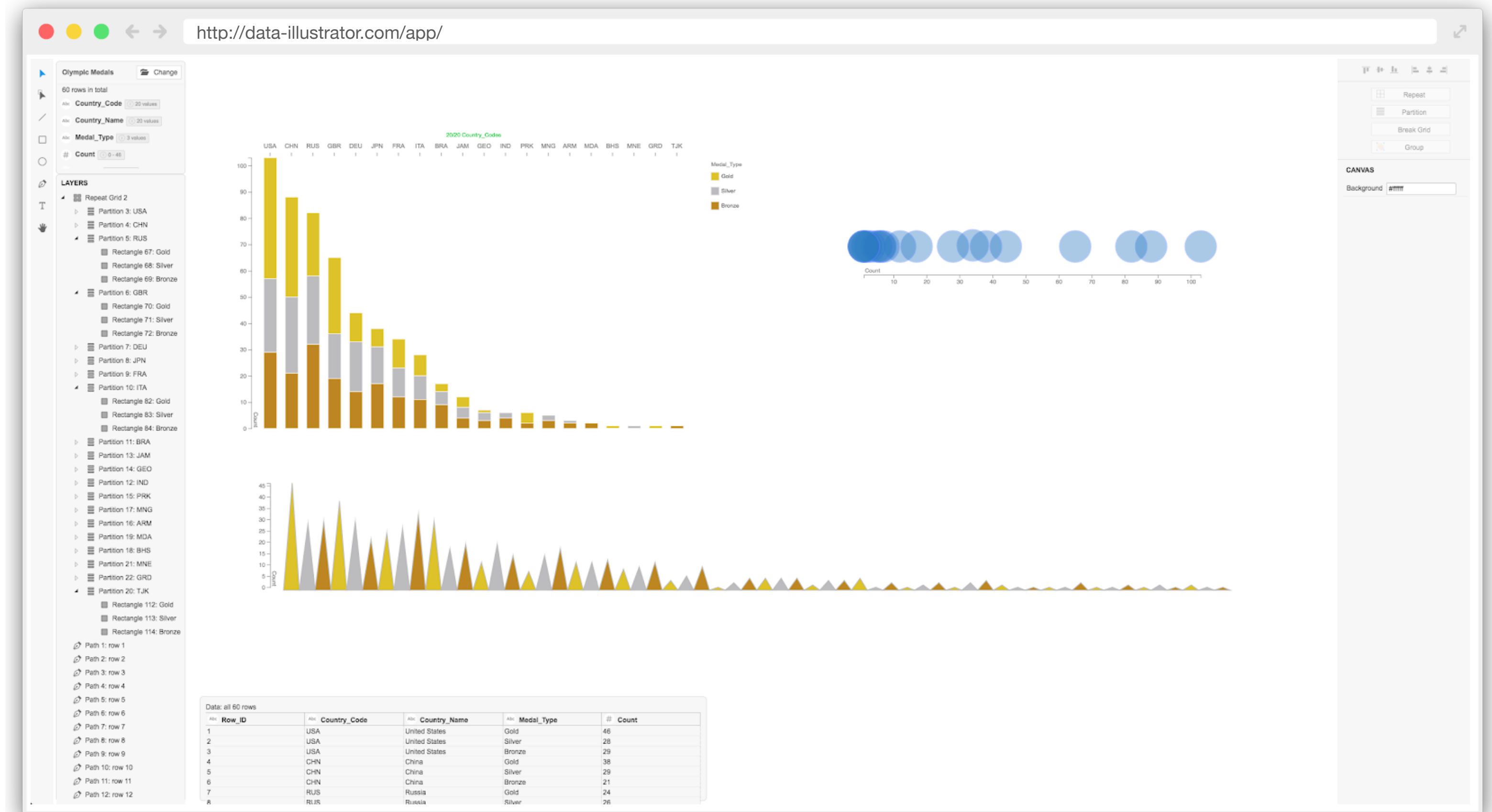


Training exercises:

3 total visualizations

Training duration:

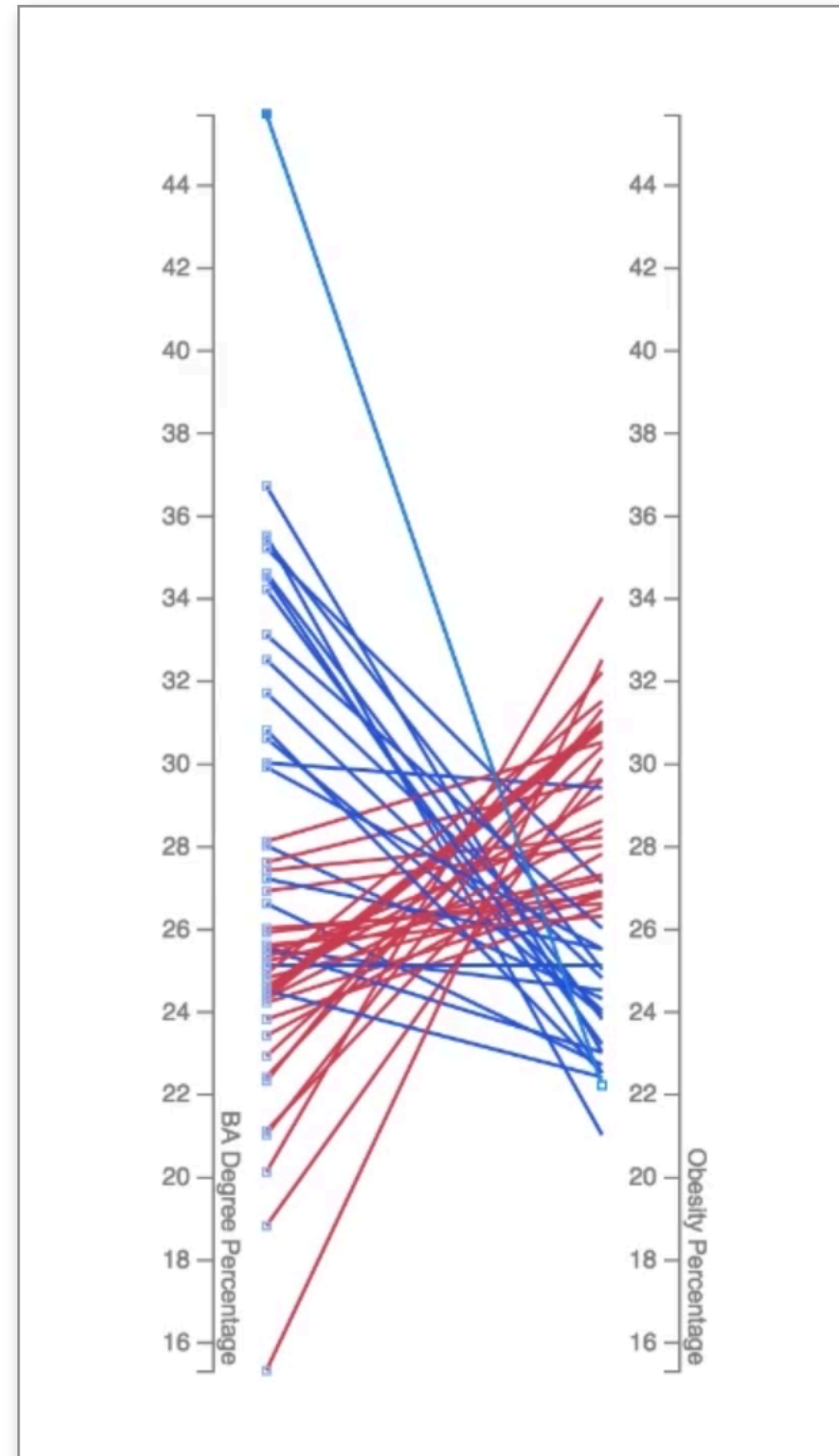
~ 40 minutes



Screenshot of Training Exercise

Obesity vs. Higher Education

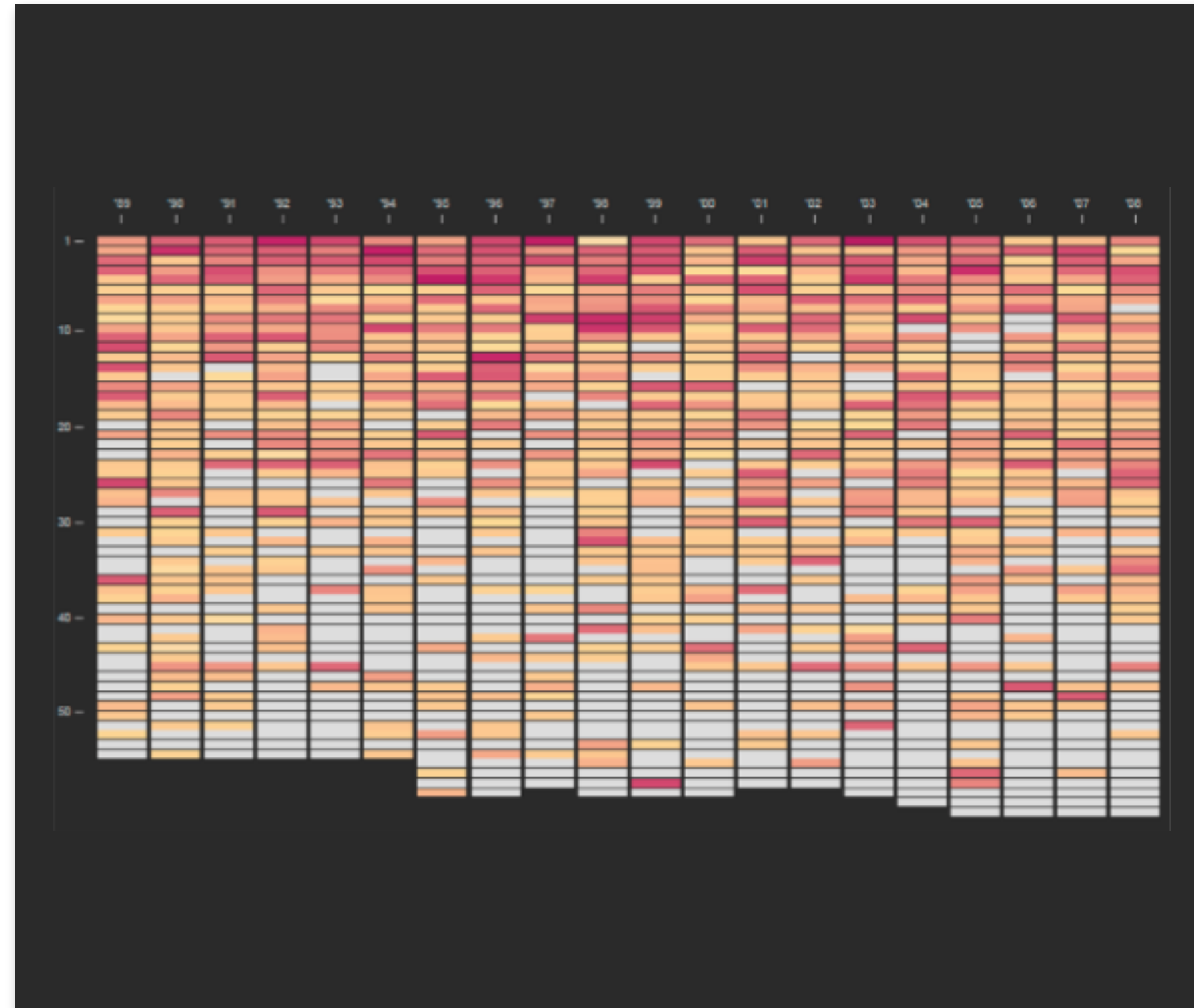
Alberto Cairo



13/13 completed
mean: **12.2** minutes
SD: **5.6** minutes

Twenty Years of the NBA Redrafted

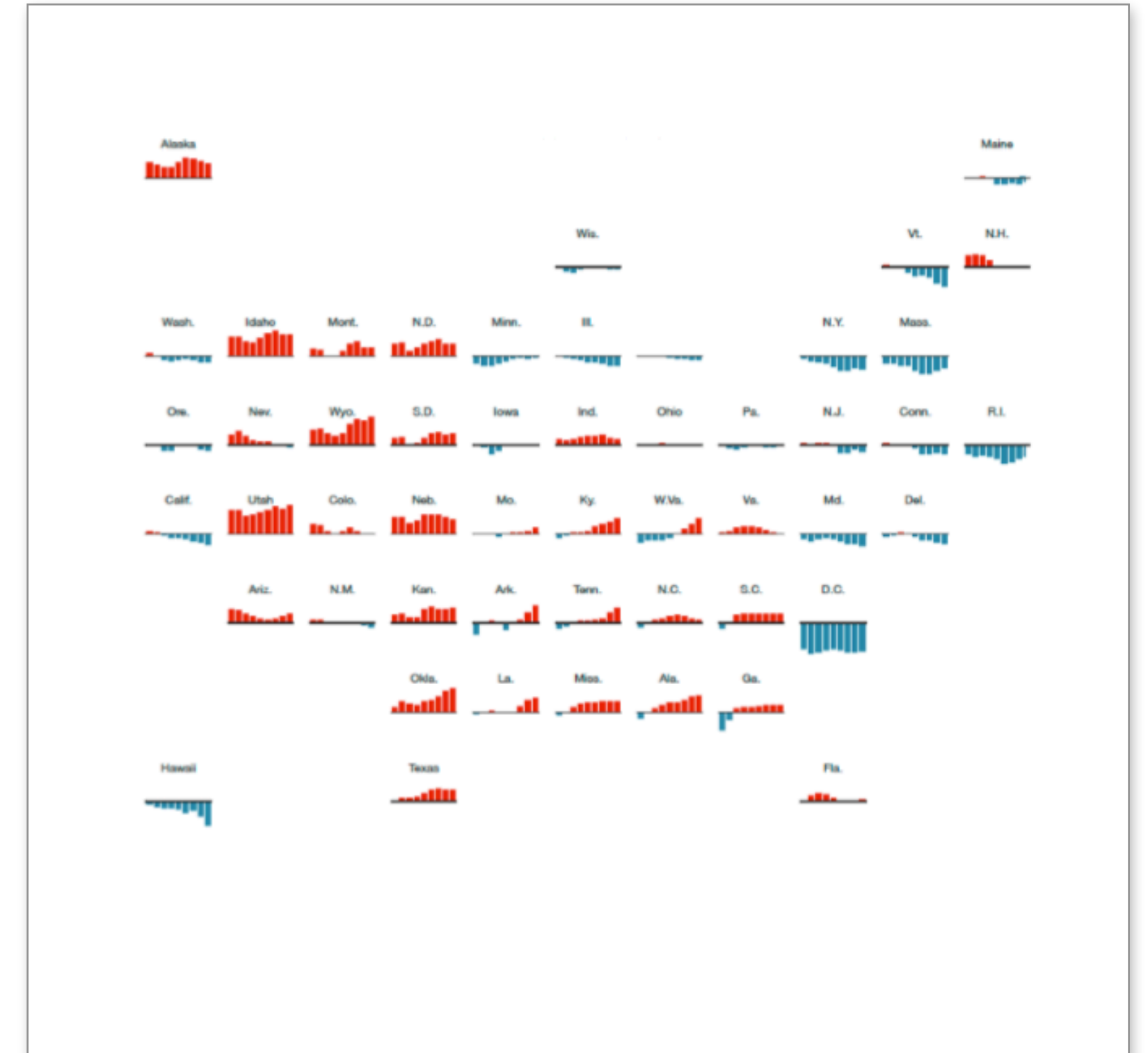
Russell Goldenberg



13/13 completed
mean: **10.8** minutes
SD: **4.3** minutes

A Field Guide to Red & Blue America

Wall Street Journal



4/13 completed
mean: **14.7** minutes
SD: **2.8** minutes

*“Tableau has a bit of a learning curve, and with Data Illustrator being based off of Adobe Illustrator, **there isn’t as much of a learning curve.**”*

*“It takes 30 minutes for me to learn [Data Illustrator] tutorial via a person, **that usually to me is not an easy program.** [Adobe] XD for me was easy ’cause I didn’t have to use any tutorials, so I’d say [learning with Data Illustrator] is somewhat difficult”*

*“I feel like it’s **more flexible than D3 or Tableau.** It’s a happy medium of being able to control the graphic visually. It’s **pretty simple** too, you don’t have to be a super expert user like with Adobe Illustrator, which is nice.”*

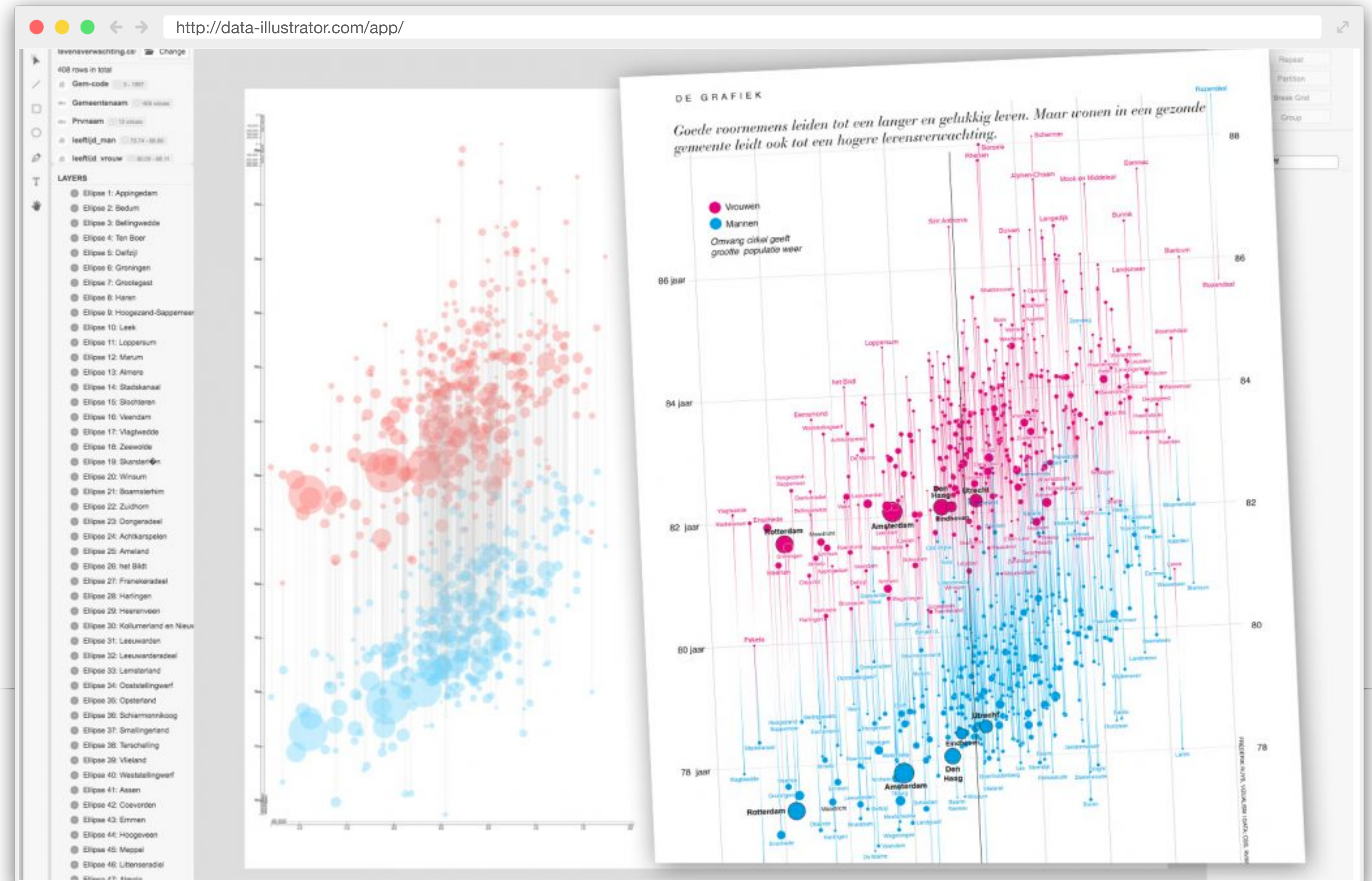


Frédéric Ruys  @fruys

Information designer @Vizualism, lecturer visual storytelling
Dutch Infographic Conference & Dataviz Festival

“The original infographic was published in 2017 in Vrij Nederland and took me **several hours** to complete in Illustrator.

Using Data Illustrator it would have taken me **just a few minutes.**”



What's Next for Data Illustrator?

- ◆ Polar coordinates & radial layout
- ◆ Hierarchy, network & geography
- ◆ Re-usable designs
- ◆ Animation and Interaction





Data Illustrator

<http://www.data-illustrator.com/>

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Georgia
Tech Visualization
Lab



Adobe