# 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


Alan Wilson


James Delorey


Sam Grigg


Bernard Kerr


John Stasko

Adobe Research

Adobe Systems, Inc

Georgia Tech

# Data Journalism

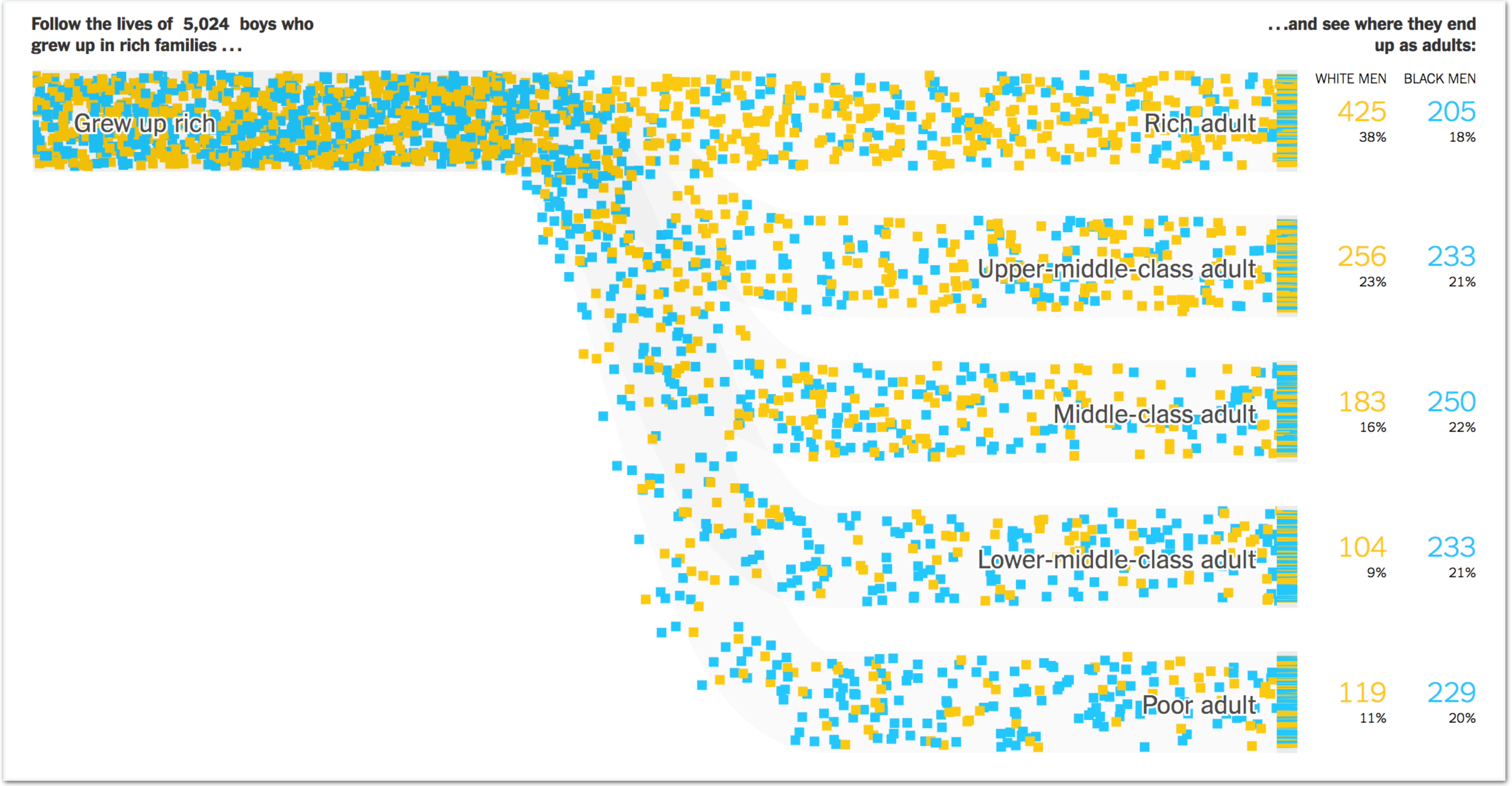
Emily Badger
Writer

Claire Cain Miller
Writer

Adam Pearce
Graphics Editor

Kevin Quealy
Graphics Editor

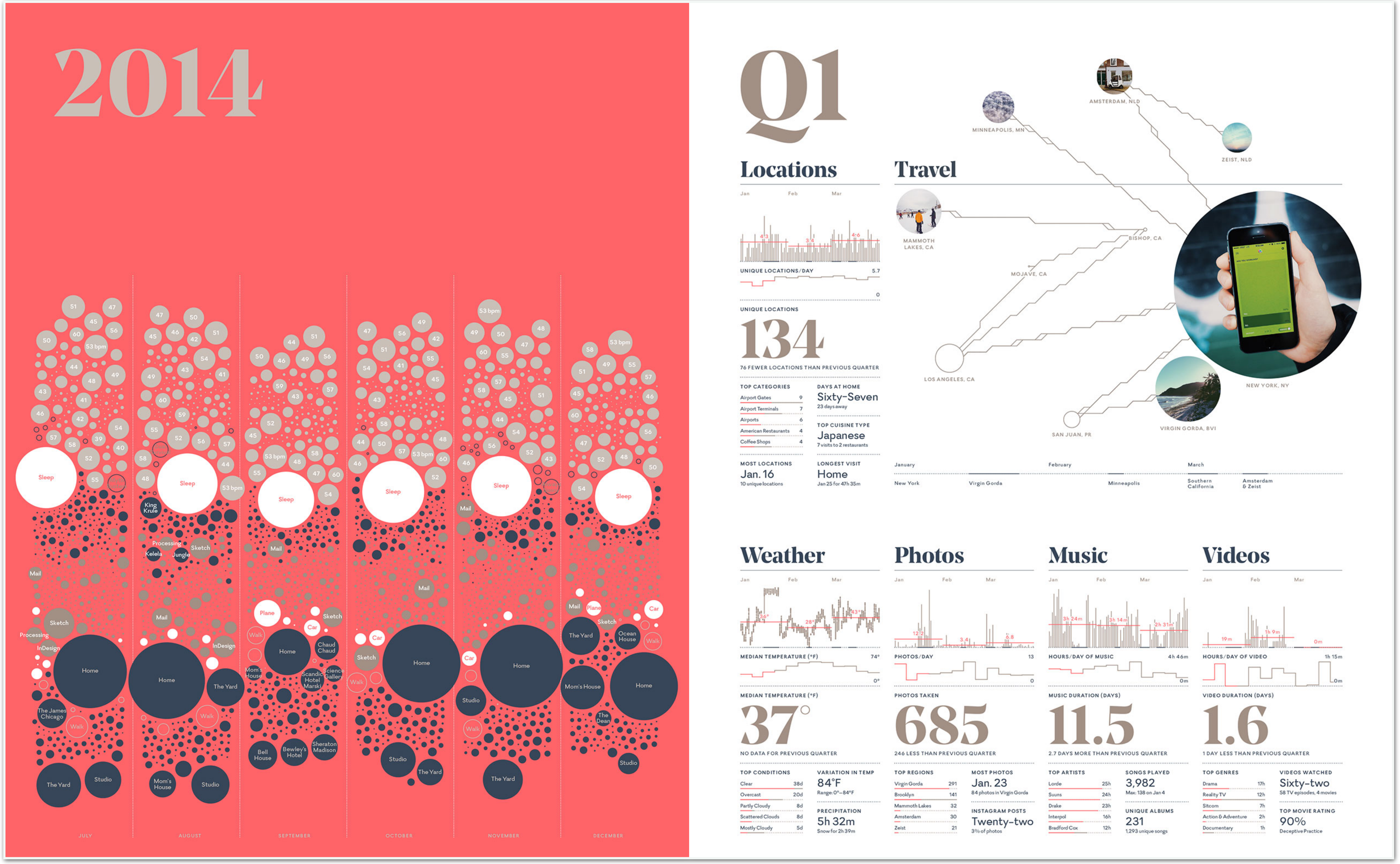
The New York Times




*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




*Personal Annual Reports*
http://feltron.com/FAR14.html

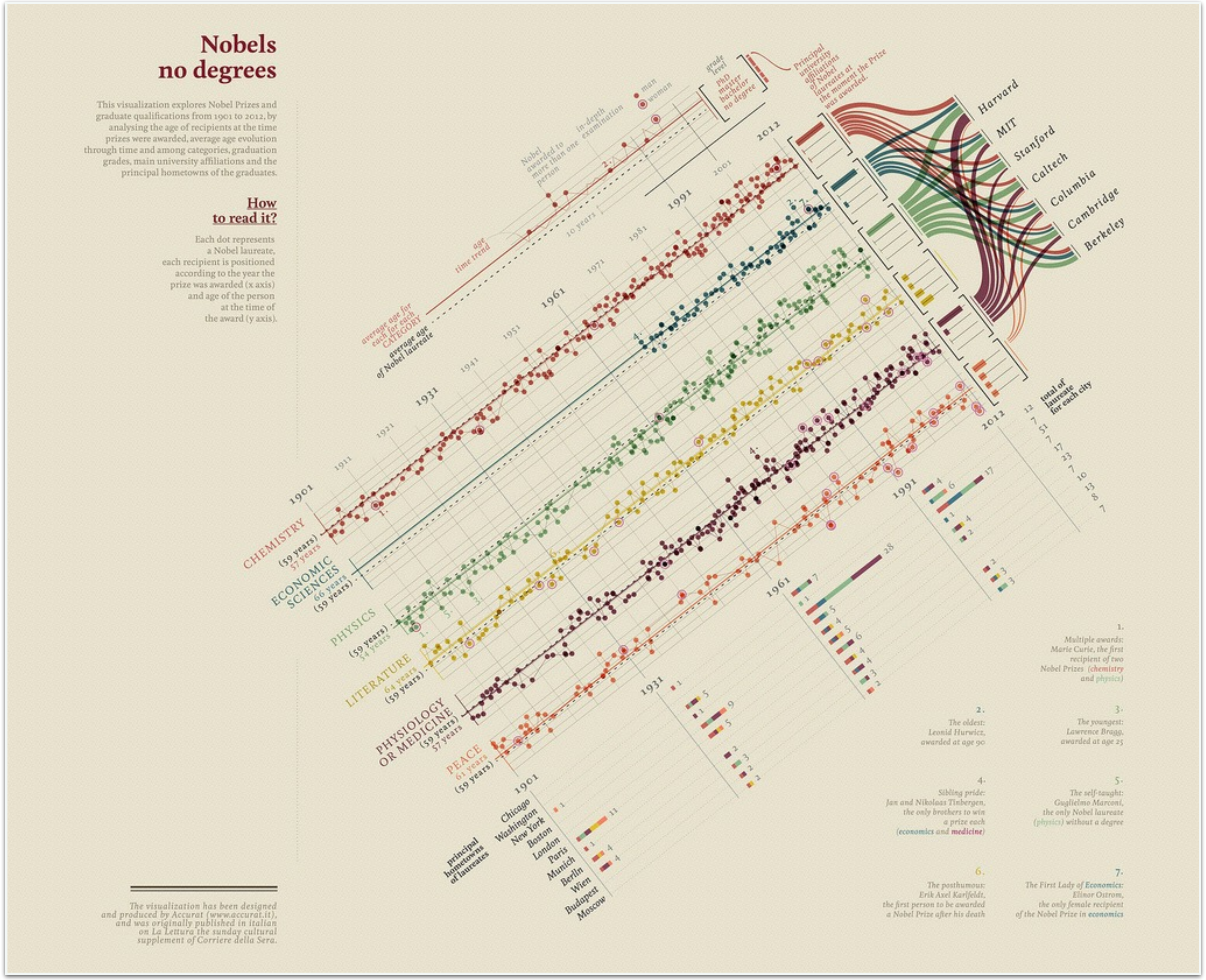
# Data Art

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

Information Designer, Artist

/IIII /I

accurat




*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**

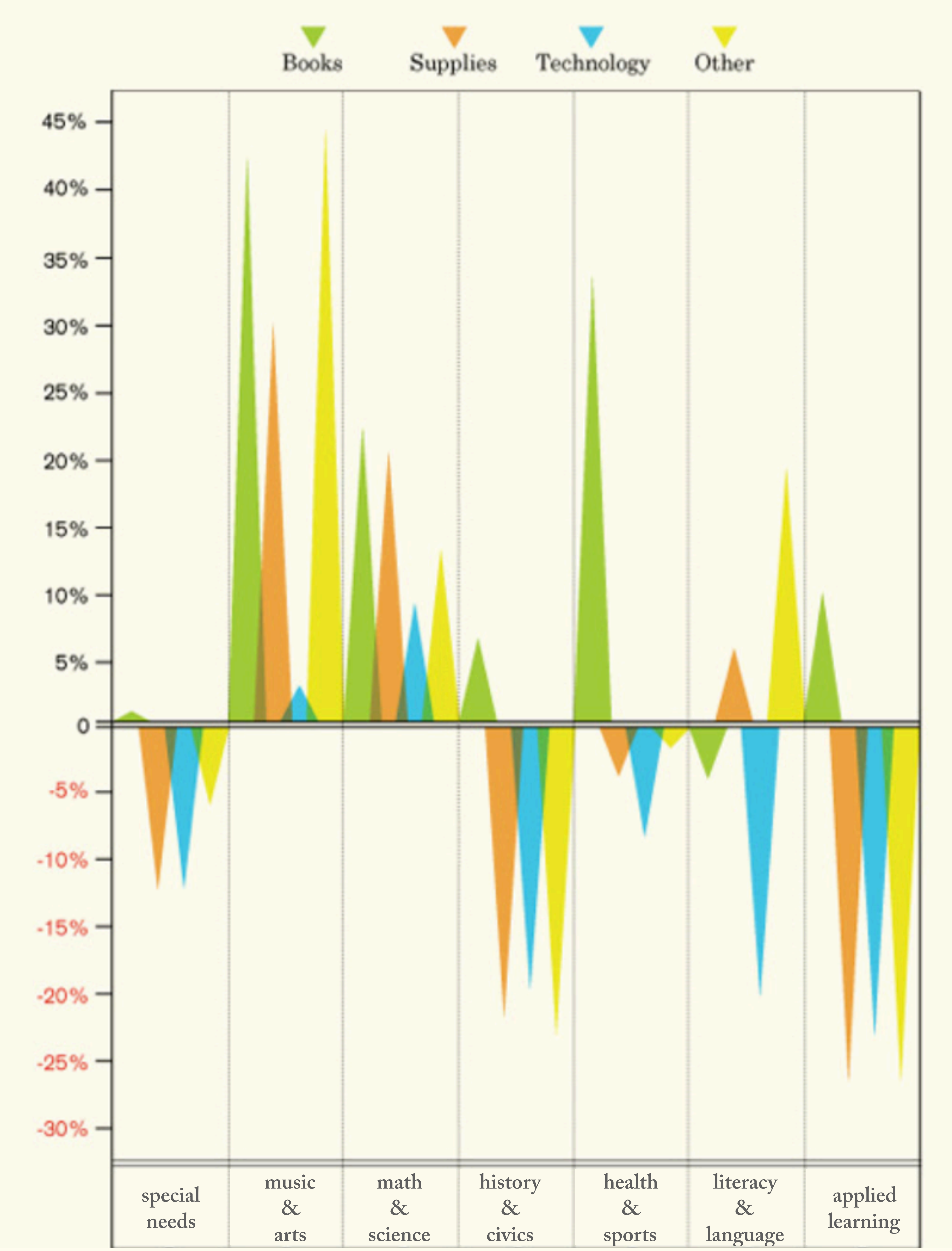
| Row ID | Subject Area | Resource Type | Chance |
|---|---|---|---|
| R1 | Special Needs | Books | 0.01 |
| R2 | Special Needs | Supplies | -0.12 |
| R3 | Special Needs | Technology | -0.115 |
| R4 | Special Needs | Other | -0.05 |
| … | … | … | … |
| R27 | Applied Learning | Technology | -0.225 |
|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

**DonorsChoose.org Project Funding**
odds of school projects

**7 subject areas**
**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 |

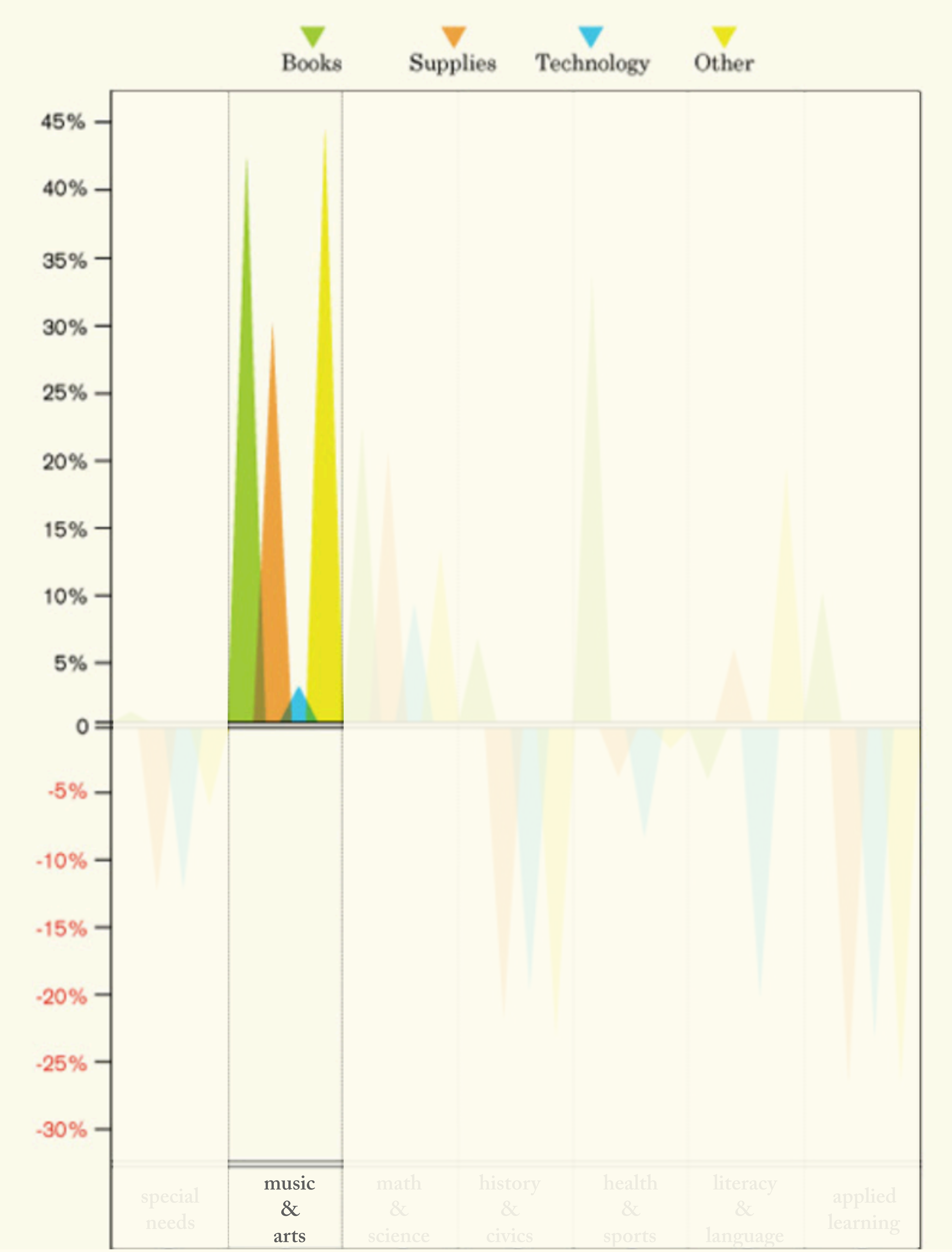


**DonorsChoose.org Project Funding**
odds of school projects

**7 subject areas**
**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 |

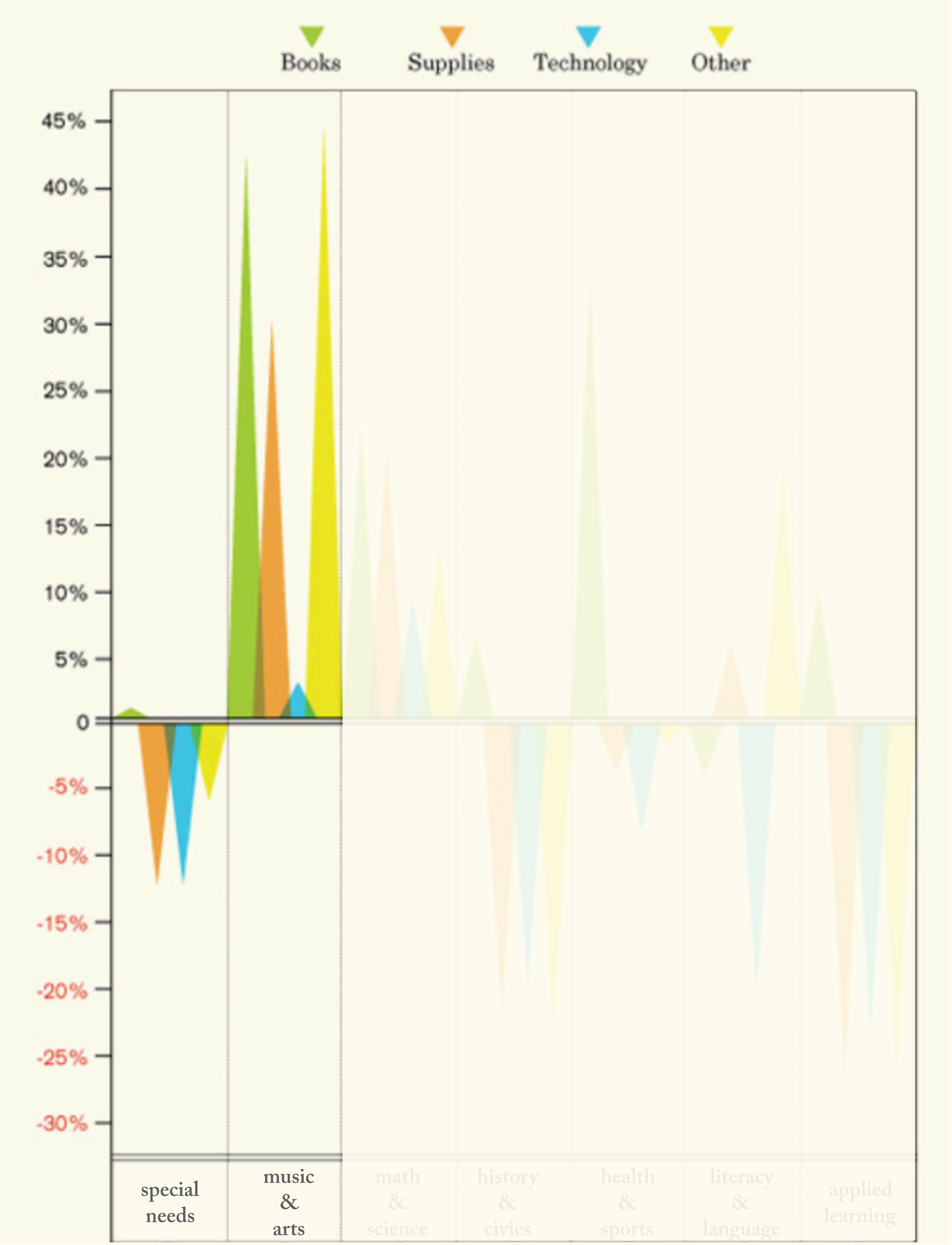


**DonorsChoose.org Project Funding**
odds of school projects

**7 subject areas**
**4 resource types**
(books, supplies, technology, other)

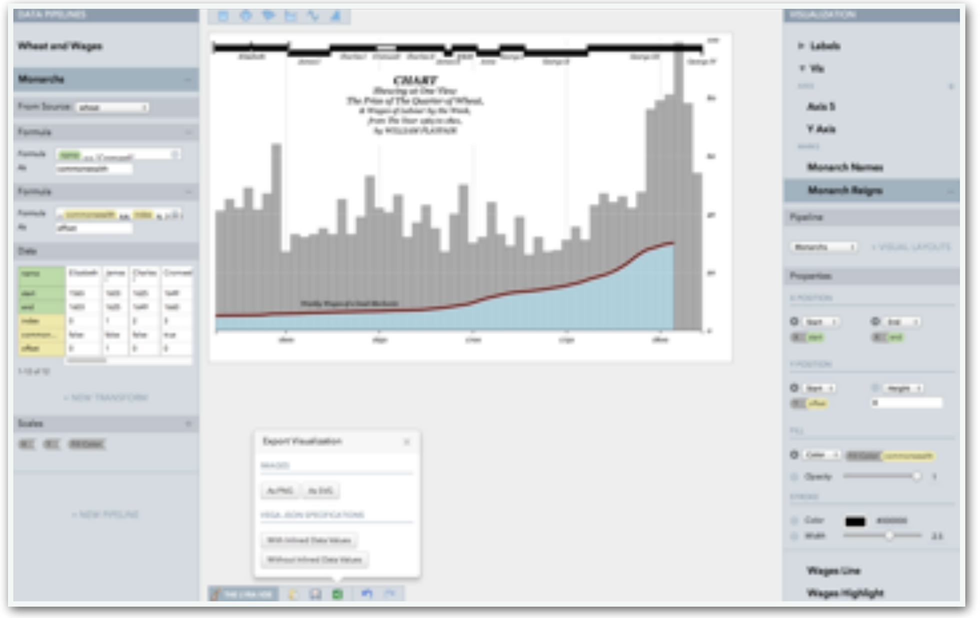
Source:
**Column5Media**

| 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 |




http://data-illustrator.com/app/
File
View
Help
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
Row_ID | Subject | 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



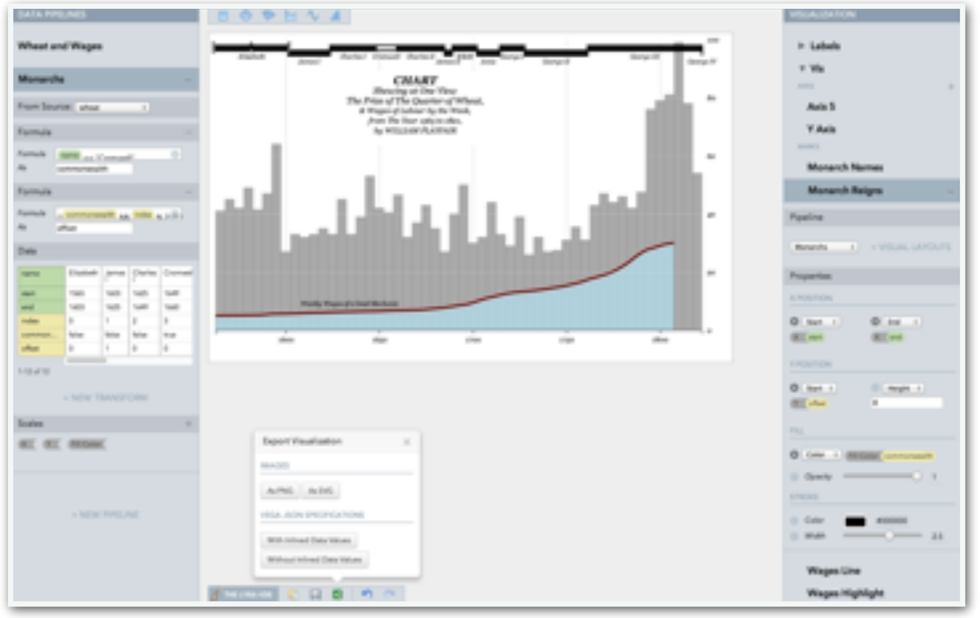
Kim et. al. (2016)
Data-driven Guides



Xia et. al. (2018)
DataInk

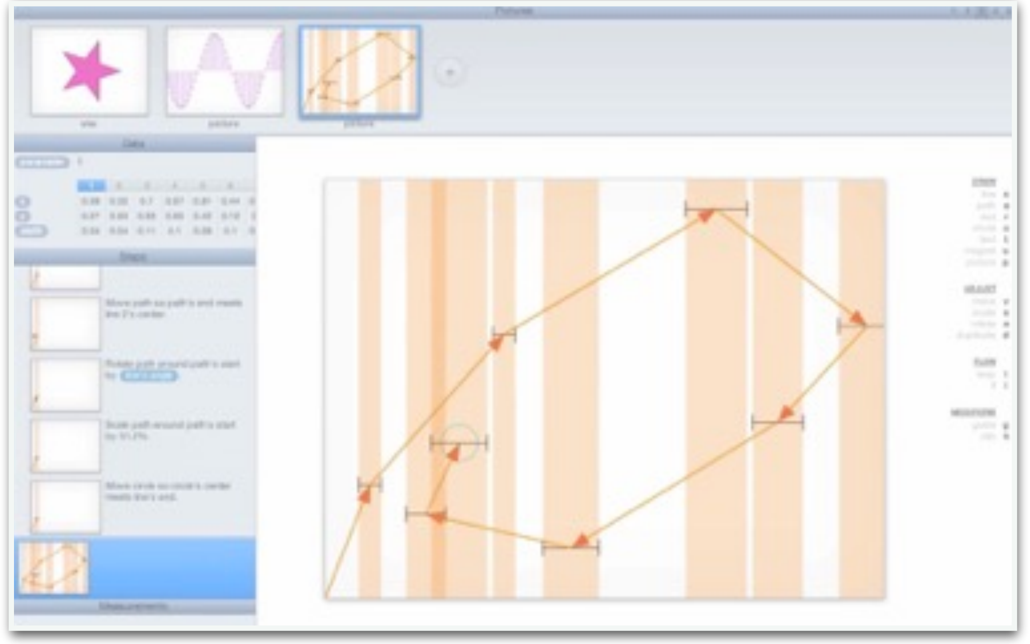
## Grammar/Template based Approach

# Yet Another Visualization Authoring Tool?

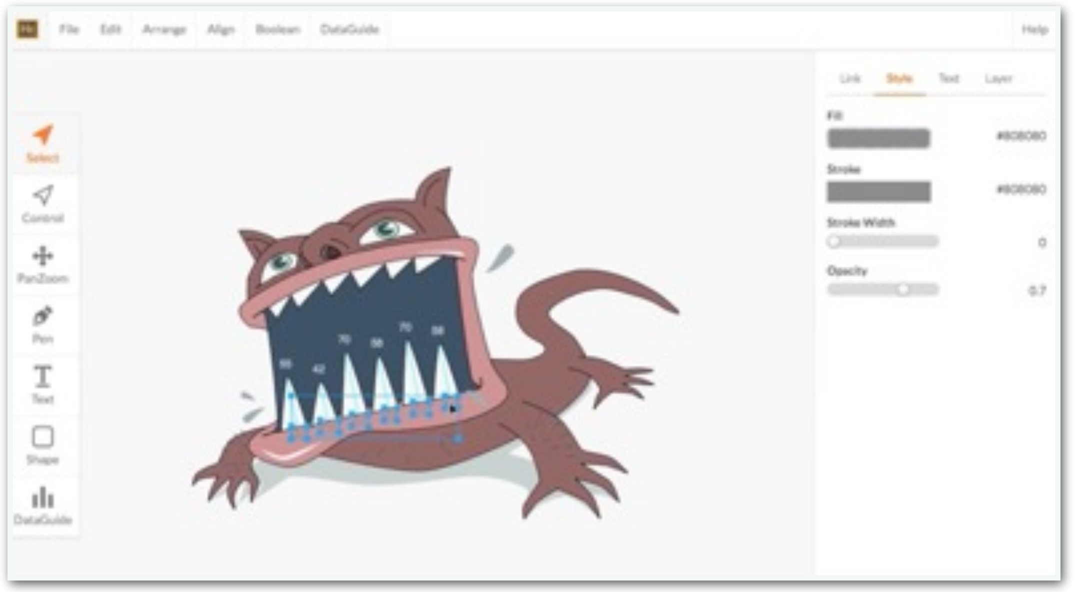


Satyanarayan and Heer (2014)
Lyra

Ren et. al. (2014)
iVisDesigner



Bret Victor (2013)
Drawing Dynamic Visualizations



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


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?

*Source: http://d3js.org/*

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 |

**Data** → Variables → Algebra → Scales → Statistics → Geometry → Coordinates → Aesthetics → **Renderer**

# 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`

**Data** → Variables → Algebra → Scales → Statistics → Geometry → Coordinates → Aesthetics → **Renderer**

# 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)**

**Data** → Variables → Algebra → Scales → Statistics → Geometry → Coordinates → Aesthetics → **Renderer**

# 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"))**

**Data** → Variables → Algebra → Scales → Statistics → Geometry → Coordinates → Aesthetics → **Renderer**

# 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"))
summary.proportion(Response*Gender)
```

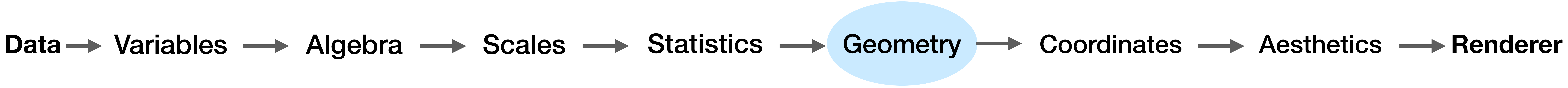
**Data** → Variables → Algebra → Scales → Statistics → Geometry → Coordinates → Aesthetics → **Renderer**

# 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"))
summary.proportion(Response*Gender)
interval.stack(summary.proportion(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"))**
**summary.proportion(Response*Gender)**
**rect(dim(2), polar.theta(dim(1)))**
**interval.stack(position(summary.proportion(response*gender)))**

**Data** → Variables → Algebra → Scales → Statistics → Geometry → Coordinates → Aesthetics → **Renderer**

# 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 |

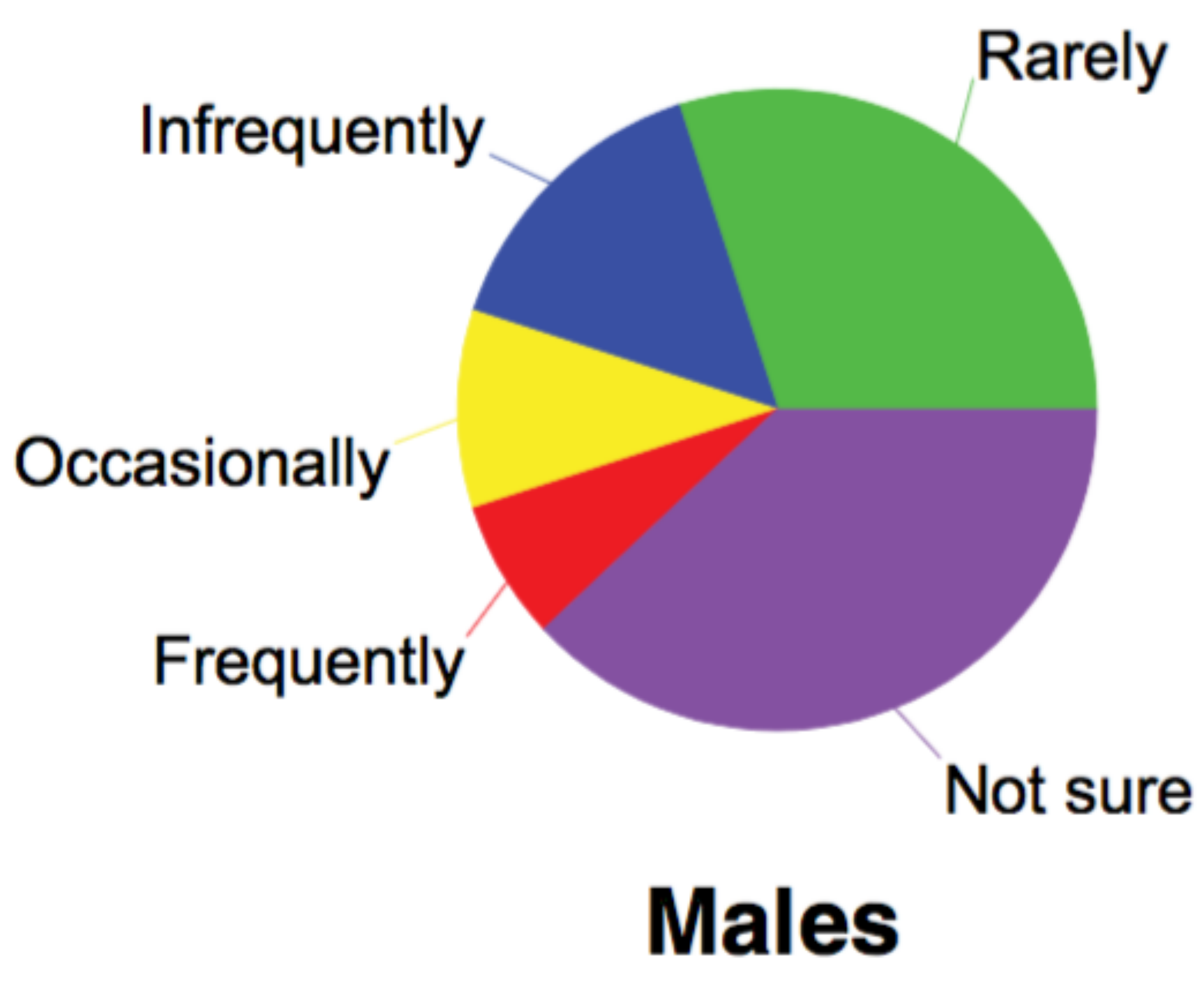
```
response = Response
gender = Gender
cross(response, gender)
cat(dim(1), values("Rarely","Infrequently",
  "Occasionally","Frequently","Not Sure”))
cat(dim(2), values(“Female”,"Male"))
summary.proportion(Response*Gender)
rect(dim(2), polar.theta(dim(1)))
interval.stack(position(summary.proportion(response*gender)),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

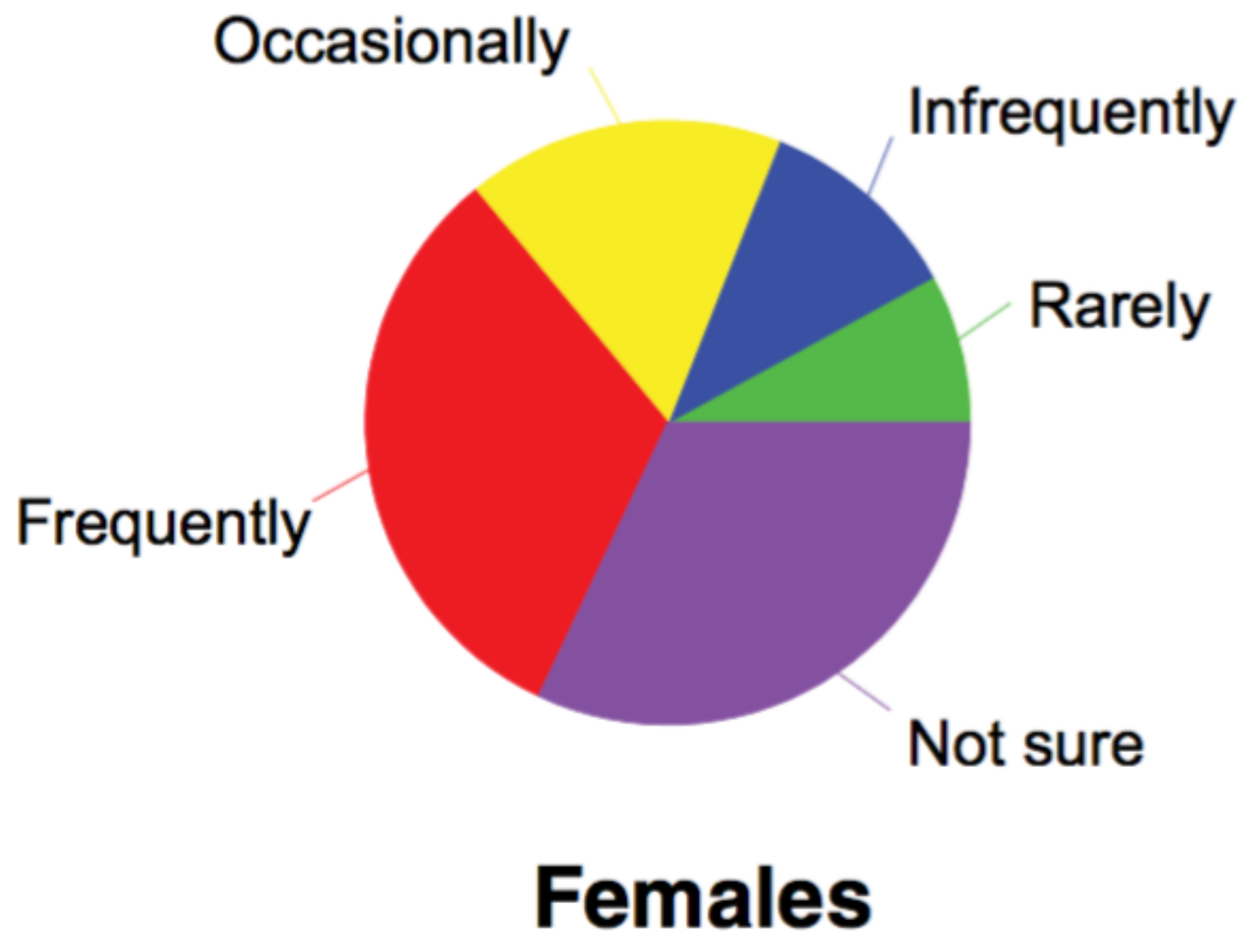
**Data** → Variables → Algebra → Scales → Statistics → Geometry → Coordinates → Aesthetics → **Renderer**

# The Grammar of Graphics

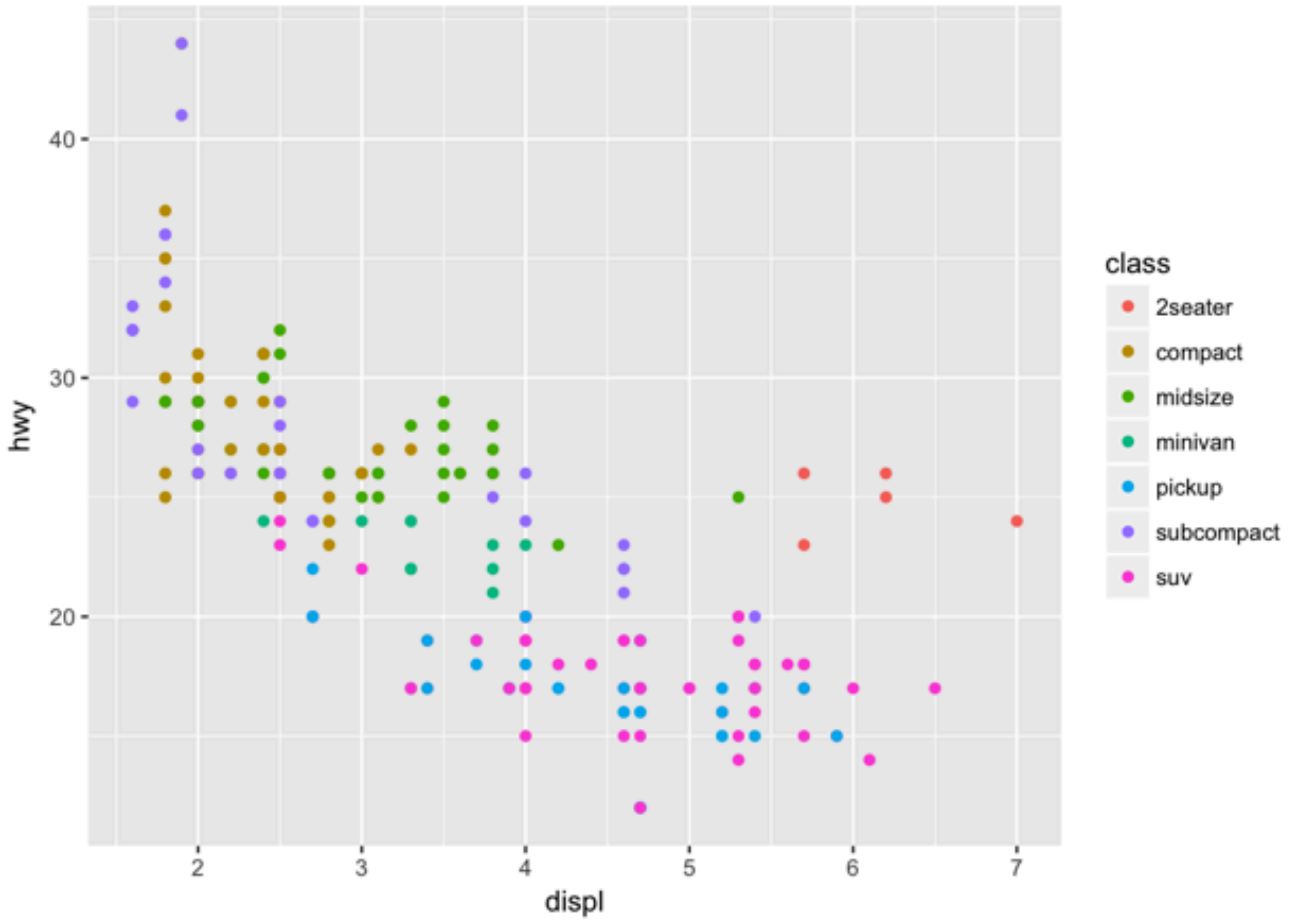
| CaseID | Response |
|---|---|
| 1 | Frequently |
| 2 | Not Sure |
| 3 | Frequently |
| ... | ... |
| 3834 | Rarely |
| 3835 | Infrequently |

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




**Data** → Variables → Algebra → Scales → Statistics → Geometry → Coordinates → Aesthetics → **Renderer**




ggplot2

Wickham, 2010

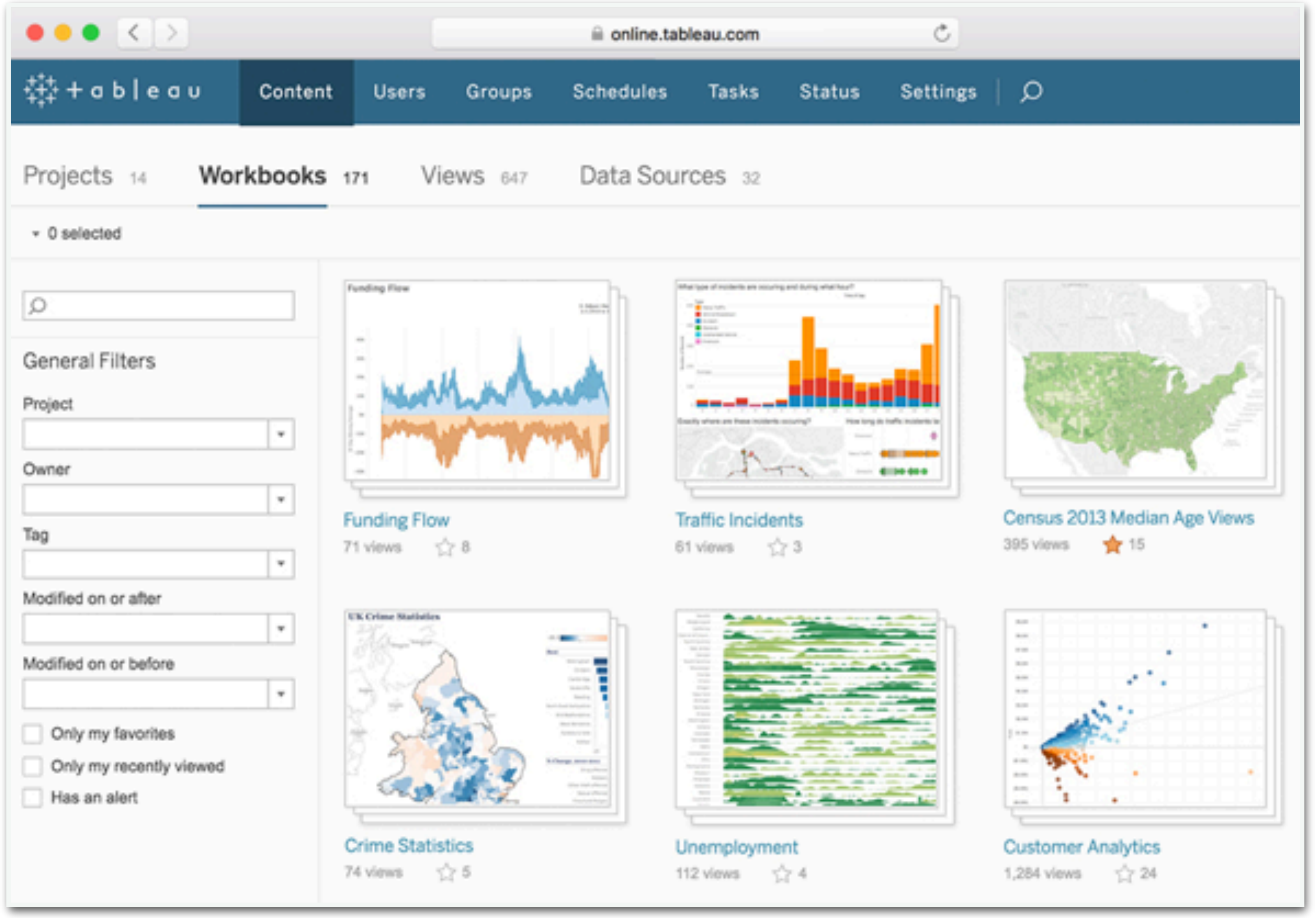
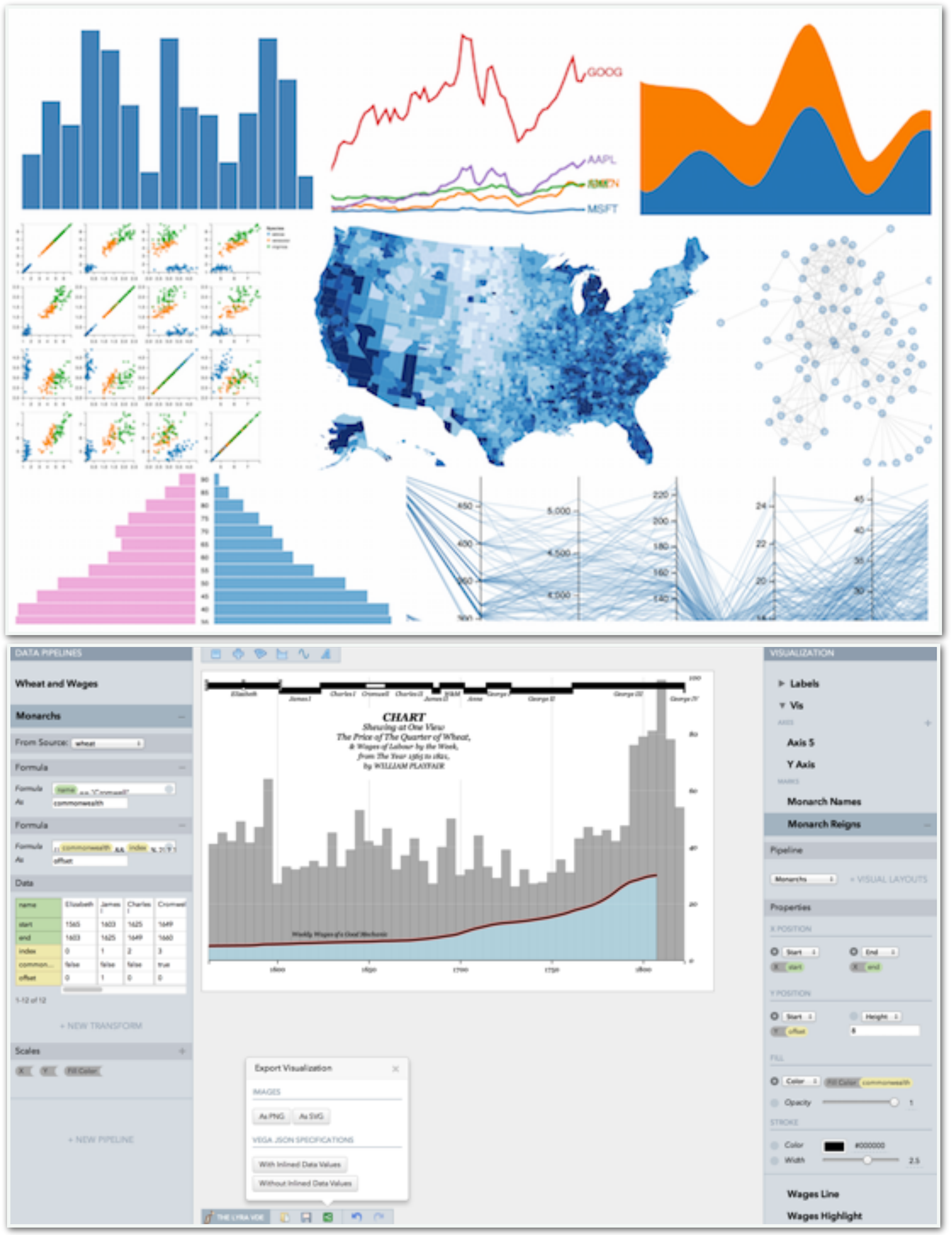



tableau
SOFTWARE

Stolte and Hanrahan, 2002

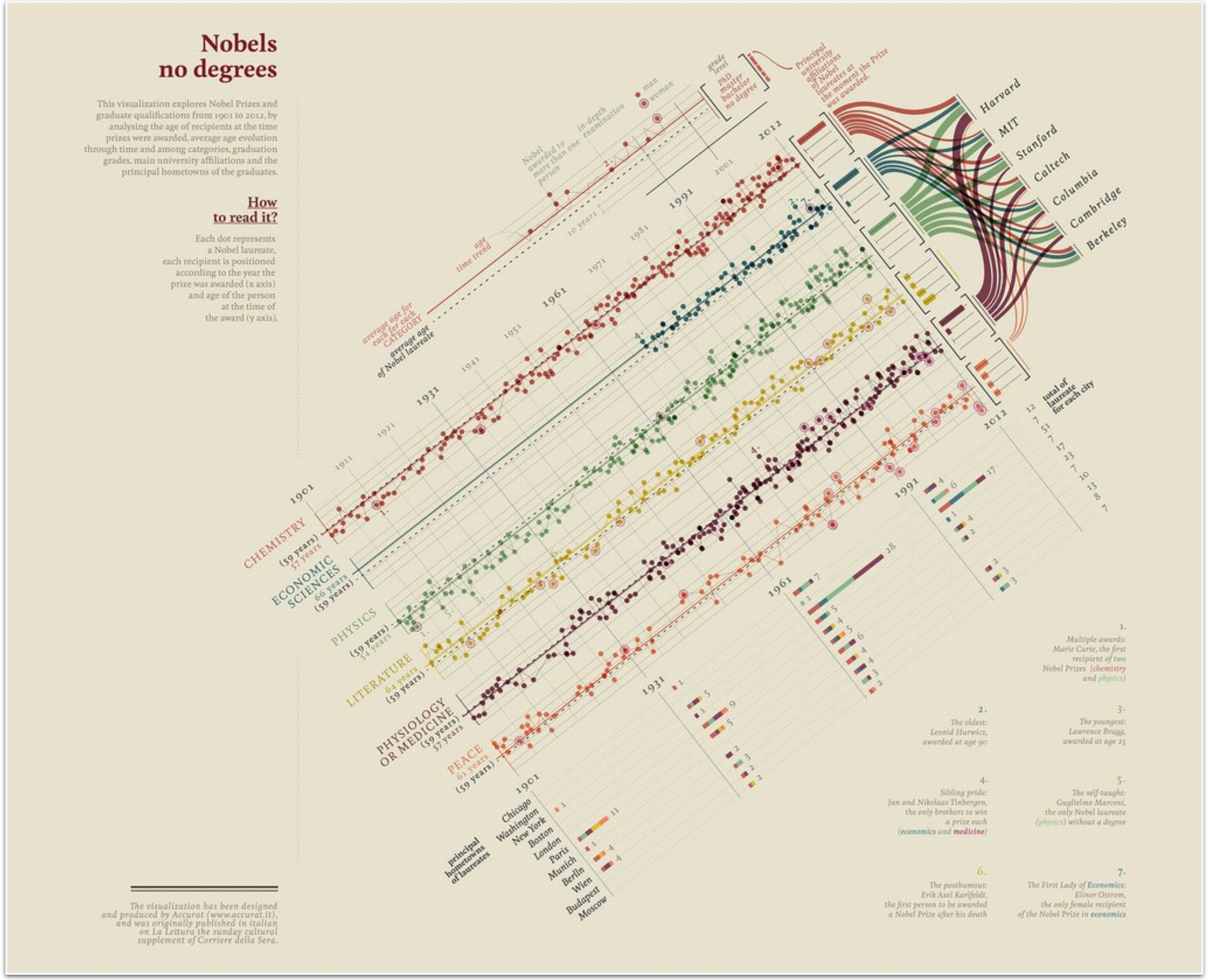



Satyanarayan and Heer, 2014

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

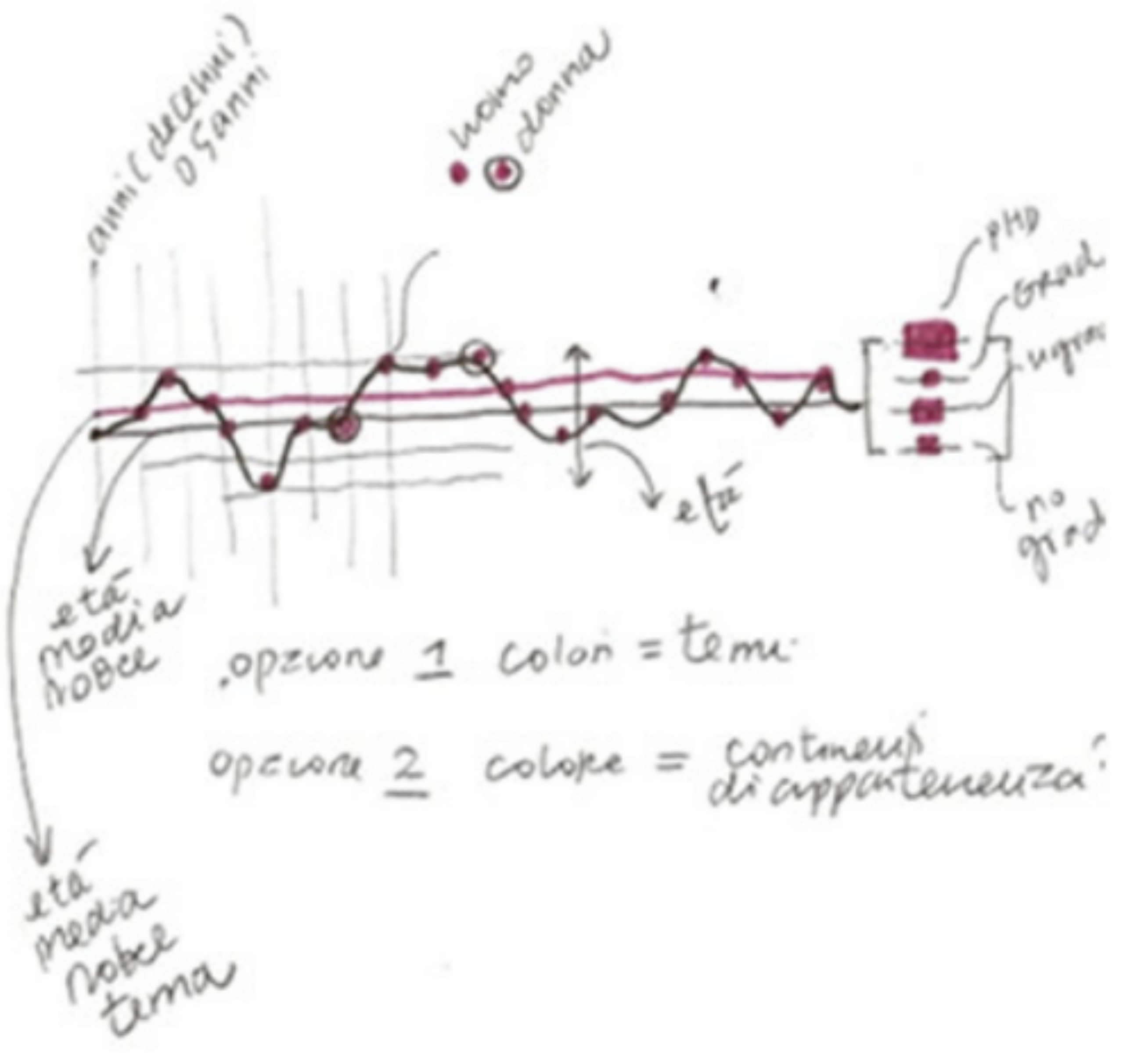
Particularly, John Cage, a famous contemporary composer, was a true source of fascination.”

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

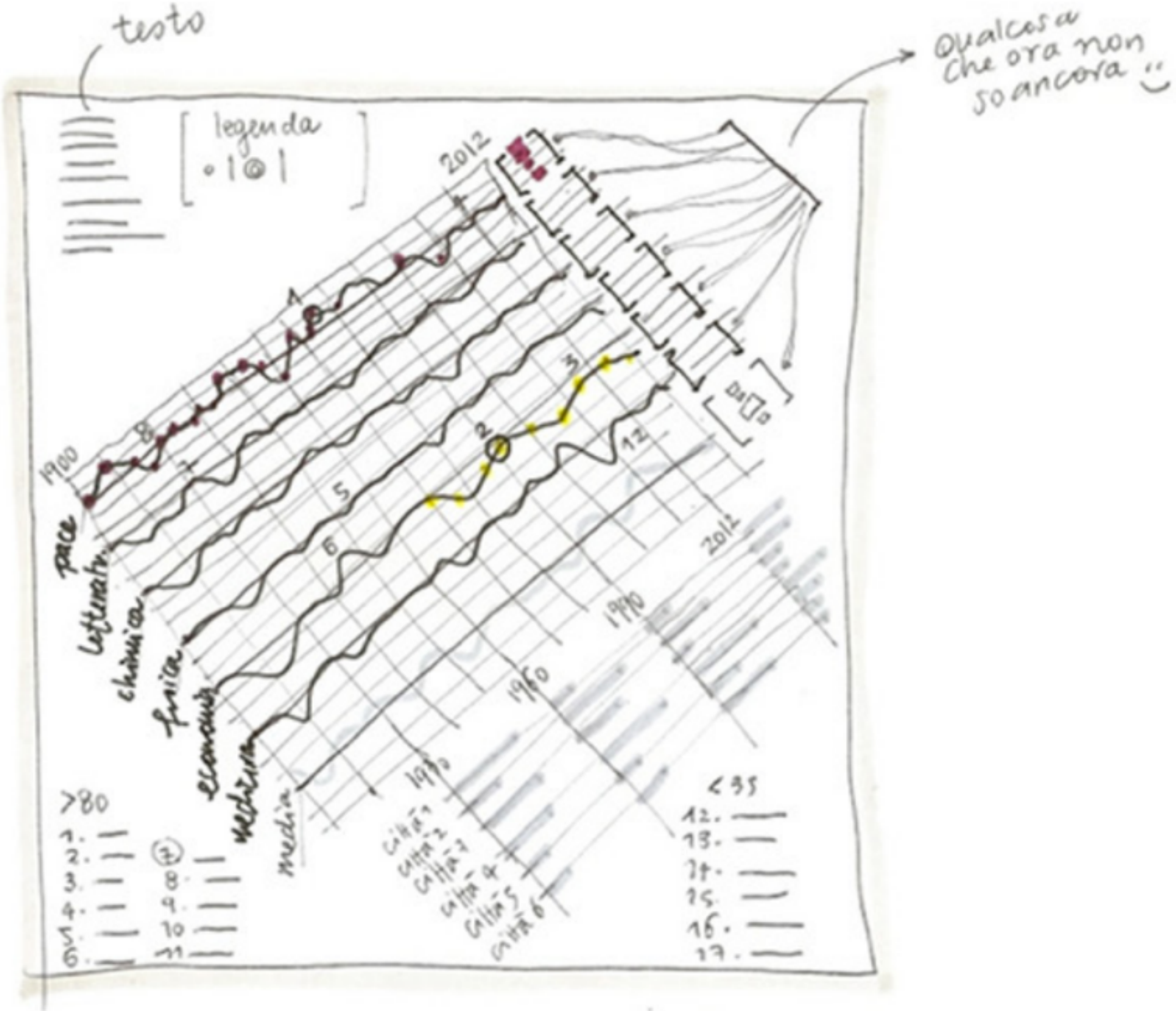


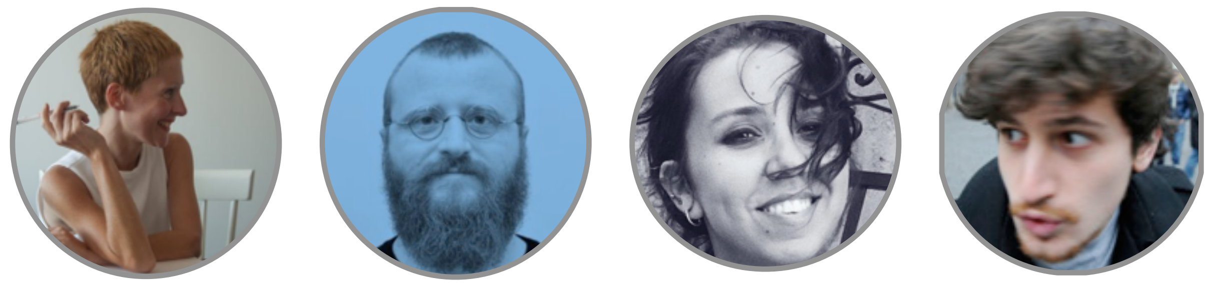

Quoted from https://www.behance.net/gallery/14159439/Nobel-no-degrees

*Nobels, no degrees*







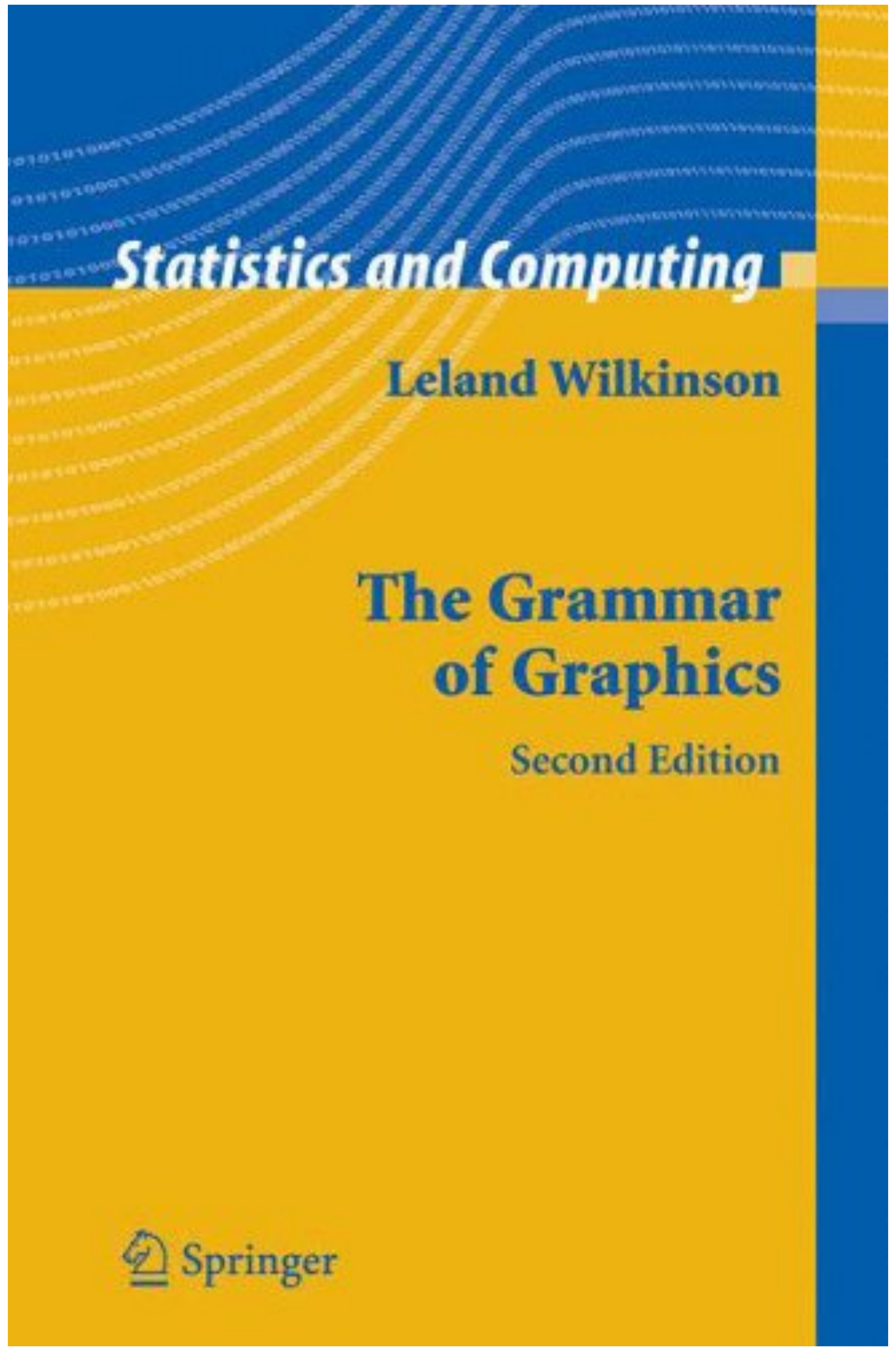
Giorgia Lupi, Gabriele Rossi,
Federica Fragapane, Francesco Majno.

*Source: https://www.behance.net/gallery/14159439/Nobel-no-degrees*

# 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

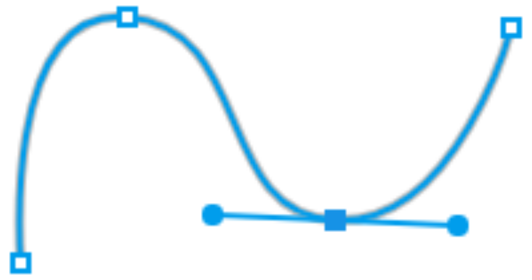
## Line

**2** anchor points

**1** line segment

**open** path

## Path



**2+** anchor points

**1+** line segments

**open/closed** path

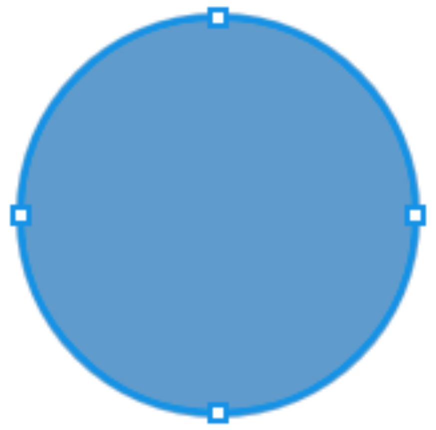
## Rectangle

**4** anchor points

**3** line segment

**closed** path

## Circle



**4** anchor points

**3** line segments

**closed** path

## Text


**point text**

non-deformable

# Graphical Primitives

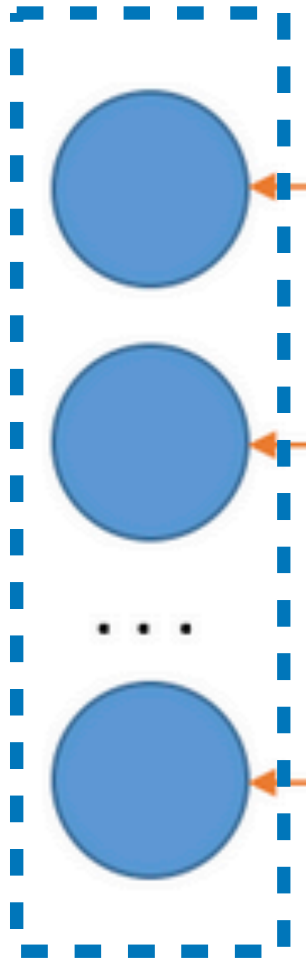
| Row ID | Country | Medal Type | Count |
|---|---|---|---|
| R1 | United States | Gold | 46 |
| R2 | United States | Silver | 29 |
| R3 | United States | Bronze | 29 |
| R4 | China | Gold | 38 |
| R5 | China | Silver | 27 |
| R6 | China | Bronze | 23 |
| ... | ... | ... | ... |
| R58 | Grenada | Gold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

# Repeat Operator

| 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"

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

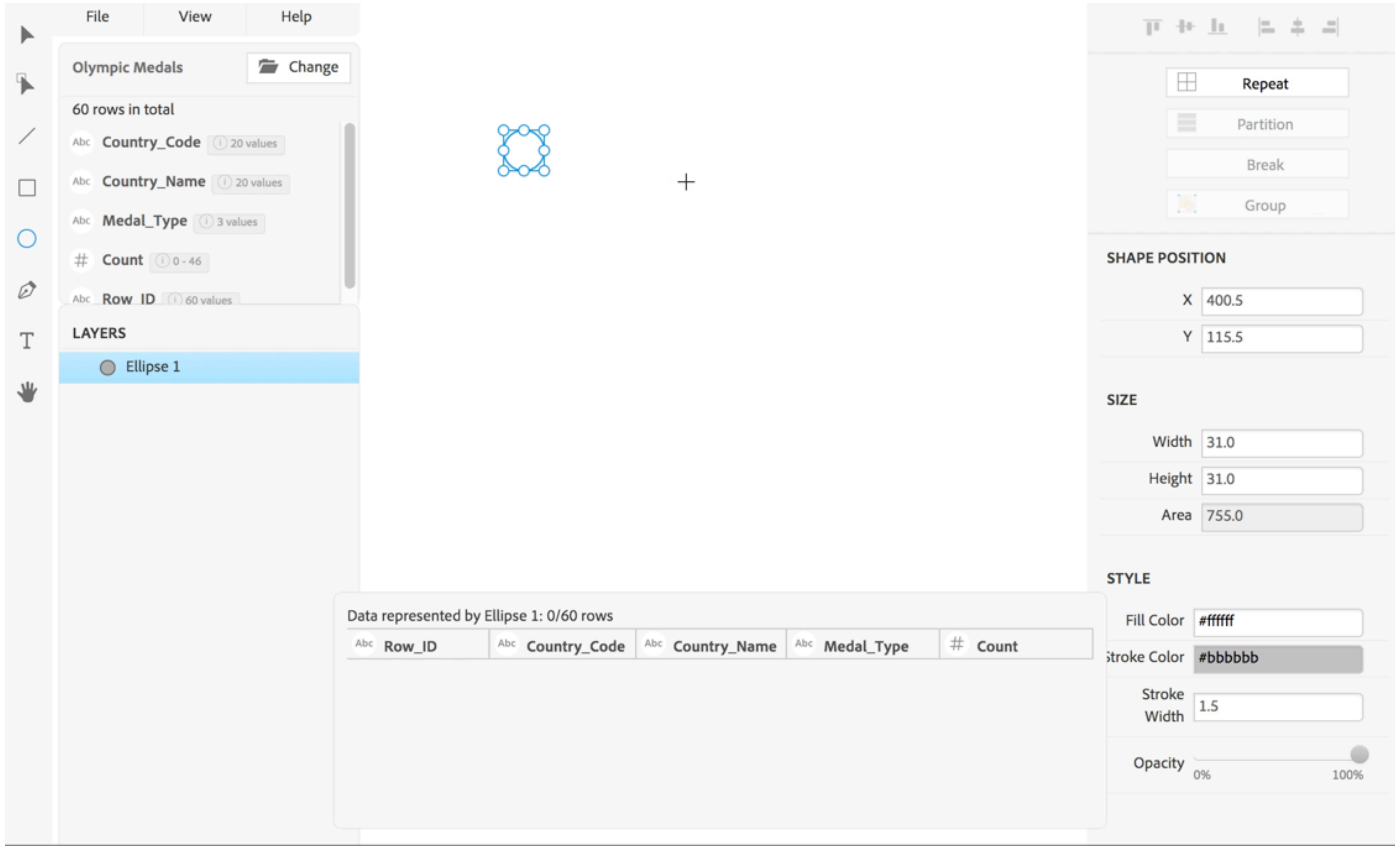
data scope of circle 3

# Repeat Operator

| Row ID | Country | Medal Type | Count |
|---|---|---|---|
| R1 | United States | Gold | 46 |
| 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 |




# Repeat and Lay out in Grid

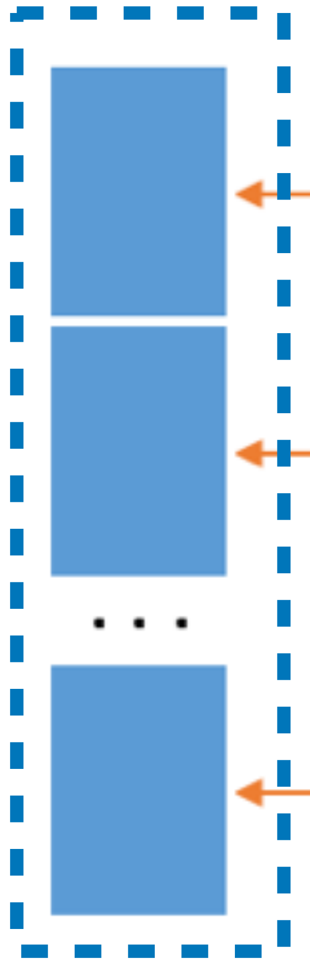
| Row ID | Country | Medal Type | Count |
|---|---|---|---|
| R1 | United States | Gold | 46 |
| R2 | United States | Silver | 29 |
| R3 | United States | Bronze | 29 |
| R4 | China | Gold | 38 |
| R5 | China | Silver | 27 |
| R6 | China | Bronze | 23 |
| ... | ... | ... | ... |
| R58 | Grenada | Gold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

Partition 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”

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

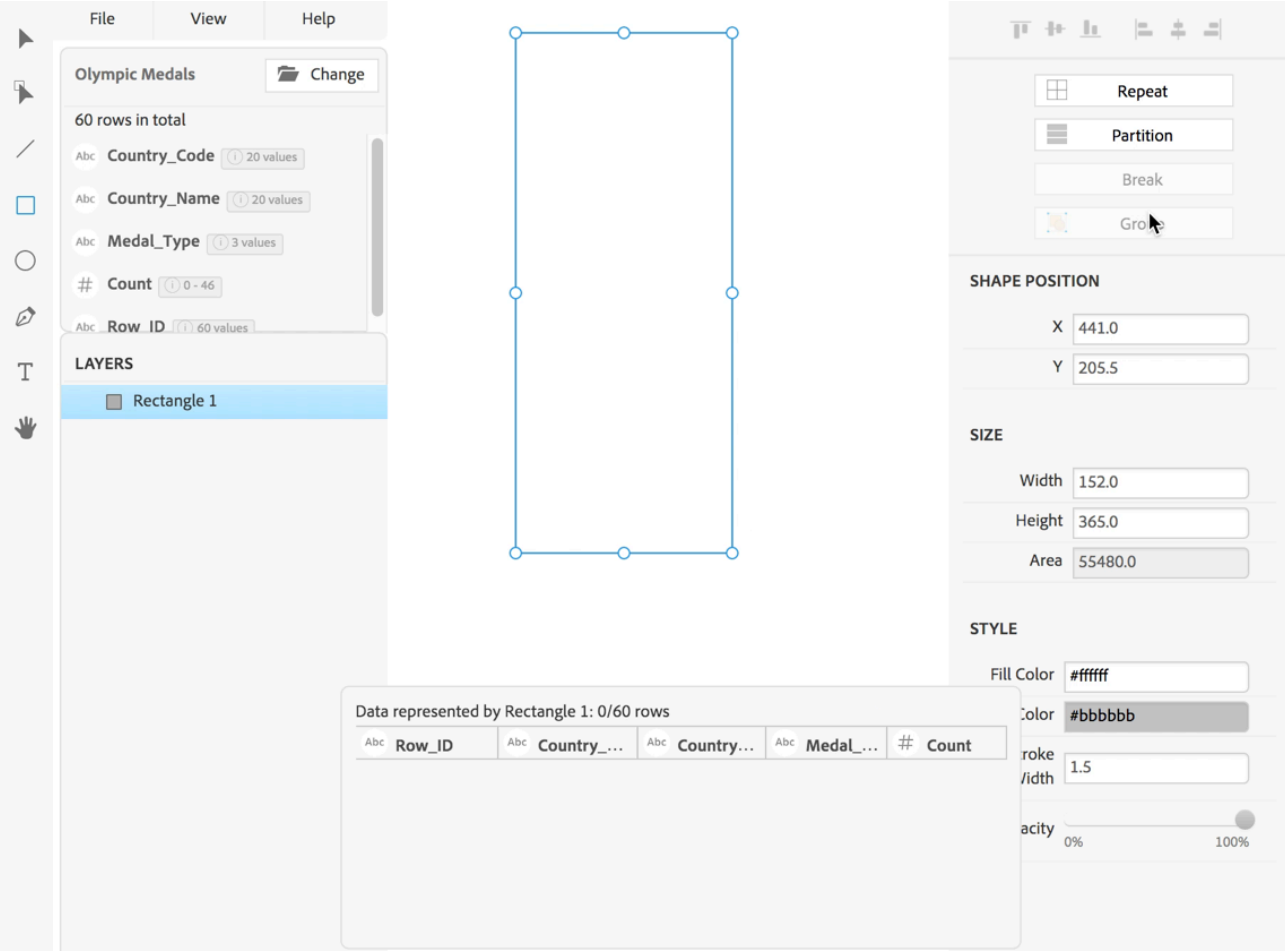
# Partition Operator

| 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"

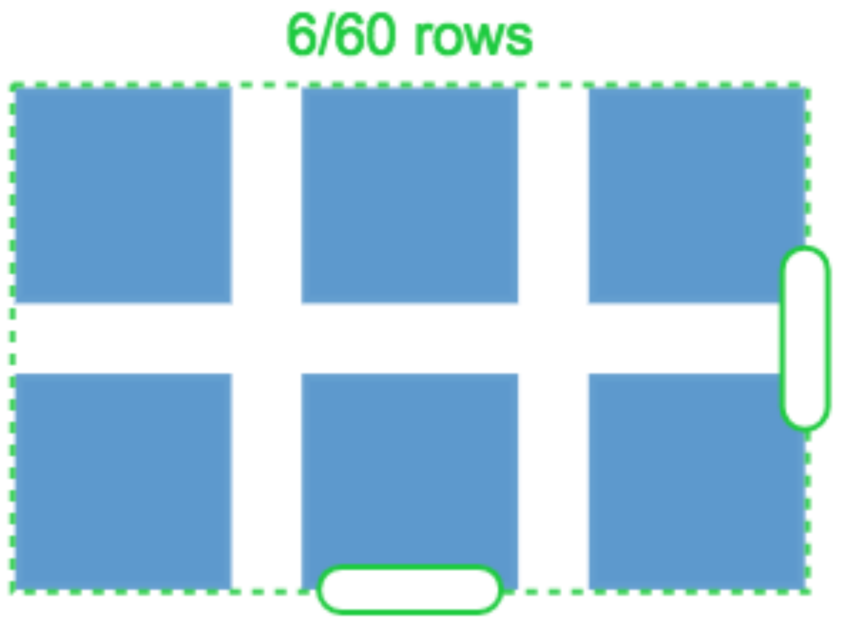
| Row ID | Country | Medal Type | Count |
|---|---|---|---|
| R1 | United States | Gold | 46 |
| R2 | United States | Silver | 29 |
| R3 | United States | Bronze | 29 |
| R4 | China | Gold | 38 |
| R5 | China | Silver | 27 |
| R6 | China | Bronze | 23 |
| ... | ... | ... | ... |
| R58 | Grenada | Gold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

. . .

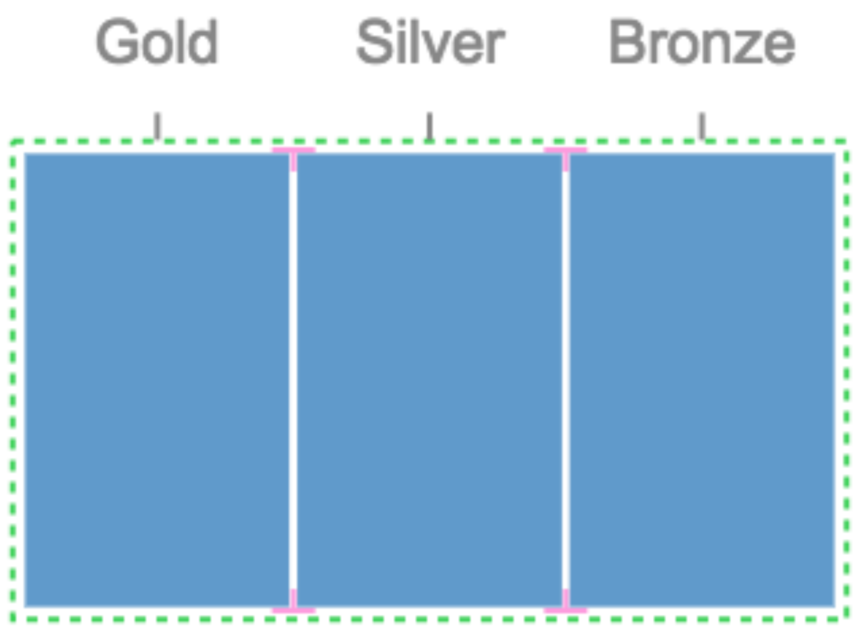



# Partition Operator

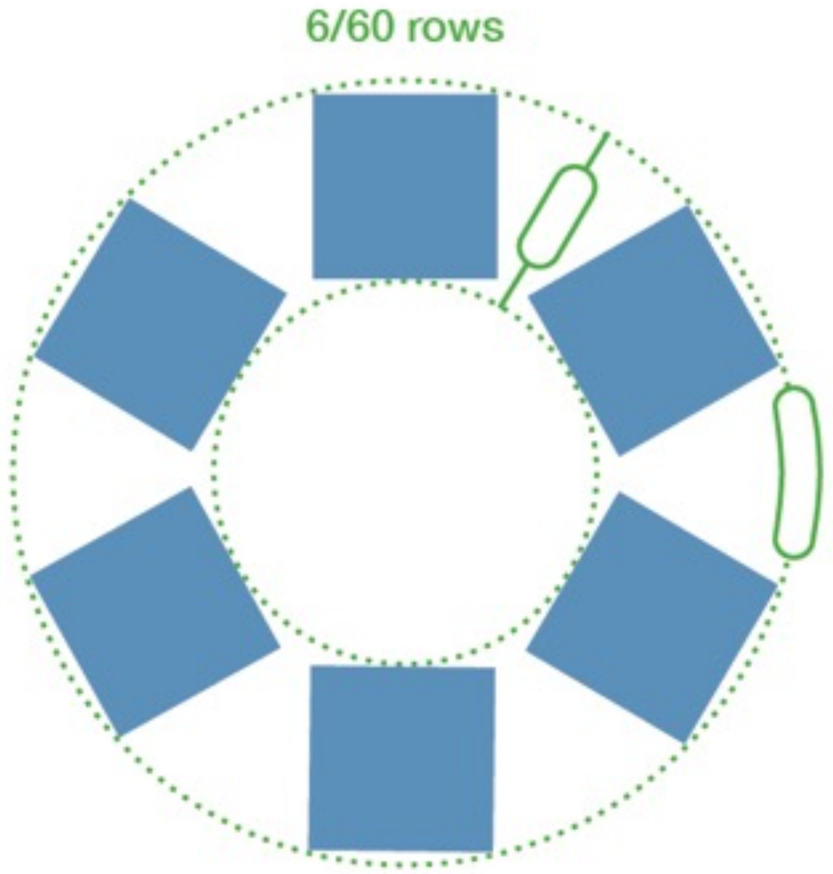
## Grid



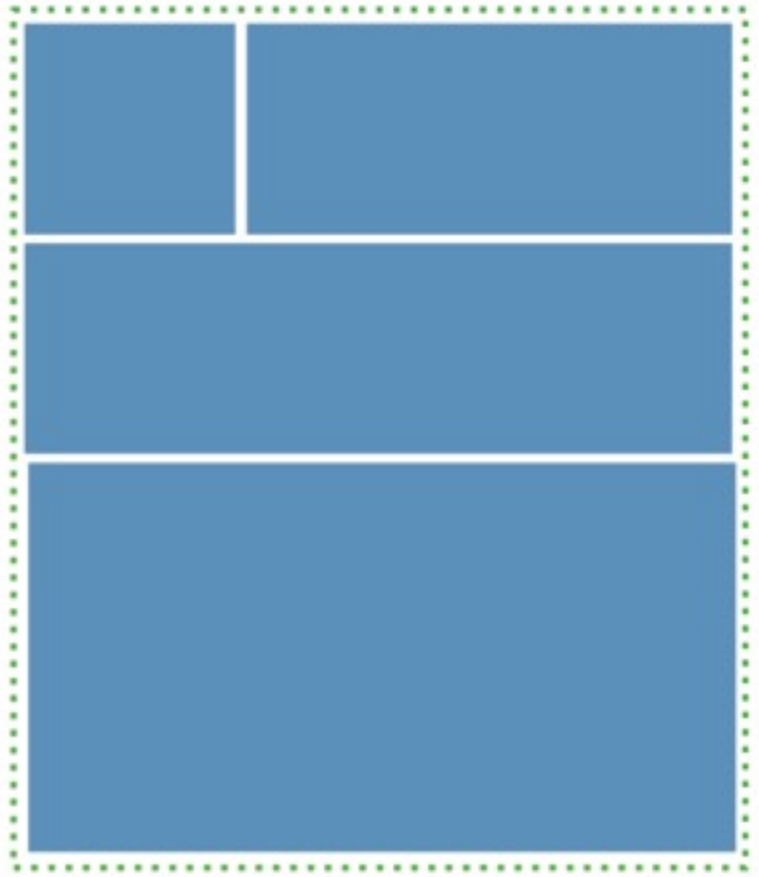

## Stack




## Radial



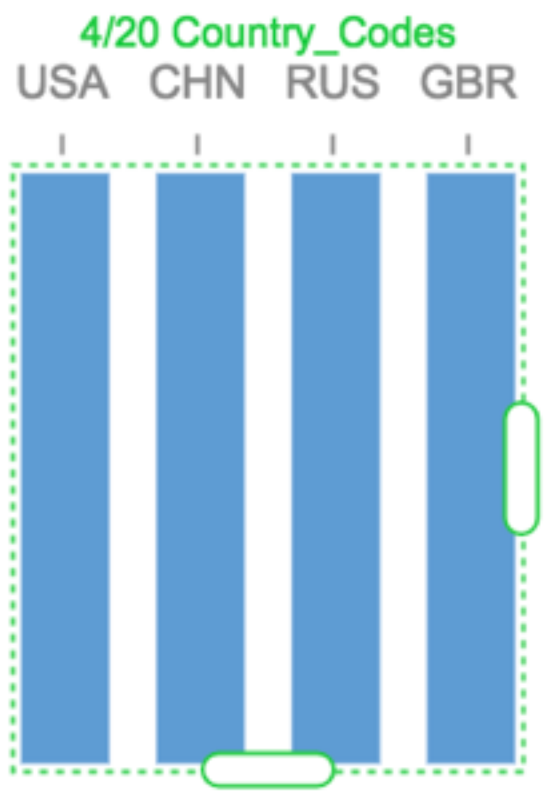

## Packing



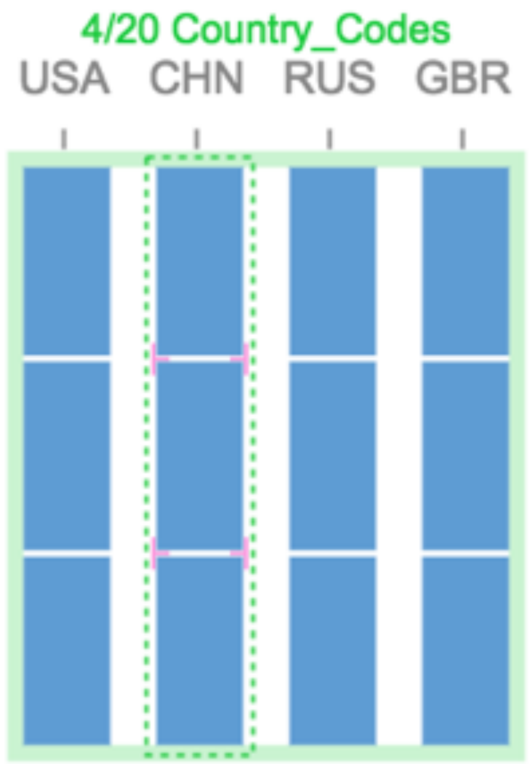
Collections

Repeat + Partition

Repeat(rect)

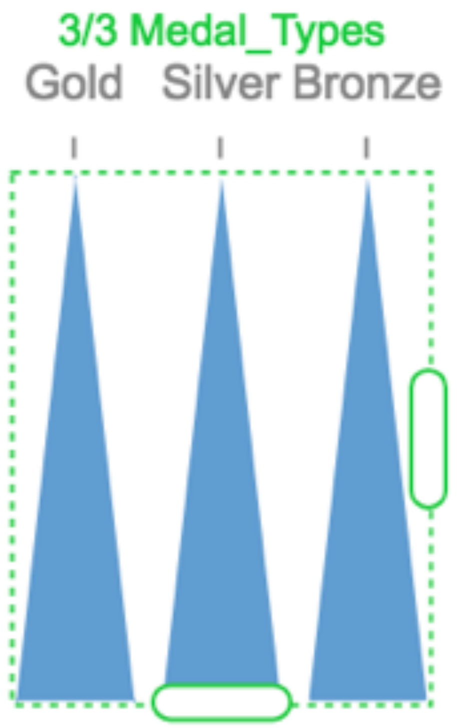



Partition(rect)

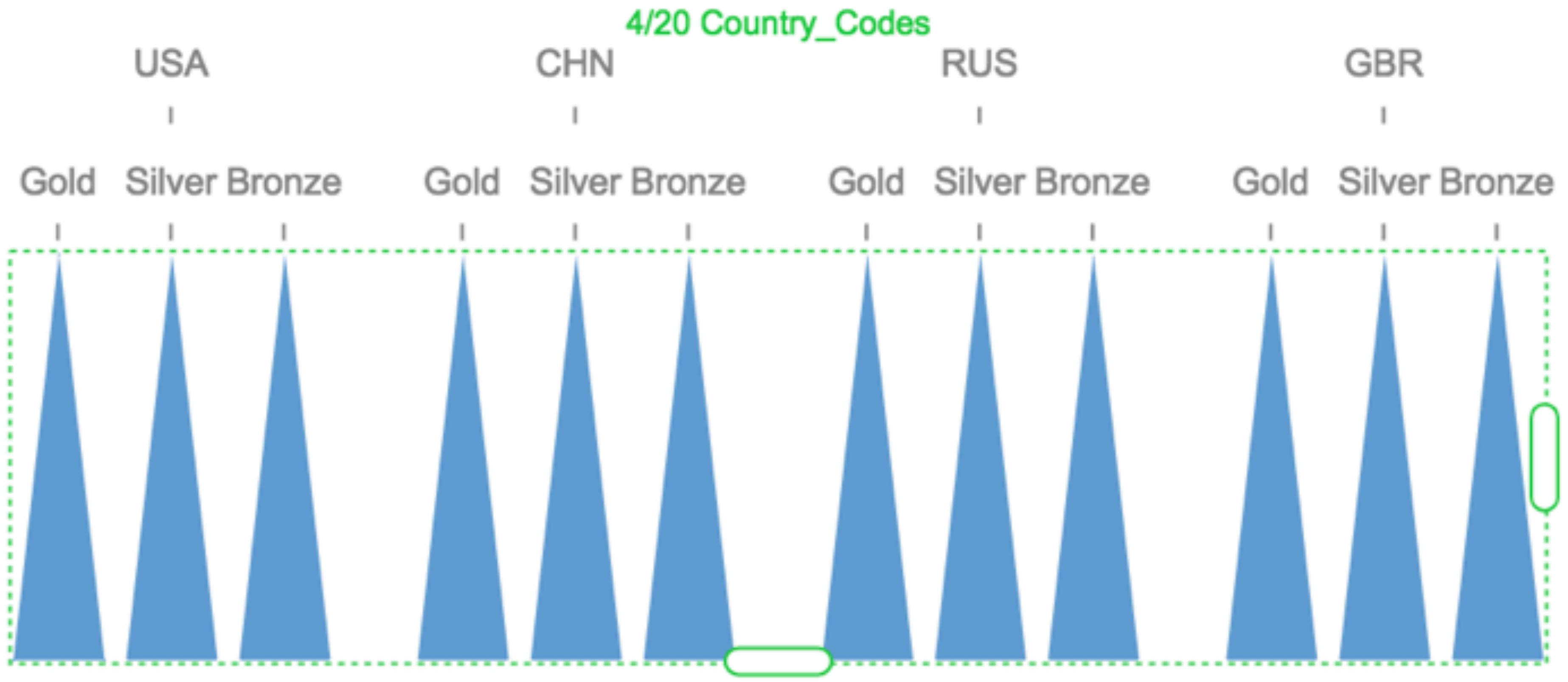



Repeat + Repeat

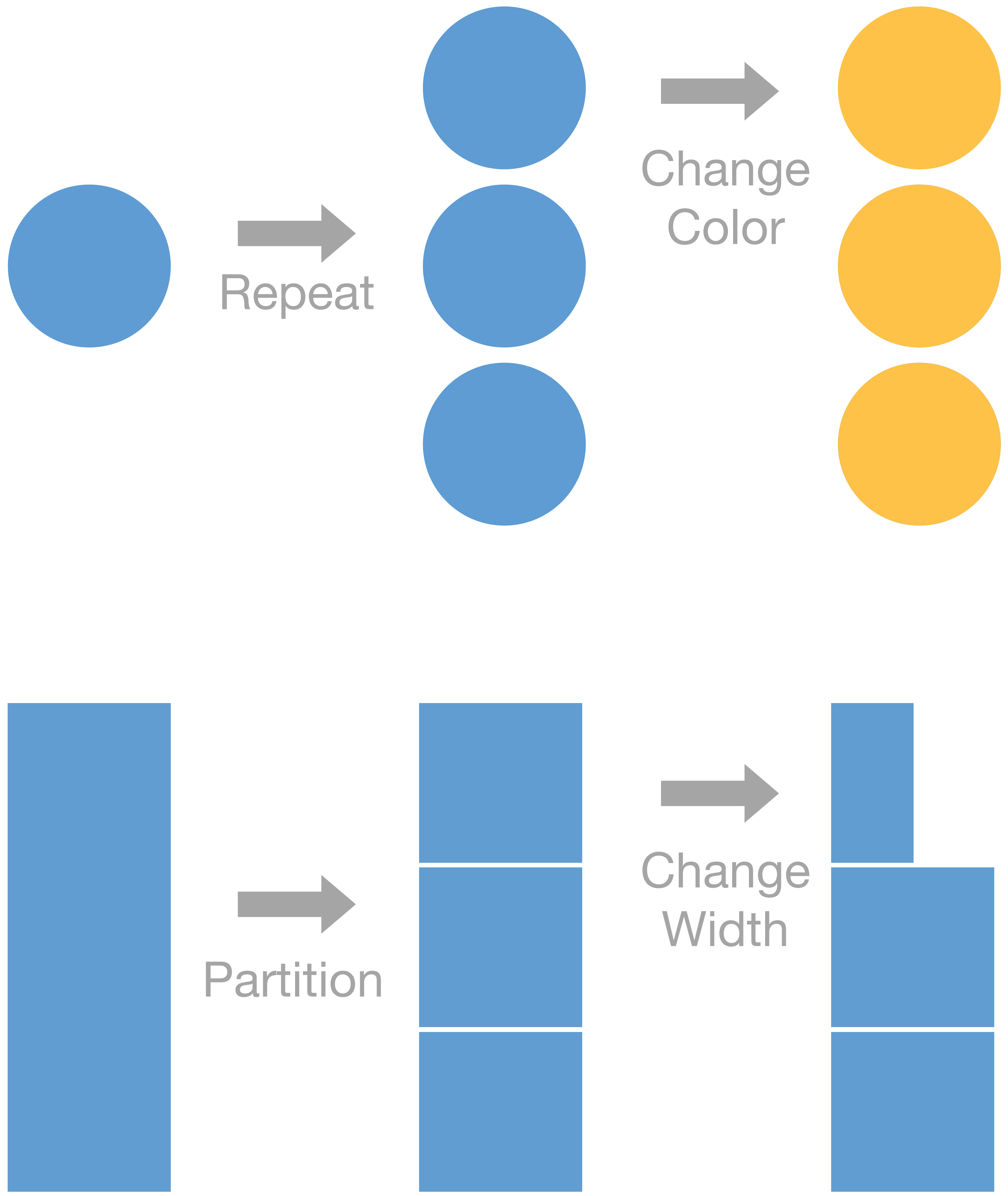
Repeat(path)



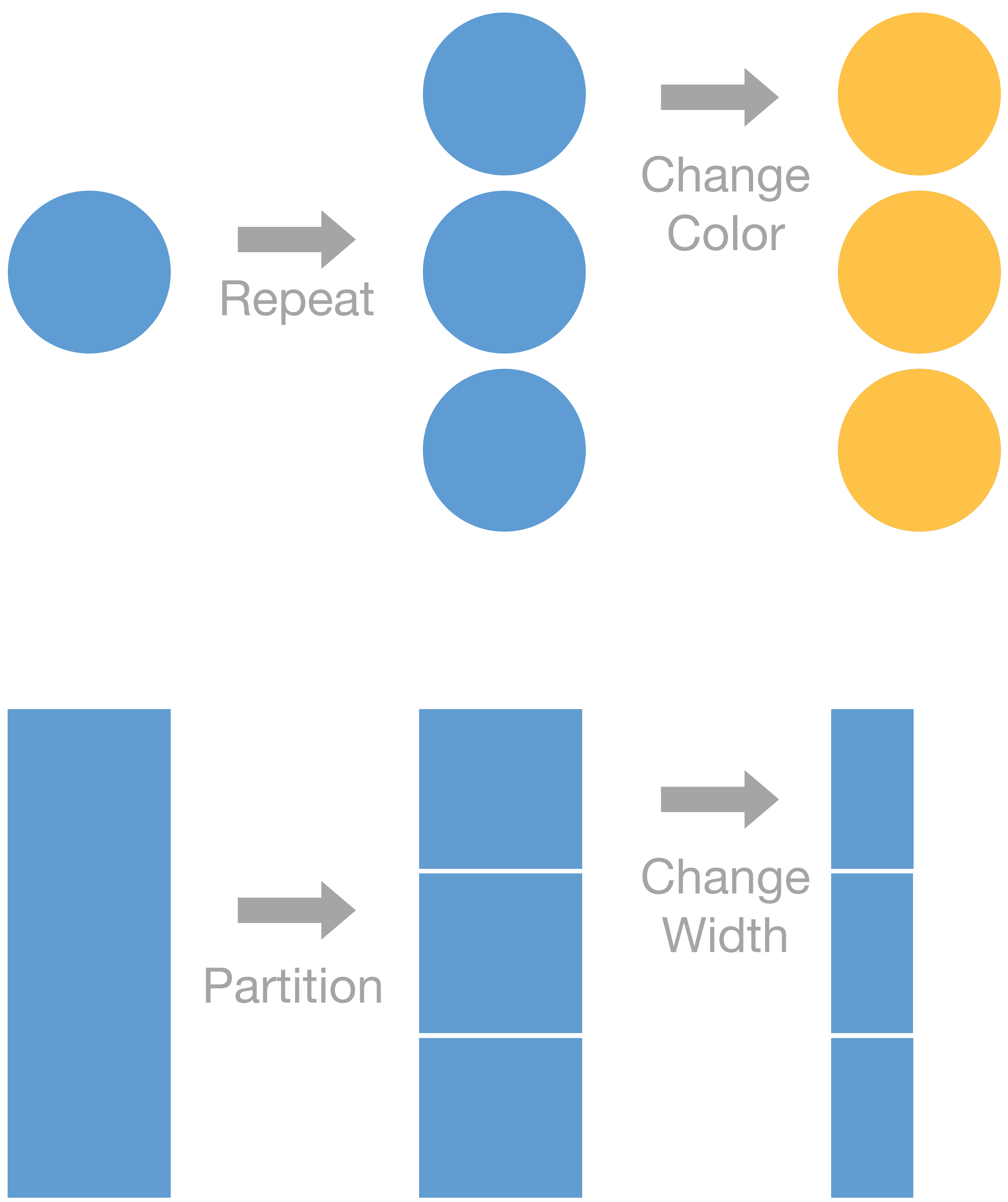

Repeat(grid)

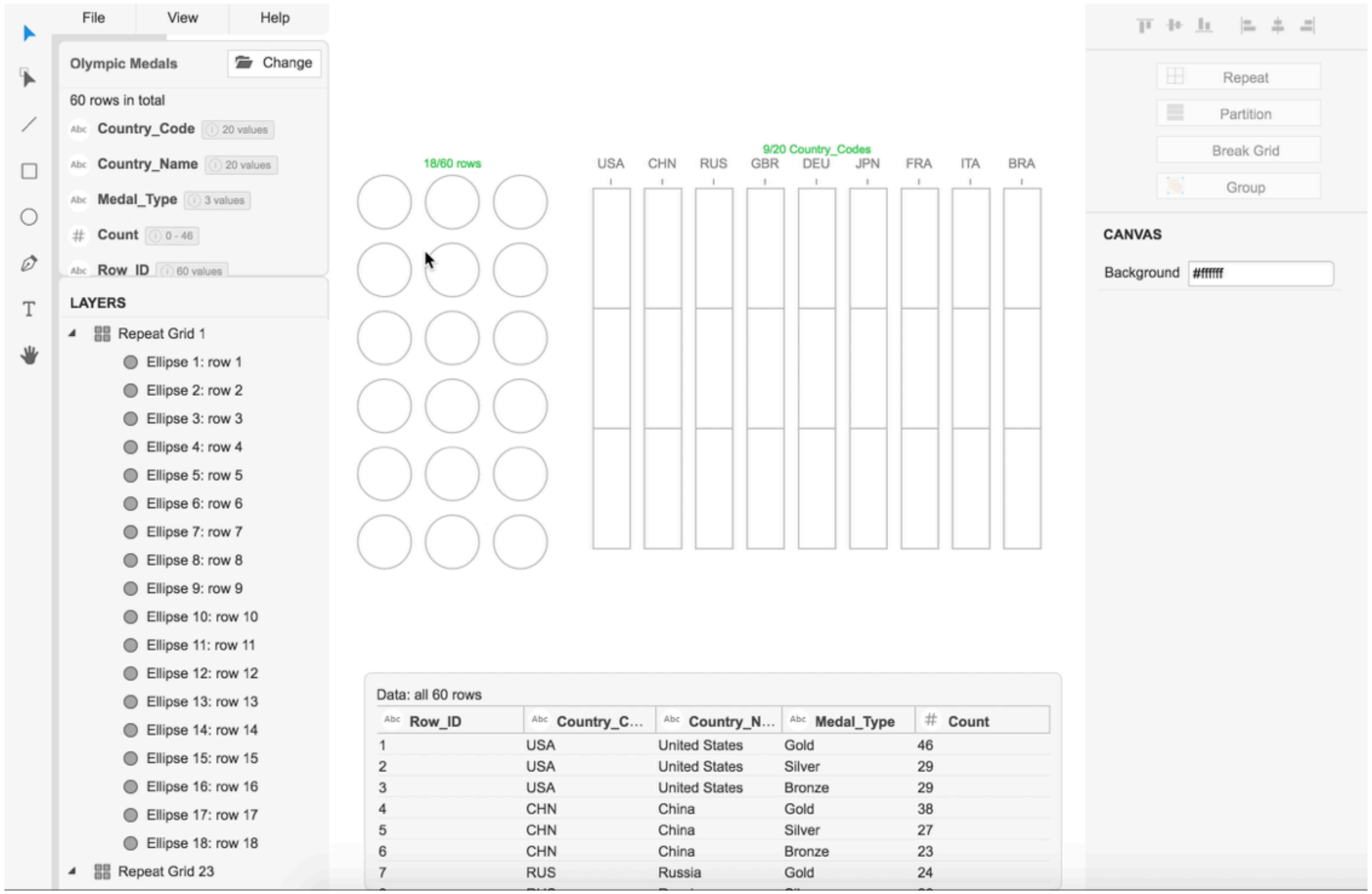



# Nested Collections




# Peer Shapes


Repeat
Change Color
Partition
Change Width


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
18/60 rows
9/20 Country_Codes
USA CHN RUS GBR DEU JPN FRA ITA BRA
Repeat
Partition
Break Grid
Group
CANVAS
Background #ffffff
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

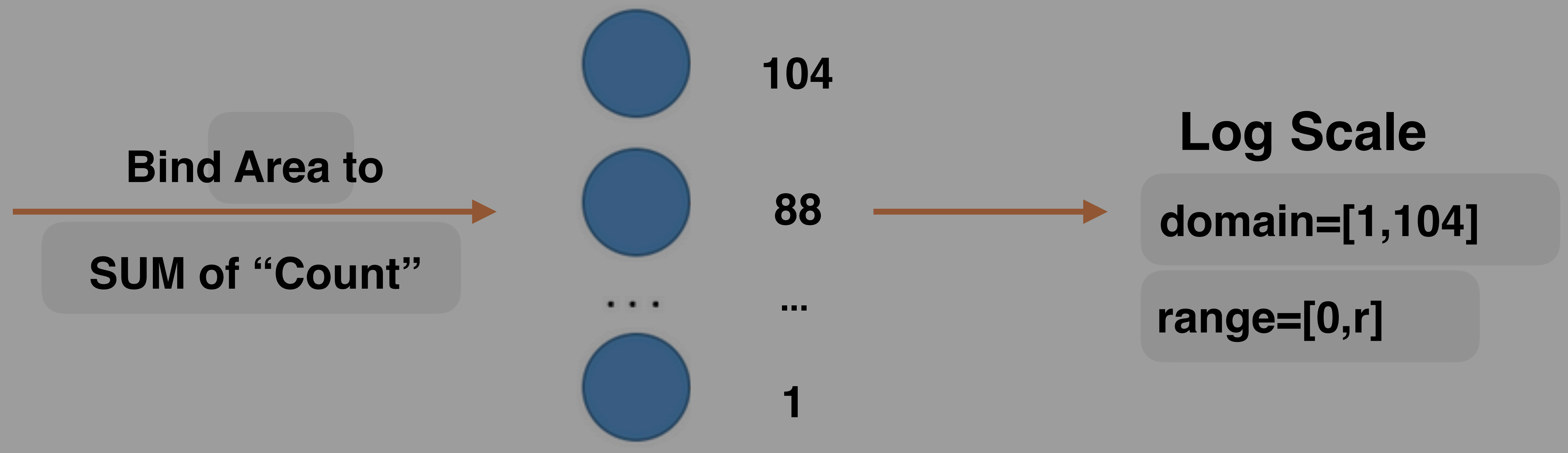
# Peer Shapes

| 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 |

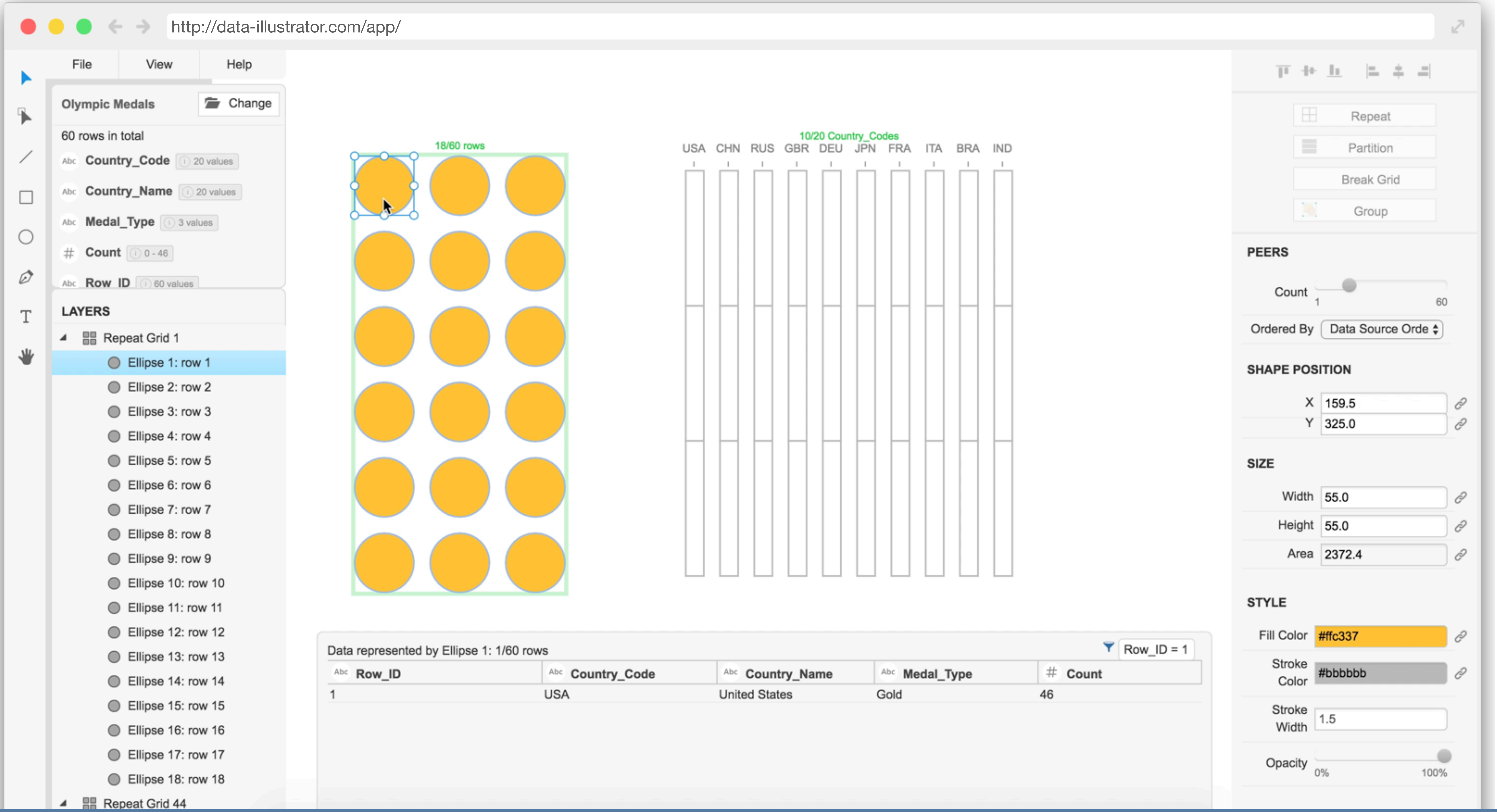
Repeat by "Country"

| 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 |

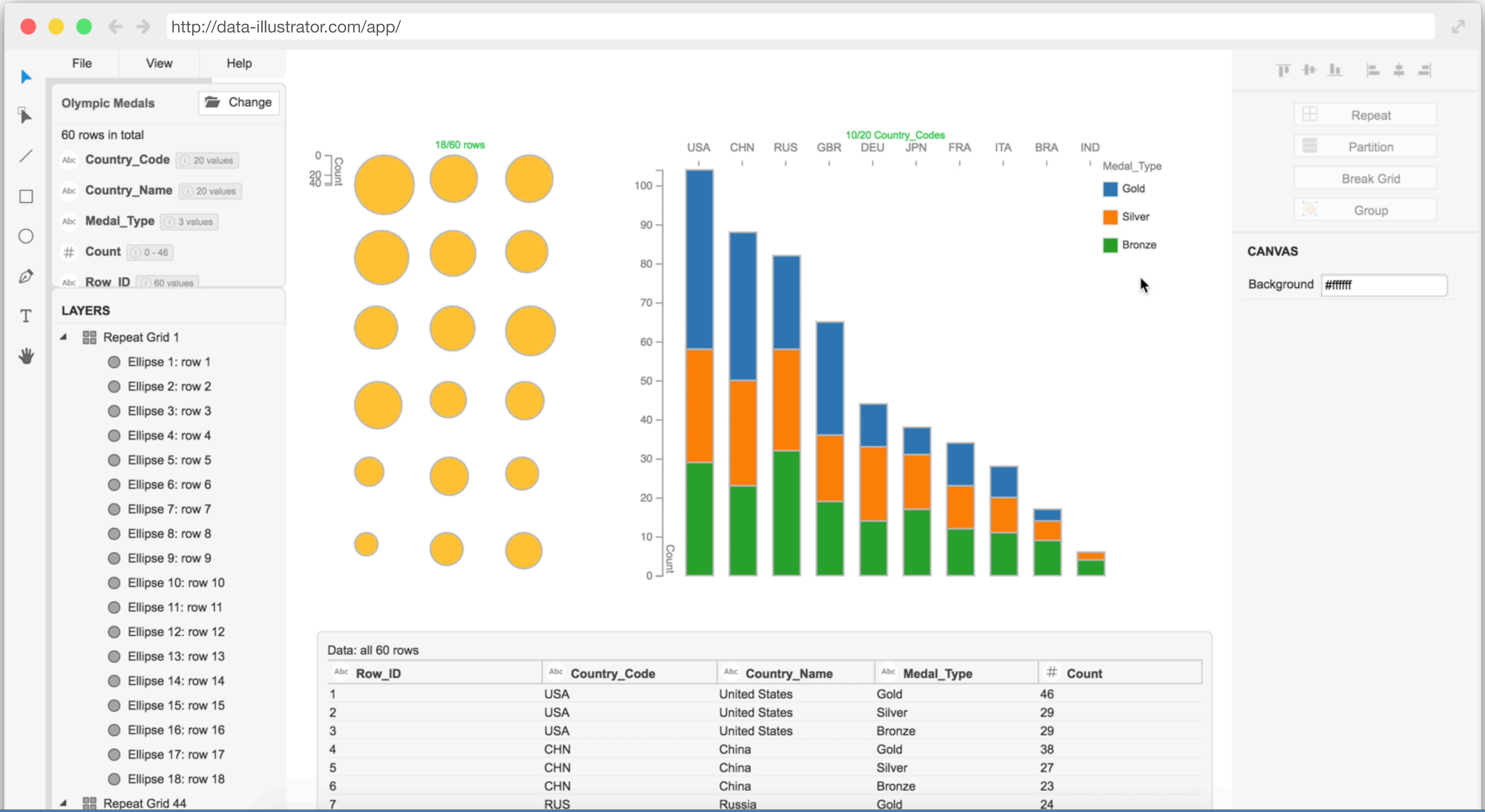
| Data Type | Visual Property | Scale |
|---|---|---|
| Numerical | x-,y- position<br>height, width, area<br>fill, stroke color | linear<br>linear, log<br>linear |
| Nominal | x-,y- position<br>fill, stroke color | ordinal point<br>categorical |
| Date | x-,y- position | linear |




# Lazy Data Binding: Create Scale




# Lazy Data Binding




# Scales & Legends

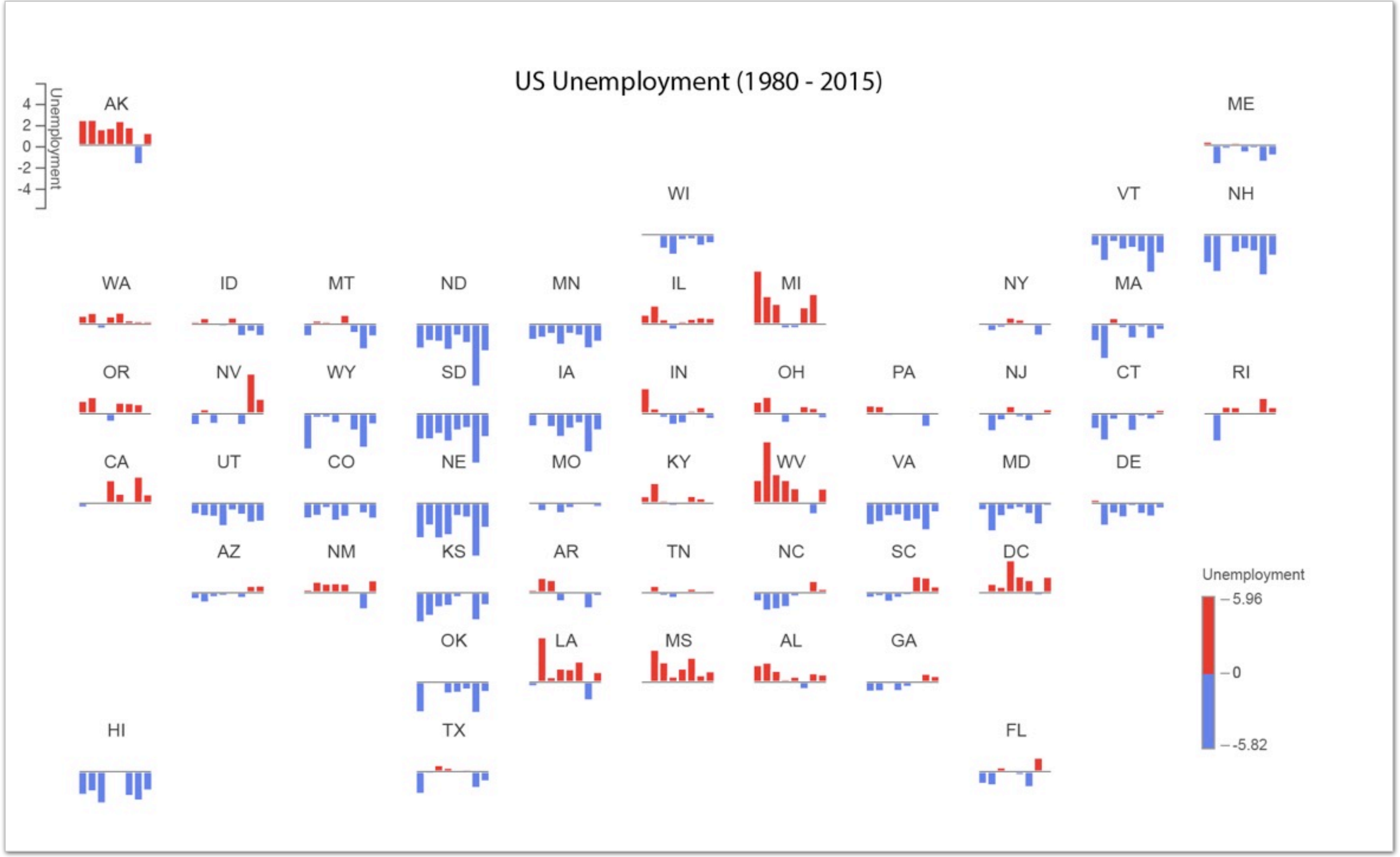
# An Example with Data Illustrator

**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 |



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

File View Help

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

| Row_ID | State | Year | Unemploy... | State Name | MapX | MapY | 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 |

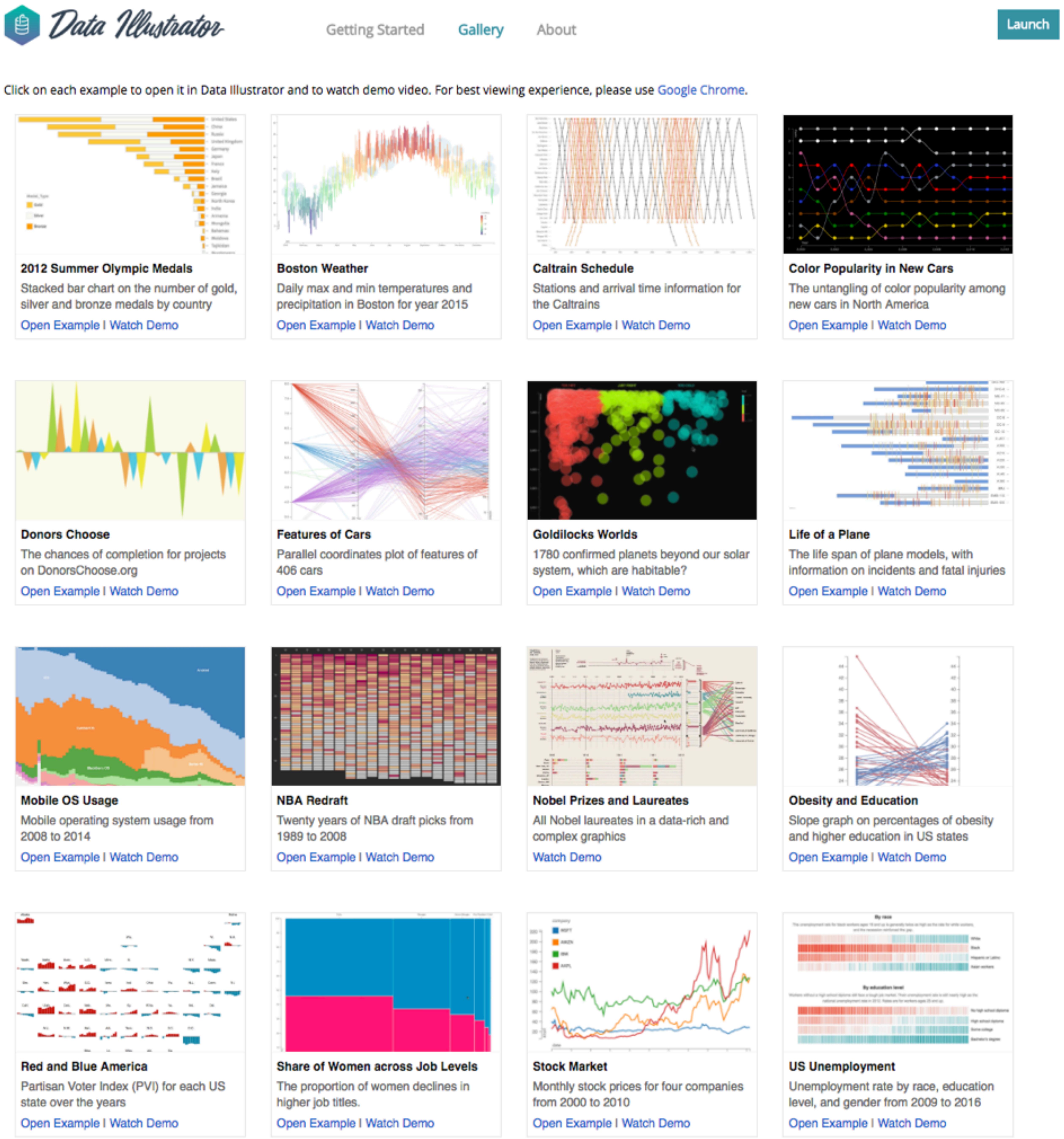
http://data-illustrator.com/app/
File
View
Help
us_state_unemployme
Change
408 rows in total
Abc State 51 values
Abc Year 8 values
# Unemployment -5.83 - 5.96
Abc State Name 51 values
# MapX 0 - 10
LAYERS
Repeat Grid 1
Rectangle 1: AK
Rectangle 2: AL
Rectangle 3: AR
Rectangle 4: AZ
Rectangle 5: CA
Rectangle 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
51/51 States
Data represented by Rectangle 1: 8/408 rows
State = AK
Row_ID State Year Unemploy... State Name MapX MapY 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
Data Source Orde
SHAPE POSITION
X 327.5
Y 76.5
SIZE
Width 21.0
Height 57.0
Area 1197.0
STYLE
Fill Color #ffffff
Stroke Color #bbbbbb
Stroke Width 1.5
Opacity
0%
100%


http://data-illustrator.com/app/
File
View
Help
us_state_unemployme
Change
408 rows in total
State
51 values
Year
8 values
Unemployment
-5.83 - 5.96
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
51/51 States
Data represented by Rectangle 412: 1/408 rows
Year = '95
State = AK
Row_ID
State
Year
Unemploy...
State Name
MapX
MapY
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


| Row_ID | State | Year | Unemploy... | State Name | MapX | MapY | 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 |


http://data-illustrator.com/app/
File
View
Help
us_state_unemployme
Change
408 rows in total
State 51 values
Year 8 values
Unemployment -5.83 - 5.96
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
Unemployment
5.96
0
-5.82
MapY
MapX
Repeat
Partition
Break Stack
Group
CANVAS
Background #ffffff
Data: all 408 rows
Row_ID
State
Year
Unemploy...
State Name
MapX
MapY
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


http://data-illustrator.com/app/
File
View
Help
us_state_unemployme
Change
408 rows in total
State
51 values
Year
8 values
Unemployment
-5.83 - 5.96
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
Unemployment
MapY
MapX
5.96
0
-5.82
Repeat
Partition
Break Stack
Group
CANVAS
Background
#ffffff
Data: all 408 rows
Row_ID State Year Unemploy… State Name MapX MapY 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

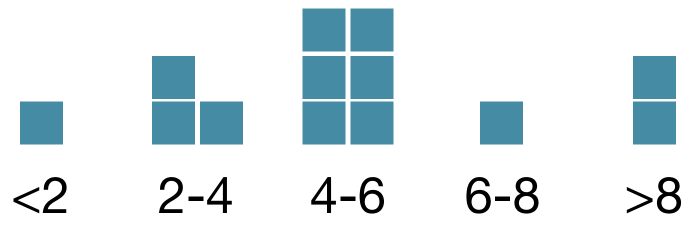



stacked bar chart
range chart
strangling chart
bump chart
triangle bar chart
parallel coordinates plot
bubble plot
gantt chart
(connected) scatterplot
stacked column chart
heat map
alluvial diagram
small multiples
slope chart
multi-series line charts
composite scatter plot
mosaic plot

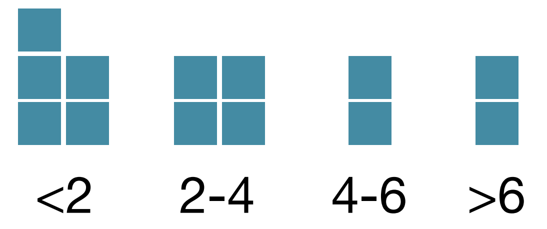
# Evaluation - User Study

**13 designers**
(7 male, 6 female)

Design experience (years):

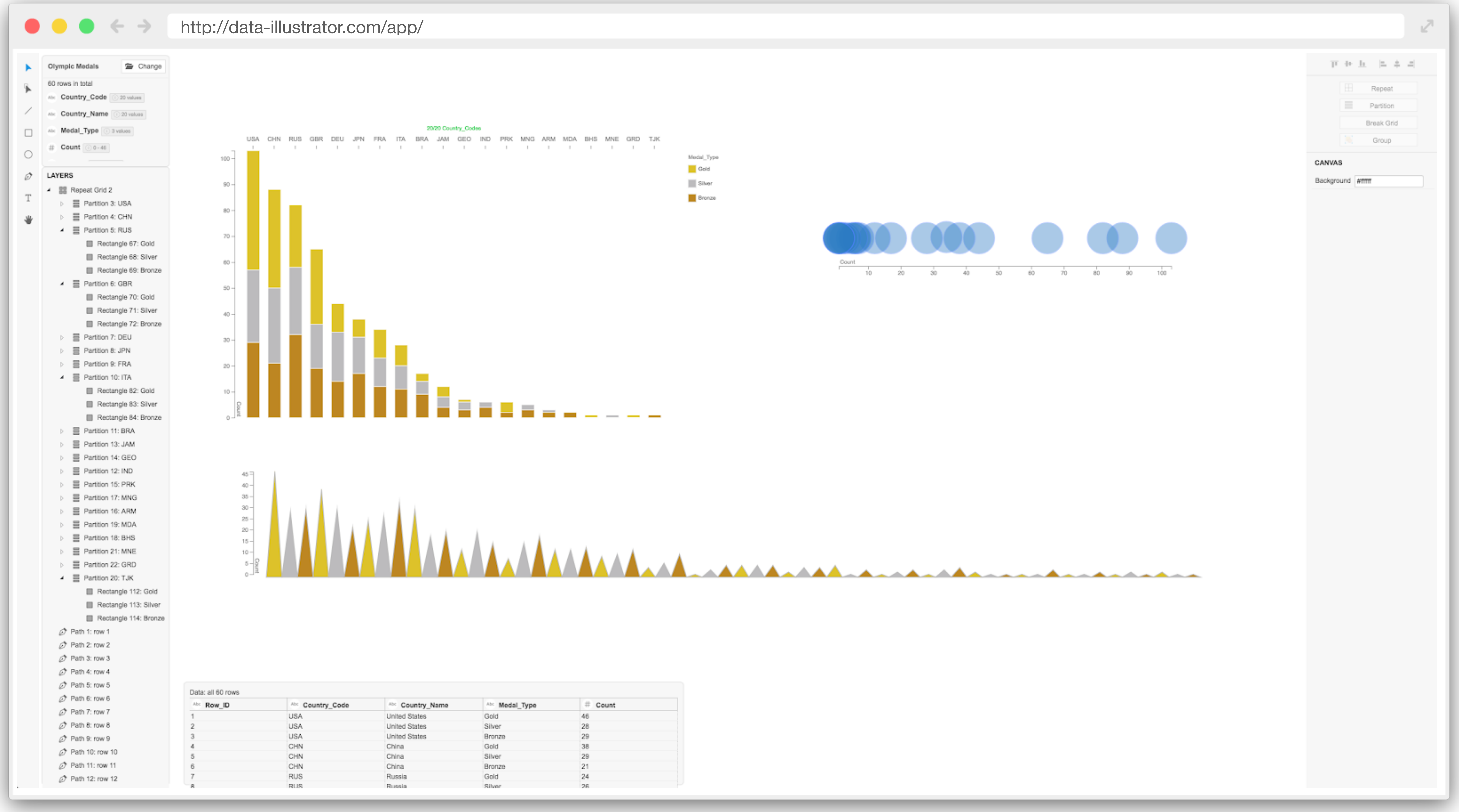



Visualization experience (years):




Training exercises:
**3 total visualizations**

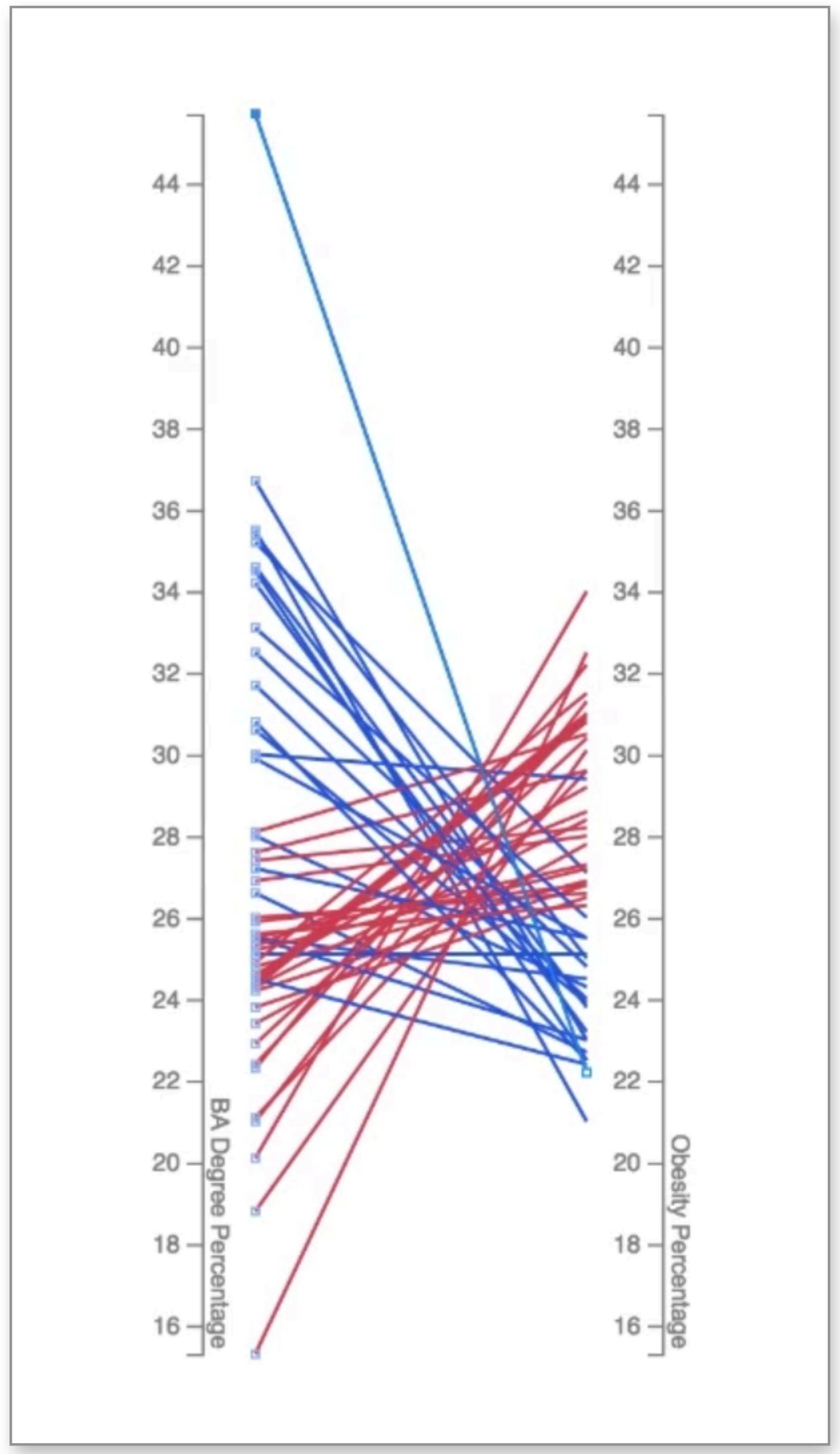
Training duration:
**~ 40 minutes**




*Screenshot of Training Exercise*

## *Obesity vs. Higher Education*

Alberto Cairo



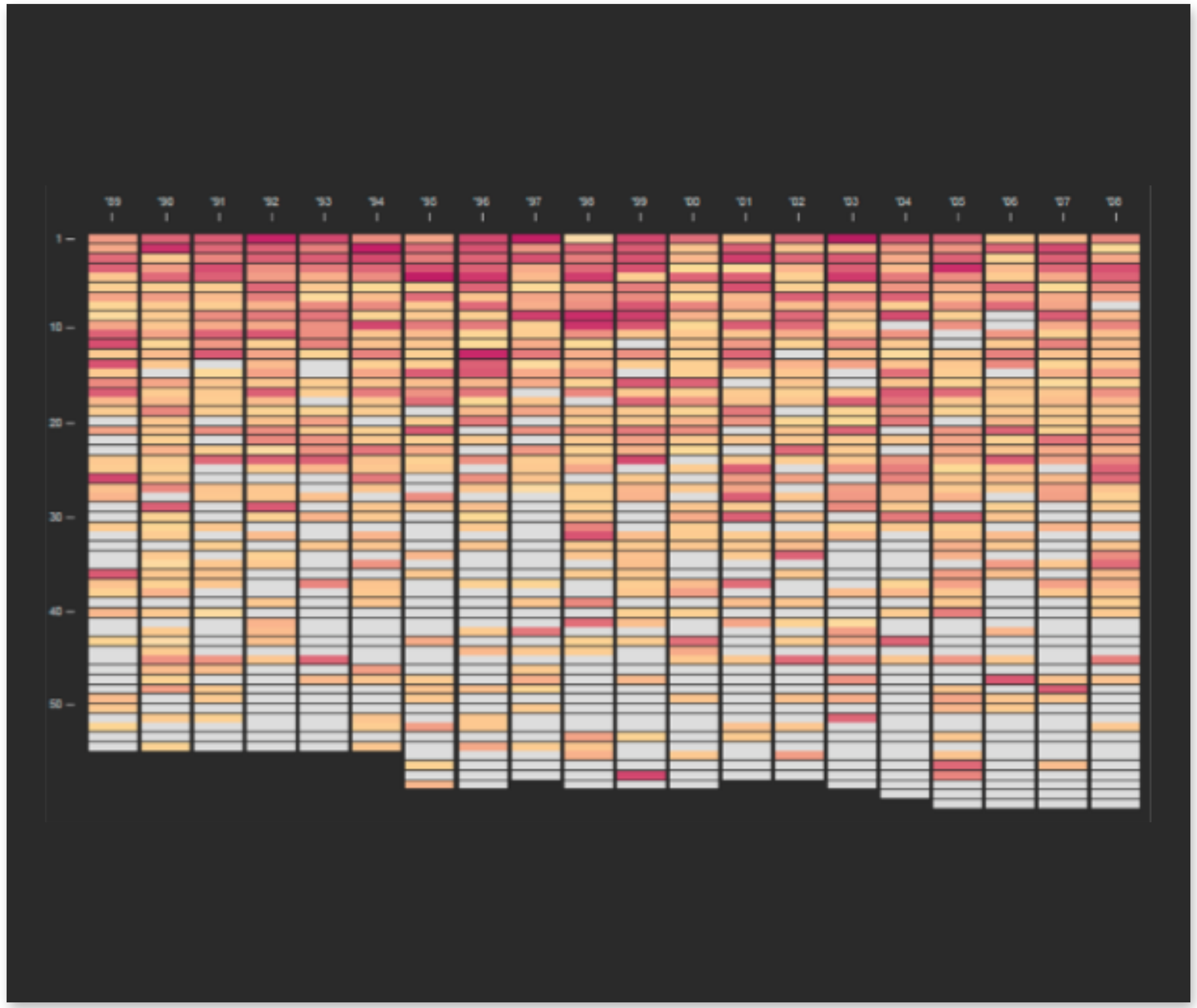

**13**/13 completed

mean: **12.2** minutes

SD: **5.6** minutes

## *Twenty Years of the NBA Redrafted*

Russell Goldenberg



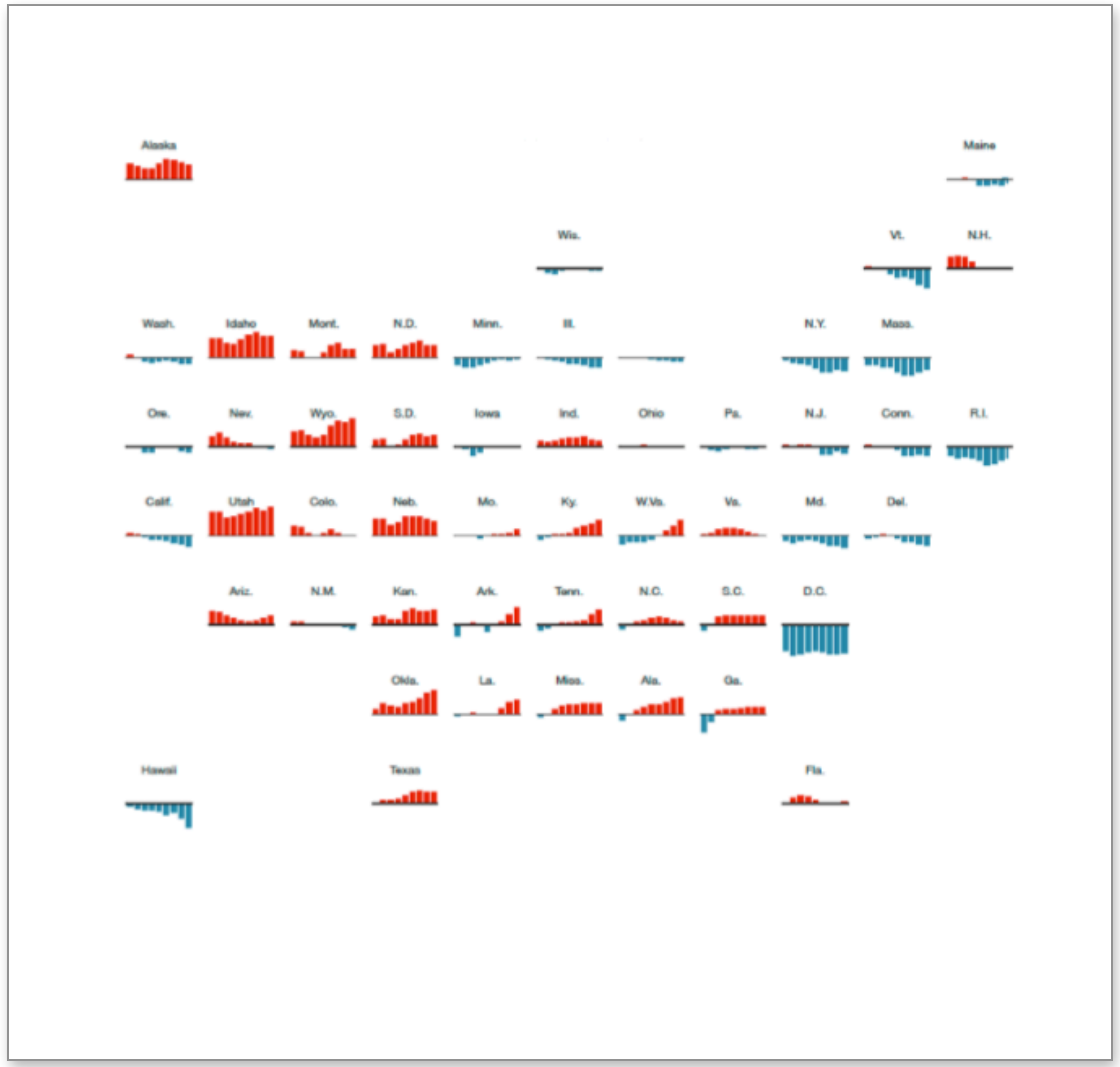
**13**/13 completed

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."*

# Frédérik 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/

App • Gallery • Tutorials

@datailllustrator

Georgia Tech Visualization Lab

Adobe