



**Barcelona  
Supercomputing  
Center**  
*Centro Nacional de Supercomputación*



## 4. Visualización de Tablas

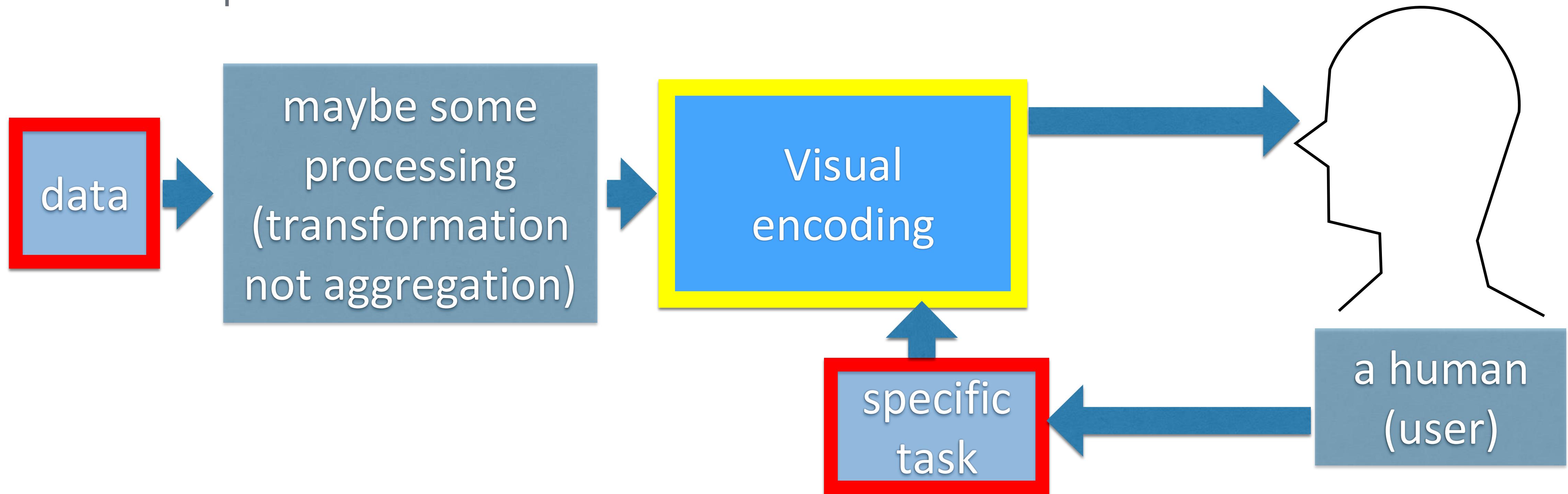
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# Data Visualisation

- Datos. El proceso empieza con uno o más datasets. Conocemos el tipo y las características de sus atributos.
- Tareas. Definición de las tareas que podemos resolver, caracterizadas como acción + objetivo



# Tablas

What?

Datasets

Attributes

## → Data Types

→ Items → Attributes → Links → Positions → Grids

## → Attribute Types

→ Categorical



→ Ordered

→ Ordinal



→ Quantitative

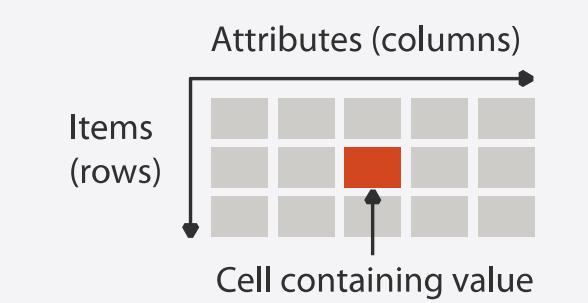


## → Data and Dataset Types

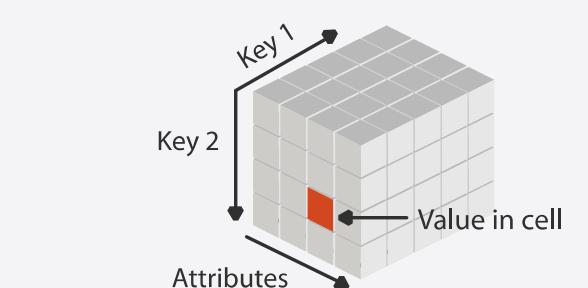
Tables	Networks & Trees	Fields	Geometry	Clusters, Sets, Lists
Items	Items (nodes)	Grids	Items	Items
Attributes	Links	Positions	Positions	
	Attributes	Attributes		

## → Dataset Types

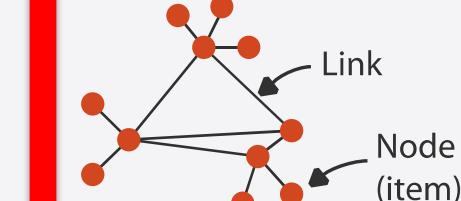
### → Tables



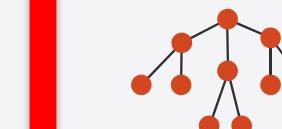
### → Multidimensional Table



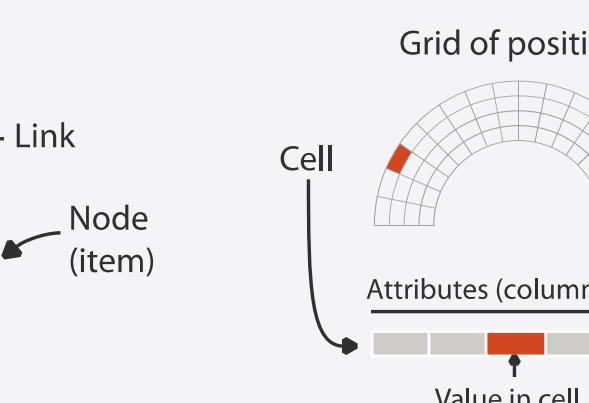
### → Networks



### → Trees



### → Fields (Continuous)



## → Ordering Direction

→ Sequential



→ Diverging



→ Cyclic



## → Geometry (Spatial)



# How?

## Encode

### → Arrange

→ Express



→ Order



→ Use



→ Separate

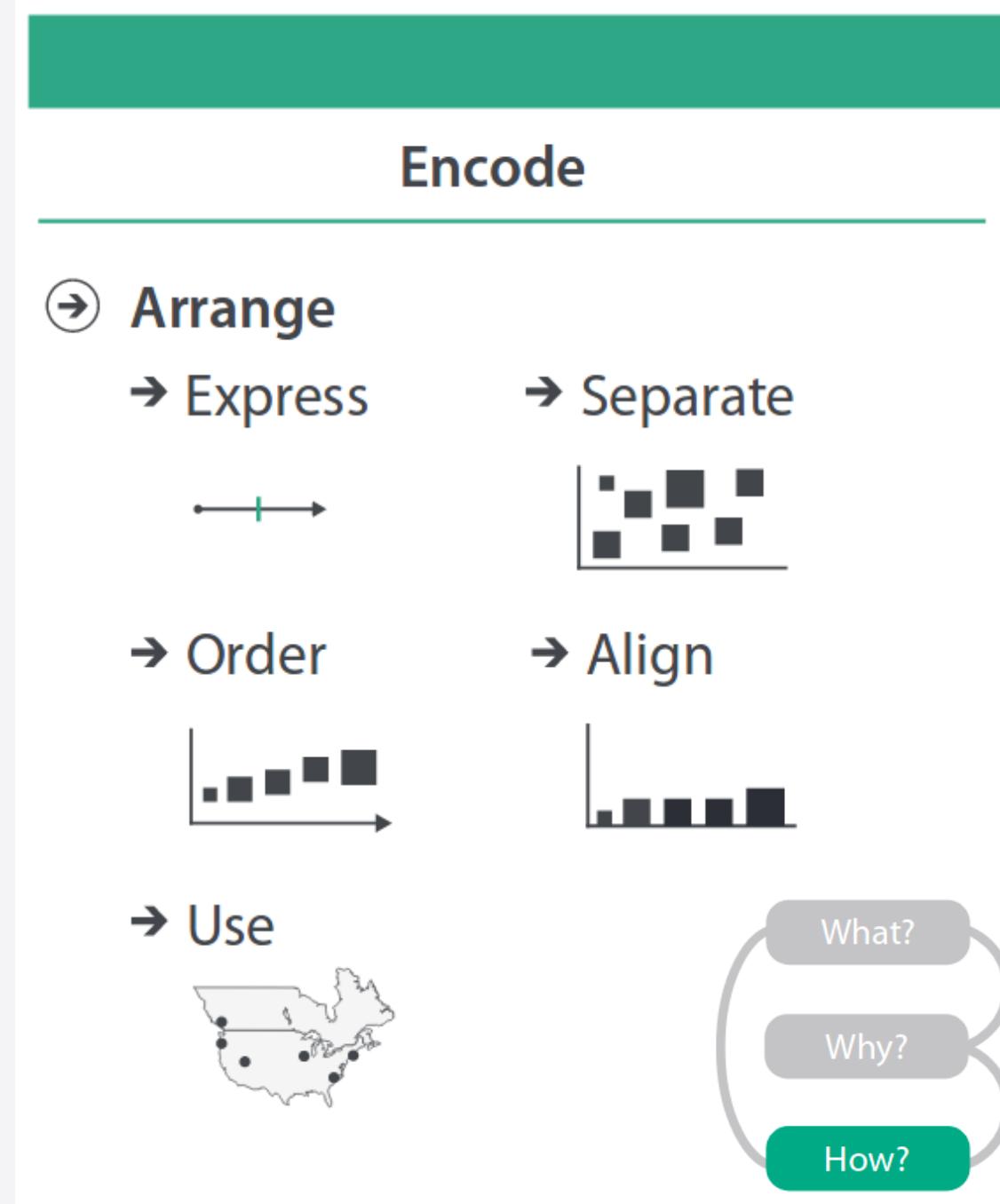


→ Align



# Tablas

How?



## Channels: Expressiveness Types And Effectiveness Ranks

### → Magnitude Channels: Ordered Attributes

Position on common scale



Position on unaligned scale



Length (1D size)



Tilt/angle



Area (2D size)



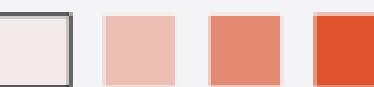
Depth (3D position)



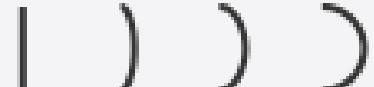
Color luminance



Color saturation



Curvature



Volume (3D size)



### → Identity Channels: Categorical Attributes

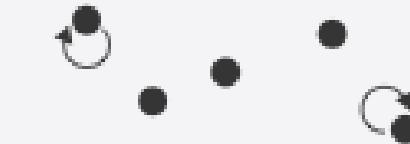
Spatial region



Color hue



Motion



Shape



Best ↑

Effectiveness

Least ↓

Same

- Codificación visual para tablas suele centrarse en **expresar el contenido**
- Las decisiones más importantes son la de **Arrange**
- El espacio domina el modelo mental del dataset del usuario.
- Los canales más efectivos son de posición en el espacio.

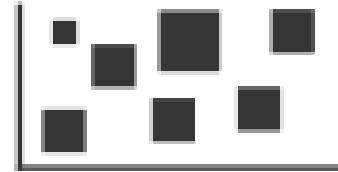
# Arrange tables

## ④ Express Values

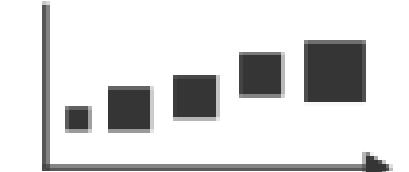


## ④ Separate, Order, Align Regions

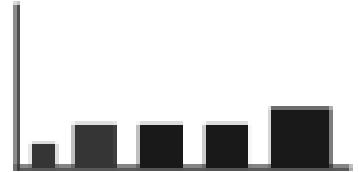
→ Separate



→ Order



→ Align



- Existen distintos tipos de tablas según el número de claves
- Key=Clave primaria = identificador único de cada fila/observación

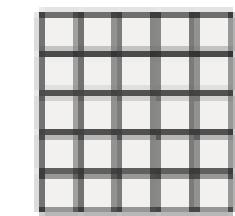
→ 1 Key

*List*



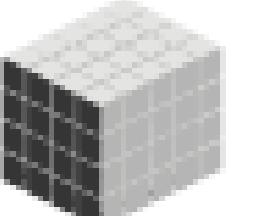
→ 2 Keys

*Matrix*



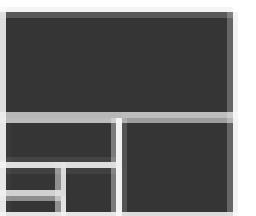
→ 3 Keys

*Volume*



→ Many Keys

*Recursive Subdivision*

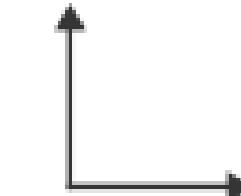


Para ordenar los datos también se tiene en cuenta:

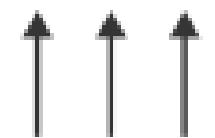
- Orientación de los ejes
- Densidad del Layout: Densa o exhaustiva

## ④ Axis Orientation

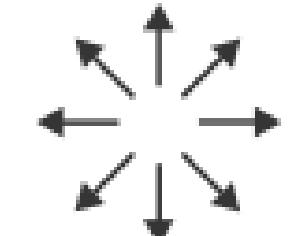
→ Rectilinear



→ Parallel

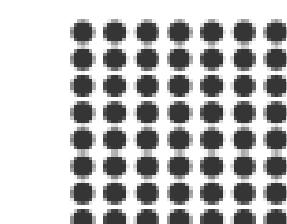


→ Radial

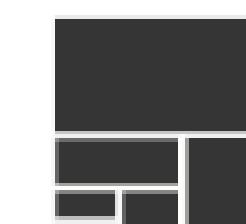


## ④ Layout Density

→ Dense



→ Space-Filling



# Keys / Values

## Key

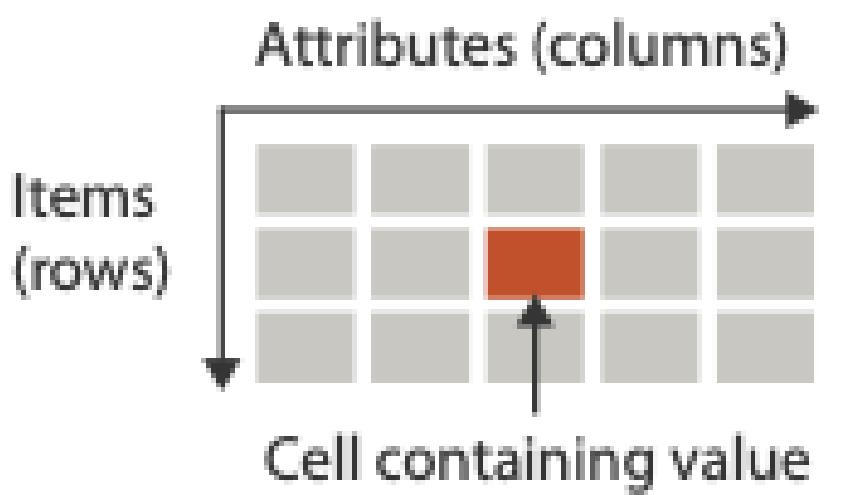
- Variable independiente
- Se puede usar como índice único para identificar ítems
- Tipo **categórico** u **ordinal**



## Value

- Variable dependiente, valor de la celda
- Categórico, ordinal o cuantitativo

## → Tables



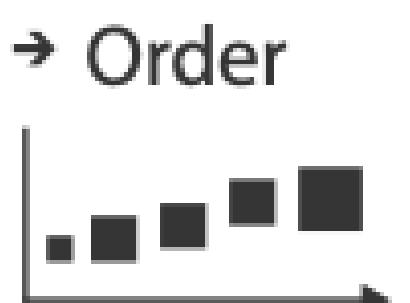
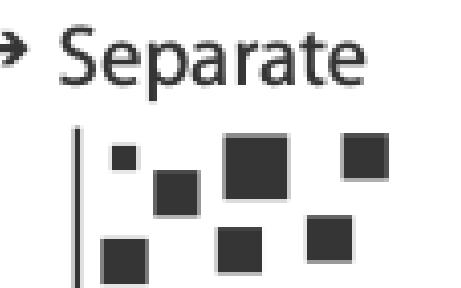
## Decisiones básicas de diseño

- ¿Cuantos Keys? ¿cuantos Valores?
- ¿De qué tipo son (Categórico, ordinal, cuantitativo)?

## → Express Values



## → Separate, Order, Align Regions



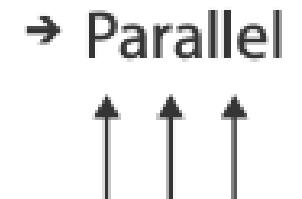
# Scatterplot

- *Expresa 2 atributos cuantitativos*
- *Sin keys, solo values*
- *Marcas: Puntos*
- *Canales: Posición X Y*
- *Tareas:*
  - *Acciones: Encontrar patrones y tendencias // Analizar distribución // Identificar outliers, clusters.*
  - *Objetivos: Todo el dataset.*
- *Escalable a cientos de elementos*

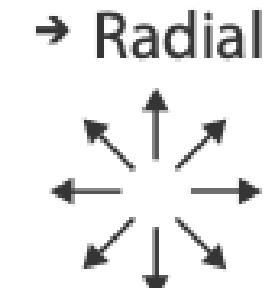
④ Axis Orientation

→ Rectilinear

→ Parallel

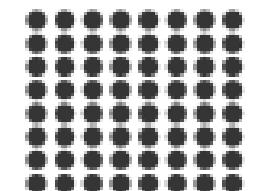


→ Radial

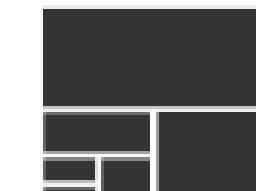


④ Layout Density

→ Dense



→ Space-Filling



Marcas

④ Points



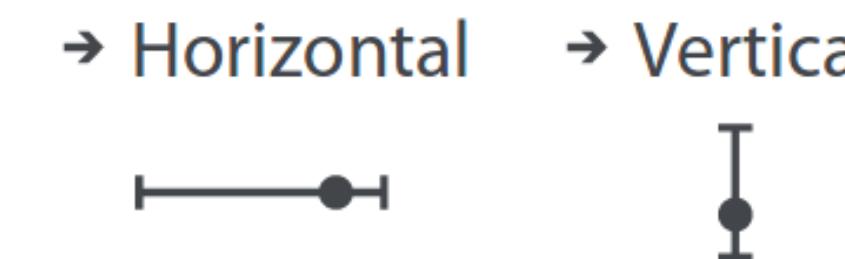
④ Lines



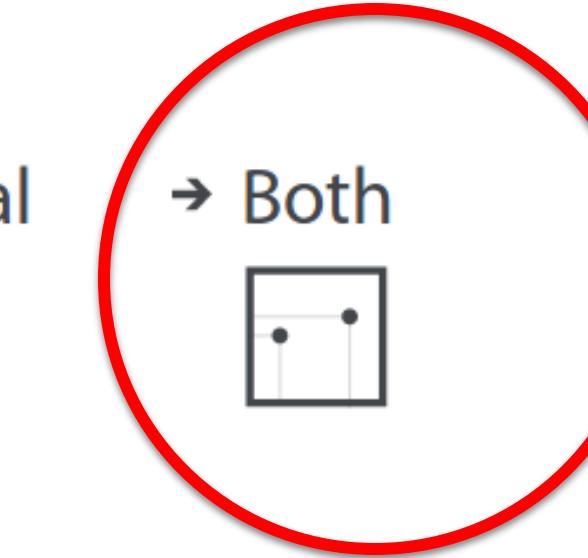
④ Areas



④ Position



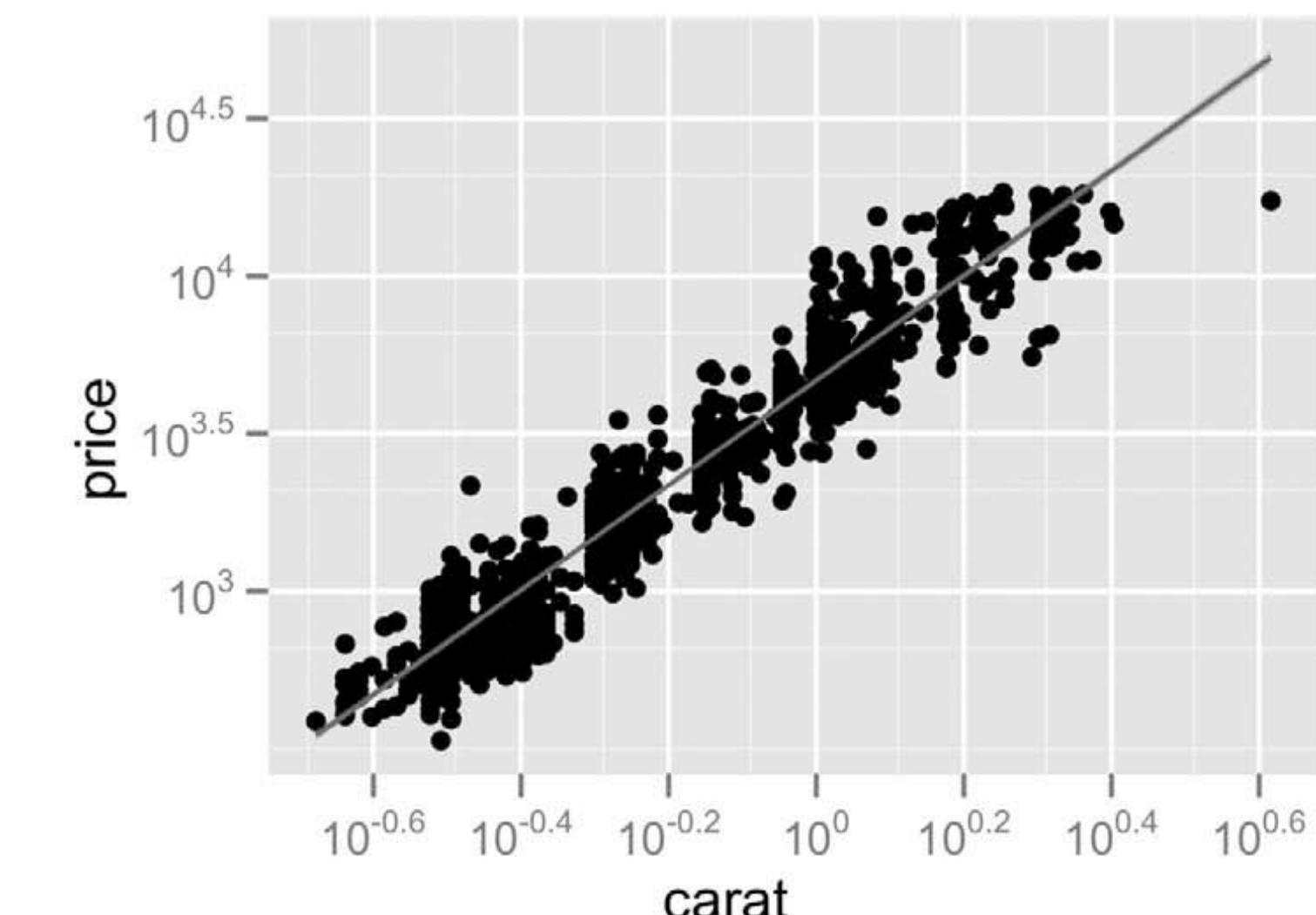
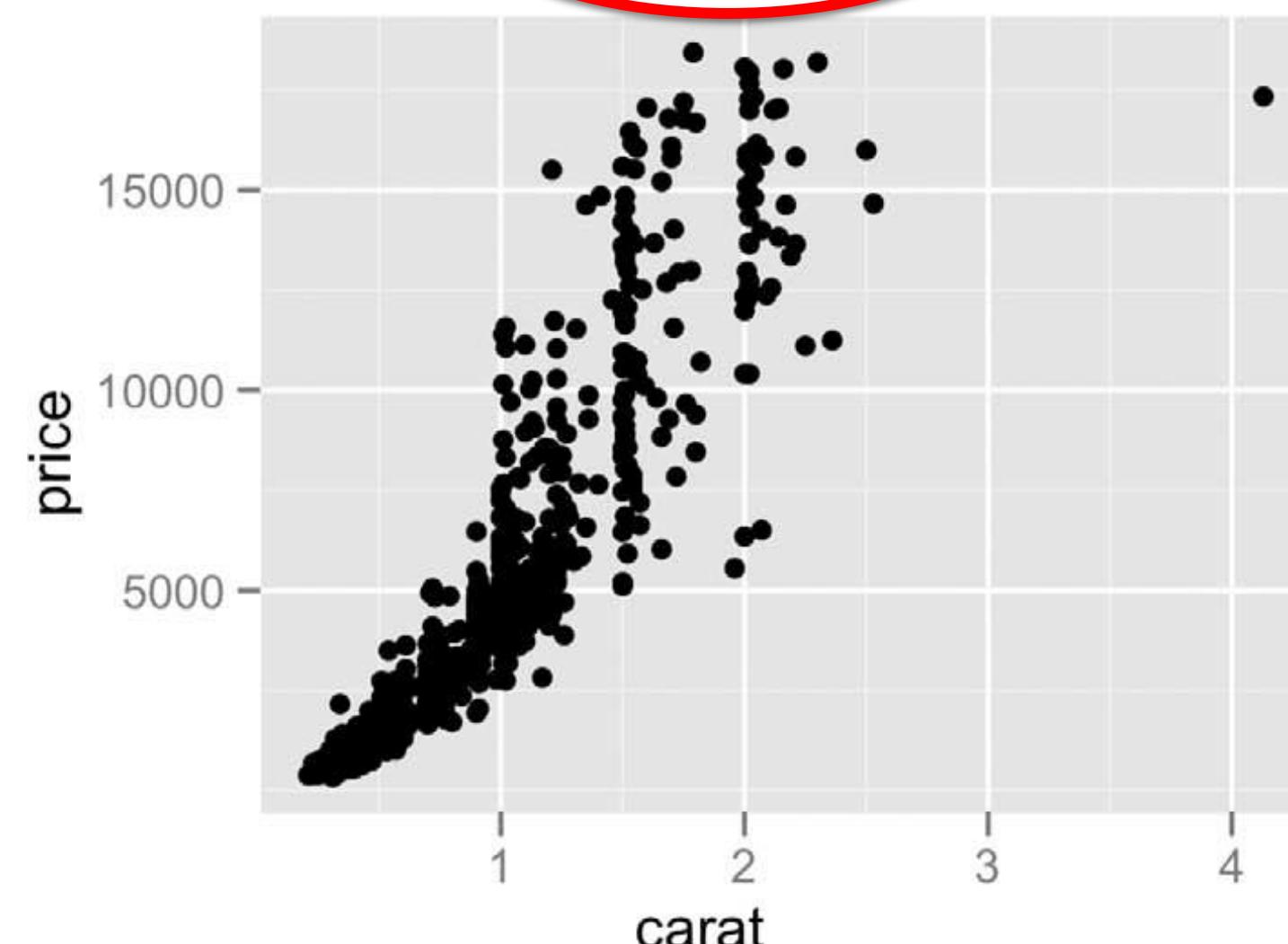
④ Both



Canales

→ Horizontal → Vertical

④ Express Values

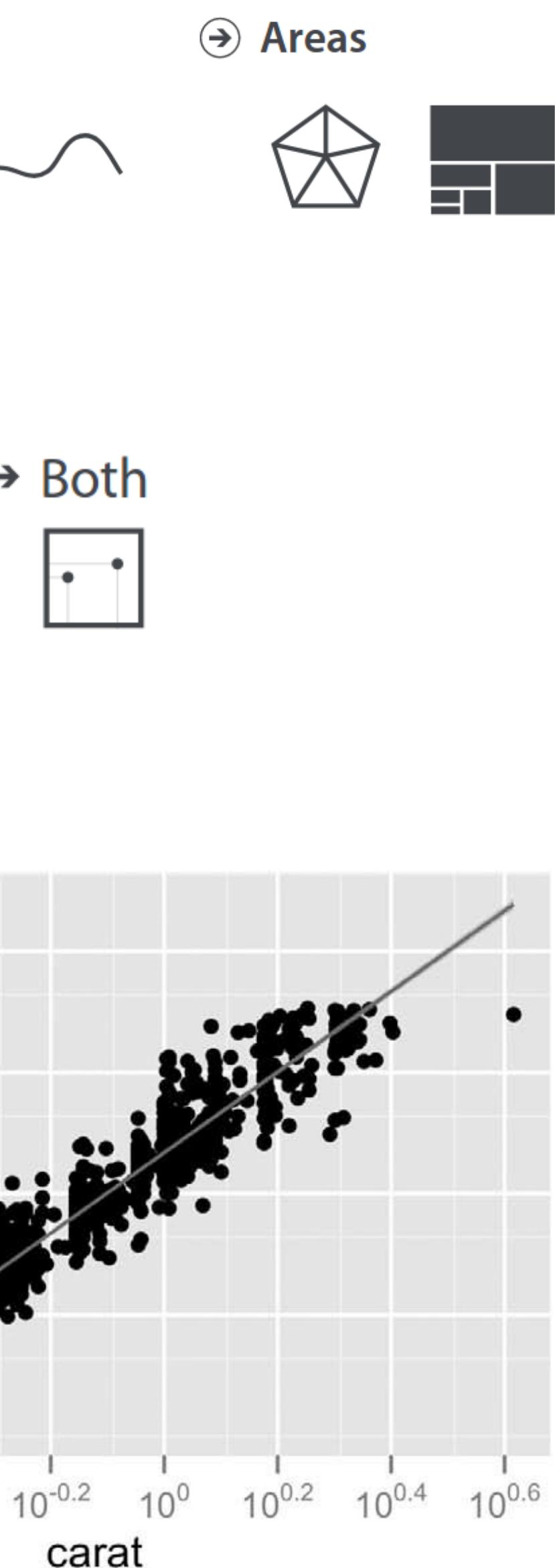
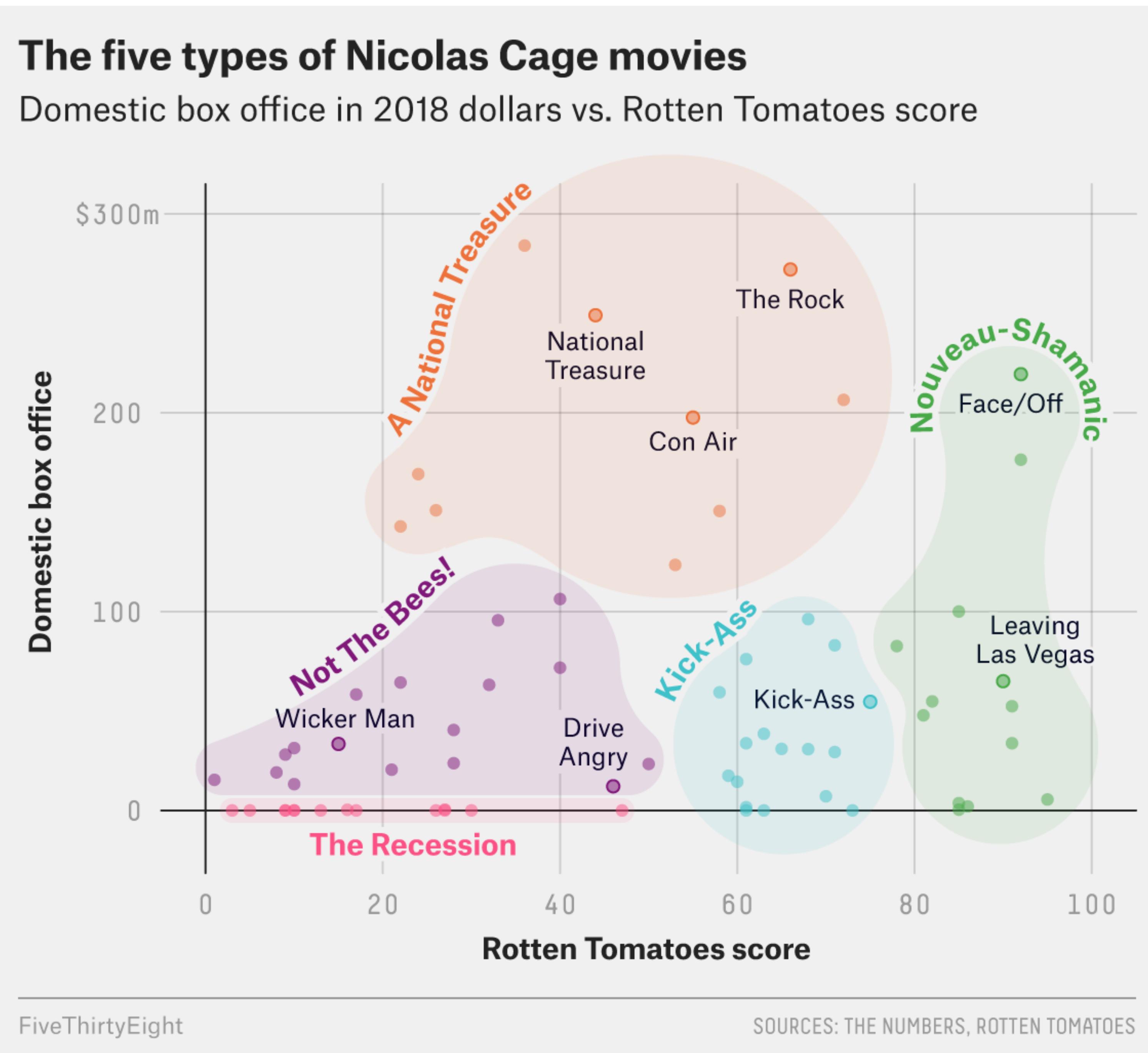


[A layered grammar of graphics. Wickham. Journ. Computational and Graphical Statistics 19:1 (2010), 3–28.] (From Visualization Analysis and Design)

# Scatterplot

- Expresa 2 atributos
- Sin keys, solo valores
- Marcas: Puntos
- Canales: Posición
- Tareas:
  - Encontrar patrones
  - Analizar distribuciones
  - Identificar outliers
- Escalable a cientos de miles

⇒ Express Value



ational and Graphical Statistics  
sign)

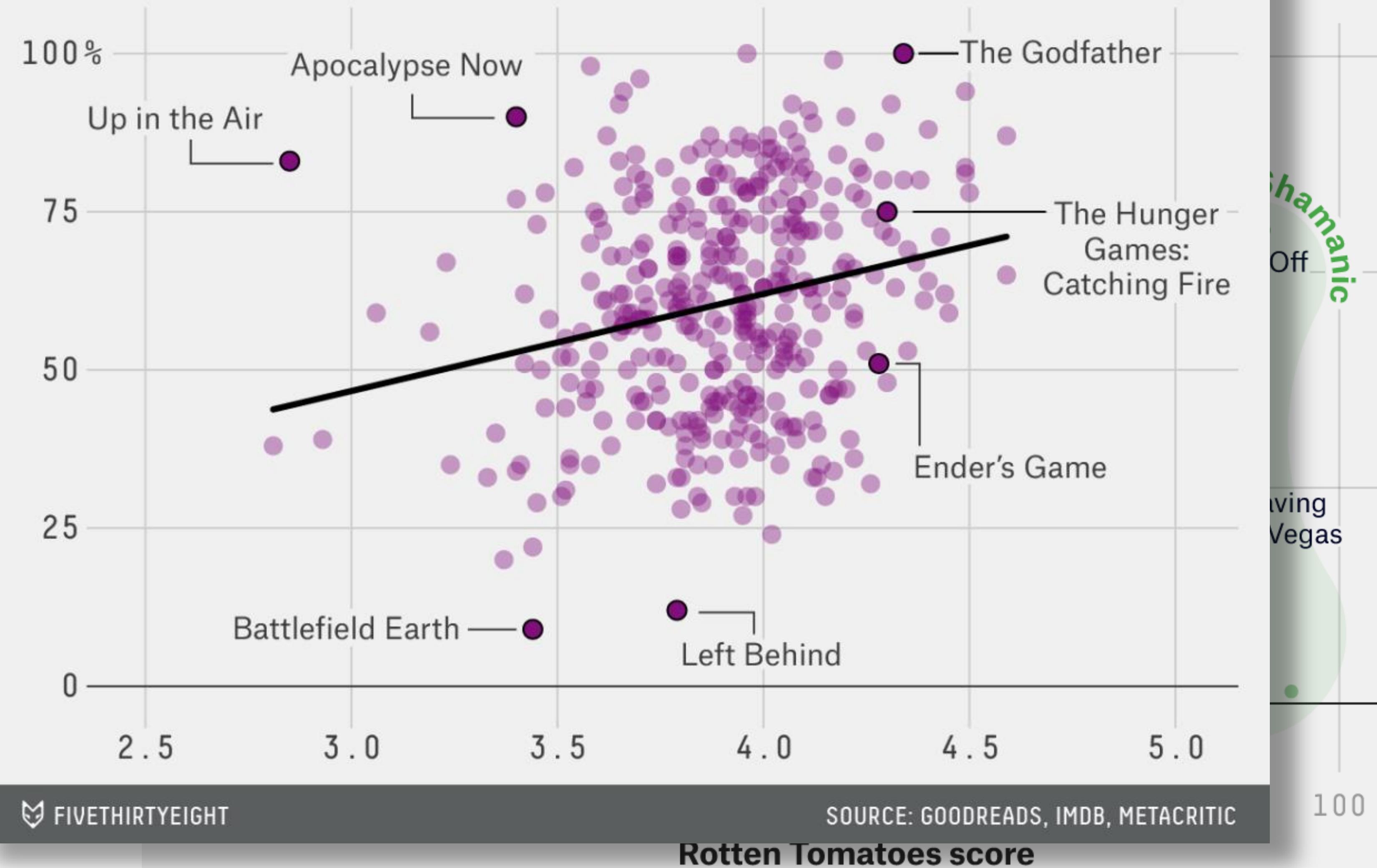
# Scatterplot

- Expressive
- Sin keys,
- Marcas:
- Canales:
- Tareas:
- Encon...
- Analiza...
- Identifi...
- Escalable

→ Ex

## When Books Become Movies

Metacritic score of films vs. Goodreads score of source novel



FIVETHIRTYEIGHT

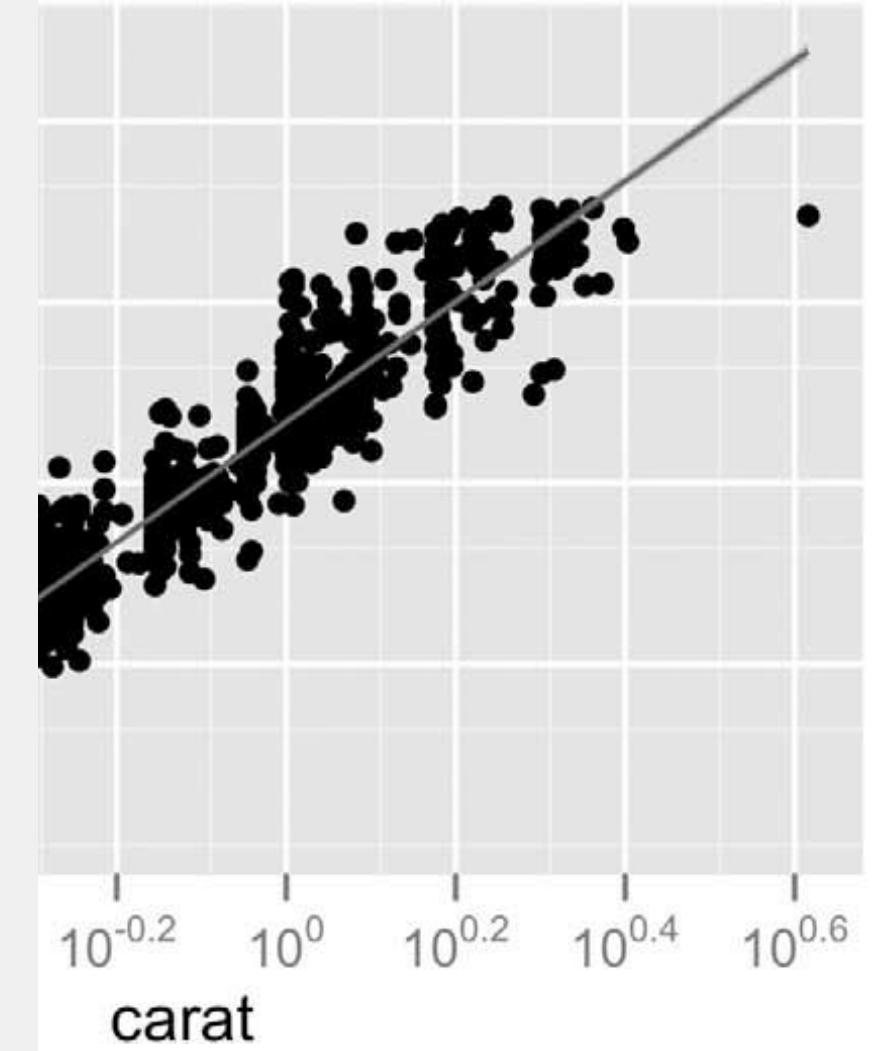
FiveThirtyEight

SOURCES: THE NUMBERS, ROTTEN TOMATOES

→ Areas



→ Both

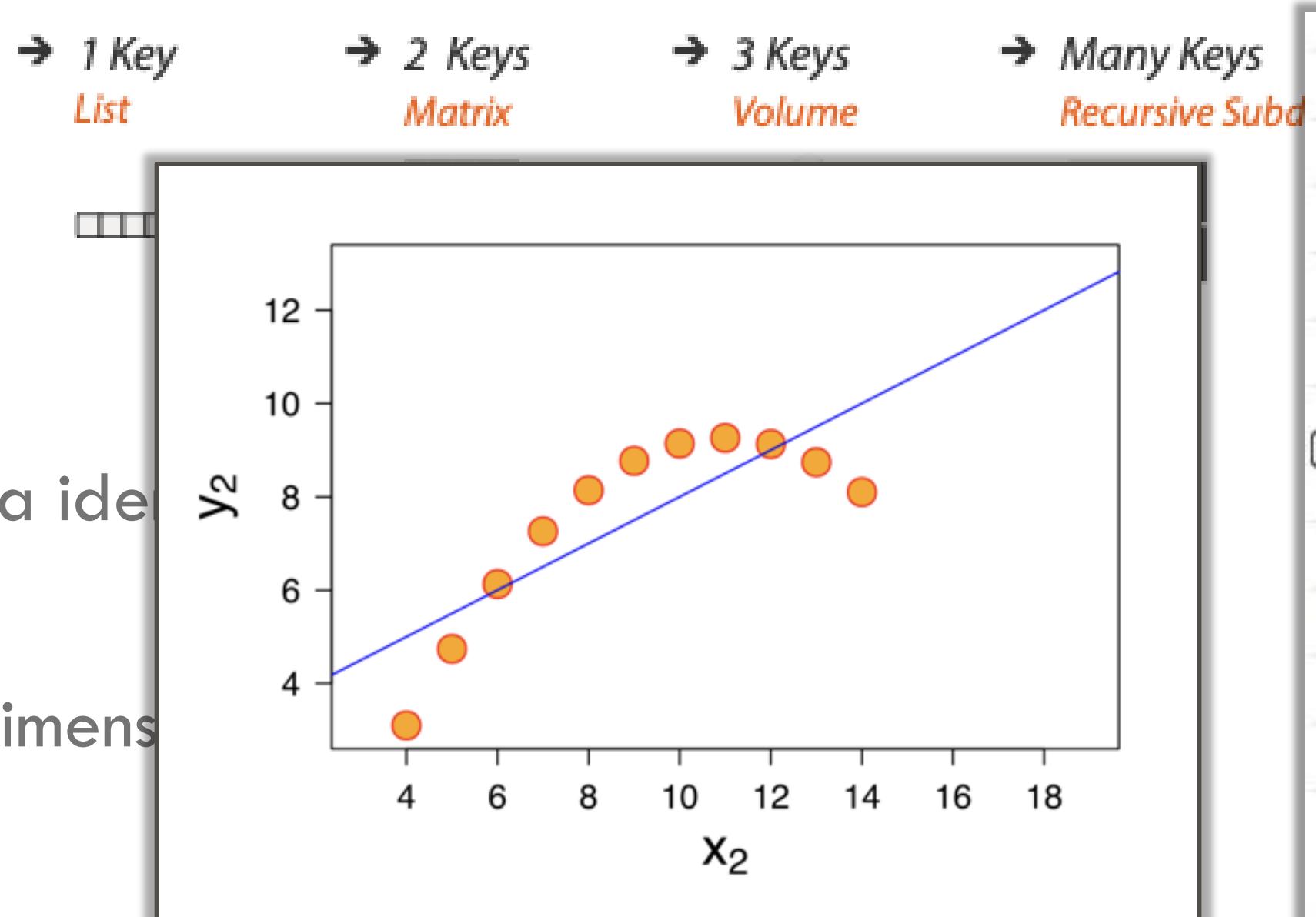


ational and Graphical Statistics  
sign)

# Keys / Values

## Key

- Variable independiente
- Se puede usar como índice único para identificar filas y columnas
- Tipo categórico u ordinal
- Tablas simples: 1 key - Tablas multidimensionales

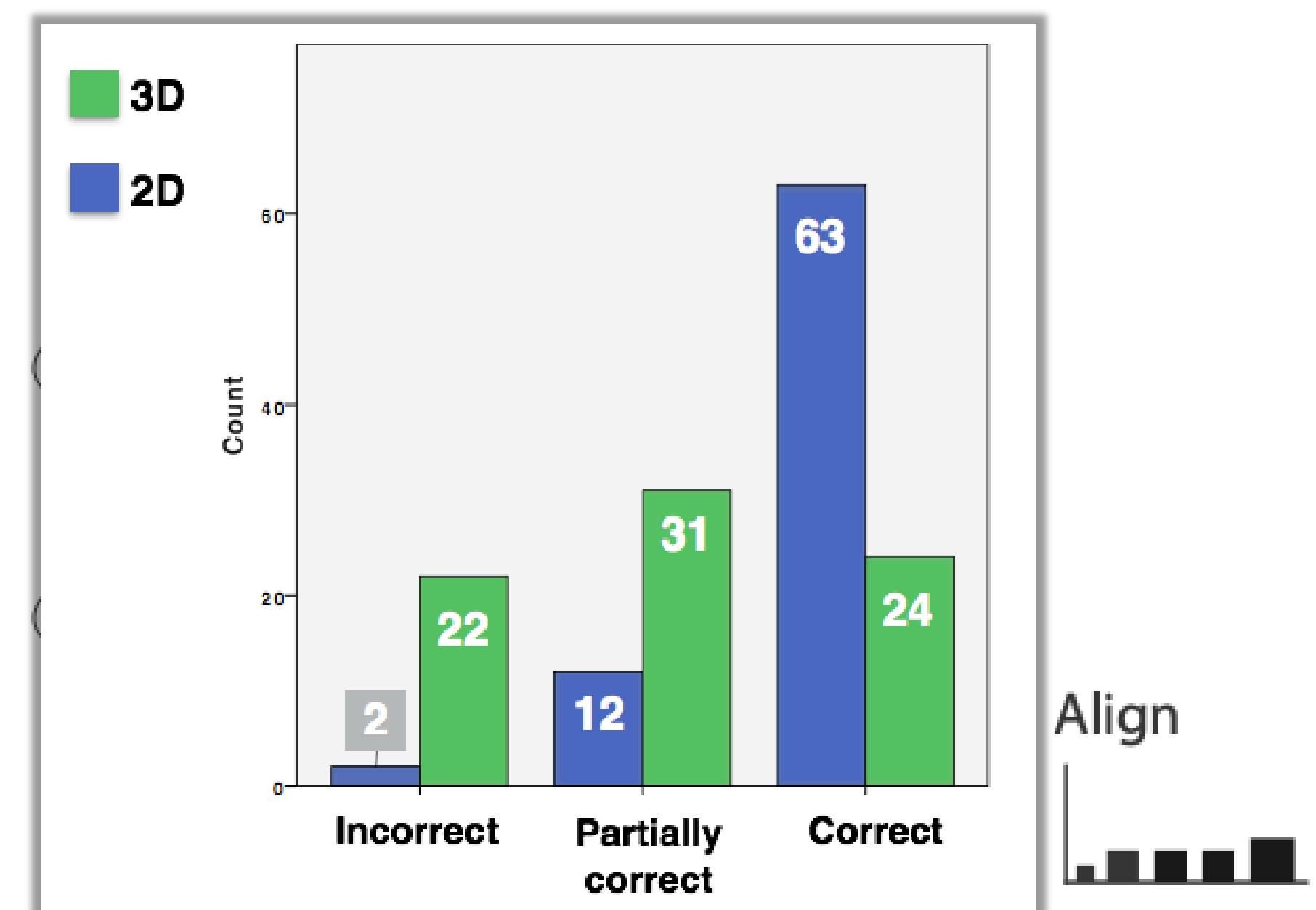


## Value

- Variable dependiente, valor de la celda
- Categórico, ordinal o cuantitativo
- Los valores únicos de ordinales y categóricos se llaman **niveles**

## Decisiones básicas de diseño

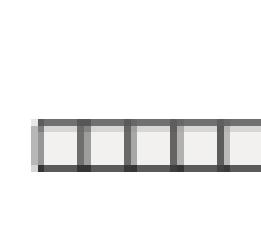
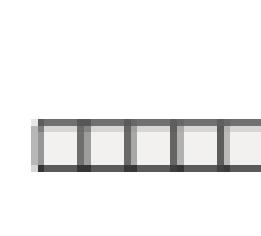
- ¿Cuántos Keys? ¿cuántos Valores?
- ¿De qué tipo son? (categorico, ordinal, cuantitativo)
- Una viz puede mostrar dos valores y ninguna clave (scatter), un valor y una clave (barchart), un valor y dos claves (heatmap), etc.



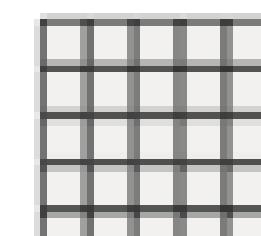
# Keys

## → Express Values

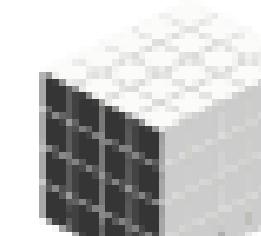
→ 1 Key  
*List*



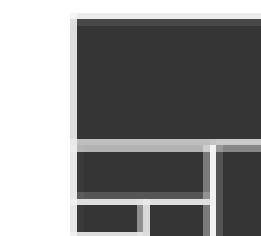
→ 2 Keys  
*Matrix*



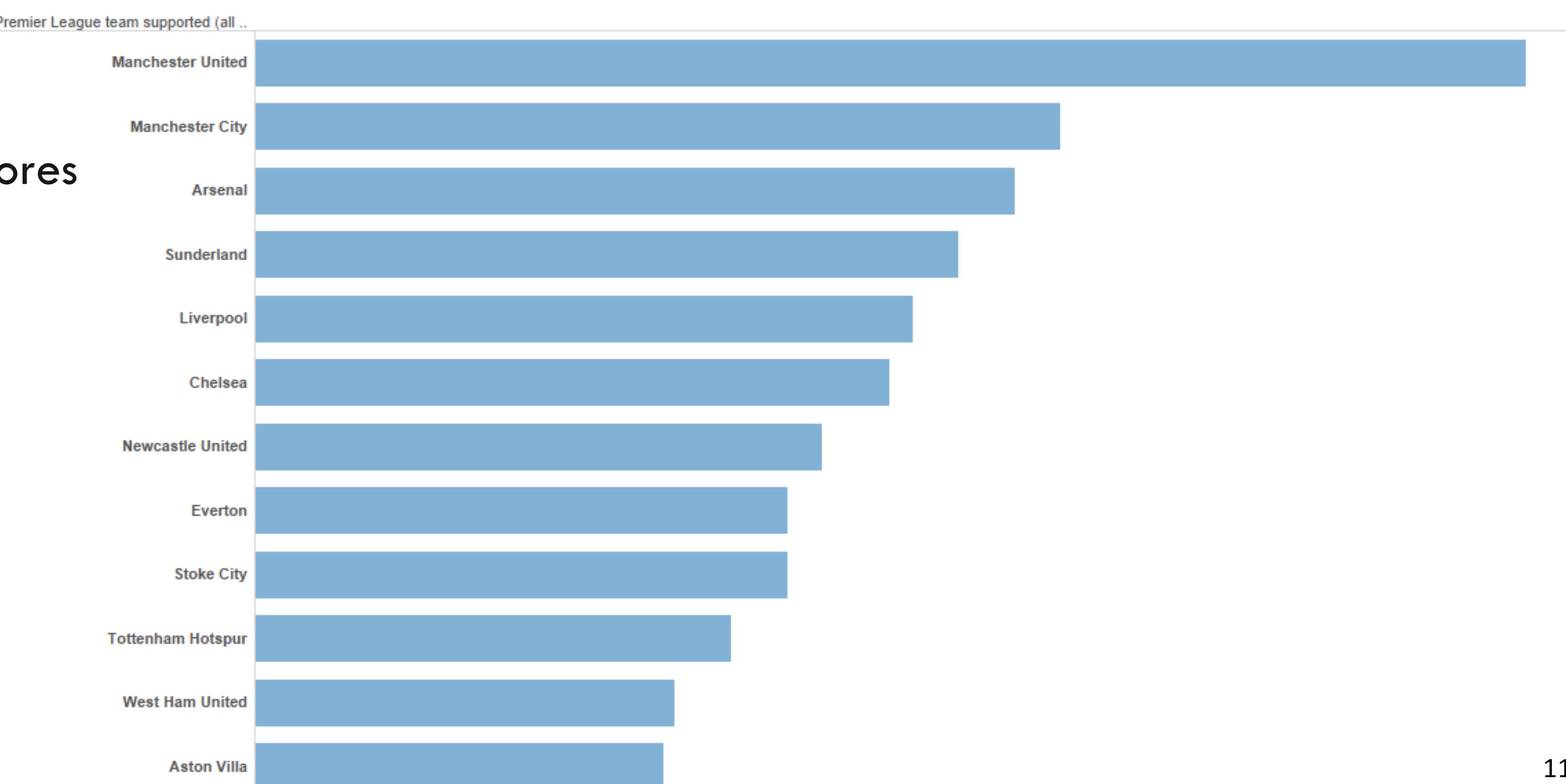
→ 3 Keys  
*Volume*



→ Many Keys  
*Recursive Subdivision*



- Estrategias de visualización que involucran valores y **claves**
- Con **una Clave** normalmente se organizan las marcas en una lista unidimensional alineada
- Las claves **NO** son cuantitativas



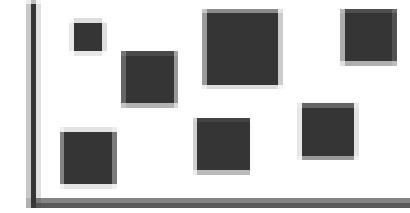
# Keys - Variables categóricas

## → Express Values

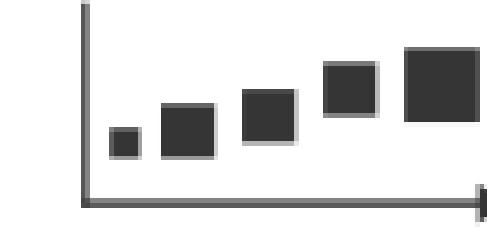


## → Separate, Order, Align Regions

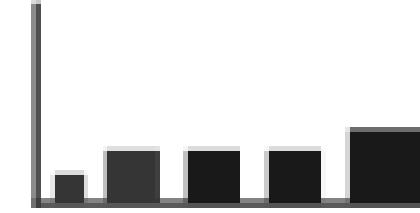
→ Separate



→ Order



→ Align



## Channels: Expressiveness Types And Effectiveness Ranks

### → Magnitude Channels: Ordered Attributes

Position on common scale



Position on unaligned scale



Length (1D size)



Tilt/angle



Area (2D size)



### → Identity Channels: Categorical Attributes

Spatial region



Color hue



Motion



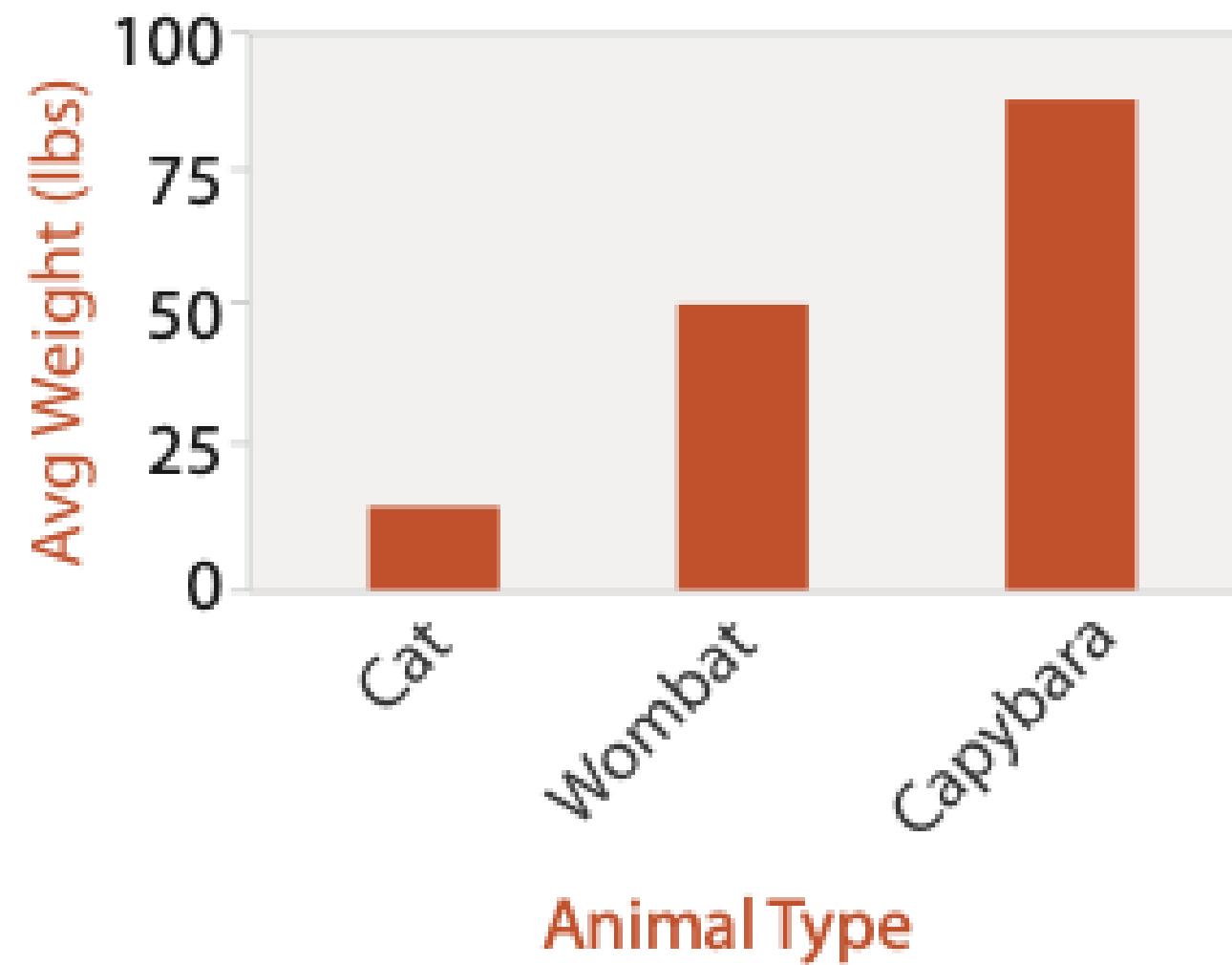
Shape



- Expresar Valores se usa con cuantitativos
- Atributos Categóricos en posición espacial es más complejo - Posición es un canal de **magnitud**
- Atributos categóricos encajan mejor con la idea de **Región**- áreas separadas y distinguibles.
- Tres operaciones:
  - **Separar** - Definir regiones y proximidad. Usar el atributo categórico
  - **Ordenar** – Se debe usar un atributo de semántica ordenable (ordinal/cuantitativo).
  - **Alinear** – Establecer un eje común.

# Bar chart

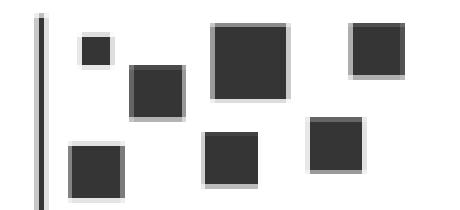
- 1 key, 1 value
- Datos: 1 categórico y 1 cuantitativo
- Marcas: Lineas
- Canales:
  - Longitud para cuantitativo
  - Regiones para categórico:
    - Una por marca
    - Separadas en un eje (X),
    - Alineadas en el otro (Y)
    - Ordenadas por cuantitativo
      - Label (alfabético) – tamaño (data-driven)
- Tareas:
  - Comparar, ver + valores
  - Escalable de docenas a cientos. Limitada por tamaño en pantalla



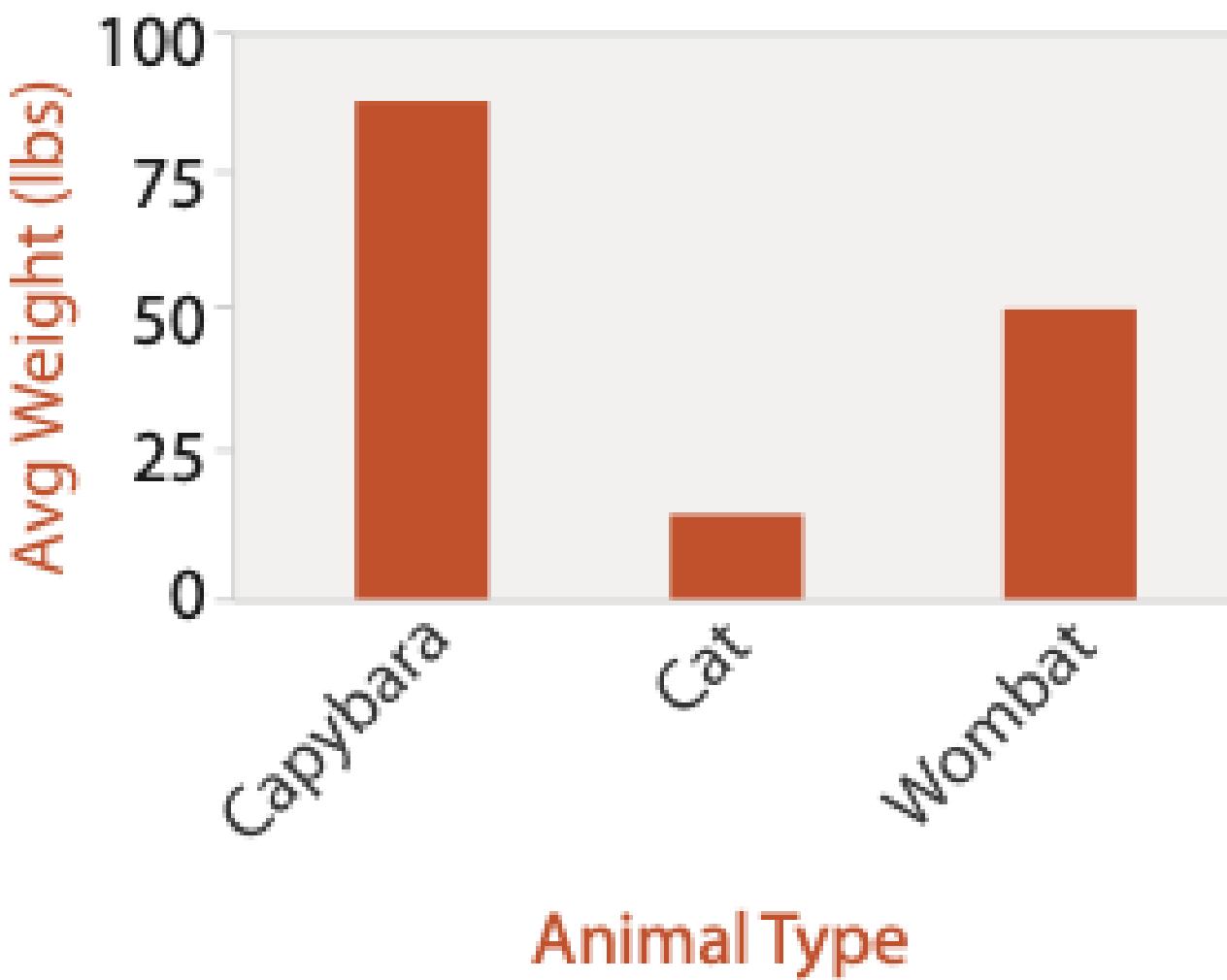
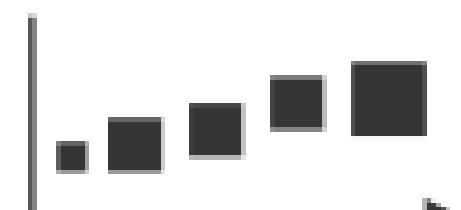
→ Express Values  
→ →

→ Separate, Order, Align Regions

→ Separate



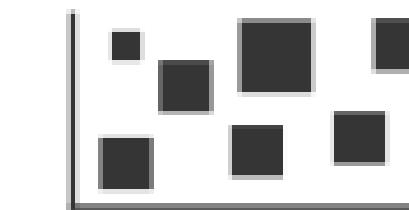
→ Order



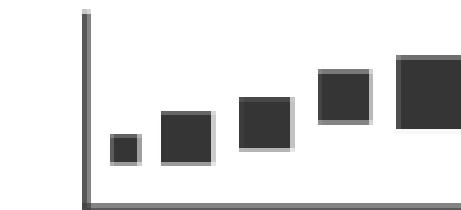
# Separar - Alinear - Ordenar

→ Separate, Order, Align Regions

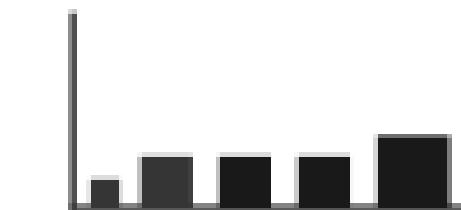
→ Separate



→ Order



→ Align

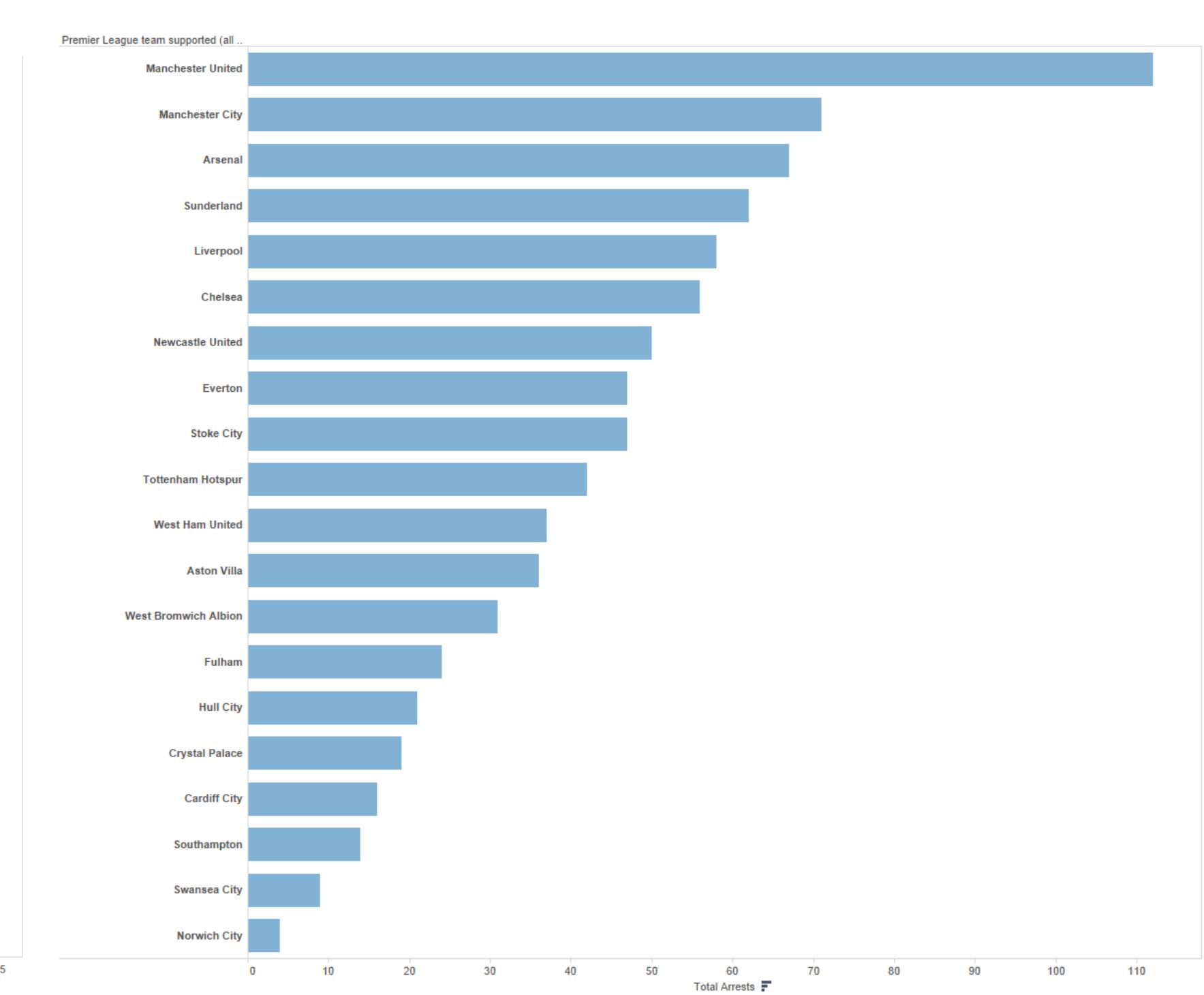
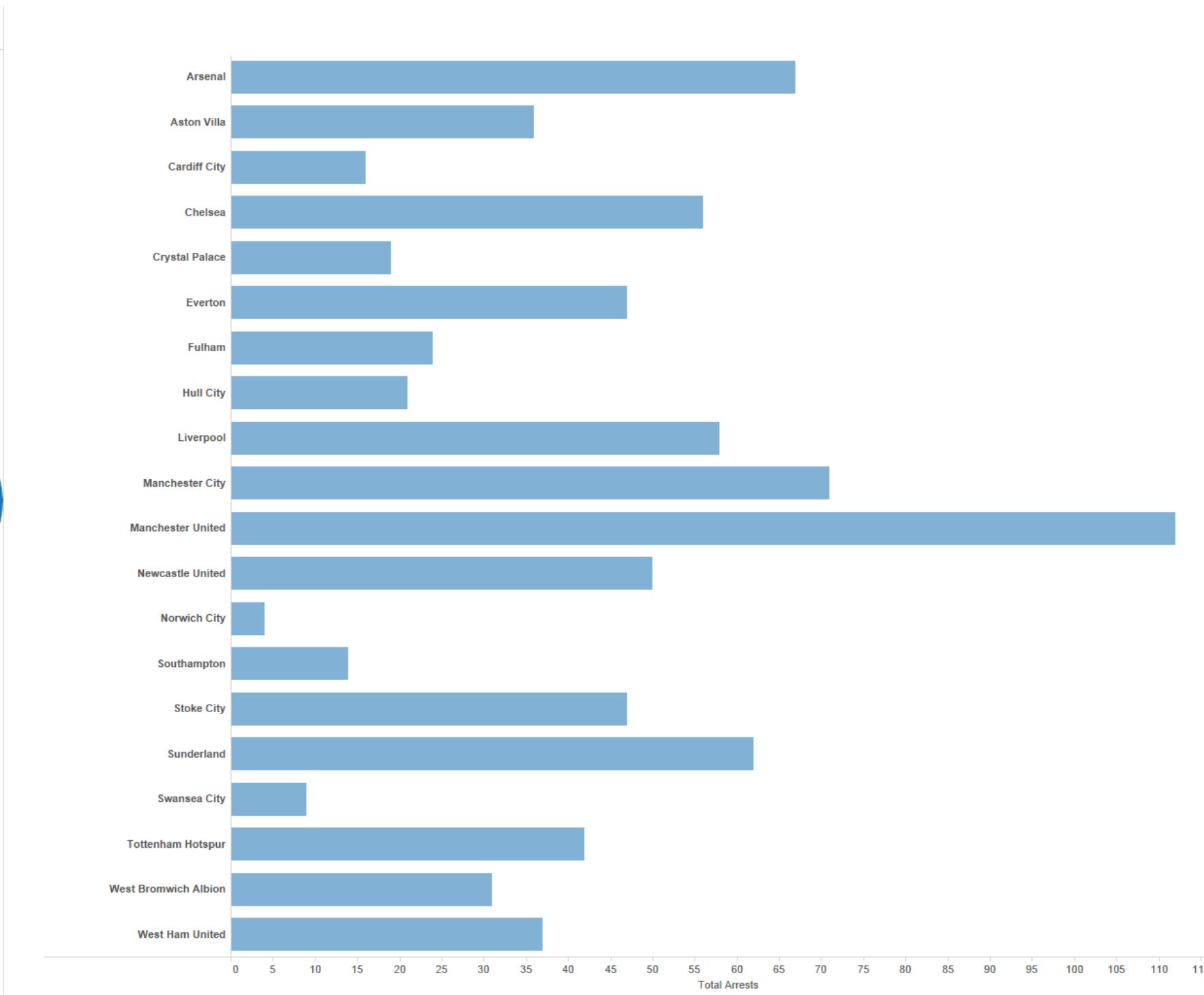
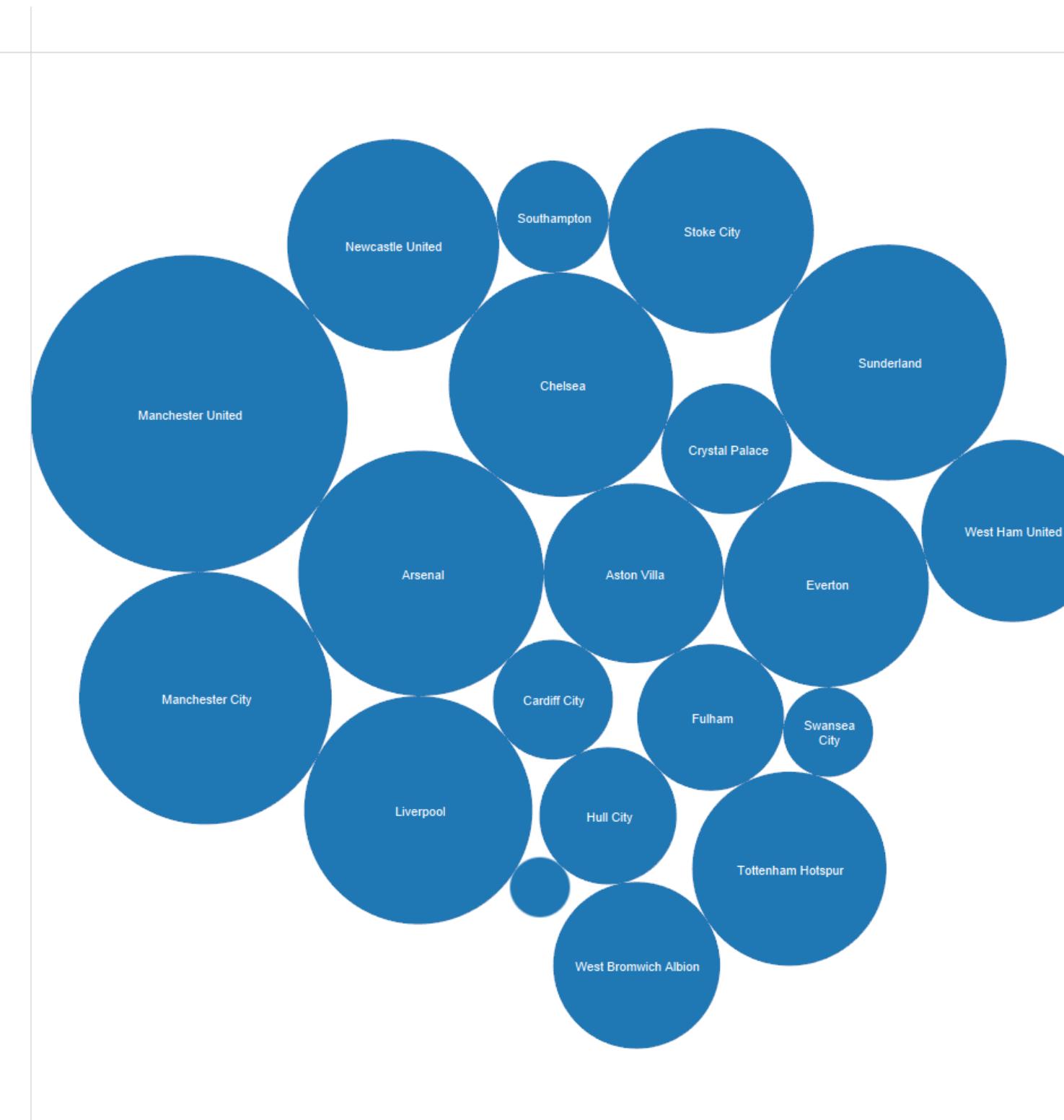


Limitaciones:

Separar- Difícil diferenciar y comparar

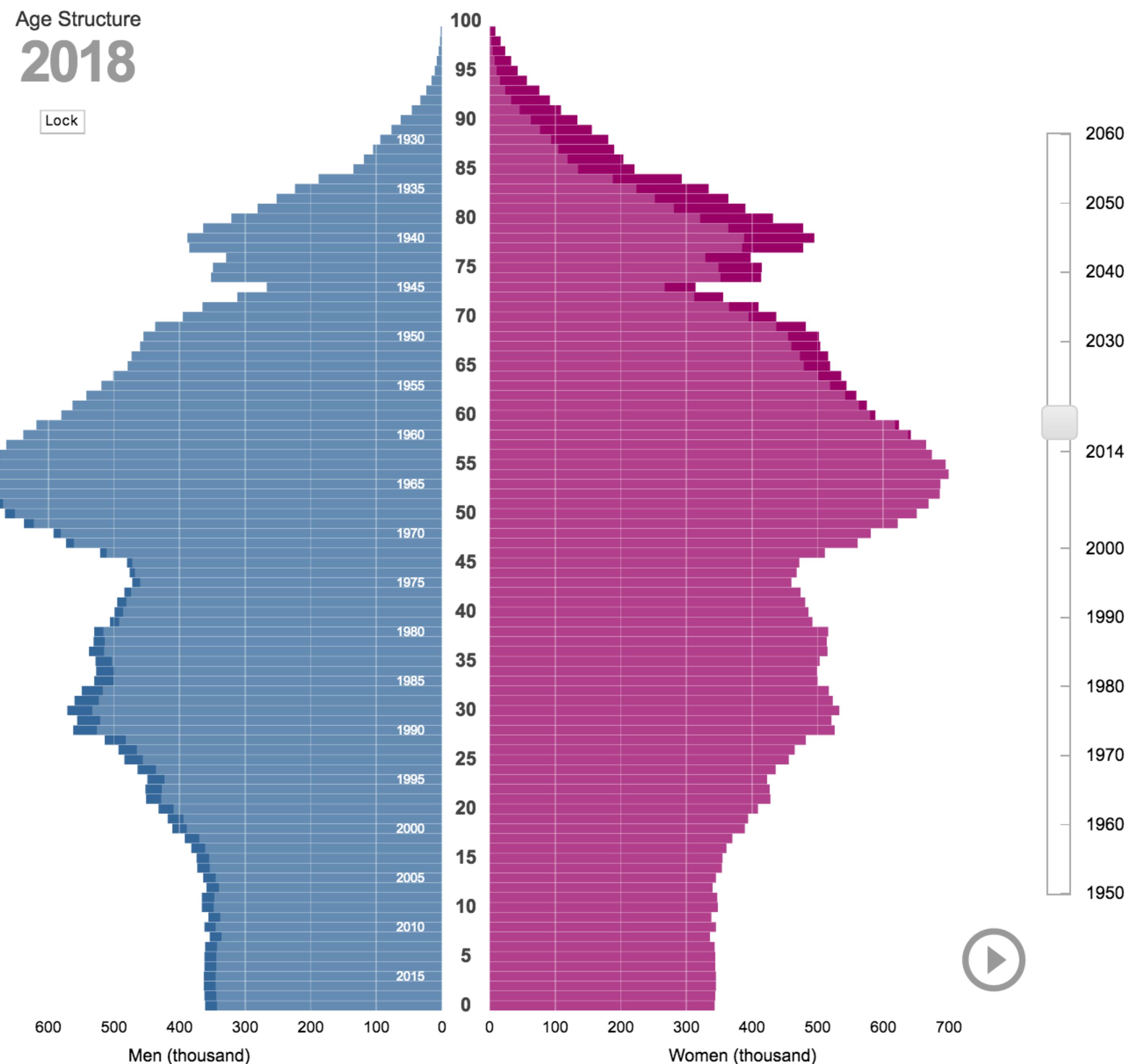
Separar + Alinear- Difícil establecer ranking visualmente. ¿Cual es el tercero más grande? ¿El séptimo?

Separar + Alinear + Ordenar- Ranking. Fácil comparar e identificar extremos



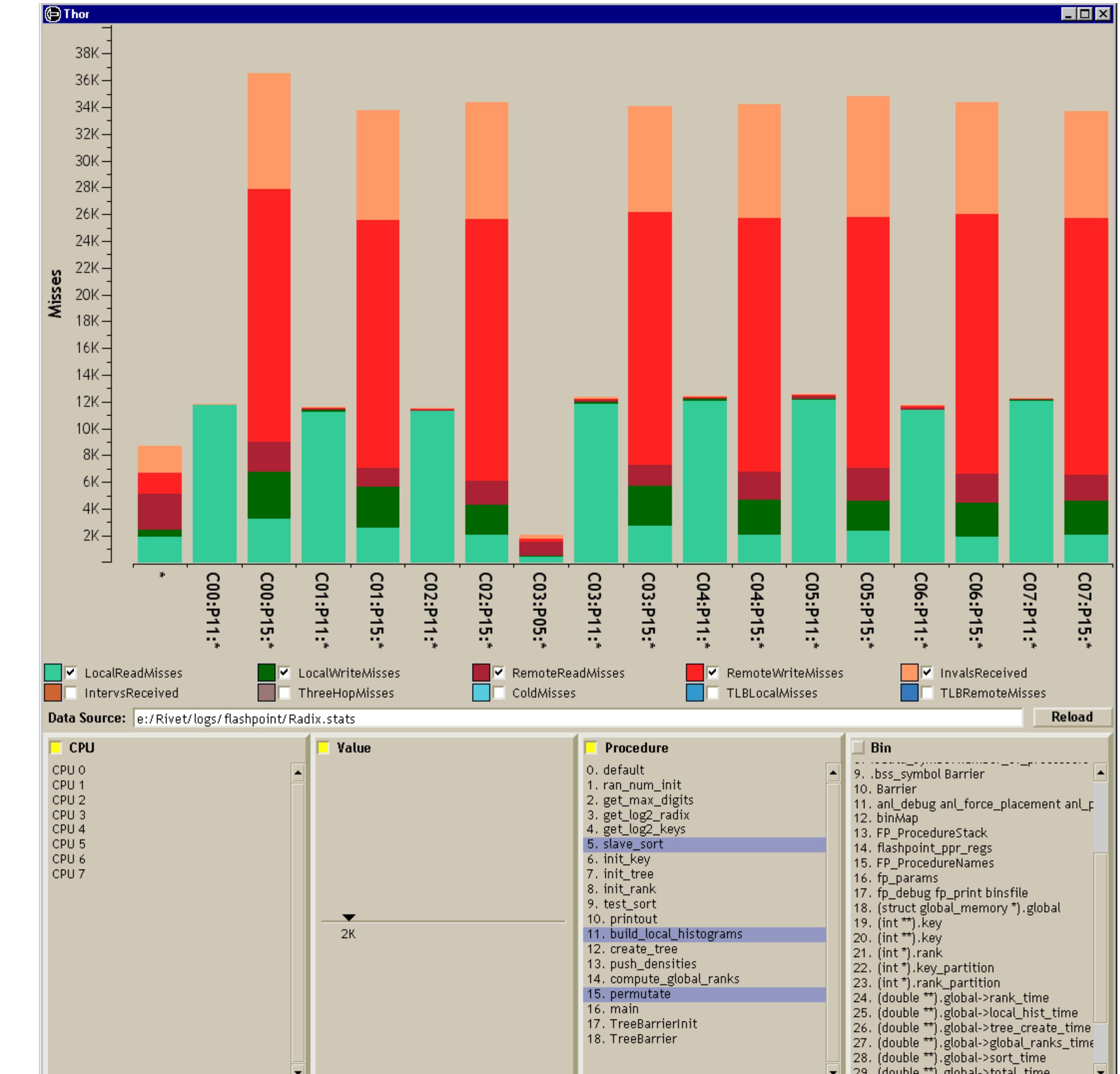
# Variación: Barras divergentes

- Pirámide poblacional ( $Y = \text{edad}/X = \text{count}$ )
- Datos: 1 categórico, 1 ordinal, 1 cuantitativo (+cuantitativo interactivo)
- Marcas: Líneas
- Canales: Longitud y color
- Regiones: Una por marca; ordenadas por atr. Ordinal (grupo de edad)
- Tarea:
  - Analizar forma de la distribución
  - Comparar distribuciones
- Limitaciones: Difícil comparar entre lados
- Solución: marcar la diferencia en un color más oscuro



# Stacked bar chart

- **2 keys, 1 value**
- Datos: 2 categórico y 1 cuantitativo
- Marcas: Lineas apiladas verticalmente
- **Glifos:** Objetos compuestos por múltiples marcas:
  - Canales: longitud y Tono
- Regiones:
  - Una por glifo
  - Alineadas:
    - Componente más bajo
    - Otros componentes del glifo
- Tareas:
  - Relaciones parte-todo
  - Escalable a <docena de niveles para el atributo apilado; igual a barras para regiones



[Using Visualization to Understand the Behavior of Computer Systems. Bosch. Ph.D. thesis,  
Stanford Computer Science, 2001.]

From: Visualization Analysis and Design

# Stacked bar chart

Ejemplo:

- Aporte al GDP global/anual en puntos porcentuales de países más ricos
- Eje vertical divergente para negativos
- Fácil identificar caídas y tendencias globales
- Difícil ver evolución por país y compararla entre países. Capas inferiores se comparan mejor que superiores.

Channels: Expressiveness Types And Effectiveness Ranks

④ **Magnitude Channels: Ordered Attributes**

Position on common scale



▲  
Effectiveness

Position on unaligned scale



Length (1D size)



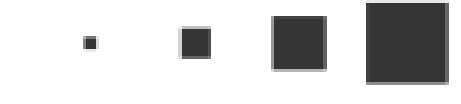
▲  
Effectiveness

Tilt/angle

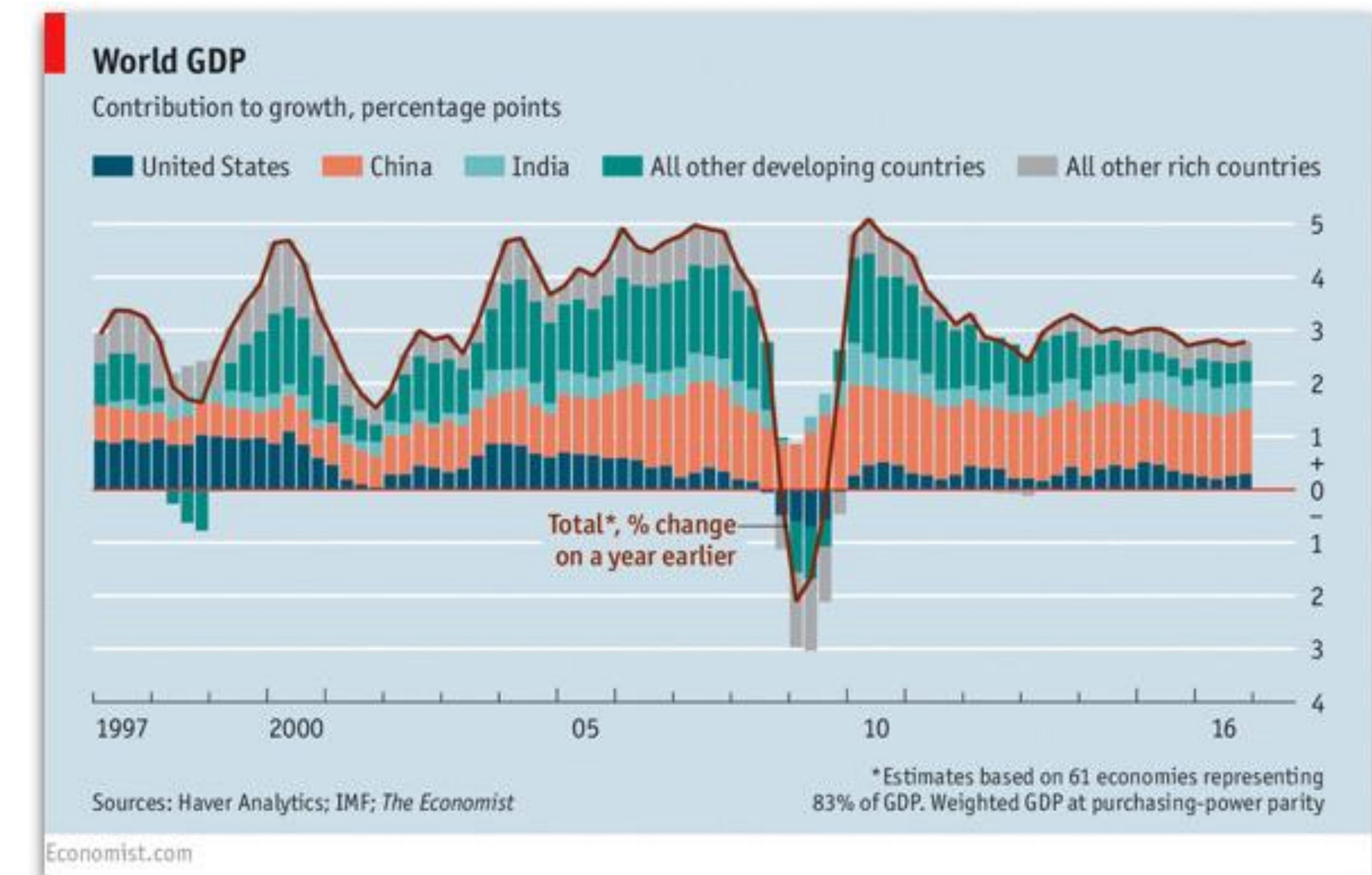


▲  
Effectiveness

Area (2D size)



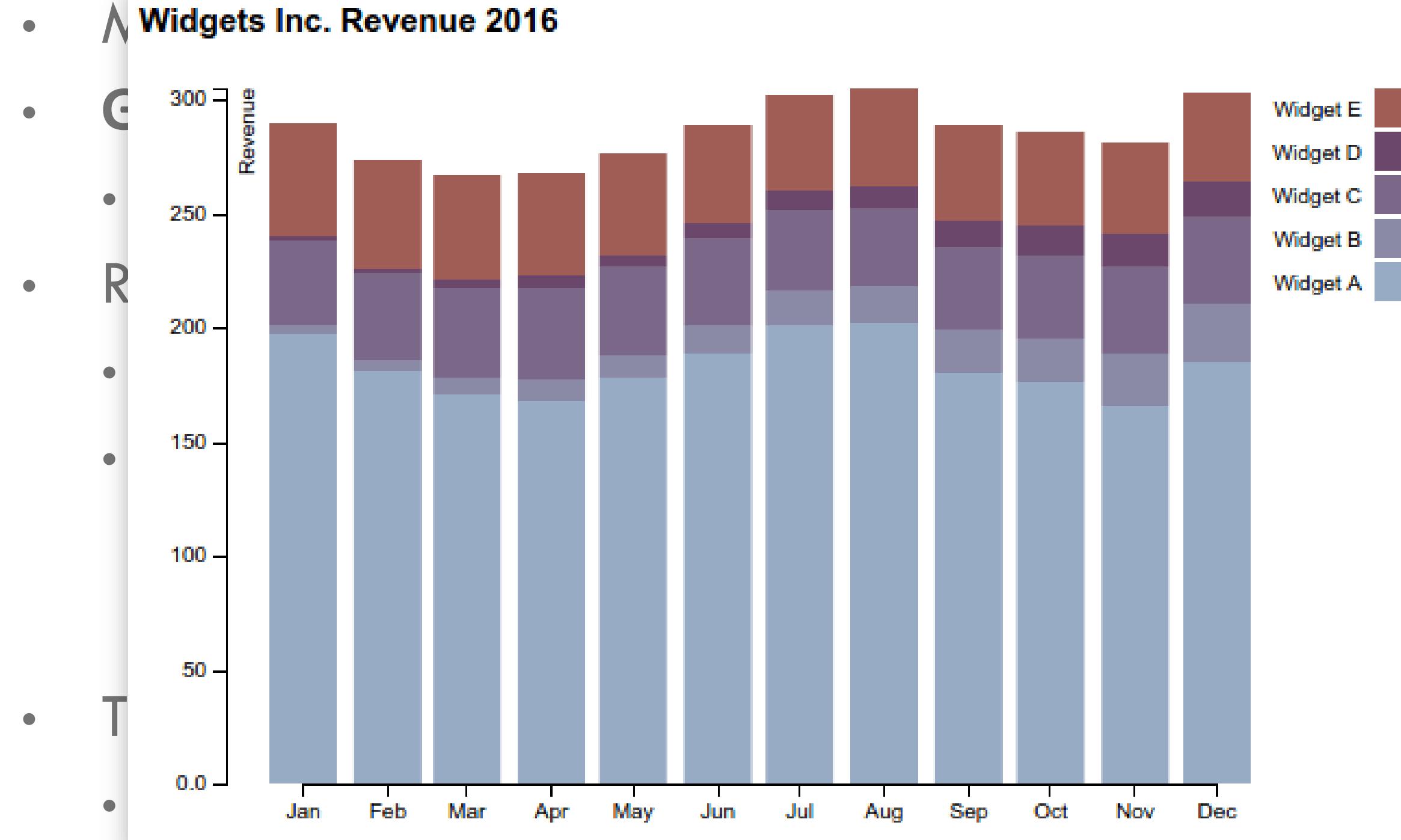
▲  
Effectiveness



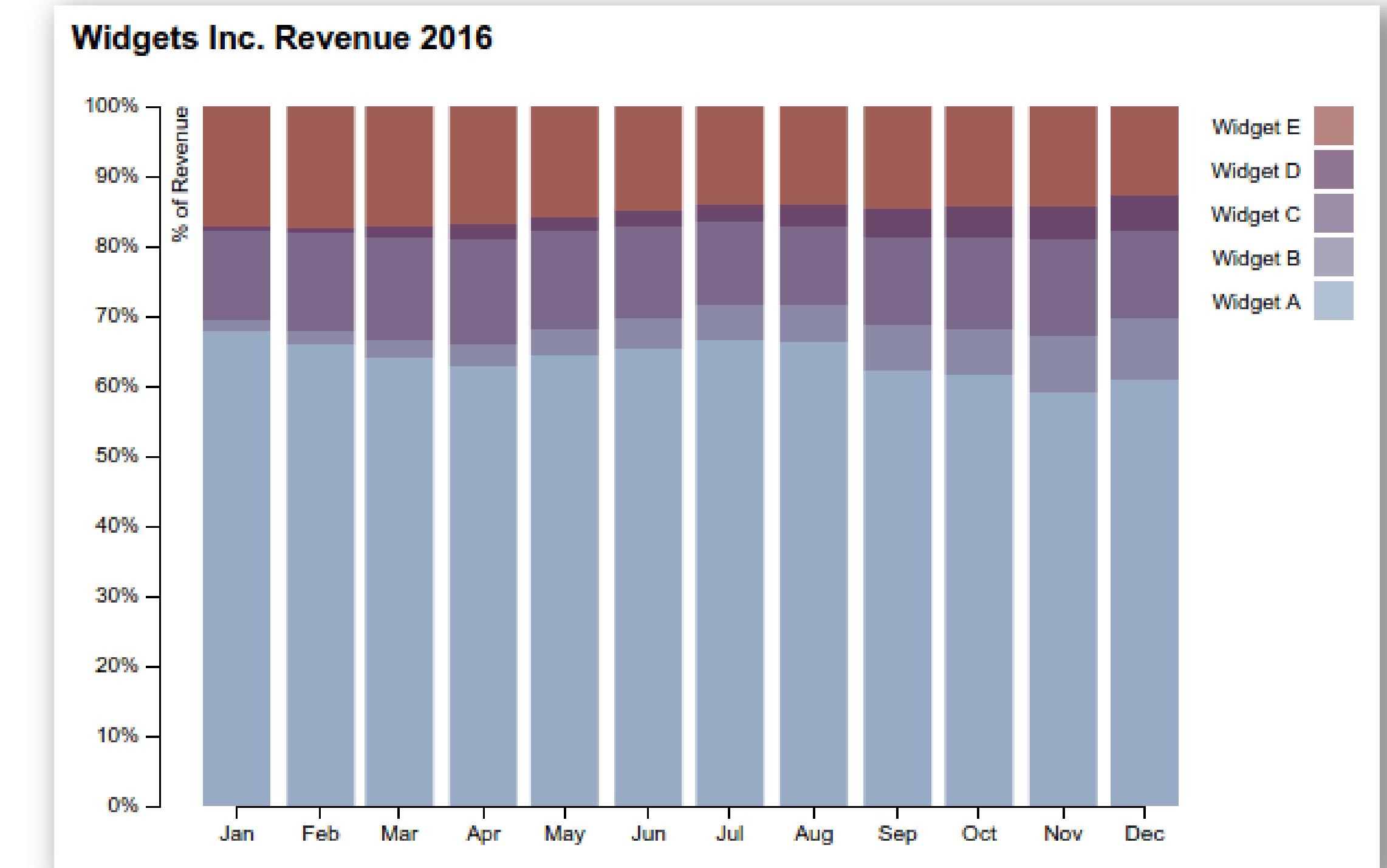
*The Economist*

# Normalized stacked bar chart

- 2 keys, 1 value
- Datos: 2 categórico y 1 cuantitativo



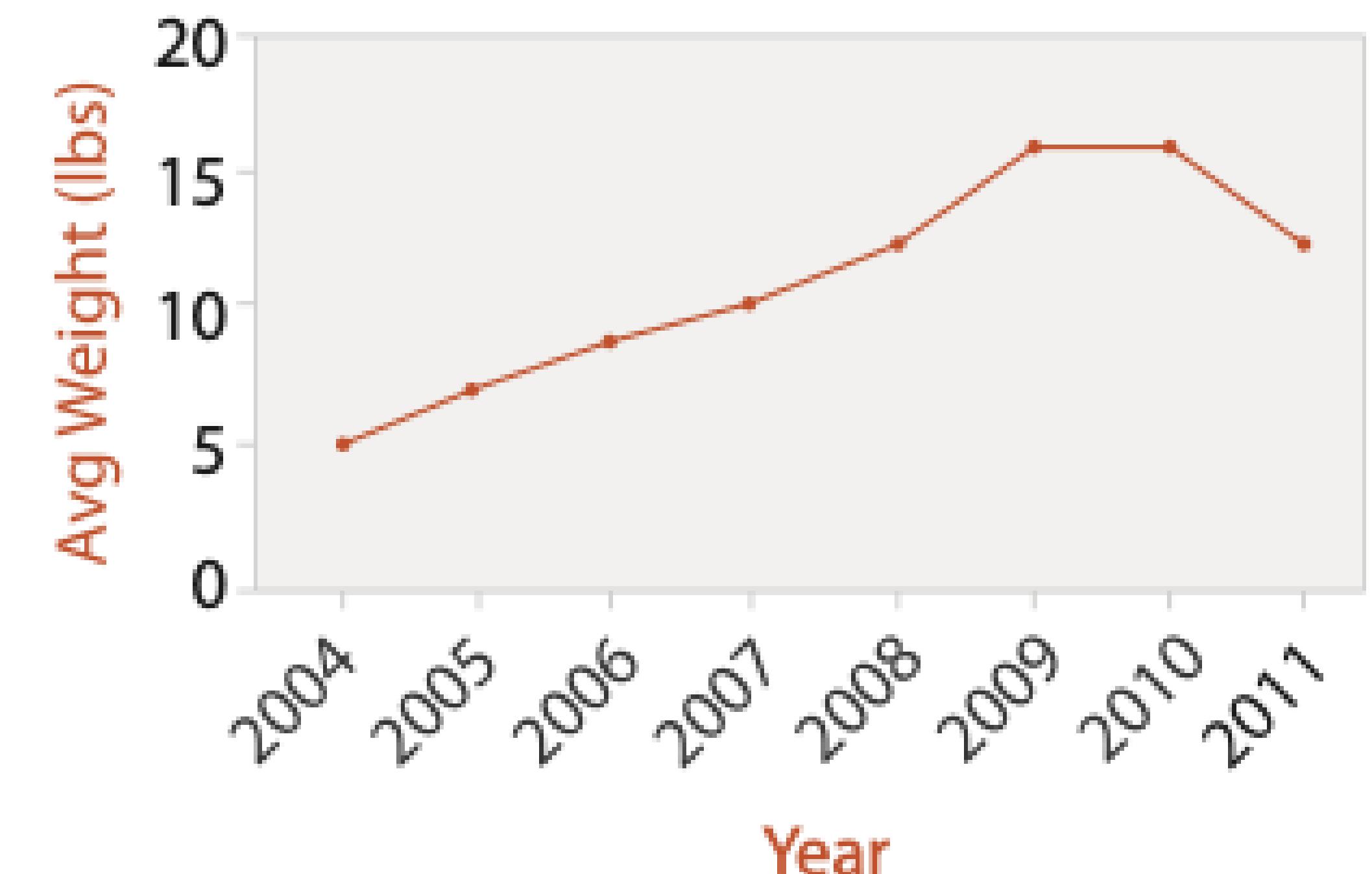
- Escalable a  $< \text{docena}$  de niveles para el atributo apilado



Chris Maness, From: [medium.com](https://medium.com)

# Line chart / dot plot

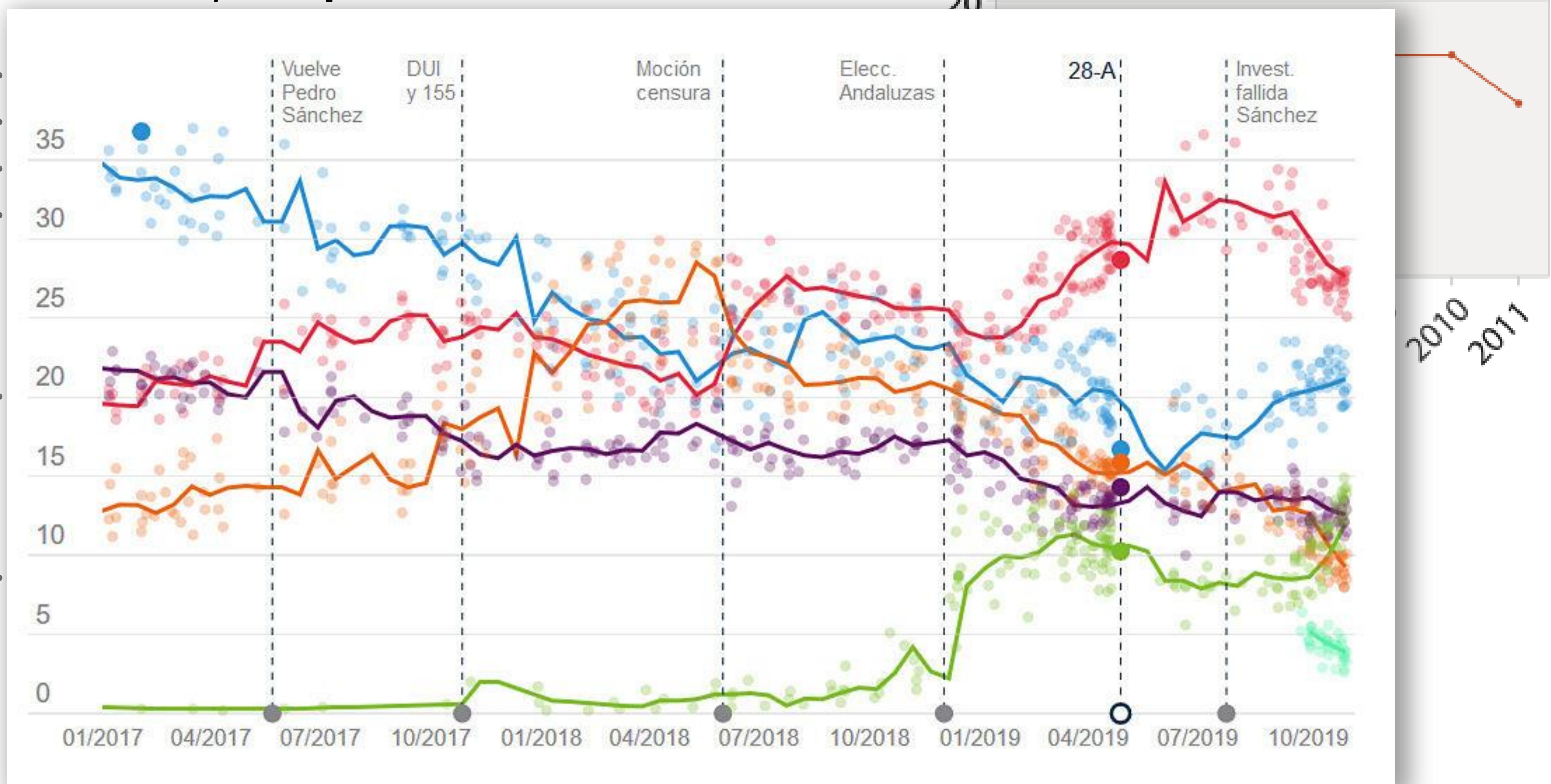
- 1 key, 1 value
- Datos: 2 cuantitativos
- Marcas: Puntos- Línea que los conecta
- Canales:
  - Posición alineada para cuantitativo
  - Separados y ordenados por key en regiones horizontales
- Tareas:
  - Identificar tendencia
  - La línea resalta el orden- Relación explícita entre un ítem y el siguiente
- Escalable a cientos de keys



A	B	C	D	E	F	G	H	
1	Row Labels	Afghanistan	Albania	Algeria	Andorra	Angola	Antigua and	Argentina
2	2000	54,8	72,6	71,3		45,3	73,6	
3	2001	55,3	73,6	71,4		45,7	73,8	
4	2002	56,2	73,3	71,6		46,5	74	
5	2003	56,7	72,8	71,7		46,8	74,2	
6	2004	57	73	72,3		47,1	74,4	
7	2005	57,3	73,5	72,9		47,4	74,6	
8	2006	57,3	74,2	73,4		47,7	74,8	
9	2007	57,5	75,9	73,8		48,2	75	
10	2008	58,1	75,3	74,1		48,7	75,2	
11	2009	58,6	76,1	74,4		49,1	75,4	
12	2010	58,8	76,2	74,7		49,6	75,6	
13	2011	59,2	76,6	74,9		50,1	75,7	
14	2012	59,5	76,9	75,1		50,6	75,9	
15	2013	59,9	77,2	75,3		51,1	76,1	

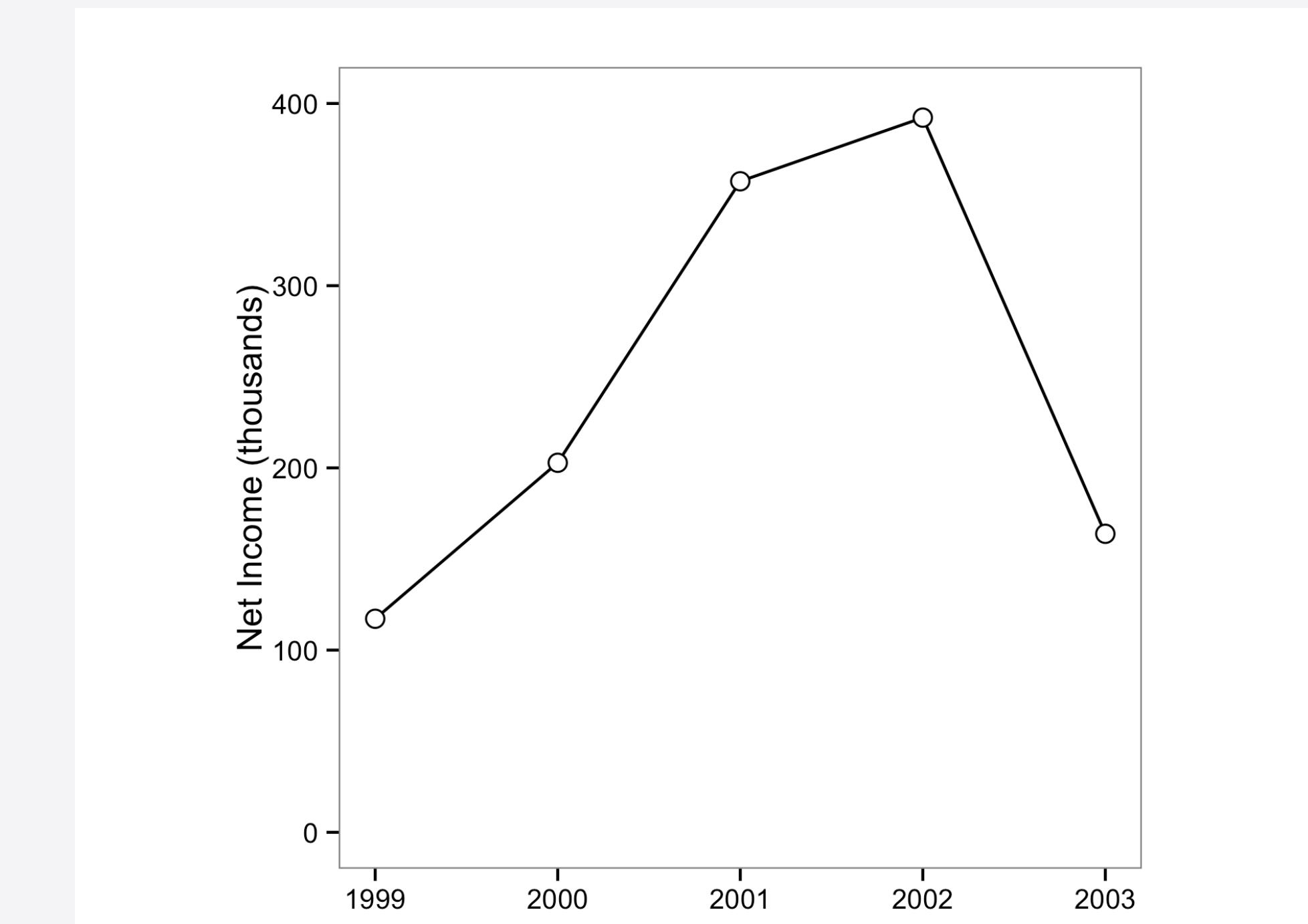
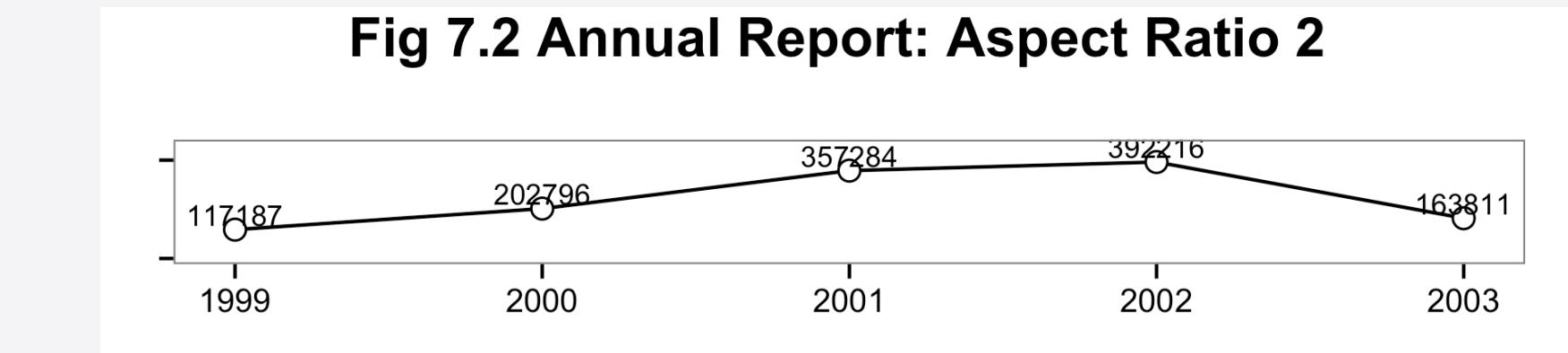
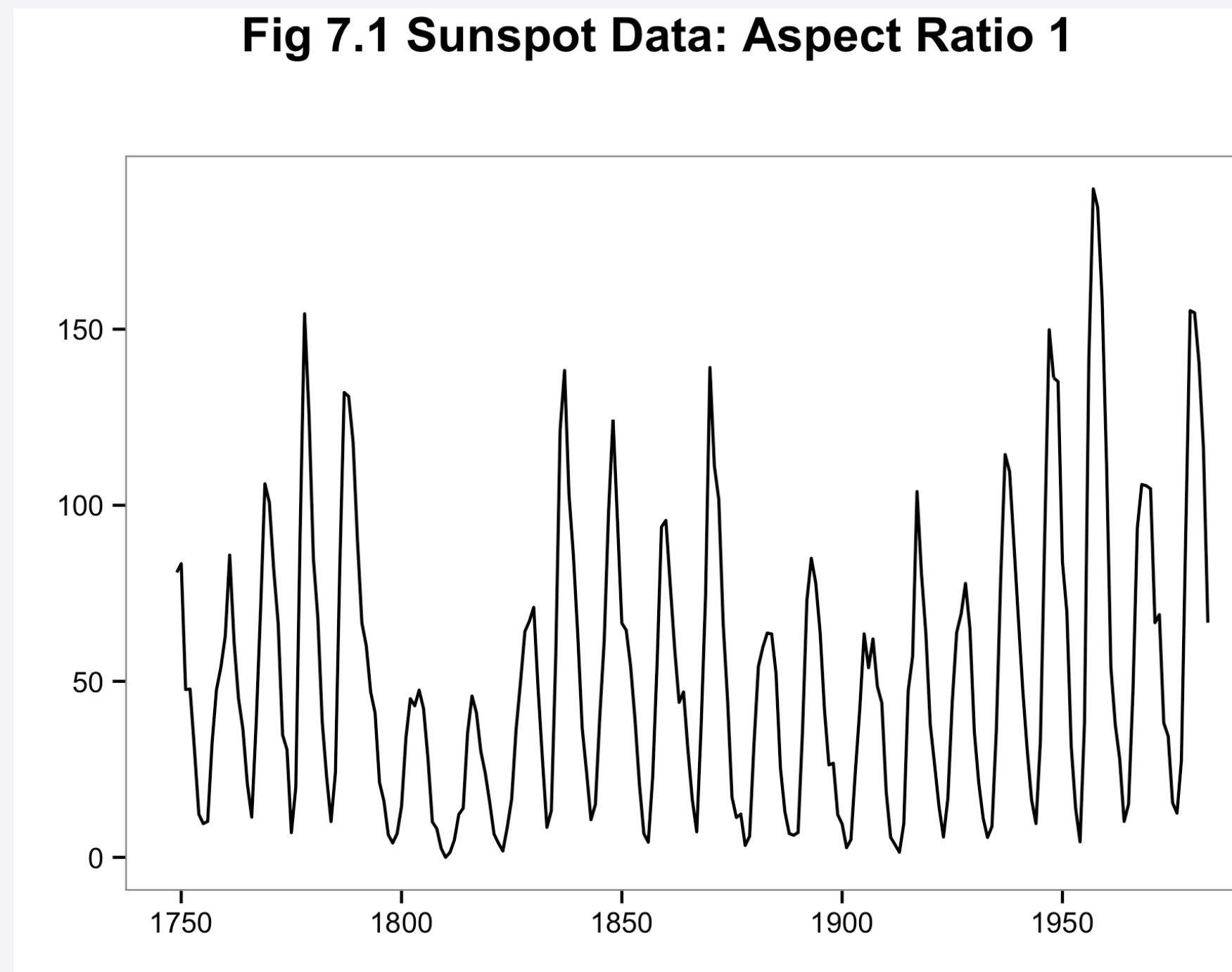
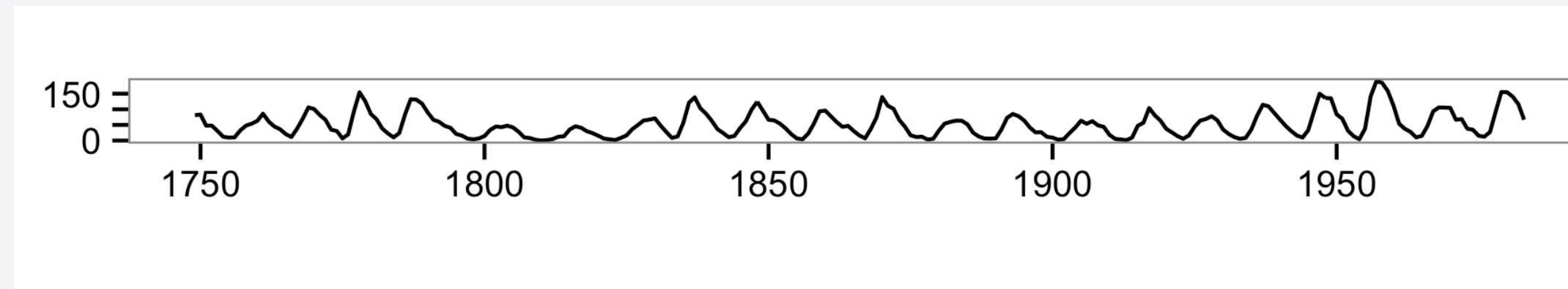
# Line chart / dot plot

20



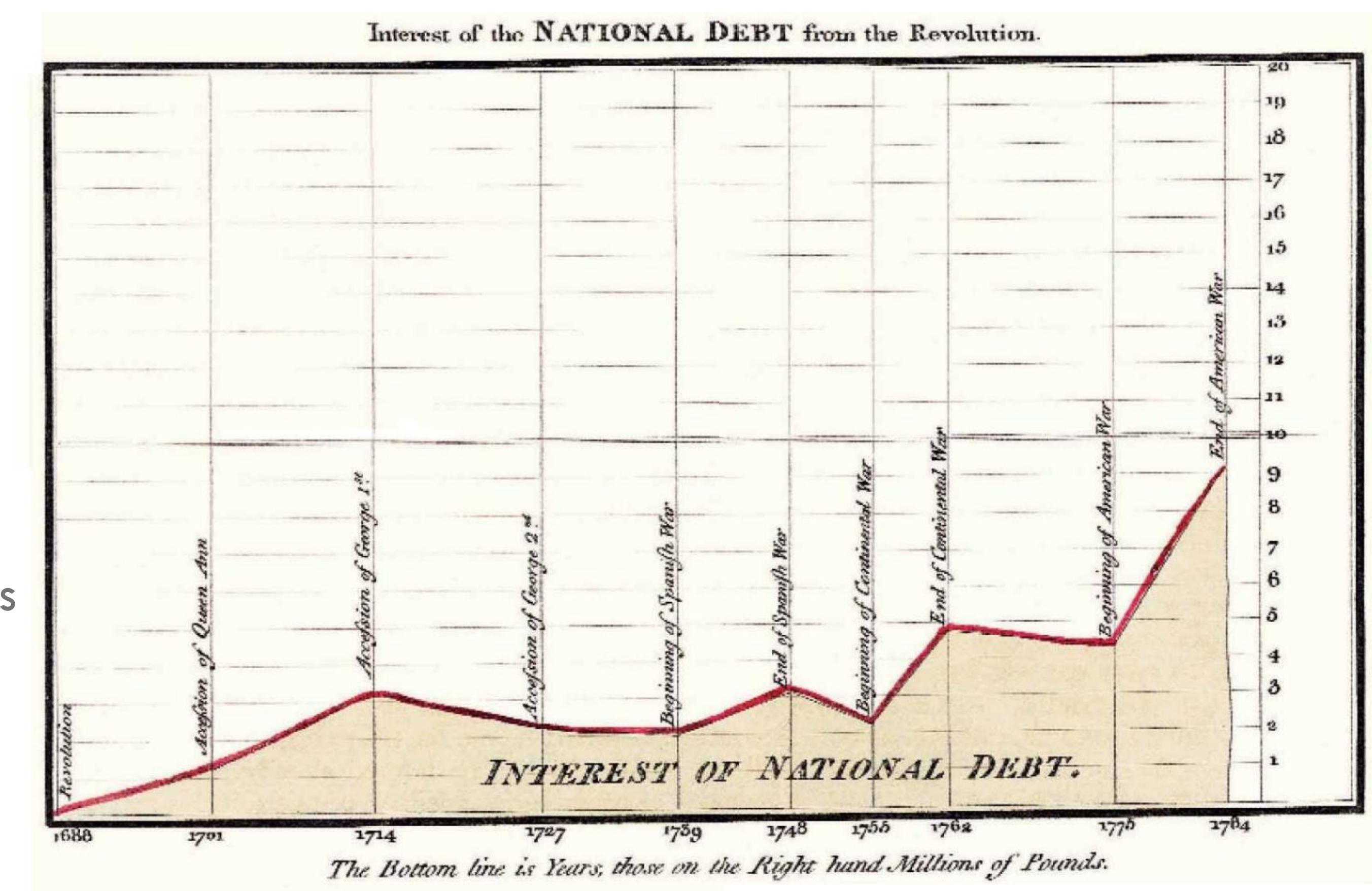
# Line chart: Aspect ratio

- 1: Inclinación a 45 (1980s)
  - Cleveland percepción: Diferenciaciones más precisas en ángulos a 45
  - Métodos automáticos para encontrar ratio óptimo.



# Area charts

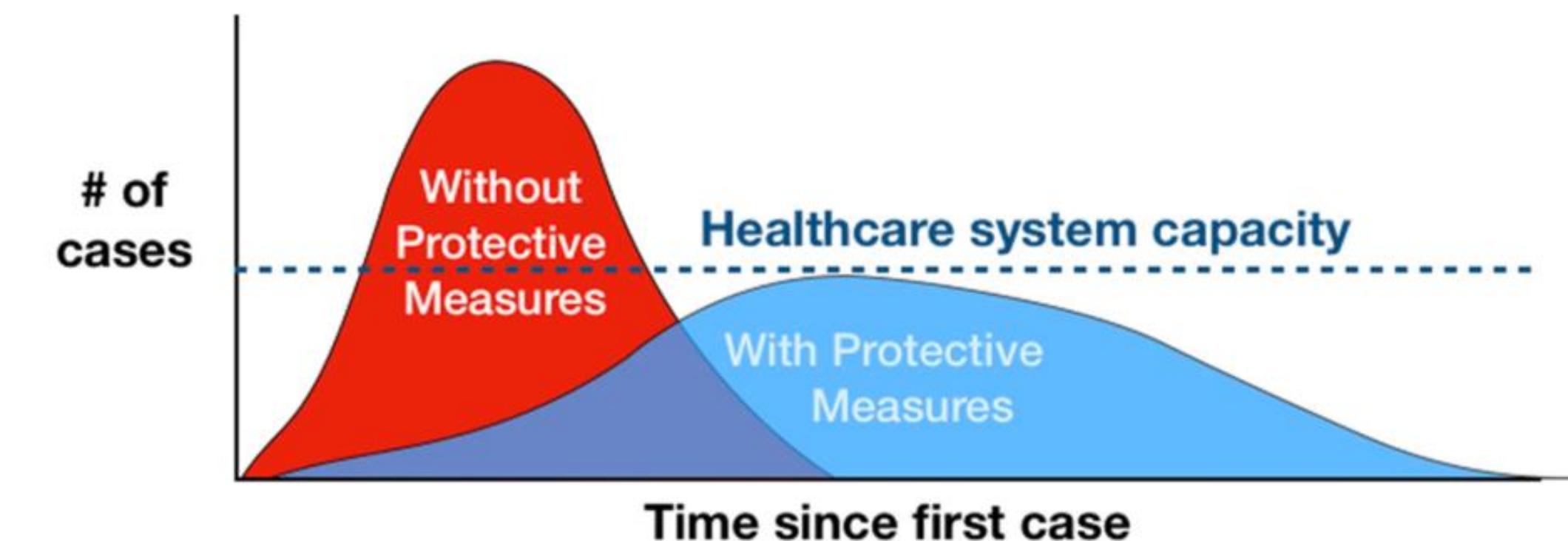
- 1 key, 1 value
- Datos: 2 cuantitativos y un categórico
- Datos derivados: geometrías
- Marcas: Línea, Área
- Canales:
  - Color
  - Posición alineada para cuantitativo
  - Separados y ordenados por key en regiones horizontales
- Tareas:
  - Mostrar variación en cantidades
  - El área resalta el orden y la asociación con “tamaño” del valor
- Escalable a cientos de keys y values



W. Playfair. From: Wikipedia

# Area charts

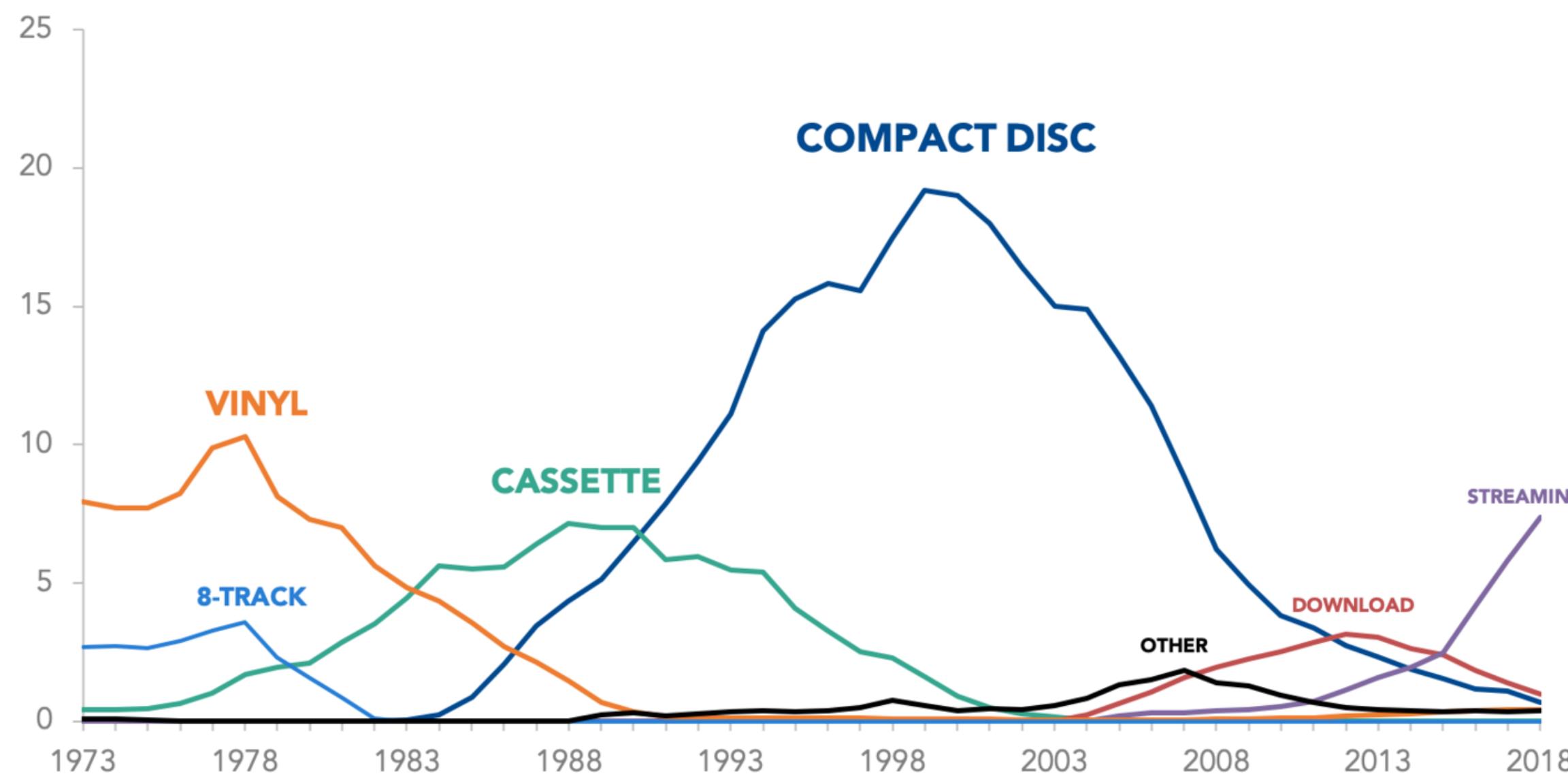
- Buenas para líneas que se cruzan o tienen subidas y bajadas pronunciadas y cerca del 0



SOURCE: [nytimes.com/2020/03/11/science/coronavirus-curve-mitigation-infection.html](https://nytimes.com/2020/03/11/science/coronavirus-curve-mitigation-infection.html)

US music sales by format (inflation-adjusted)

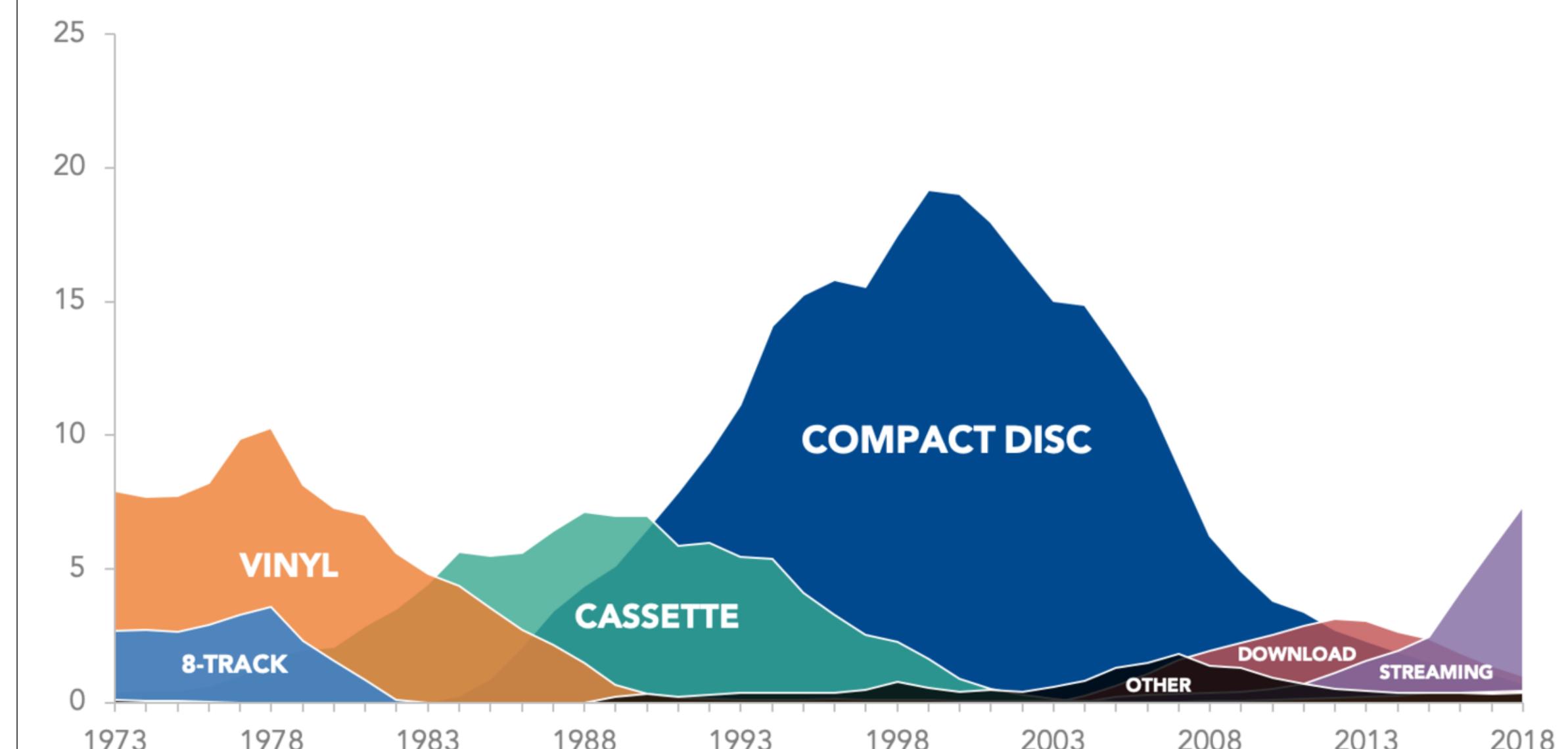
IN BILLIONS (USD)



SOURCE: Recording Industry Association of America

US music sales by format (inflation-adjusted)

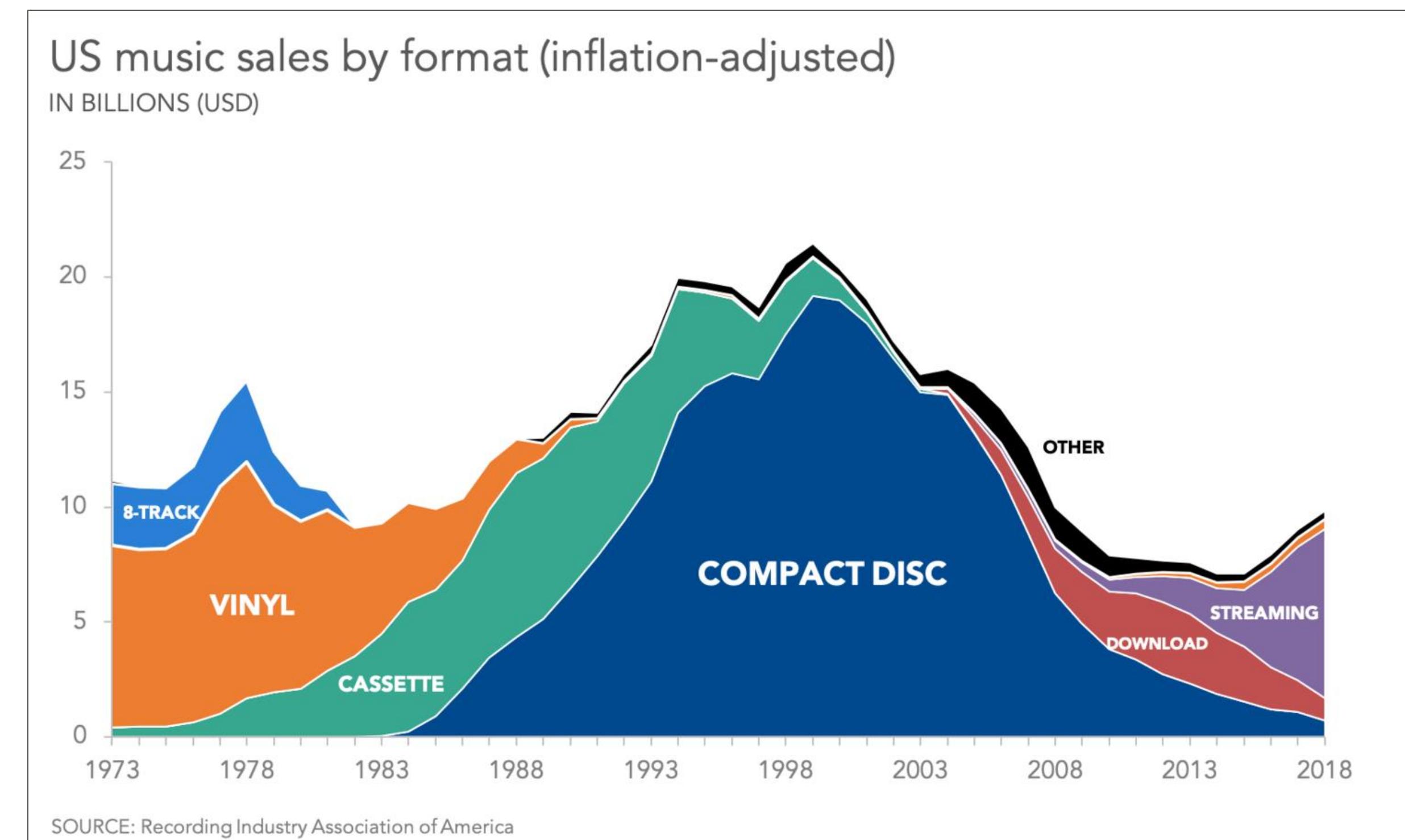
IN BILLIONS (USD)



SOURCE: Recording Industry Association of America

# Stacked area charts

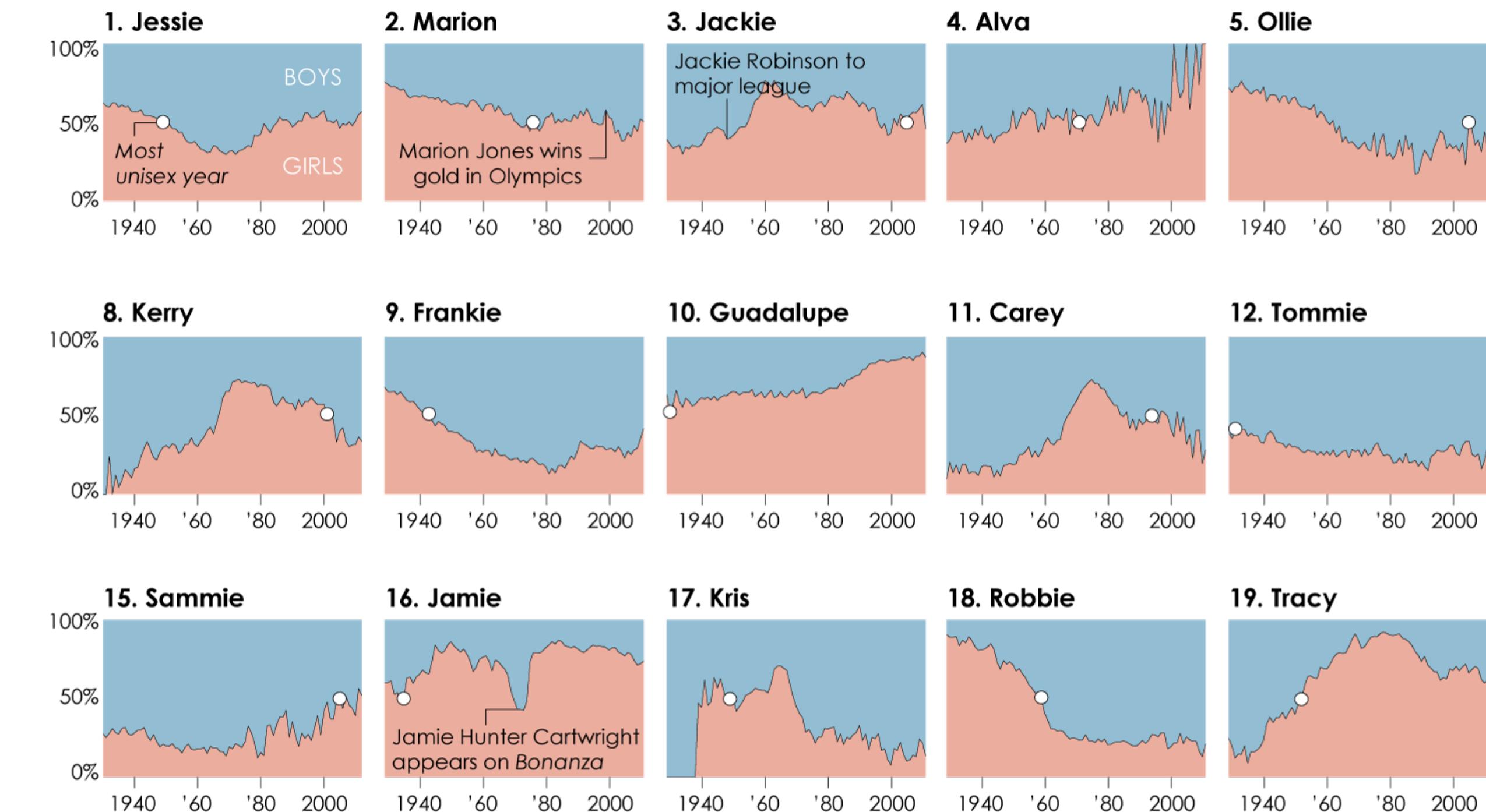
- Enfatiza continuidad horizontal vs. ítems verticales
- datos
  - 1 categ (soporte)
  - 1 ordinal key (tiempo)
  - 1 cuantitativo (USD)
- Datos derivados
  - geometría: capas, altura codifica el cuantitativo
  - 1 cuantitativo (orden de capas)
- Escalabilidad
  - Cientos de keys temporales
  - Docenas a cientos de keys verticales
  - Más que barras apiladas: No requiere espacio intermedio y muchas capas no ocupan todo el gráfico



# Normalized stacked area charts

- Enfatiza continuidad horizontal vs. ítems verticales
- datos
  - 1 categ (sexo)
  - 1 ordinal key (tiempo)
  - 1 cuantitativo (%)
- Datos derivados
  - geometría: capas, altura codifica el cuantitativo
- Escalabilidad
  - Cientos de keys temporales
  - Docenas a cientos de keys verticales
  - Más que barras apiladas: No requiere espacio intermedio y muchas capas no ocupan todo el gráfico

## The Most Unisex Names in US History



Nathan Yau

# Normalized stacked area charts

- Permite comparaciones
- Óptimo cuando además resalta patrones específicos de los datos

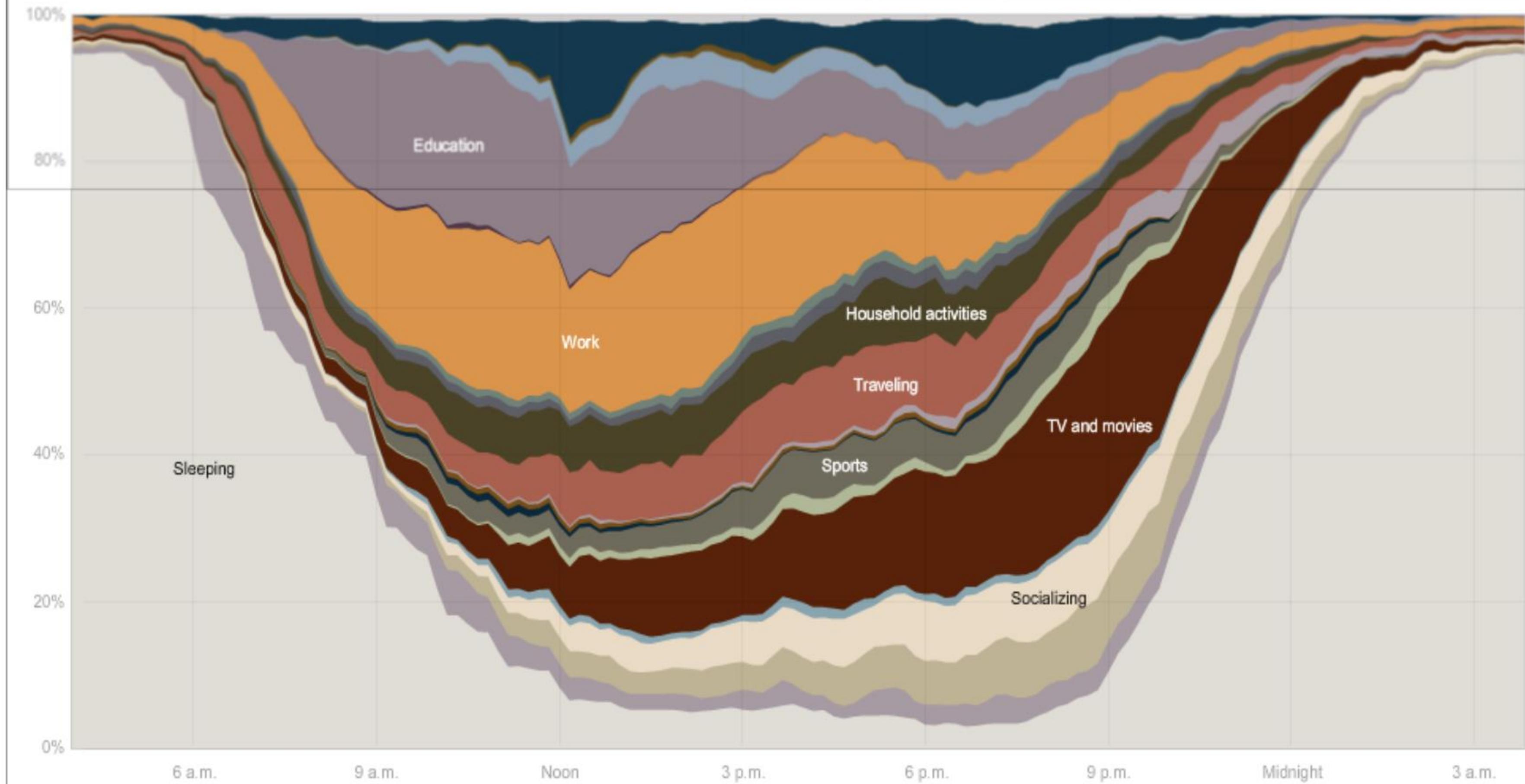
## How Different Groups Spend Their Day

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

### People ages 15 to 24

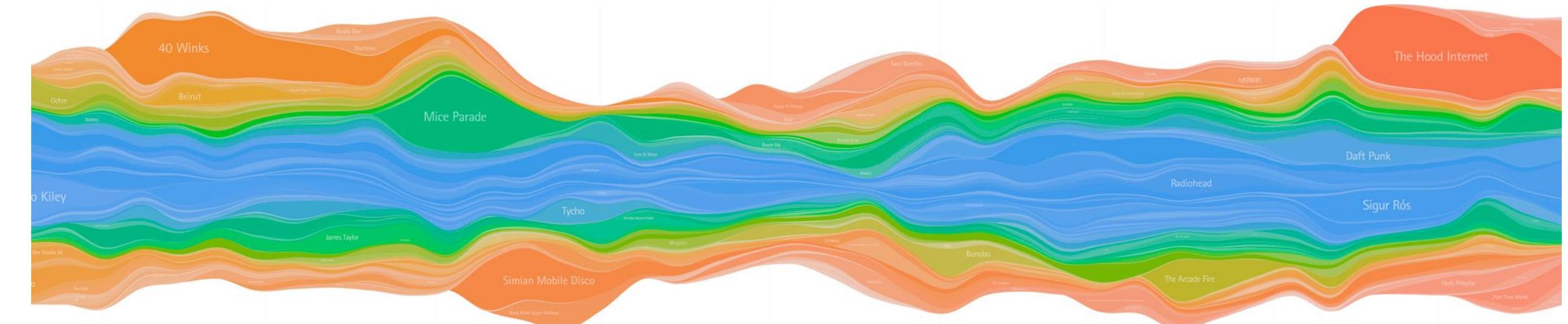
About half of this group is enrolled in school. While the young spend the most time on the telephone, they spend the least time on calls to family members.

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



# Streamgraph

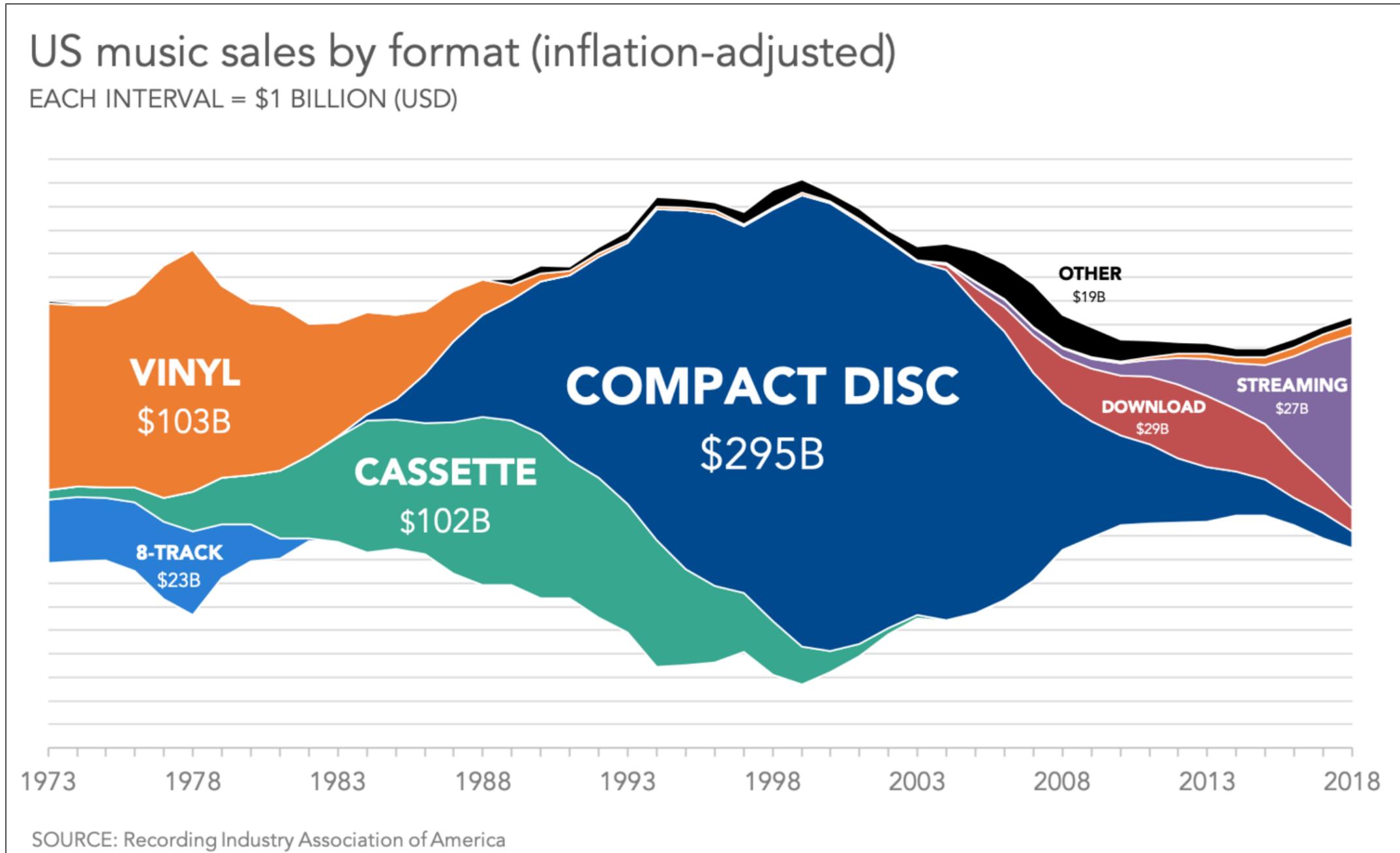
- Generalized stacked graph
  - Enfatiza continuidad horizontal vs ítems verticales
  - datos
    - 1 categ key (artista)
    - 1 ordenado key (tiempo)
    - 1 cuantitativo (counts)
  - Datos derivados
    - Geometría por capas en el tiempo
    - Altura de capas codifica el atr. cuant.
    - 1 cuantitativo (orden de capas)
  - Escalabilidad
    - hundreds of time keys
    - Docenas a cientos de keys
    - Más que barras apiladas: No requiere espacio intermedio y muchas capas no ocupan todo el gráfico



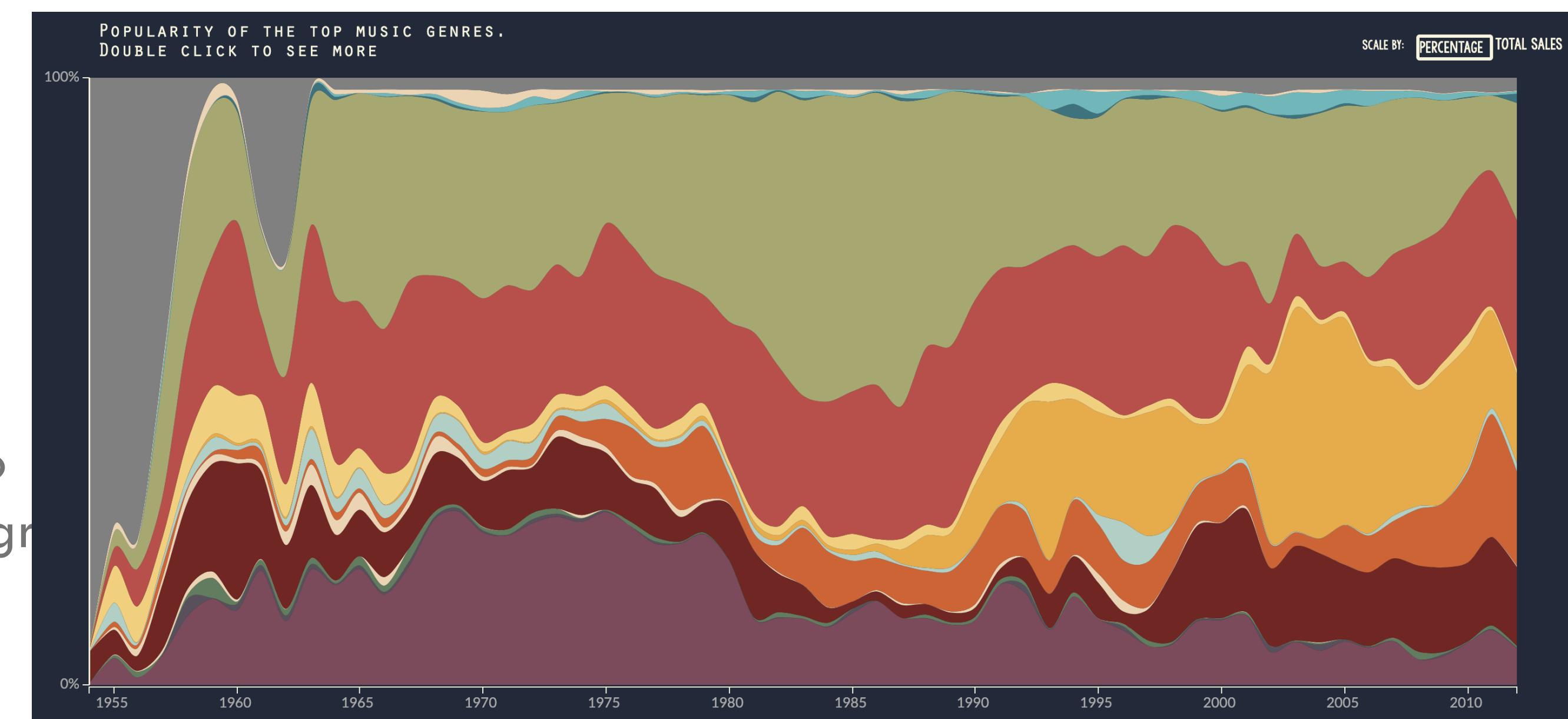
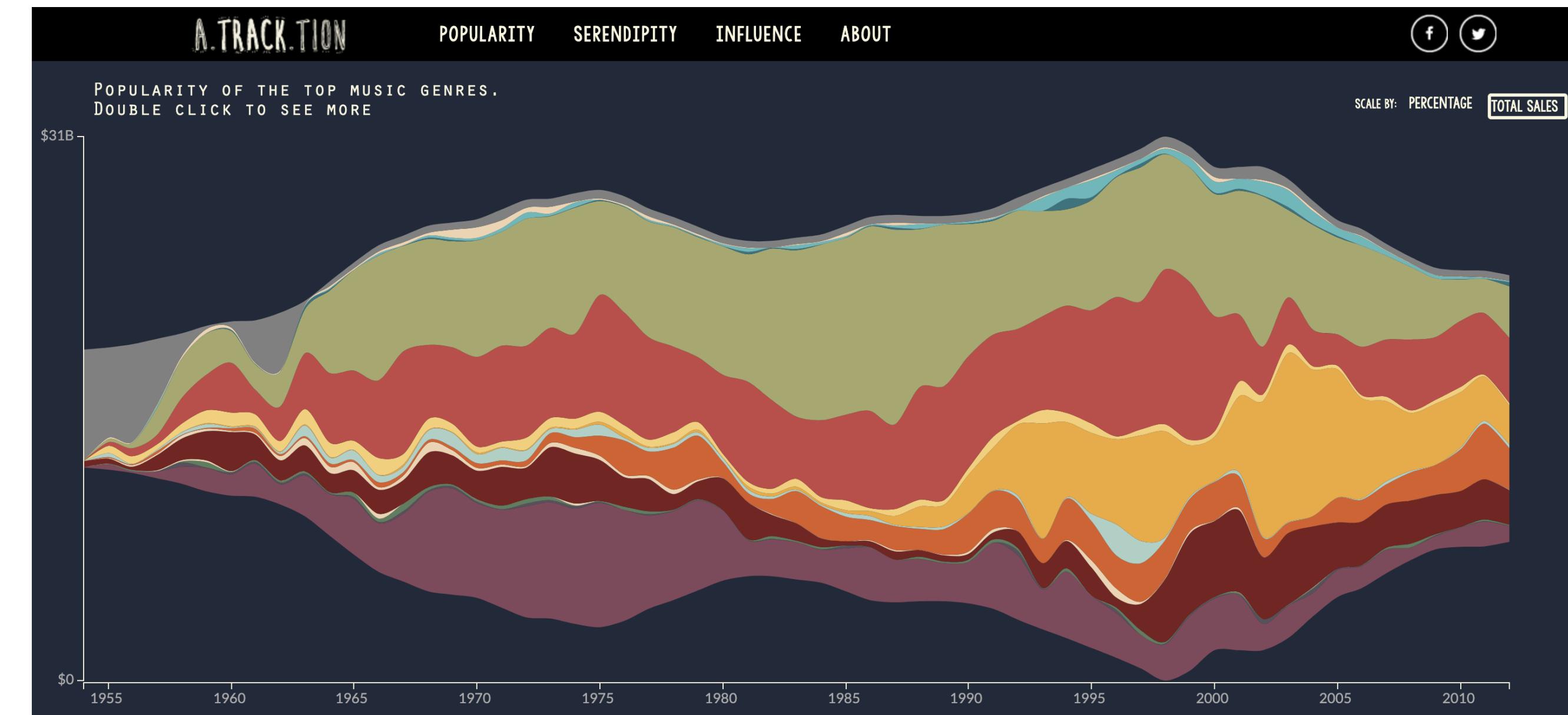
[Stacked Graphs Geometry & Aesthetics. Byron and Wattenberg. IEEE Trans. Visualization and Computer Graphics (Proc. InfoVis 2008) 14(6): 1245–1252, (2008).]

# Streamgraph

- Generalized stacked graph
  - Enfatiza continuidad horizontal vs ítems verticales

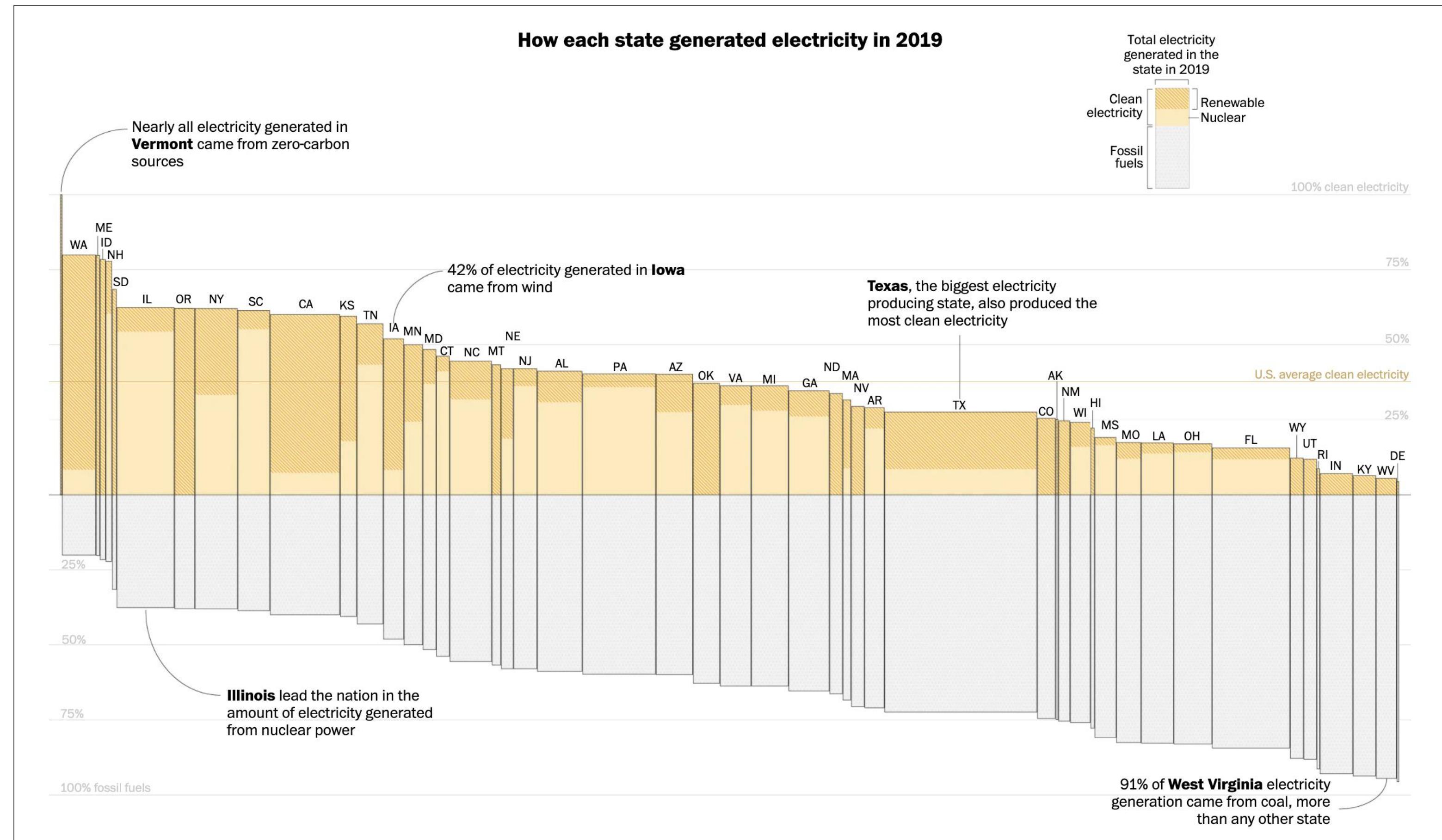


- Docenas a cientos de keys
- Más que barras apiladas: No requiere espacio intermedio y muchas capas no ocupan todo el gr

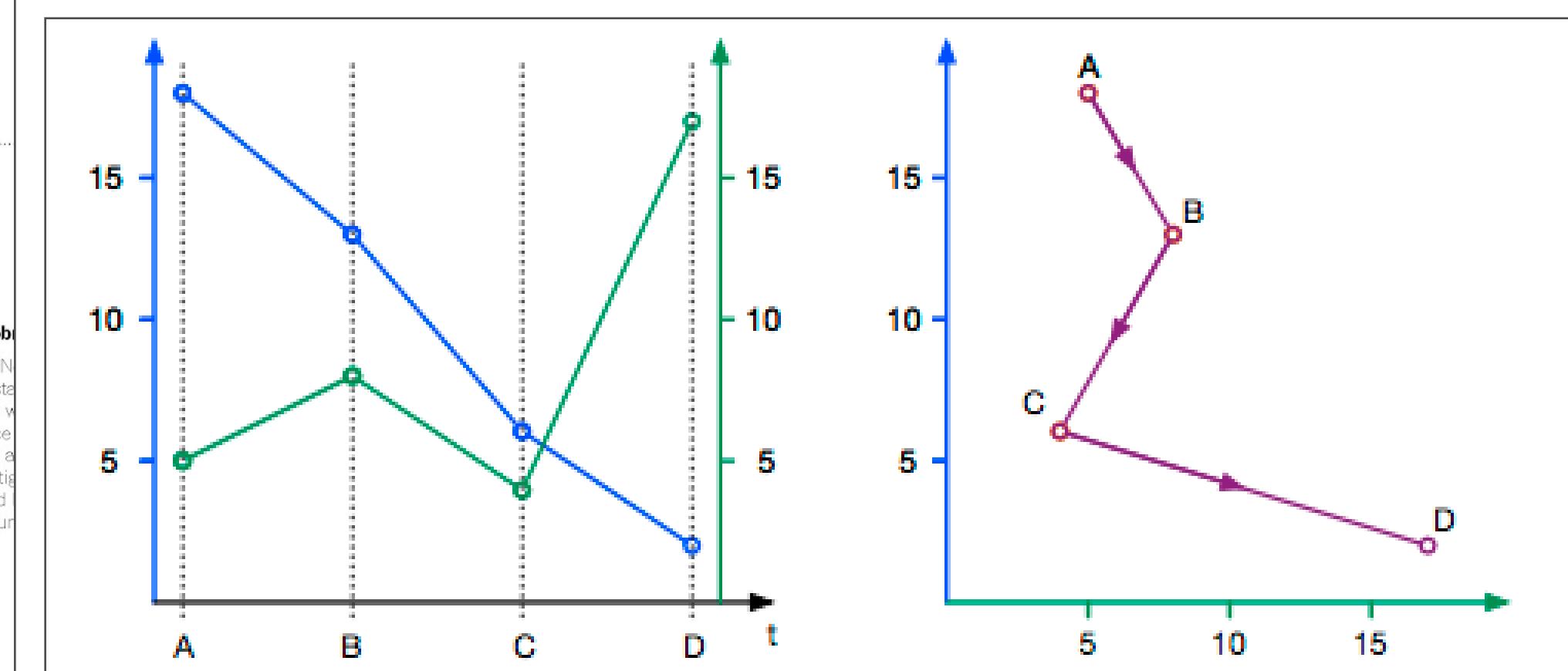
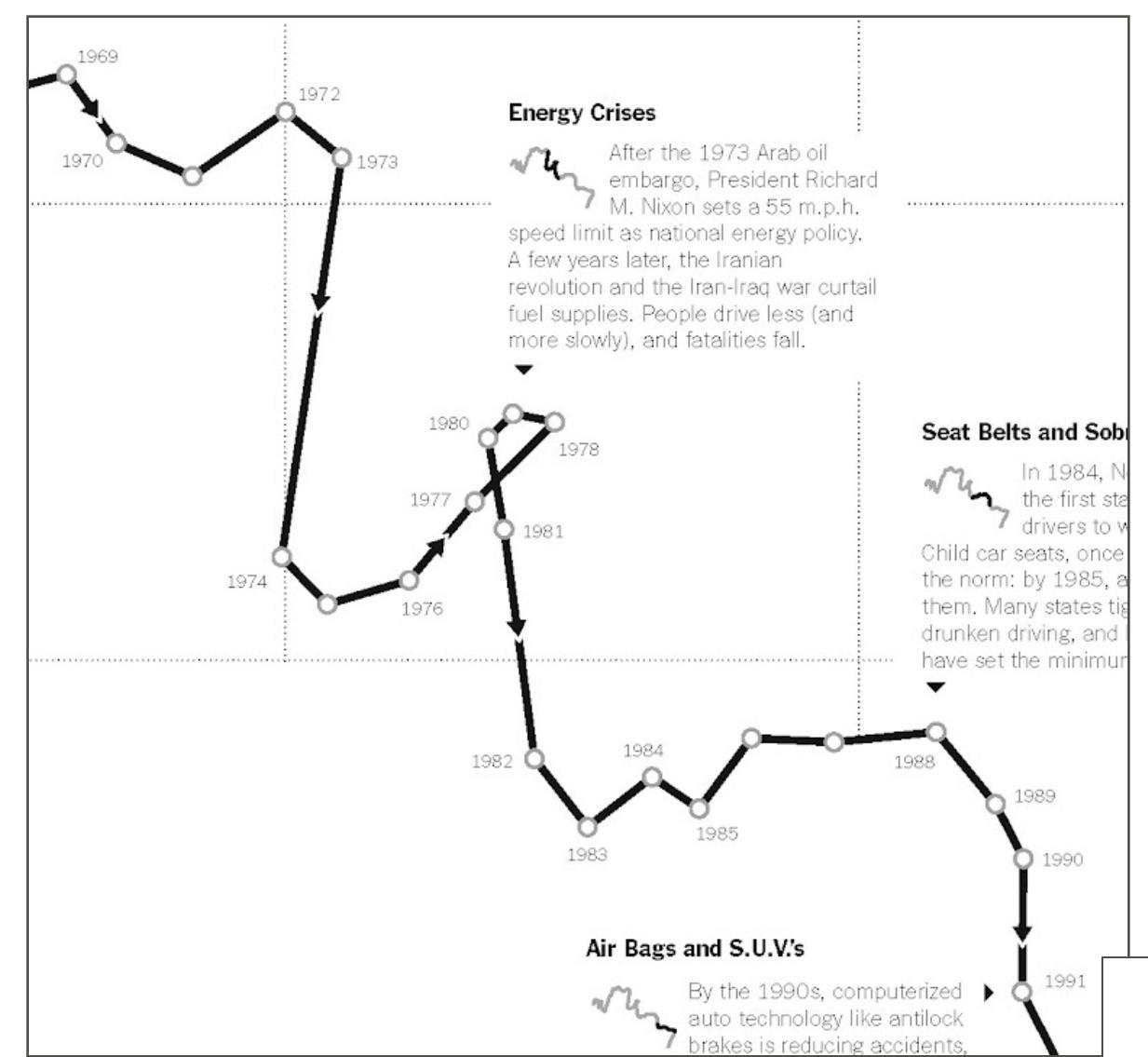


# Mosaic plot

- Similar a stacked bar chart, pero puede incluir una variable más en el ancho de cada barra
- 2 categóricas: división horizontal y división dentro de cada glifo
- 2 cuantitativas: ancho de cada barra y altura (subdividida dentro de cada barra)
- Válido para relaciones parte-todo
- Requieren esfuerzo para interpretarlas, pero pueden mostrar relaciones difíciles de ver en otras gráficas



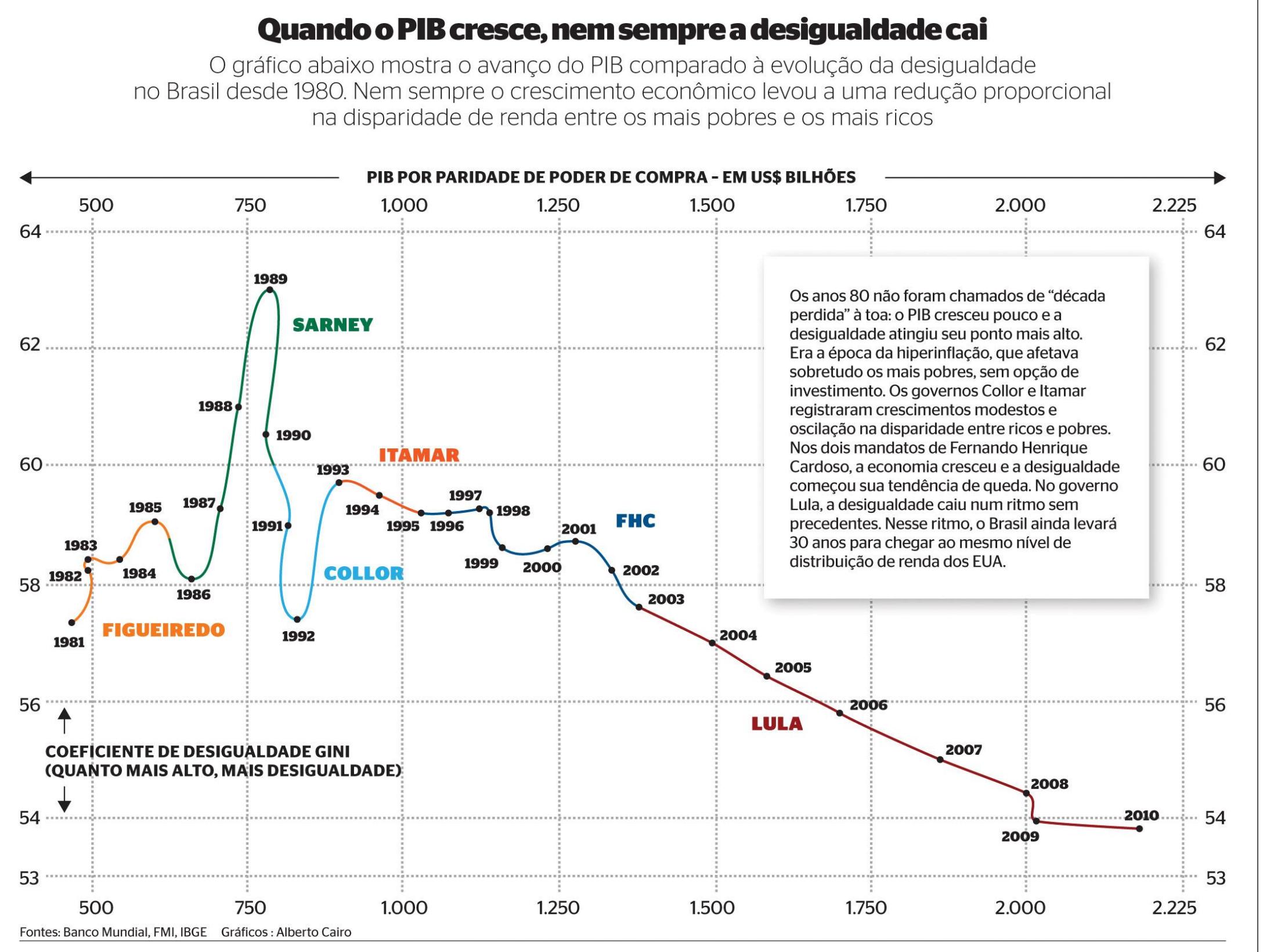
# Connected scatterplots



## Scatterplot con marcas de conexión (líneas)

- Popular en periodismo
- Ejes horiz + vert: Values
- line connection marks: Orden temporal
- Estudio experimental:
  - Gráfica atractiva pero la correlación no queda clara

[The Connected Scatterplot for Presenting Paired Time Series.  
Haroz, Kosara and Franconeri. IEEE TVCG 22(9):2174-86,  
2016.]



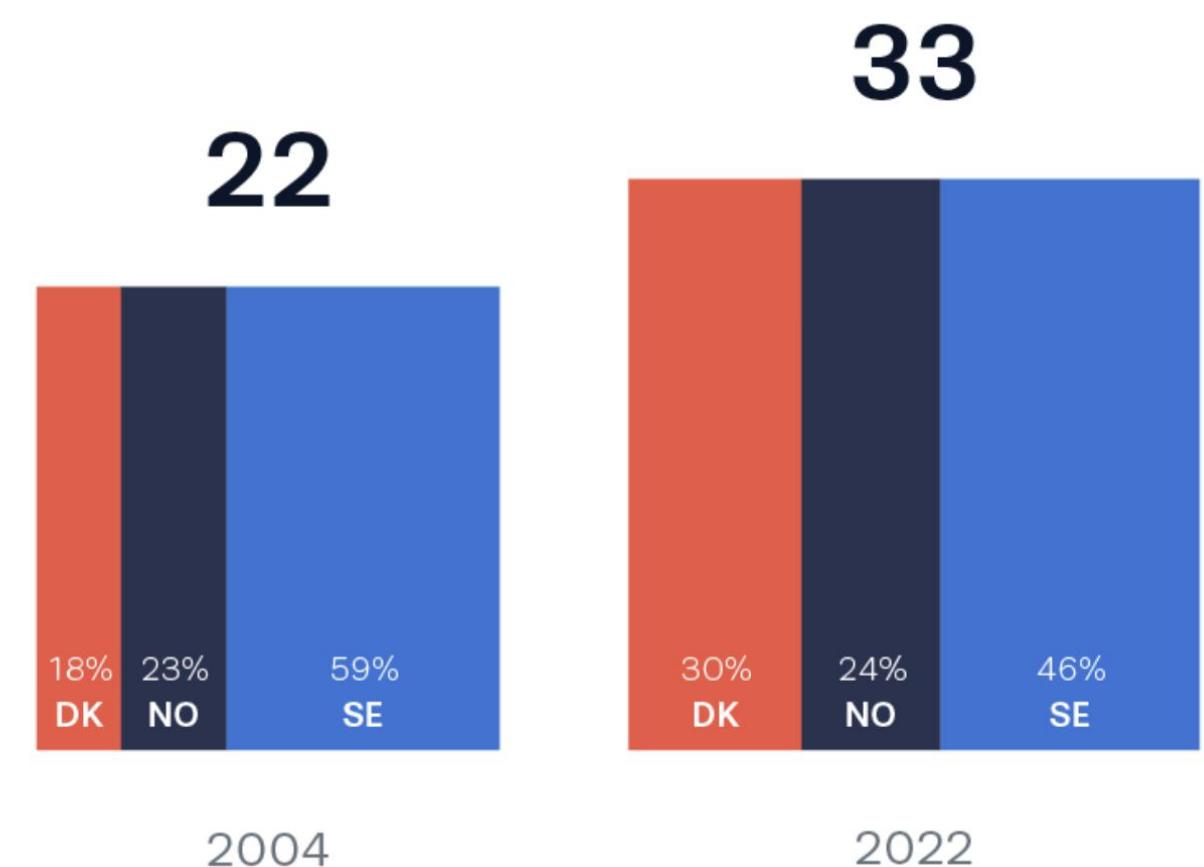
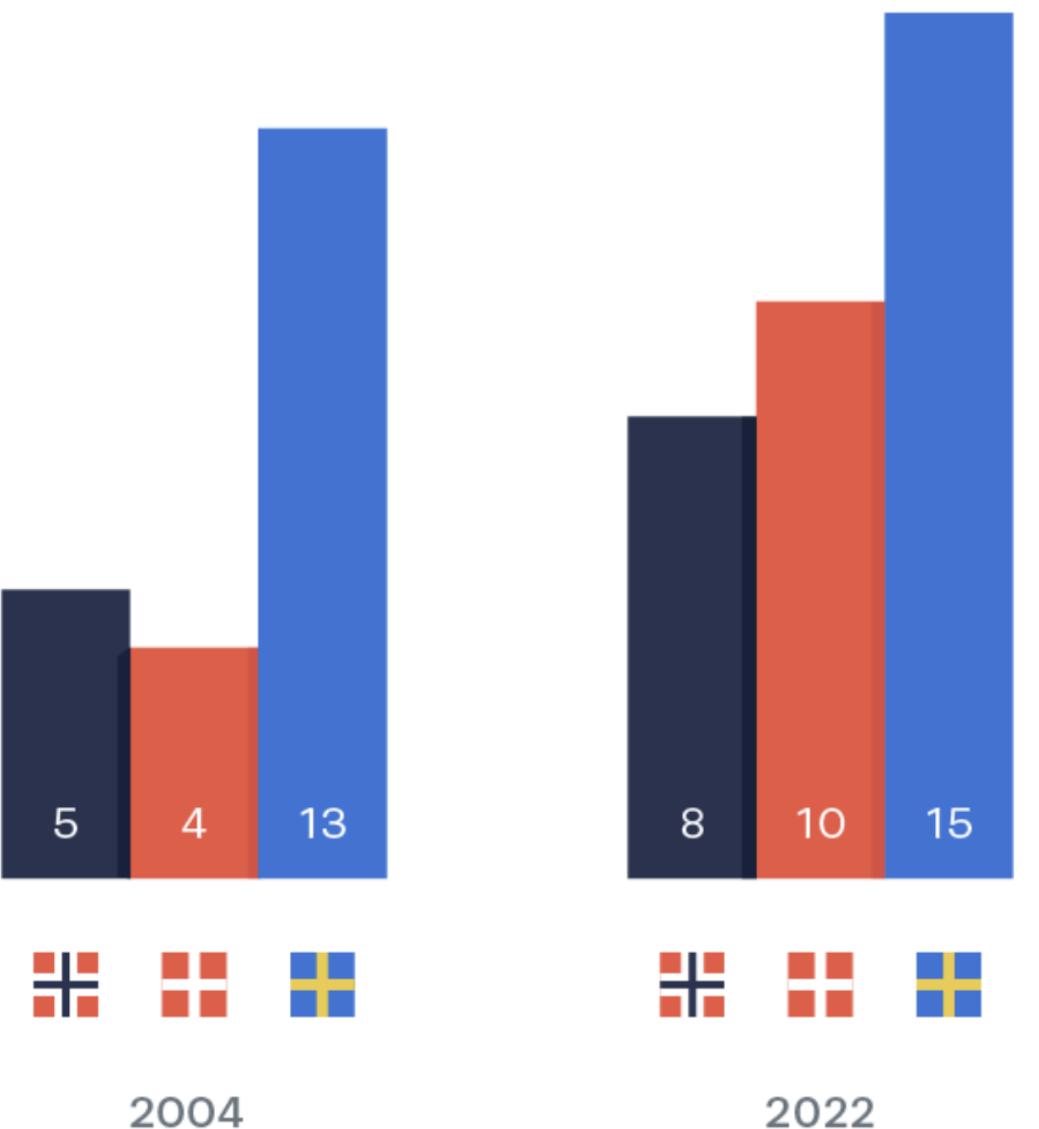


## 1 dataset 100 visualizations

Can we come up with 100 visualizations from one simple dataset?

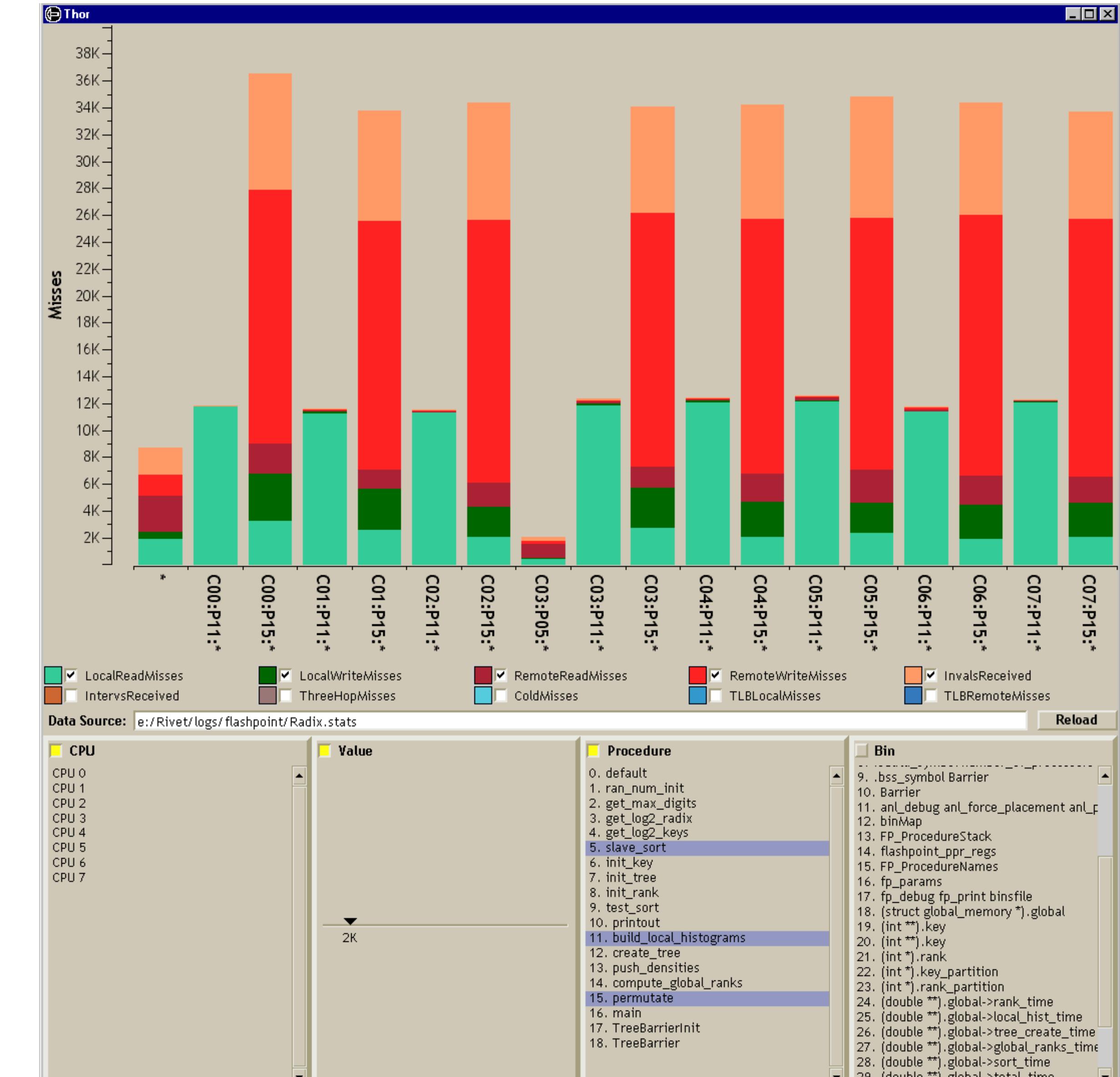
As an information design agency working with data visualization every day, we challenged ourselves to accomplish this using insightful and visually appealing visualizations.

We wanted to show the diversity and complexity of data visualization and how we can tell different stories using limited visual properties and assets.



# Stacked bar chart

- 2 keys, 1 value
- **Datos: 2 categórico y 1 cuantitativo**
- Marcas: Lineas apiladas verticalmente
- **Glifos:** Objetos compuestos por múltiples marcas:
  - Canales: longitud y Tono
- Regiones:
  - Una por glifo
  - Alineadas:
    - Componente más bajo
    - Otros componentes del glifo
- Tareas:
  - Relaciones parte-todo
  - Escalable a <docena de niveles para el atributo apilado; igual a barras para regiones



[Using Visualization to Understand the Behavior of Computer Systems. Bosch. Ph.D. thesis,  
Stanford Computer Science, 2001.]

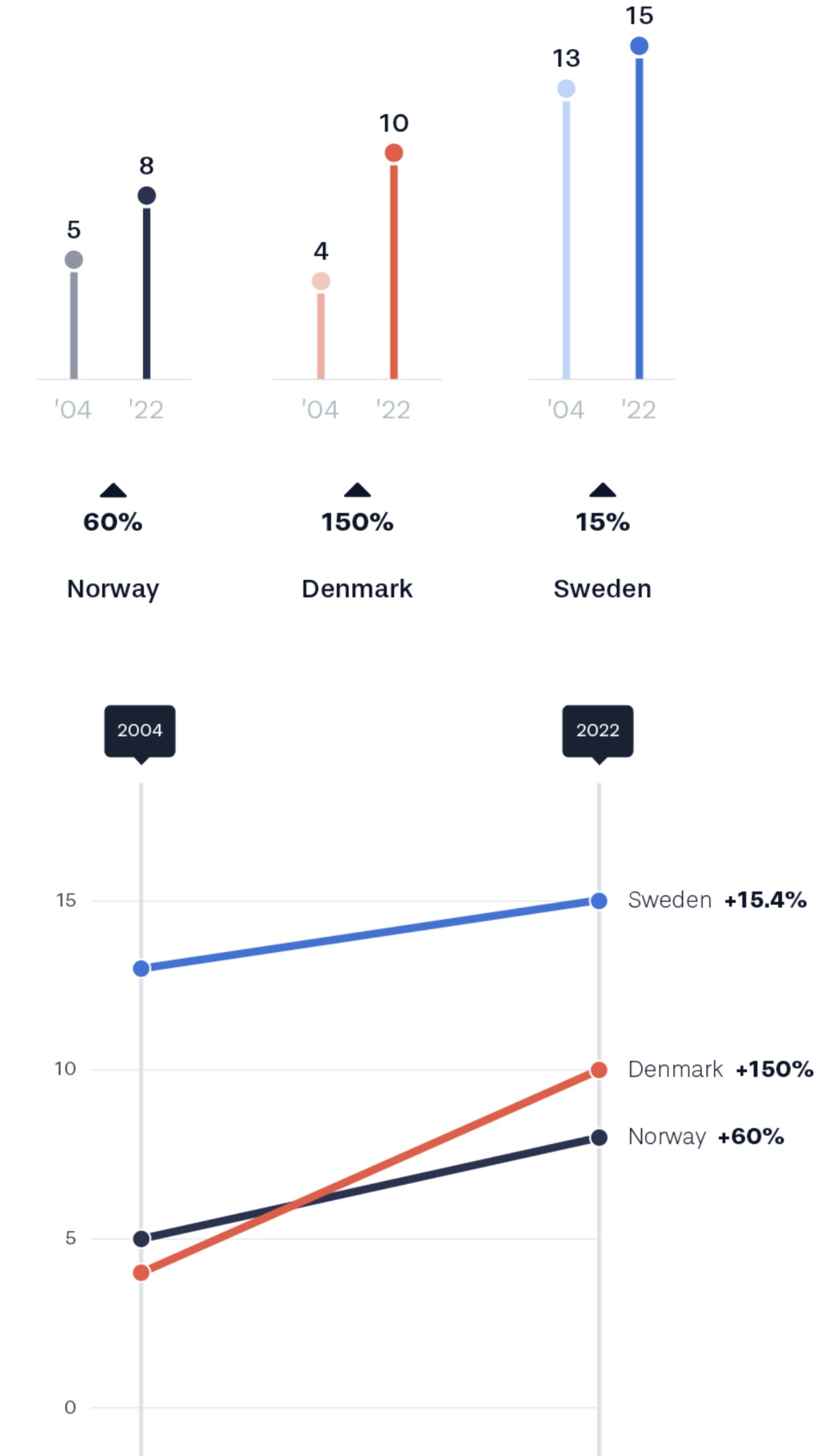
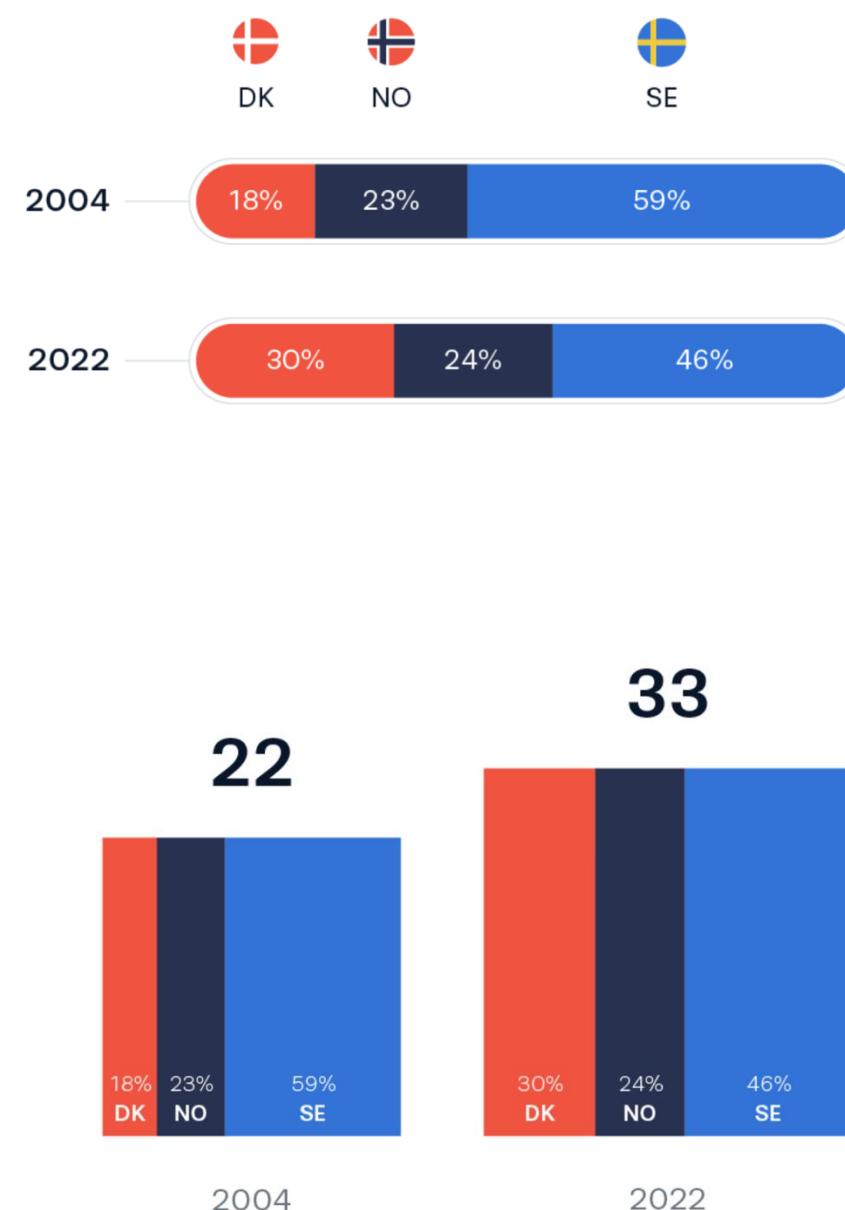
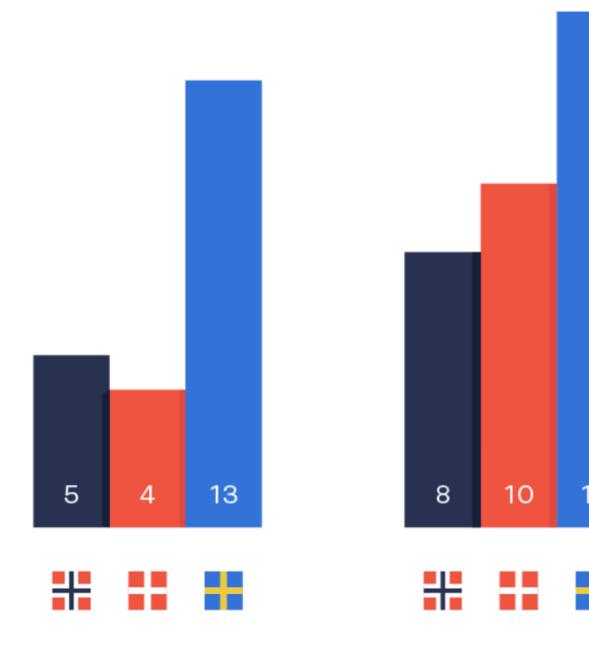
From: Visualization Analysis and Design

# 1 dataset 100 visualizations

Can we come up with 100 visualizations from one simple dataset?

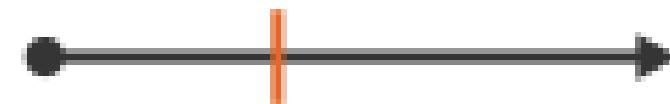
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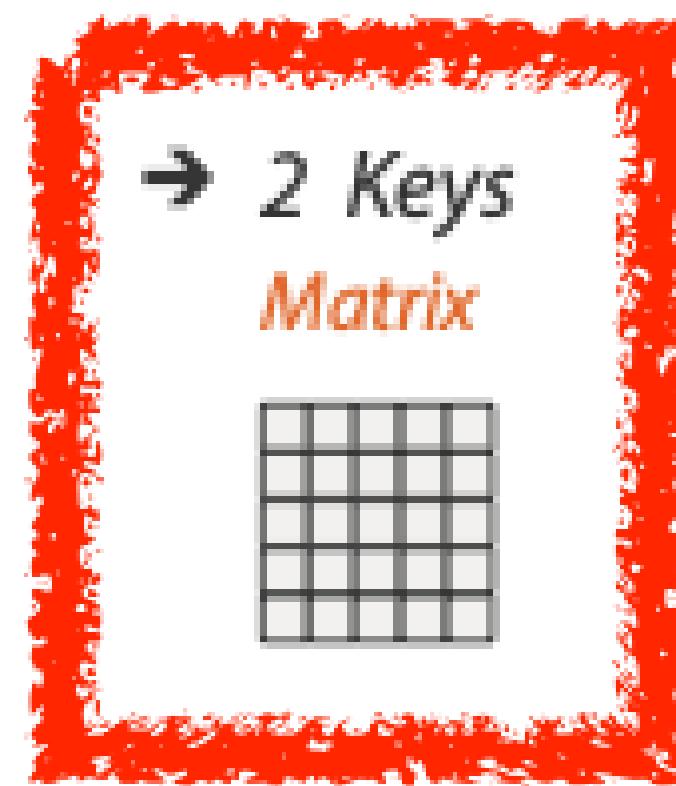
# 2 Keys

→ Express Values



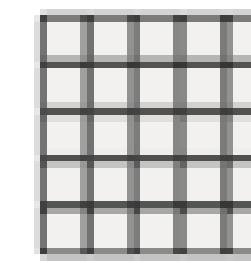
→ 1 Key

*List*



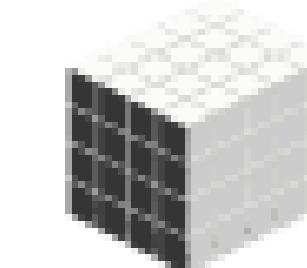
→ 2 Keys

*Matrix*



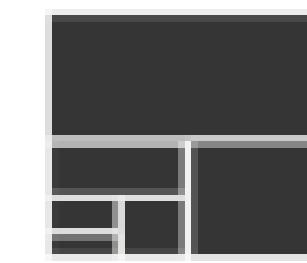
→ 3 Keys

*Volume*



→ Many Keys

*Recursive Subdivision*

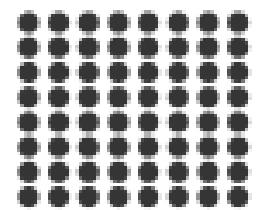


# Heatmap

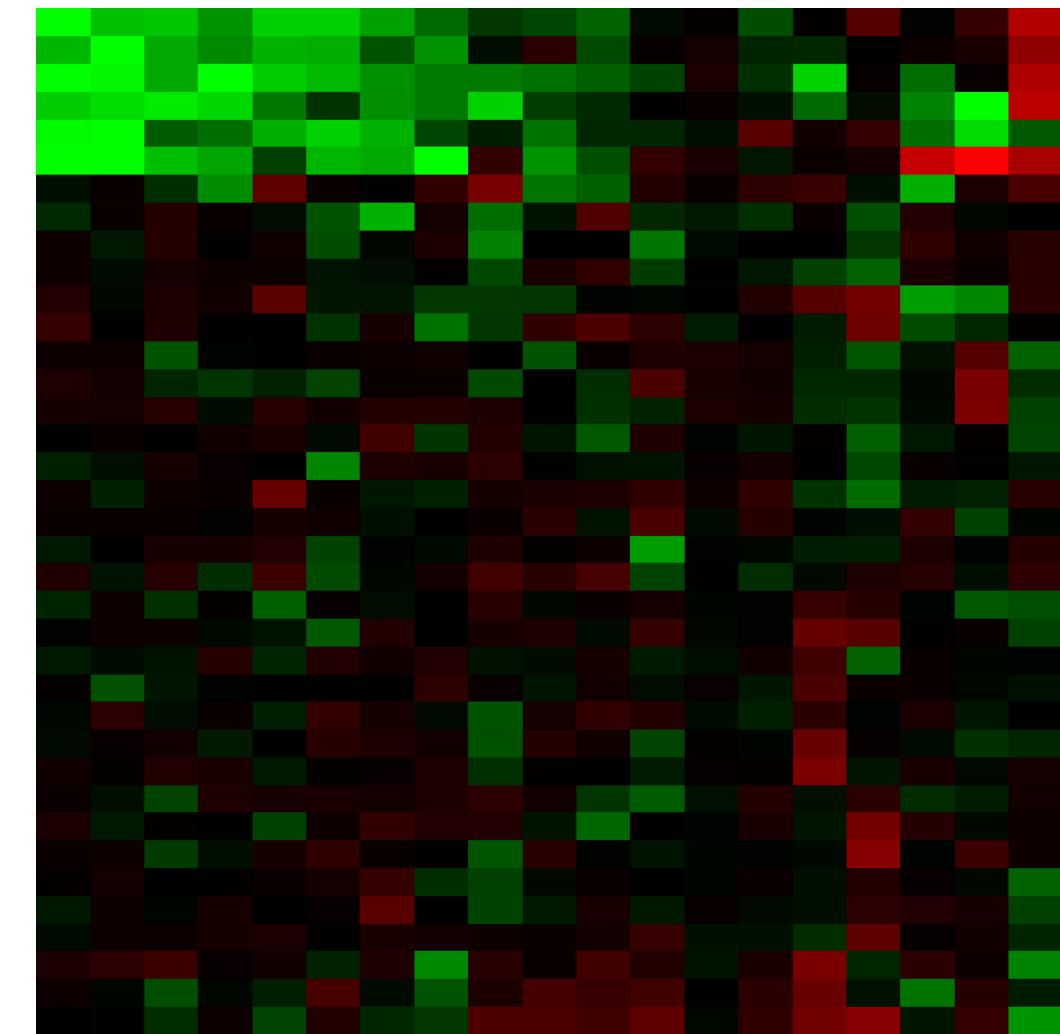
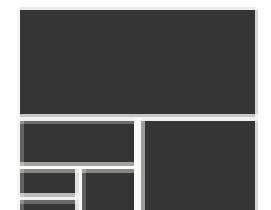
- Dos keys, un valor
- Datos
  - 2 categóricos (gen, condición experimental)
  - 1 cuantitativo (niveles de expresión)
- Marcas: Áreas
  - Separar y alinear en matriz 2D
  - Indexado por los 2 atributos categóricos
- Canales
  - color por cuant.
  - Mapa de color divergente ordenado
- Tarea
  - Identificar + clusters y outliers
- Escalabilidad
  - 1M items, 100s de niveles categ., ~10 niveles en el attr. quant

## ④ Layout Density

→ Dense



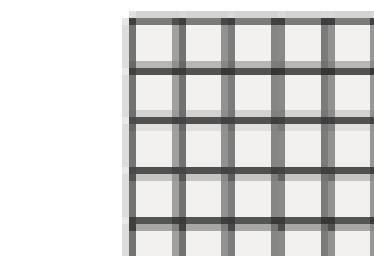
→ Space-Filling



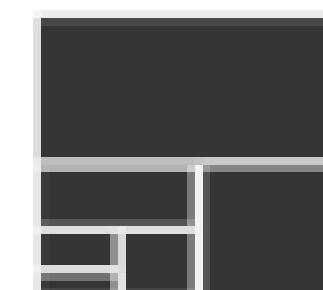
→ 1 Key  
List



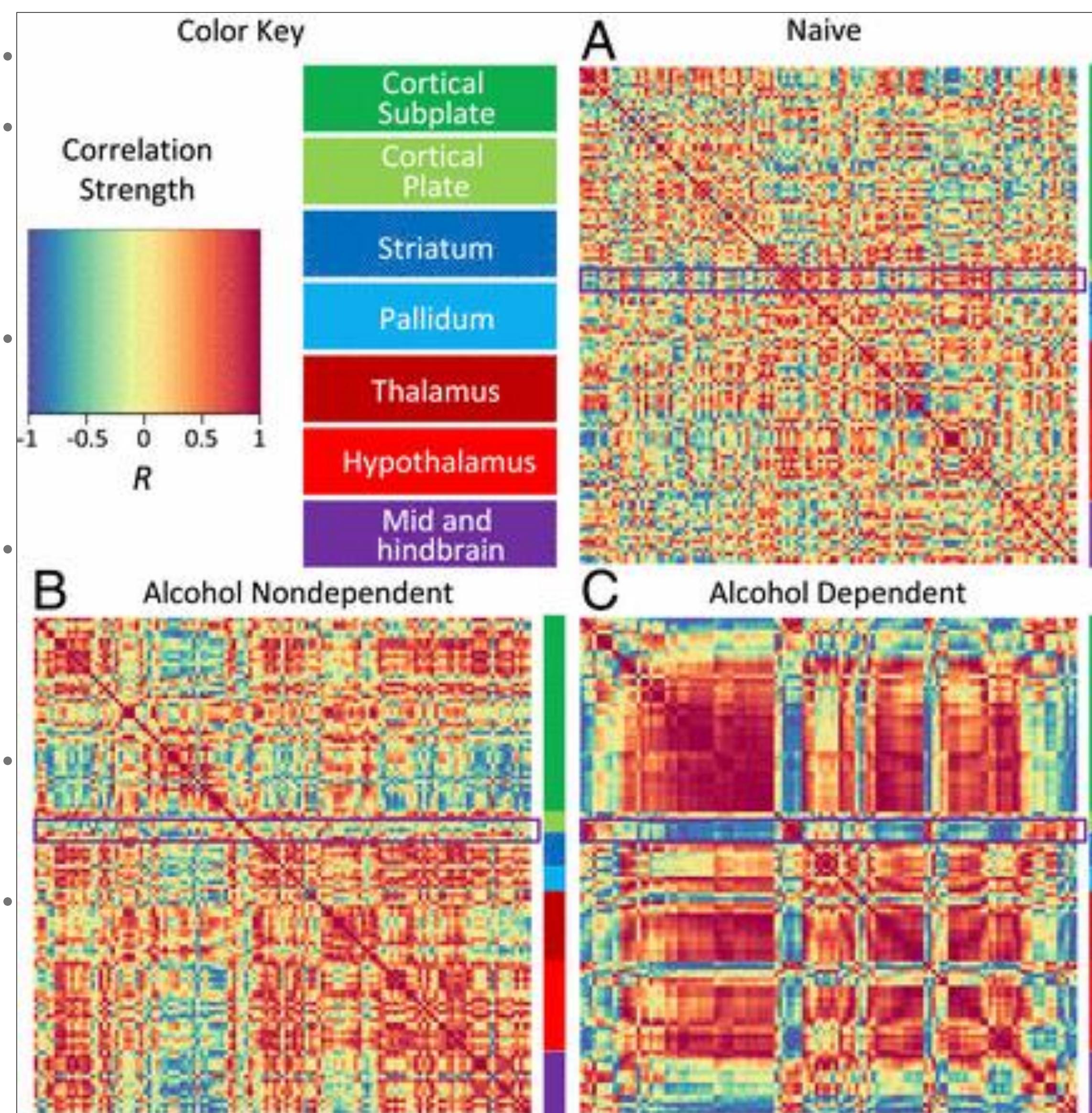
→ 2 Keys  
Matrix



→ Many Keys  
Recursive Subdivision

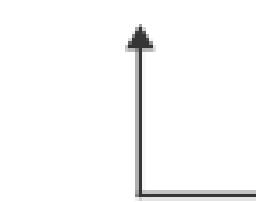


# Heatmap

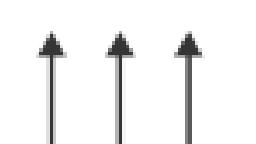


④ Axis Orientation

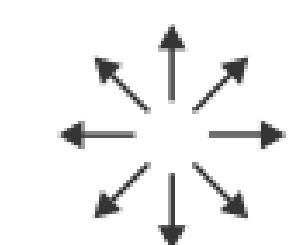
→ Rectilinear



→ Parallel

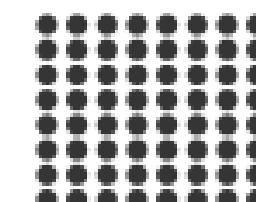


→ Radial

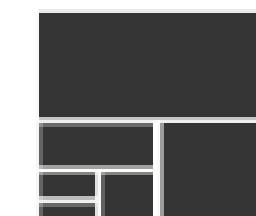


④ Layout Density

→ Dense



→ Space-Filling



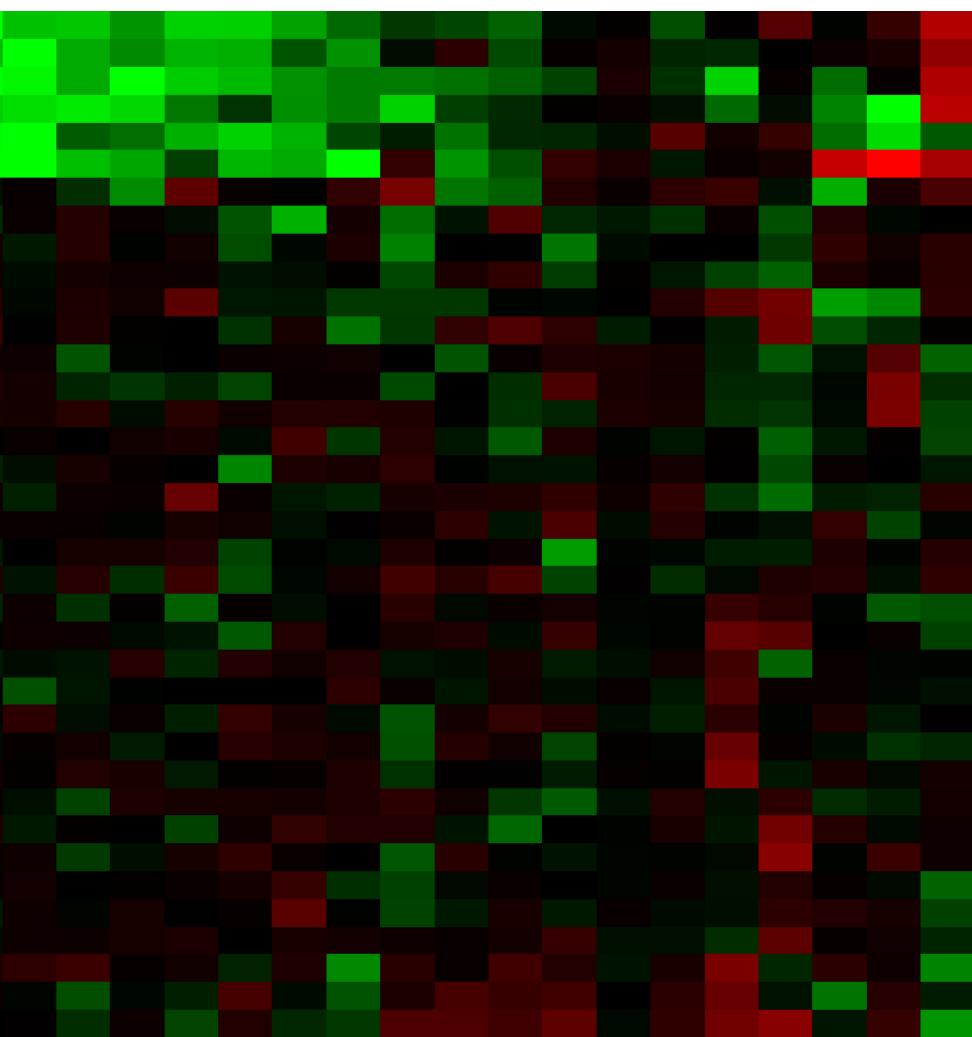
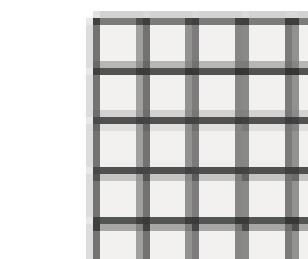
→ 1 Key

List

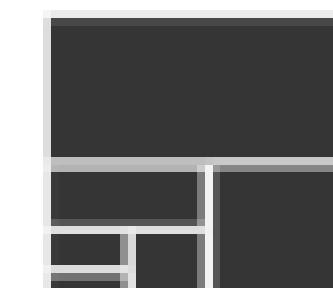


→ 2 Keys

Matrix



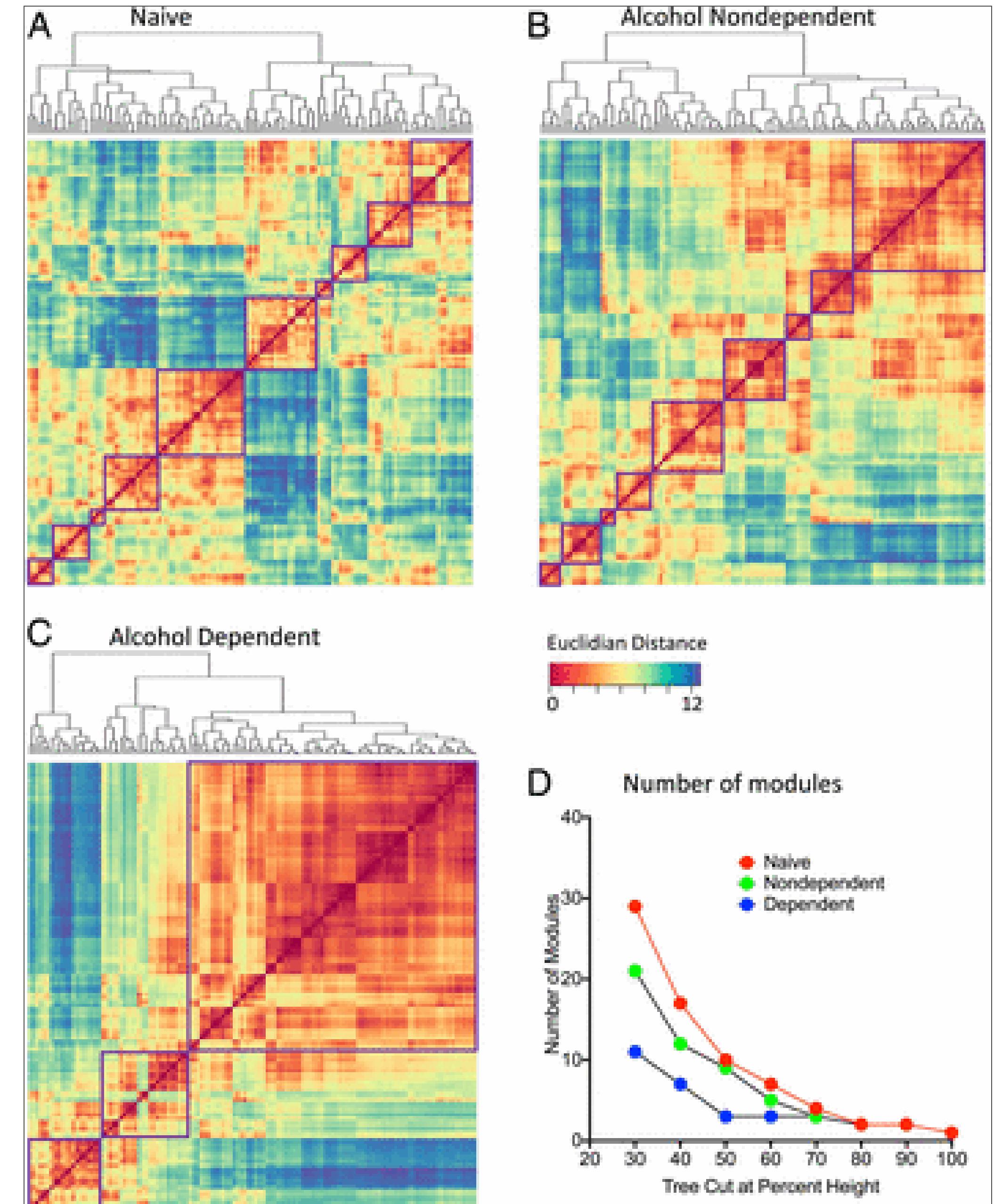
→ Many Keys  
Recursive Subdivision



# Cluster heatmap

Además de lo anterior:

- Datos derivados: Clusters jerárquicos
- Dendrogramas
  - Relaciones jerárquicas en árbol conectadas por líneas
  - Alineados por las hojas del árbol para comparar mejor la longitud de las ramas
- Heatmap
  - Marcas (re-)ordenadas según clusters
- Tareas:
  - Evaluar + calidad de clusters automáticos.
  - Detectar + nuevos patrones en la correlación



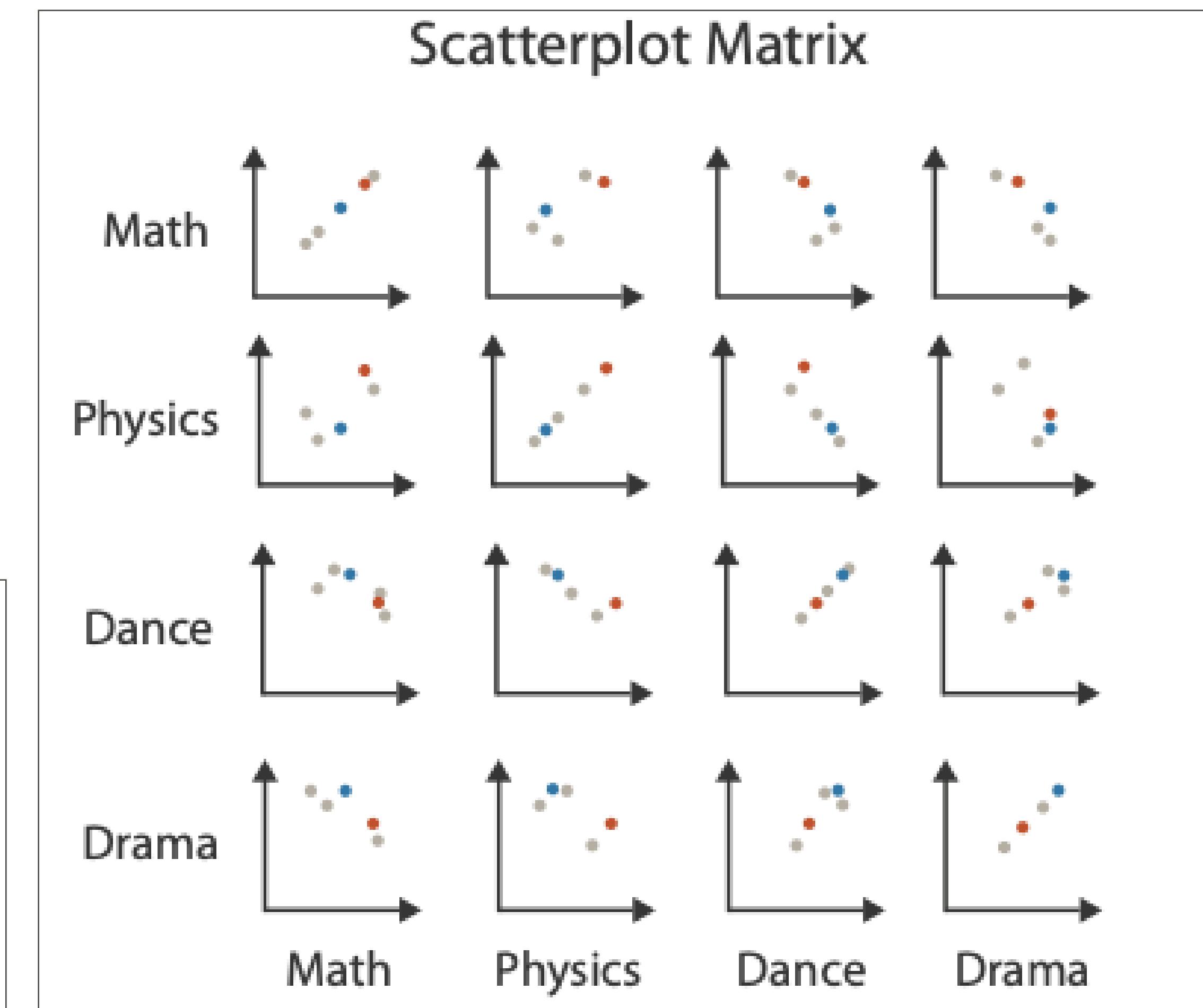
Brain-wide functional architecture remodeling by alcohol dependence and abstinence. Kimbrough, A., et al. (2020)

# Scatterplot matrix

## Scatterplot matrix (SPLOM)

- Matriz densa donde cada celda contiene una gráfica entera.
- Muestra todas las combinaciones posibles de pares de atributos
- Ejes rectilíneos, marcas: puntos
- Tareas:
  - Detectar + tendencias, correlaciones, outliers
- Escalabilidad:
  - Una docena de atributos
  - Docenas a cientos de items

Table				
	Math	Physics	Dance	Drama
	85	95	70	65
	90	80	60	50
	65	50	90	90
	50	40	95	80
	40	60	80	90



after [Visualization Course Figures. McGuffin, 2014. <http://www.michaelmcguffin.com/courses/vis/>]

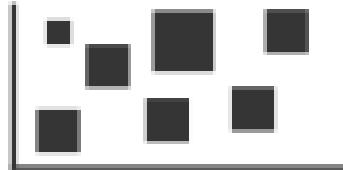
# Arrange tables

## ④ Express Values

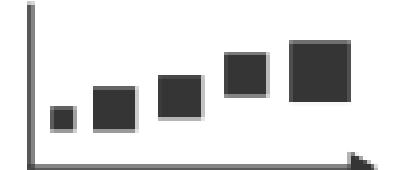


## ④ Separate, Order, Align Regions

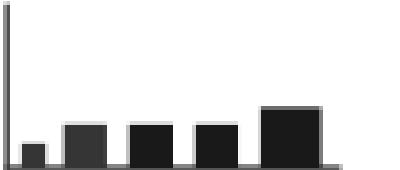
→ Separate



→ Order



→ Align



- Existen distintos tipos de tablas según el número de claves
- Key=Clave primaria- identificador único de cada observación

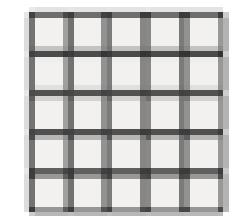
→ 1 Key

*List*



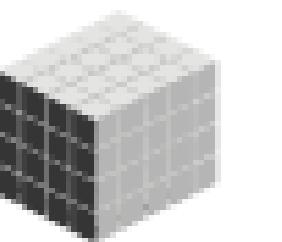
→ 2 Keys

*Matrix*



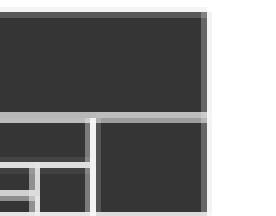
→ 3 Keys

*Volume*



→ Many Keys

*Recursive Subdivision*

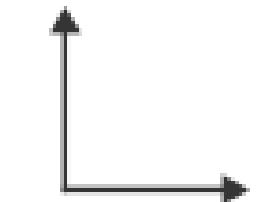


Para ordenar los datos también se tiene en cuenta:

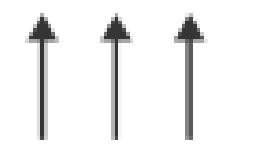
- Orientación de los ejes
- Densidad del Layout: Densa o exhaustiva

## ④ Axis Orientation

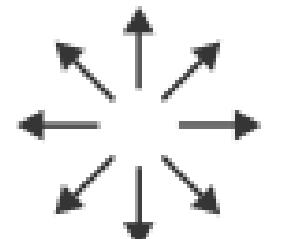
→ Rectilinear



→ Parallel

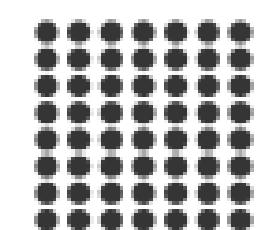


→ Radial

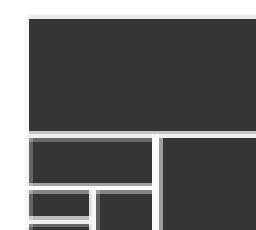


## ④ Layout Density

→ Dense



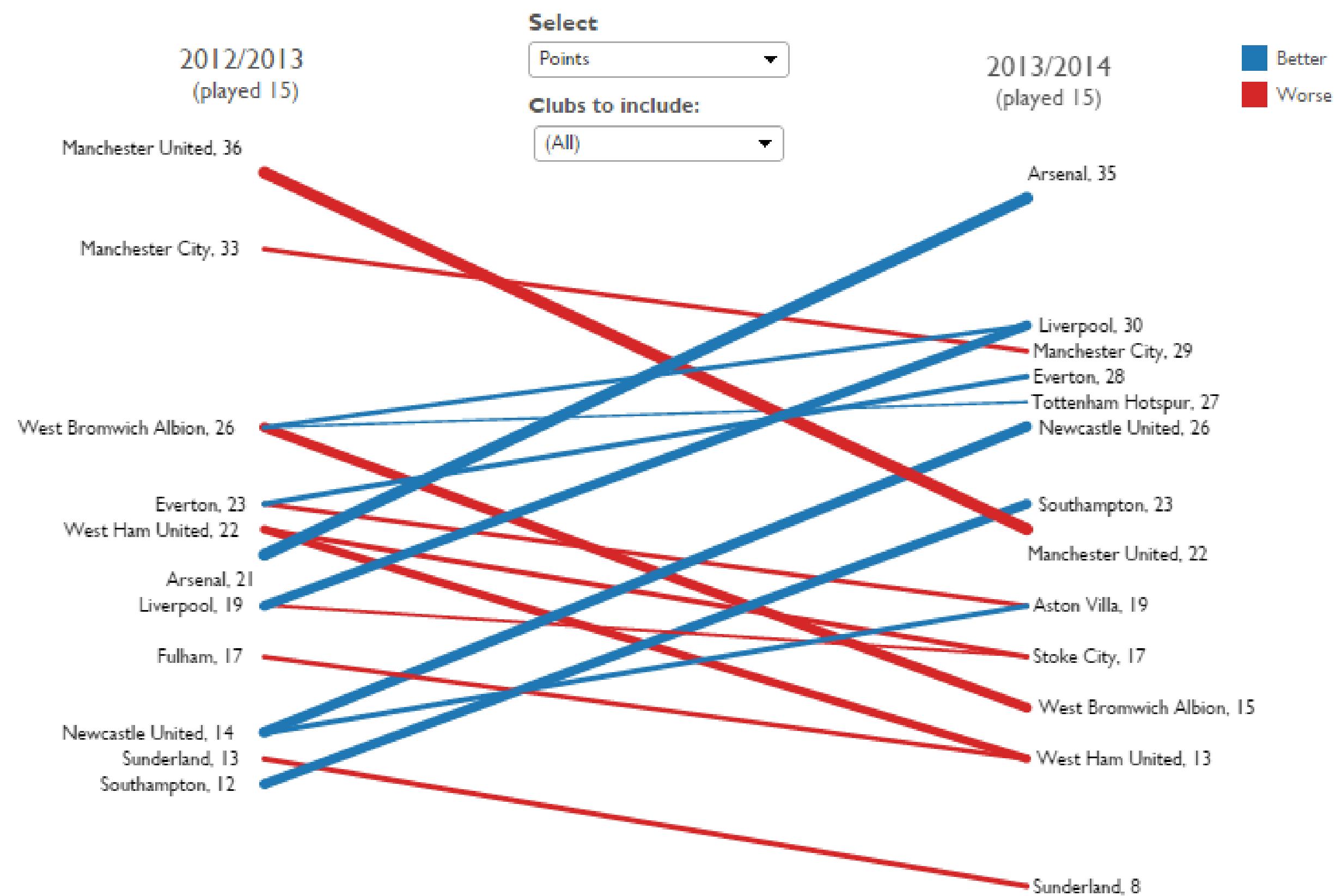
→ Space-Filling



# Slopegraphs

- Resalta el cambio entre valores de un ranking
- Datos
  - 2 valores cuantitativos
  - (1 atributo derivado: cambio de magnitud)
- Marcas: puntos y líneas de conexión
- Canales:
  - 2 pos. vertical: Expresar valores
  - linewidth/tamaño, color
- Tarea:
  - Resaltar cambios en un ranking
- Escalabilidad:
  - Cientos de niveles

Barclay's Premier League Tables: Comparing 2012/2013 Starts to 2013/2014 Starts



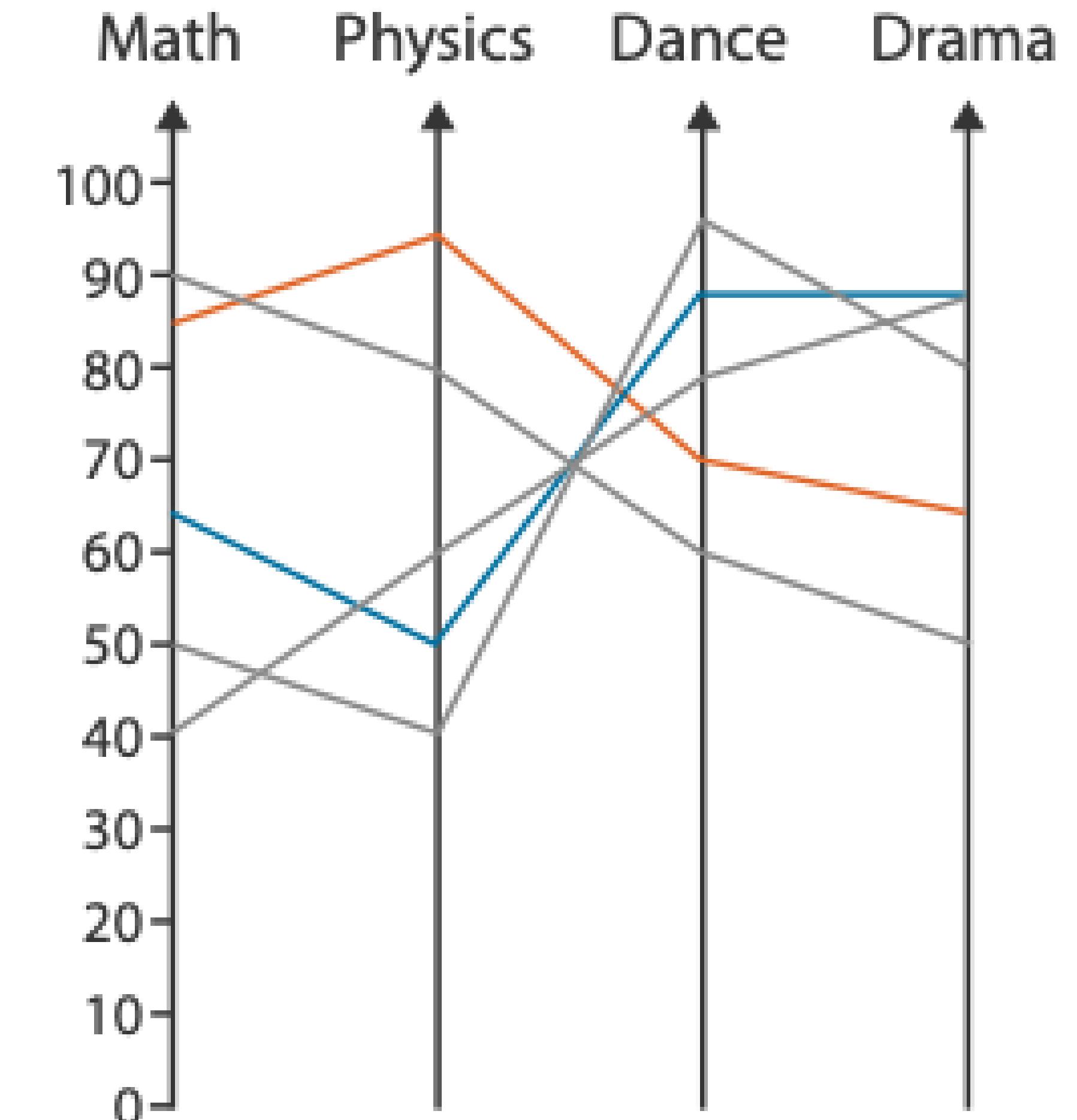
<https://public.tableau.com/profile/ben.jones#!/vizhome/Slopegraphs/Slopegraphs>

# Coordenadas paralelas

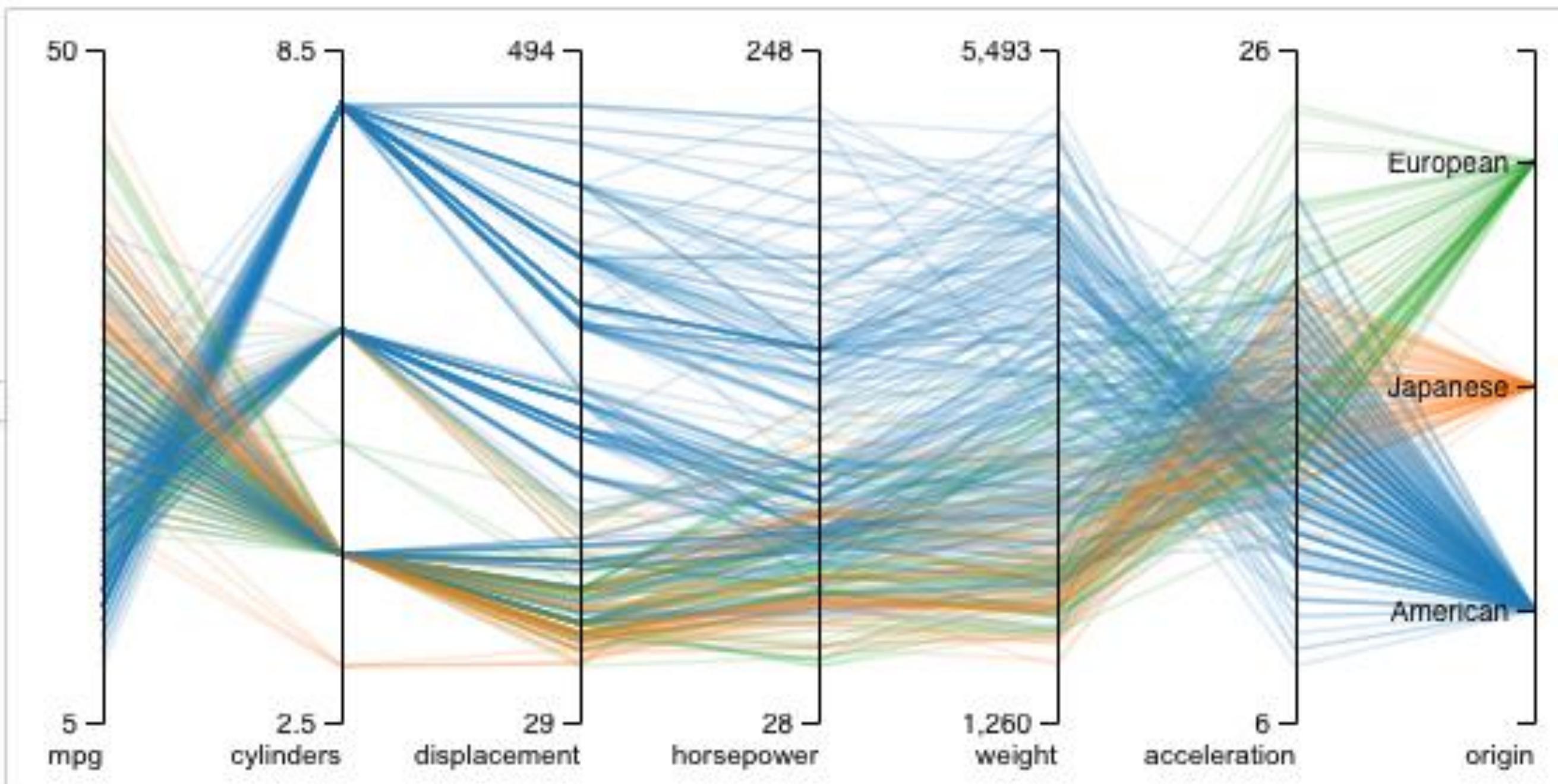
- Muestra un número X de atributos cuantitativos sobre ejes en paralelo.
- Marcas: puntos sobre cada eje según su valor
- Líneas zig-zag representan ítems a través de los ejes
- Tareas:
  - Identificar correlaciones
  - Overview de todos los atributos
  - outliers
- **Ordenar los ejes no es trivial**
- Escalabilidad:
  - Docenas de atributos.
  - Cientos de ítems.

Table				
	Math	Physics	Dance	Drama
	85	95	70	65
	90	80	60	50
	65	50	90	90
	50	40	95	80
	40	60	80	90

## Parallel Coordinates



# Coordenadas paralelas



Visflow.org

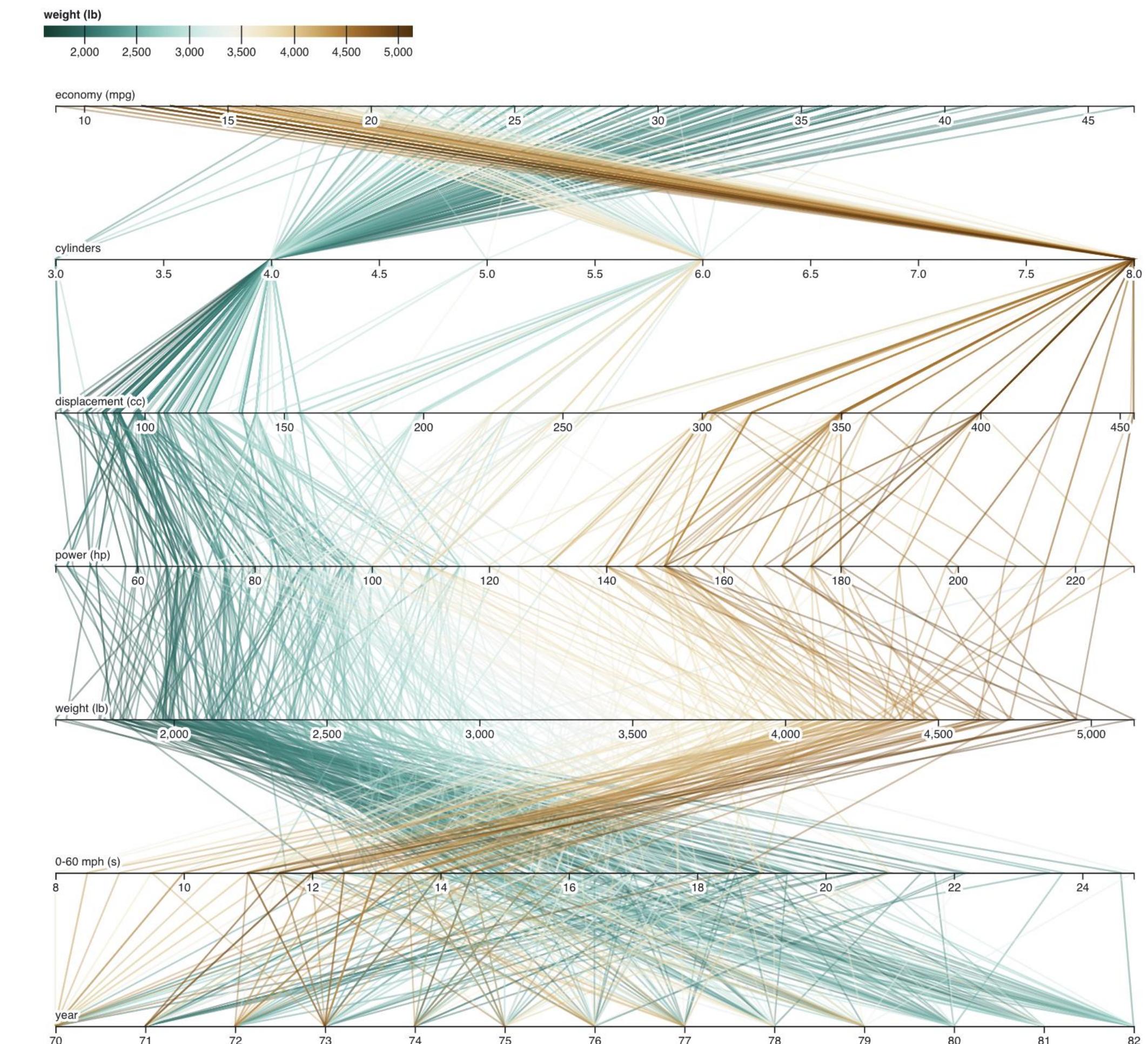
Correlaciones negativas entre eficiencia y cilindros

Positiva entre cilindros, ccs y potencia

Negativa para peso y aceleración

El último eje y el color muestran país de procedencia

Difícil escoger el orden de los ejes (opciones automáticas e interactivas).



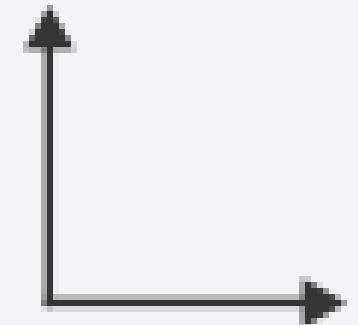
Mike Bostock

# Orientación: Limitaciones

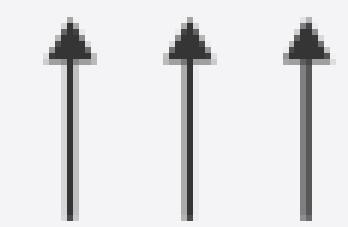
- Rectilinear:
  - No escalable en número de ejes
    - 2 ejes óptimo
    - 3 problemático
    - 4+ imposible
- Paralelo:
  - No intuitivo, tiempo de entrenamiento

## → Axis Orientation

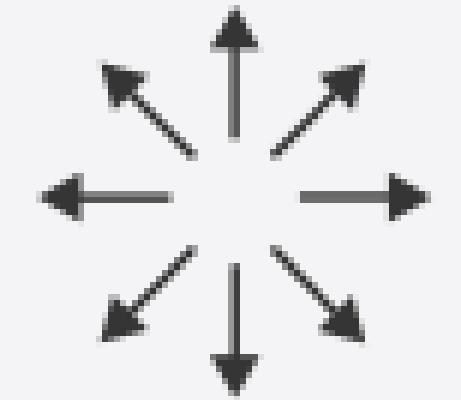
→ Rectilinear



→ Parallel



→ Radial

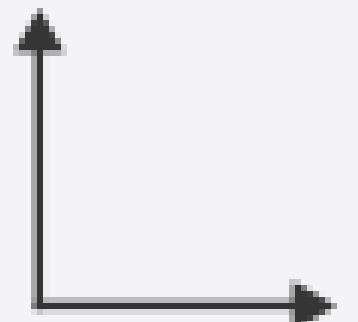


# Orientación: Limitaciones

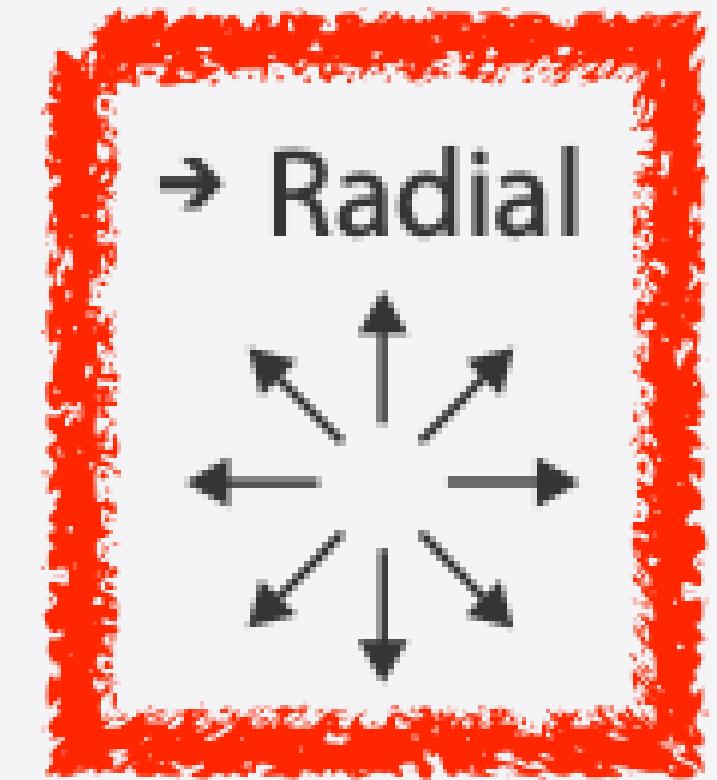
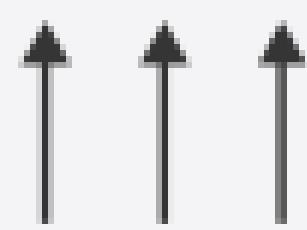
- Rectilinear:
  - No escalable en número de ejes
    - 2 ejes óptimo
    - 3 problemático
    - 4+ imposible
- Paralelo:
  - No intuitivo, tiempo de entrenamiento

## → Axis Orientation

→ Rectilinear

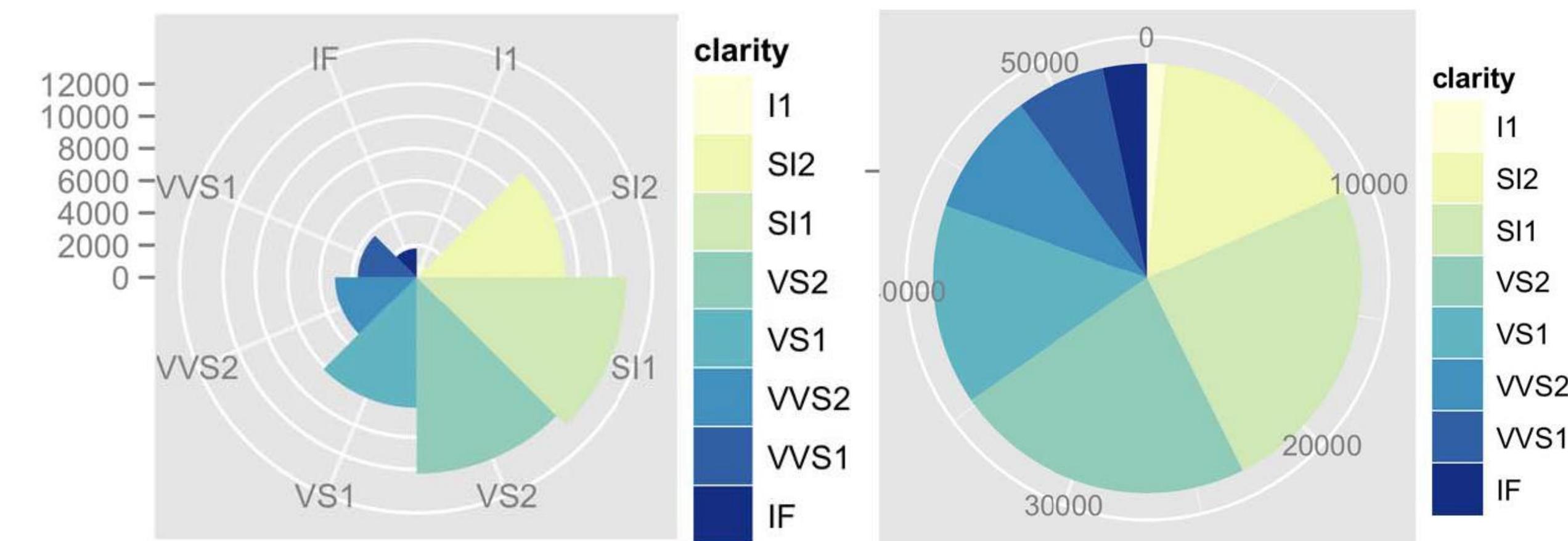
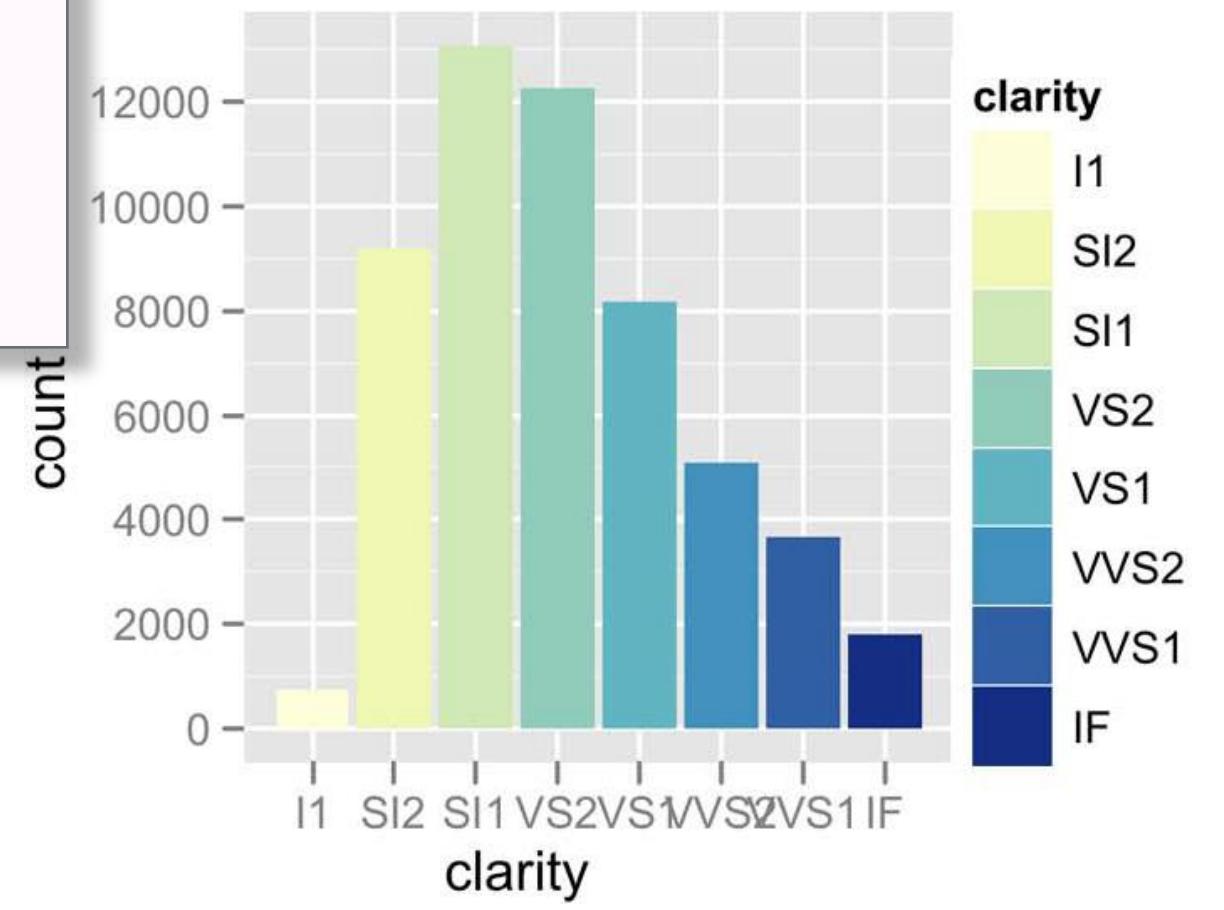
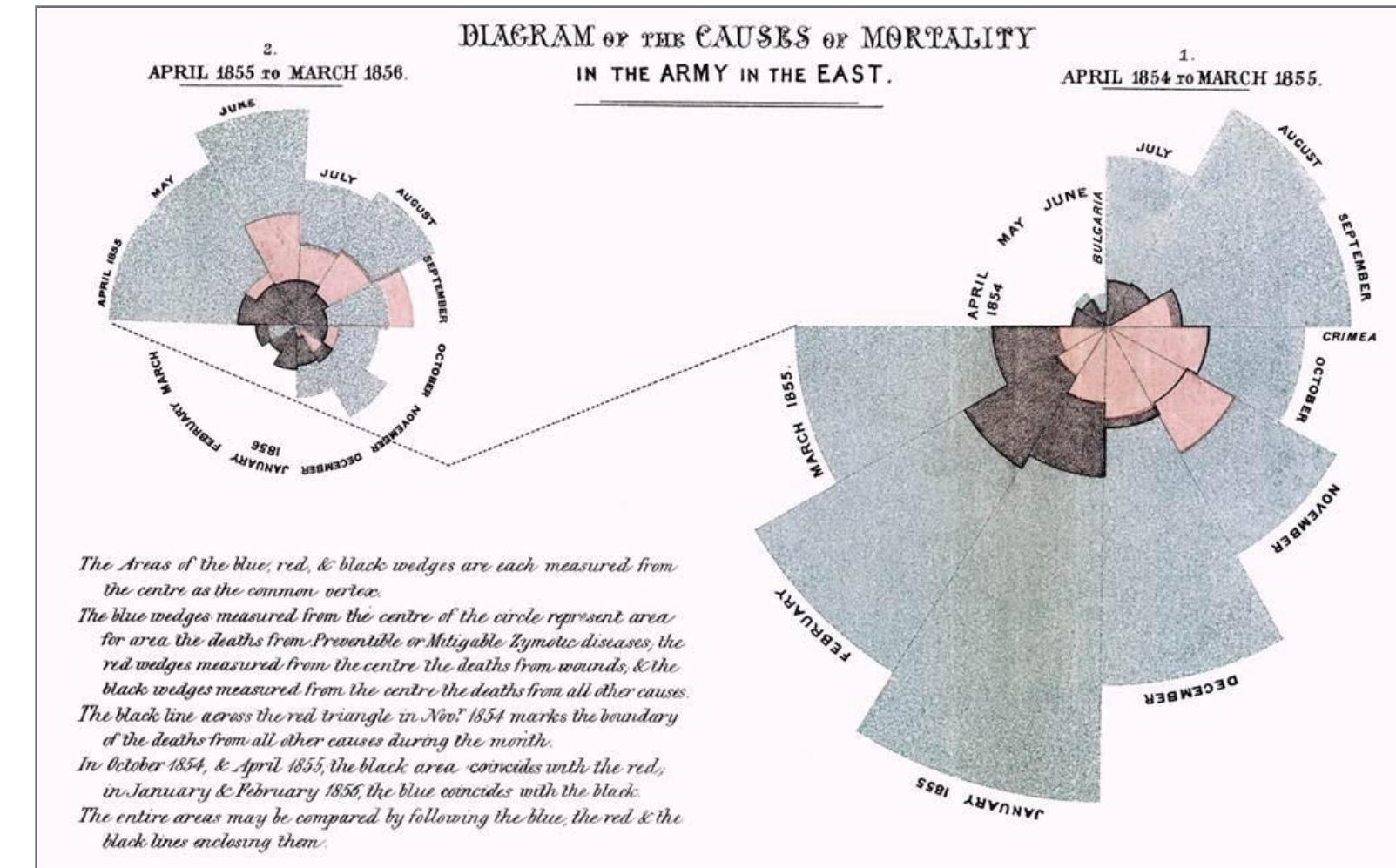


→ Parallel



# Pie chart - polar area chart

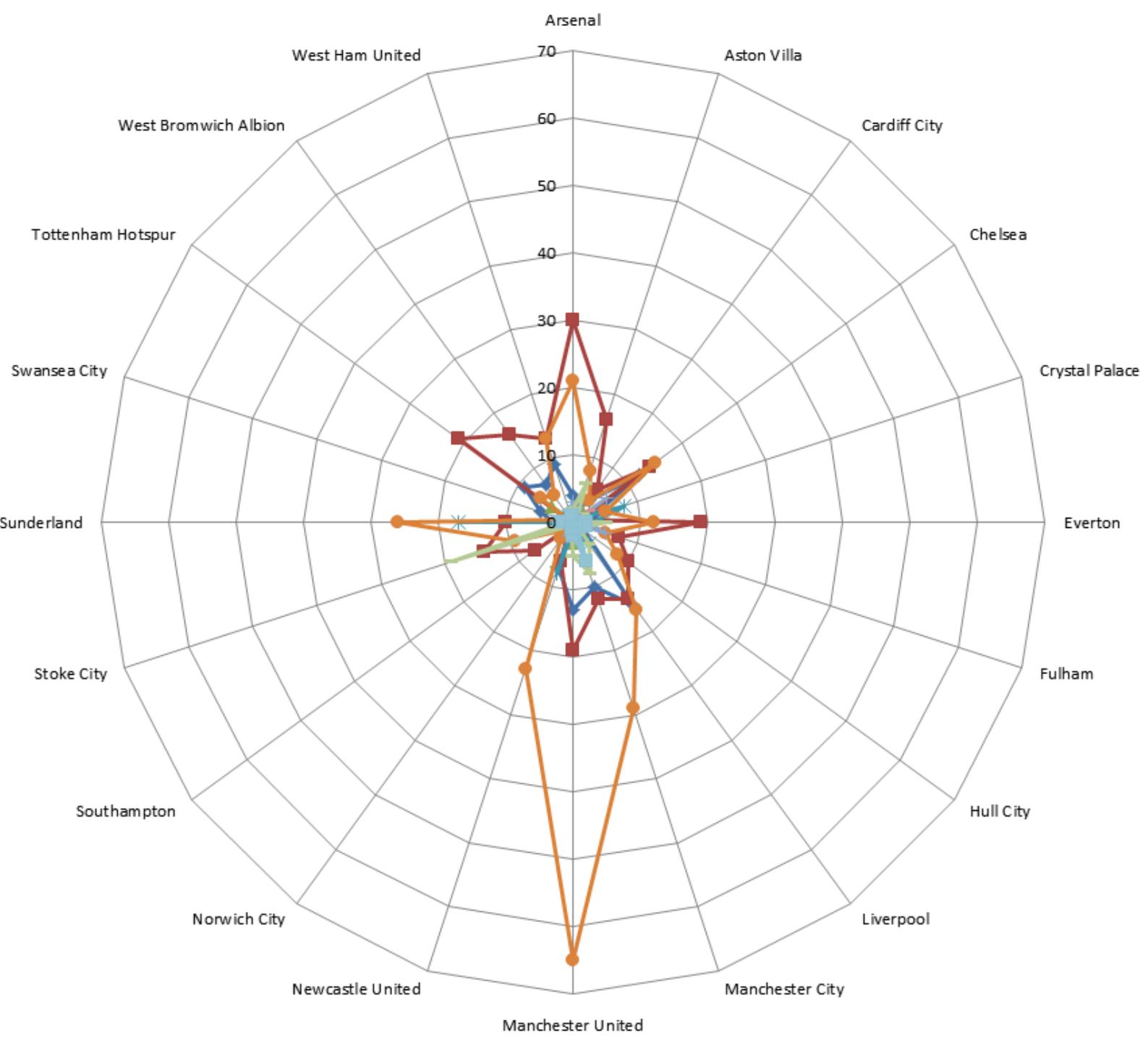
- Pie chart
  - Marcas de área con canal de ángulo
  - Precisión: Menor que length (bars)
- Polar area chart
  - Marcas de área con canal de longitud
  - Más similitud con barras
- Datos:
  - 1 key categórico, 1 value cuantitativo
- Tarea:
  - Relaciones parte-todo



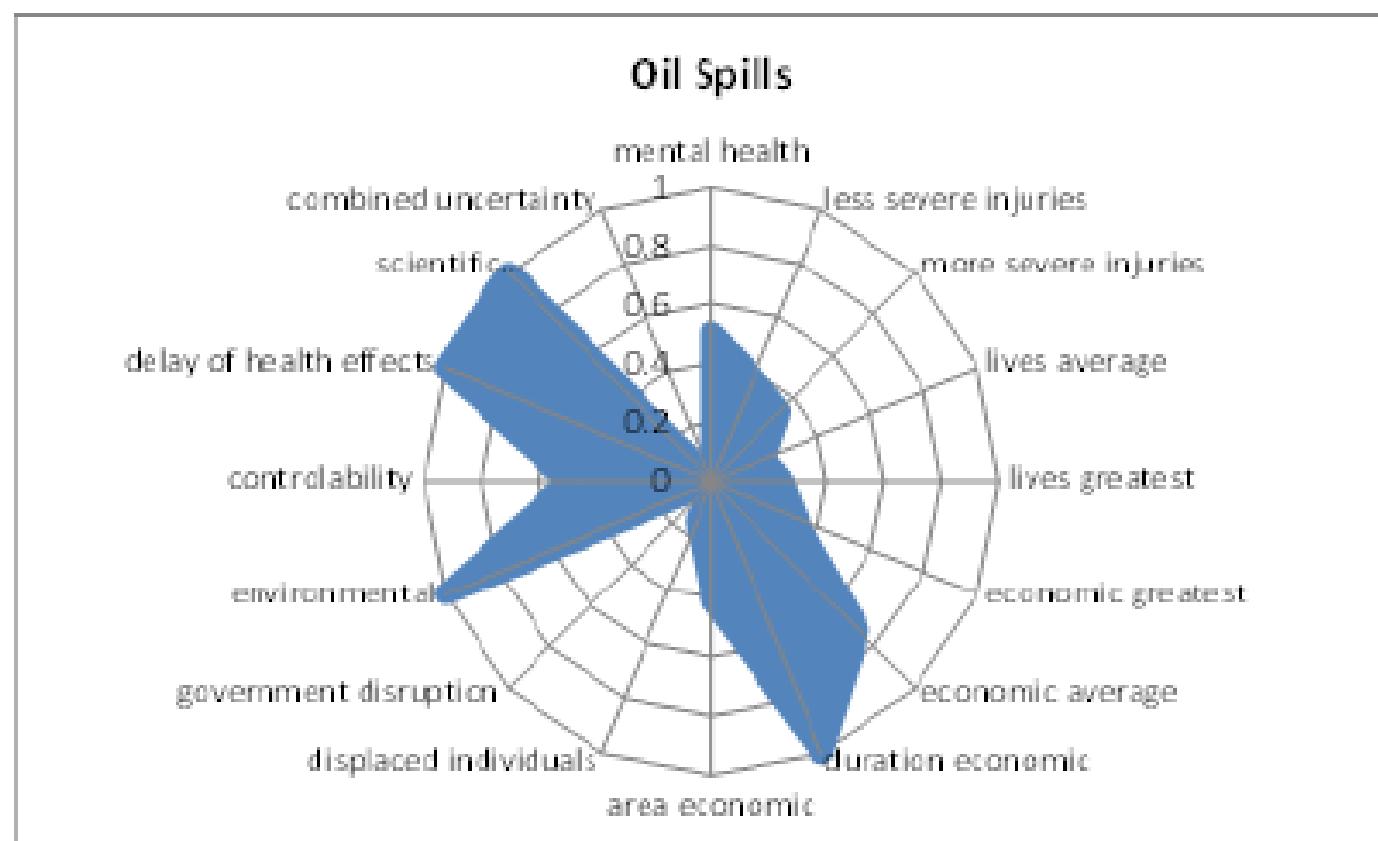
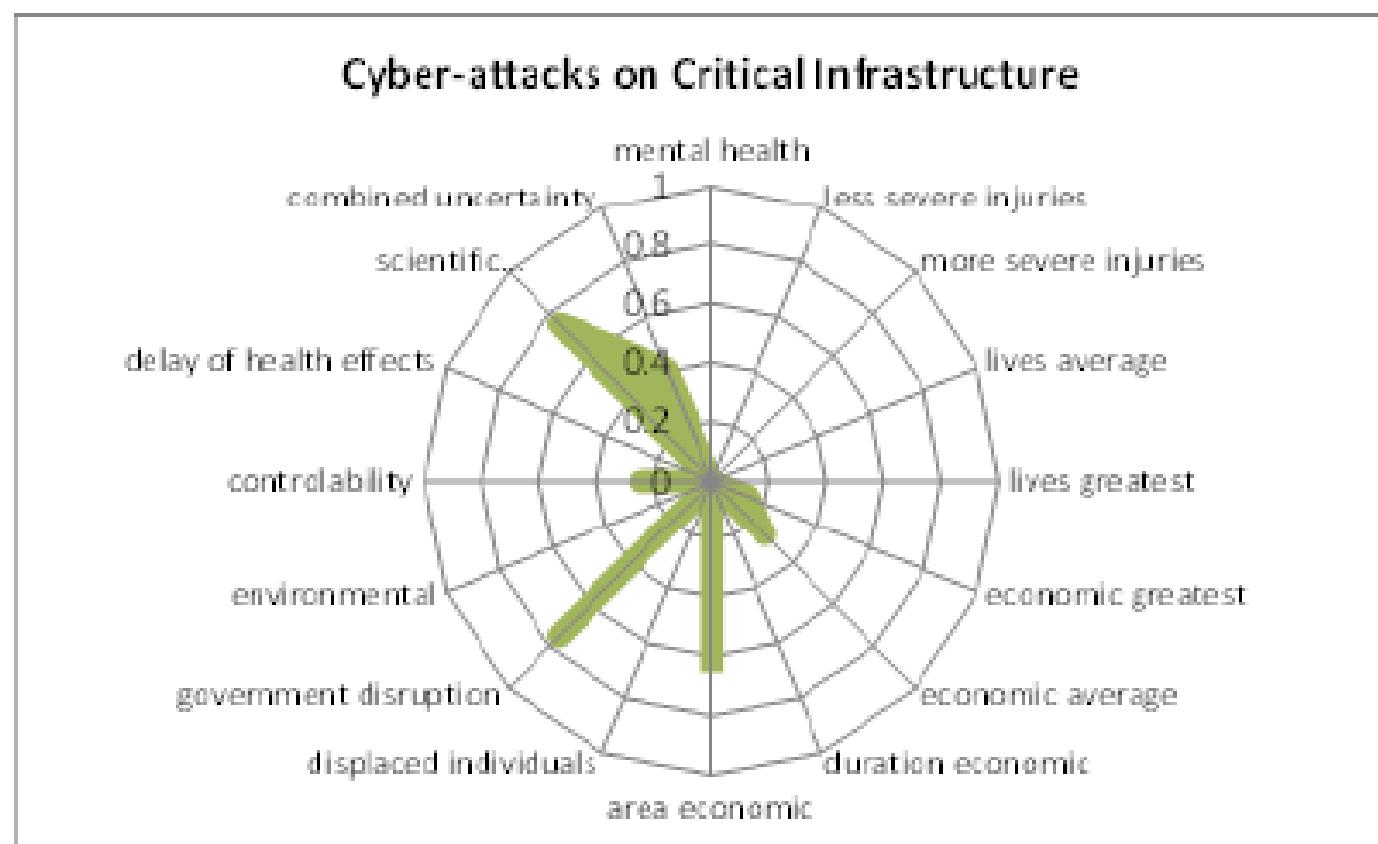
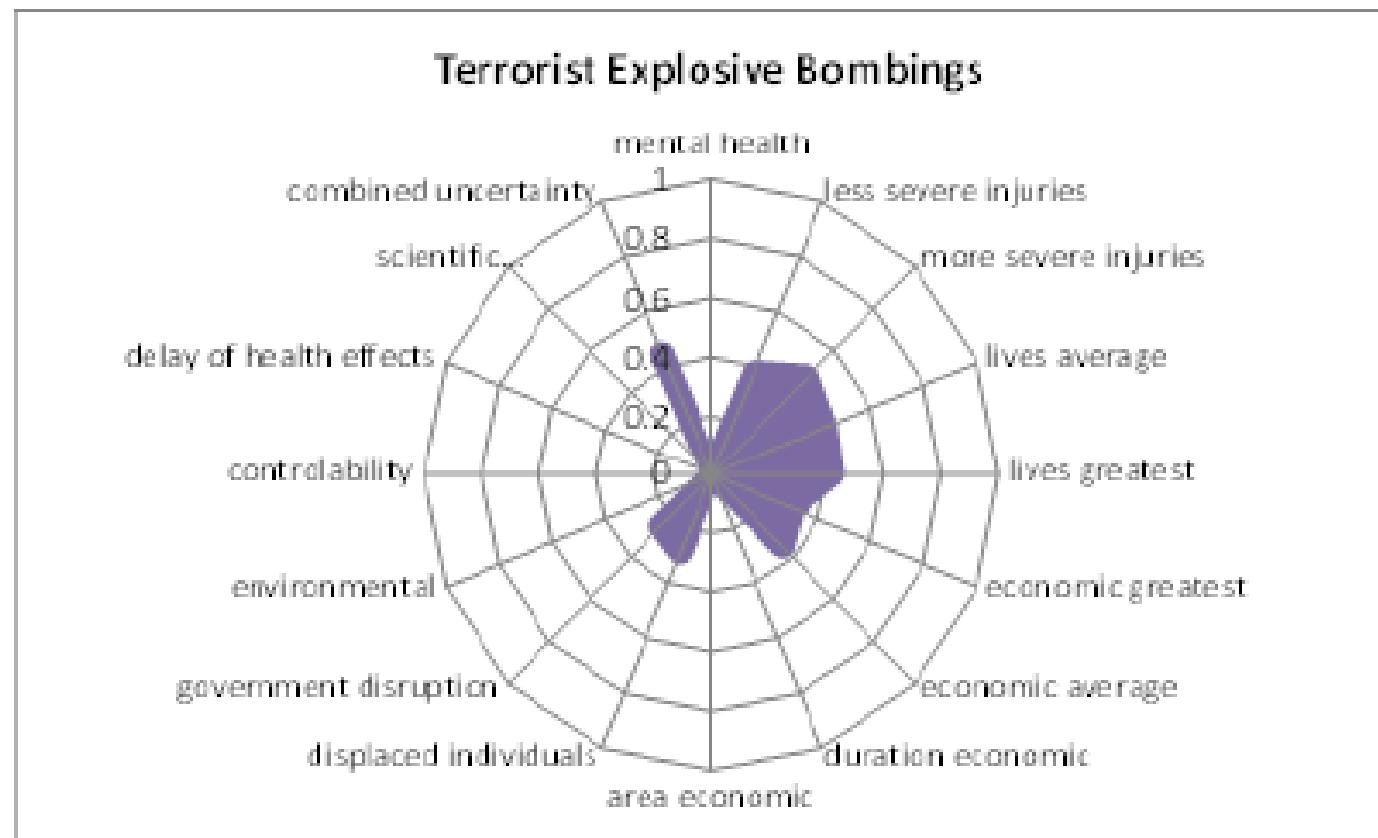
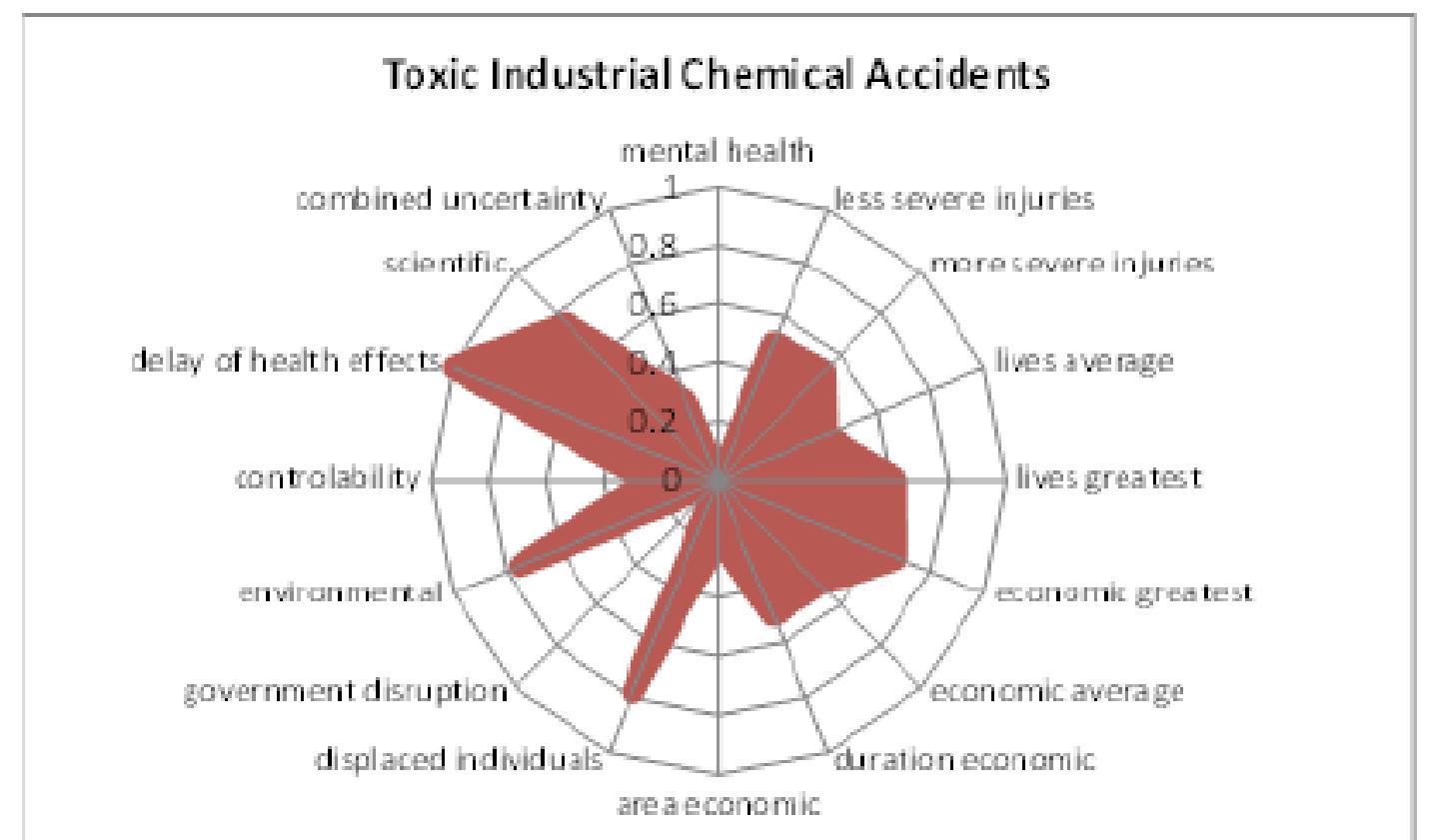
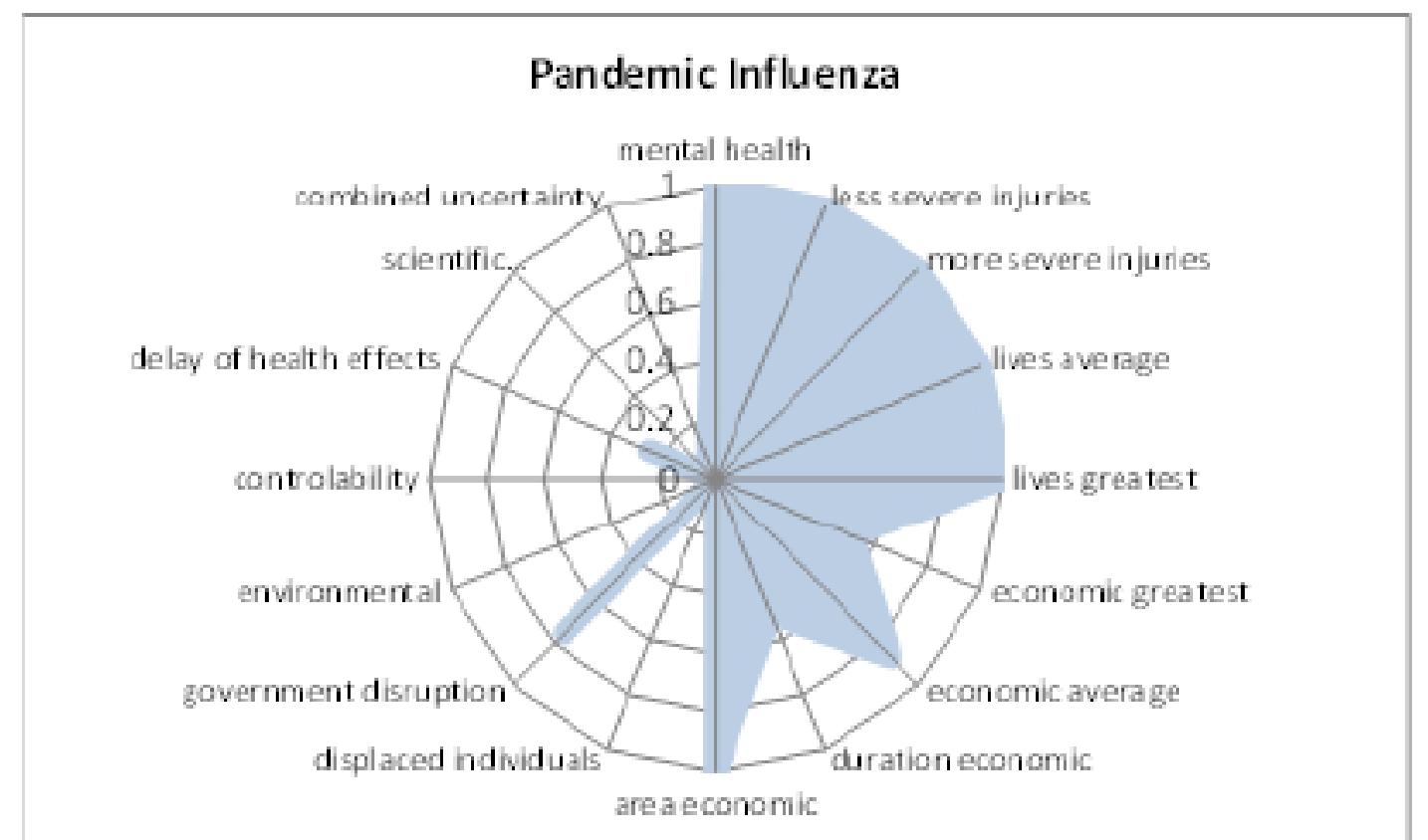
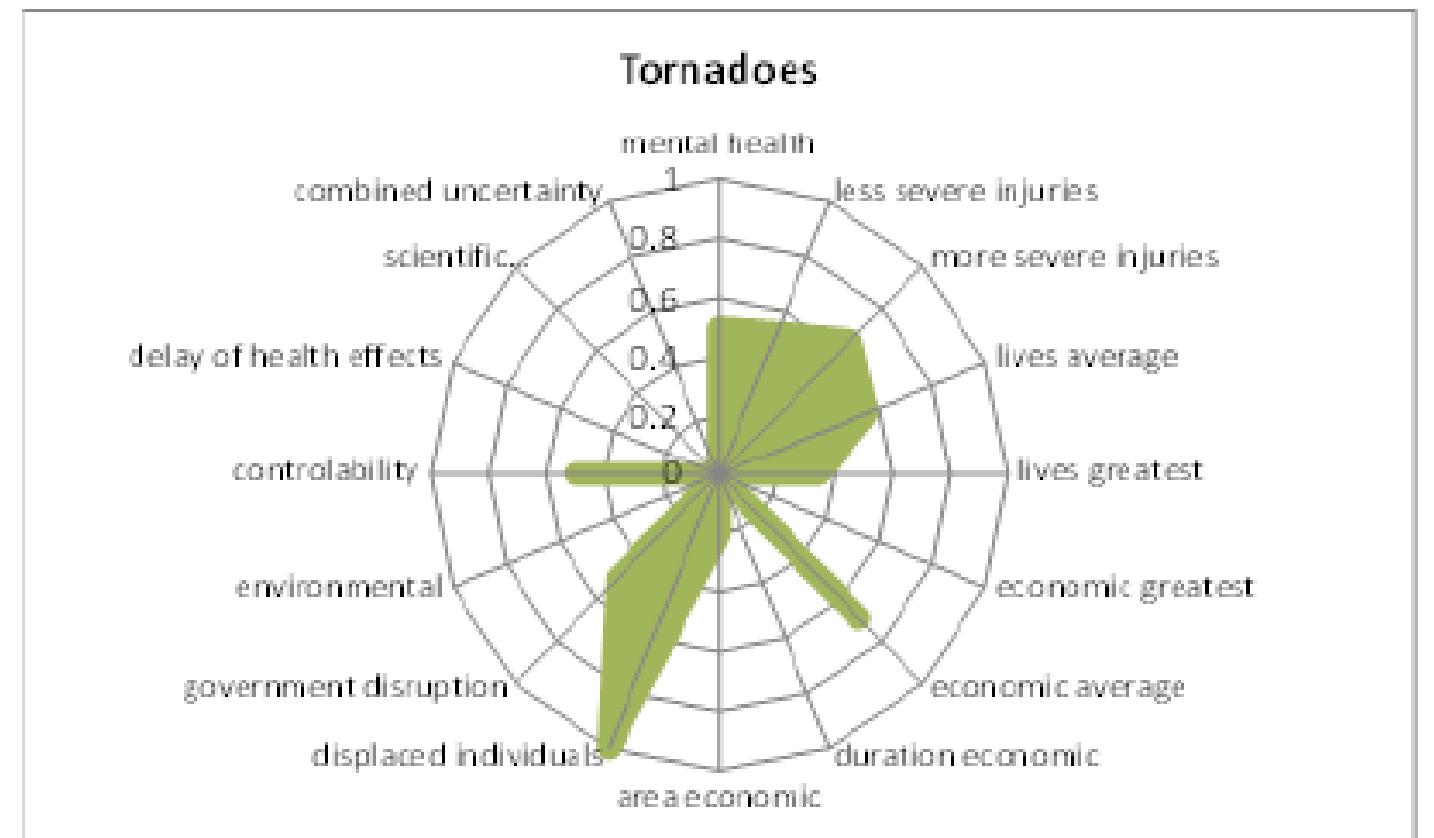
# Radar Plots

Limitación:

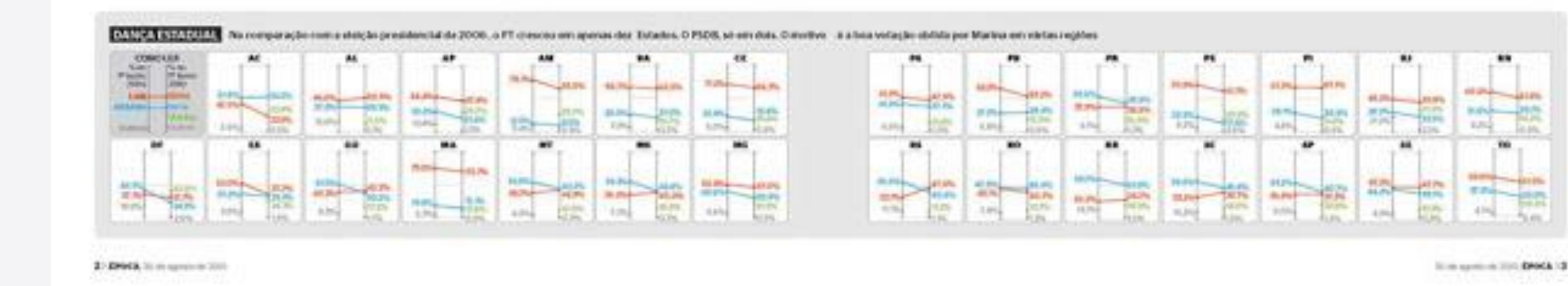
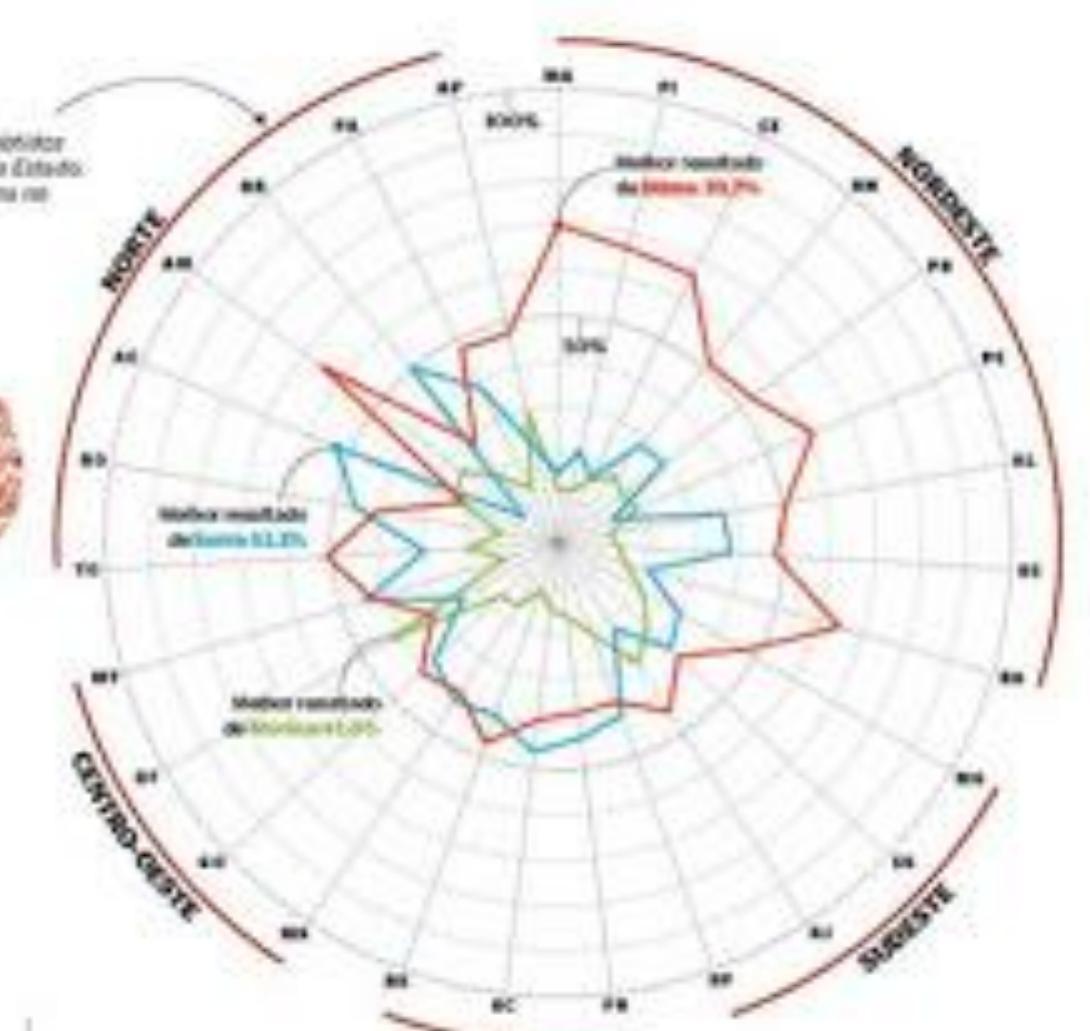
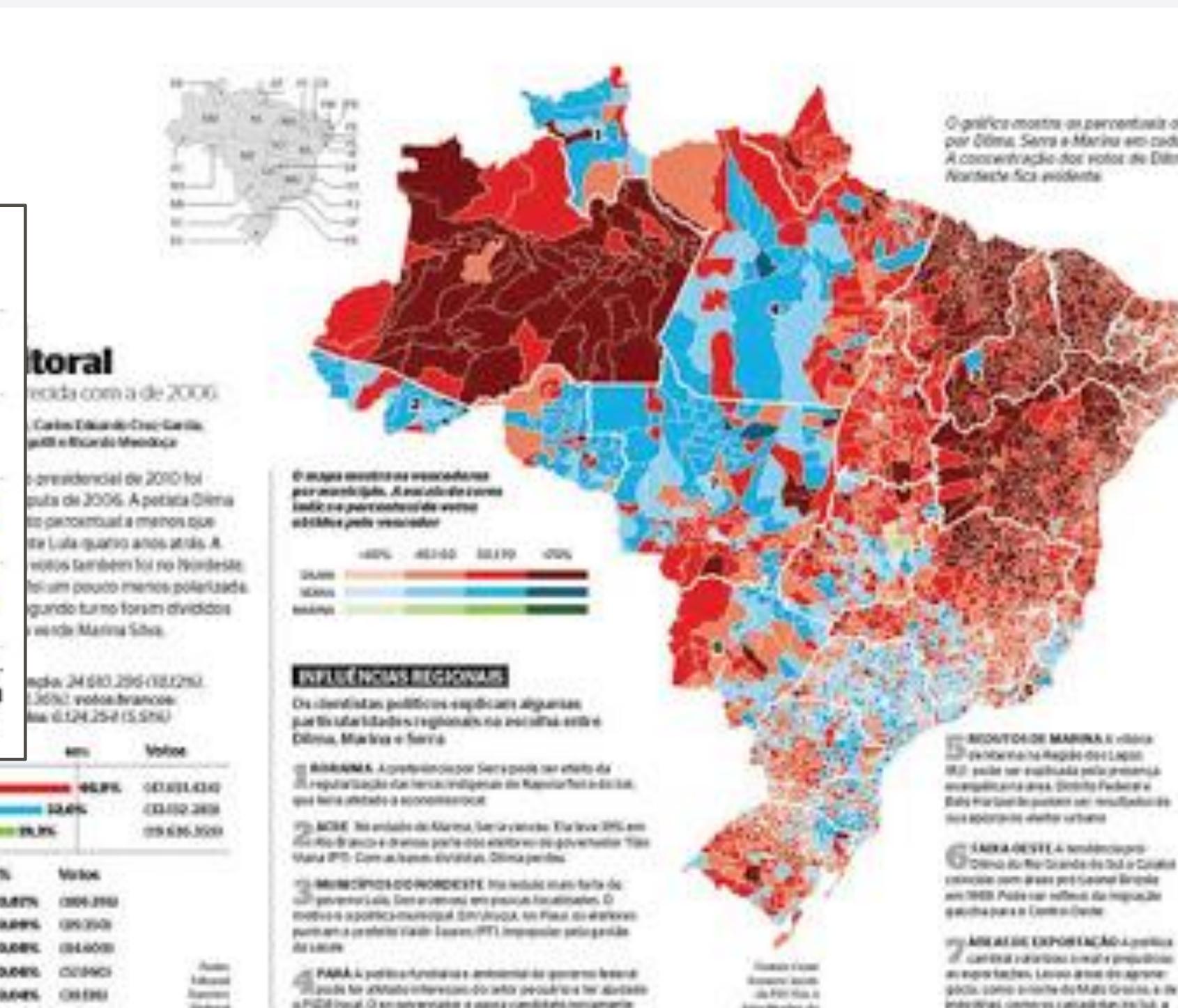
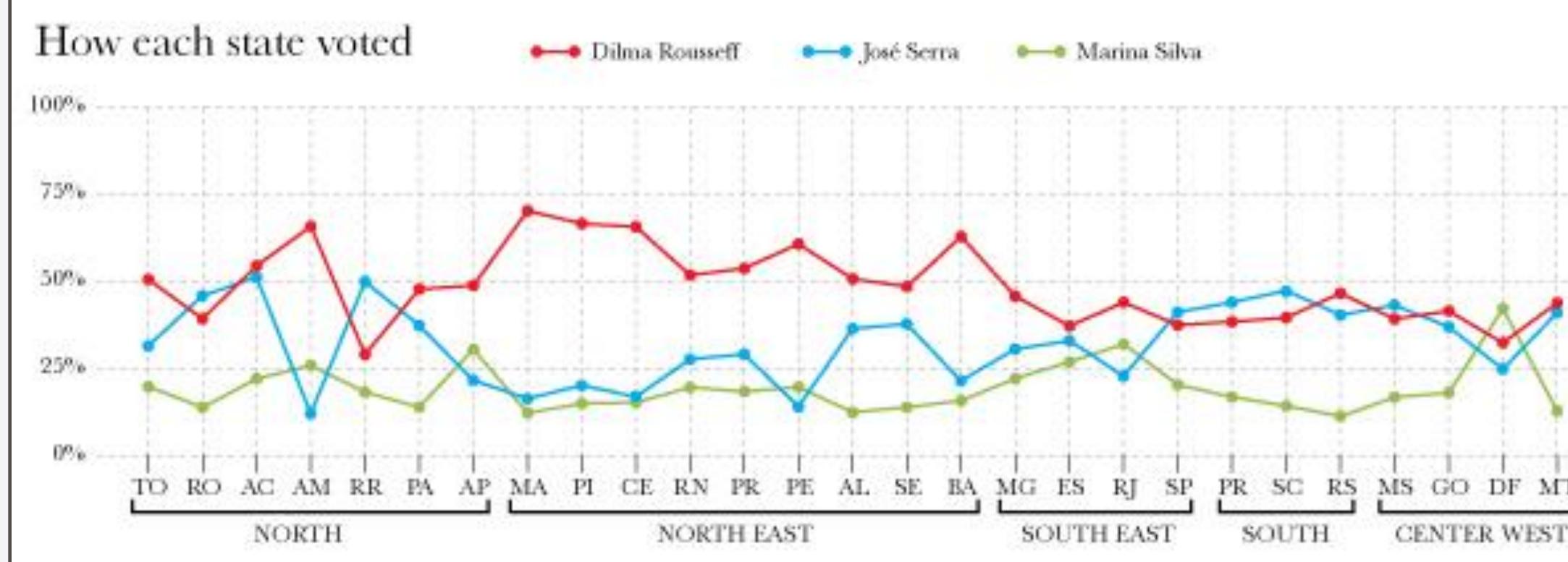
- Mejor para categorías no-cílicas



[Slide courtesy of Ben Jones]. From: Visualization analysis and design



# “Radar graphs: Avoid them (99.9% of the time)”



## The functional art: Radar graphs: Avoid them (99.9% of the time)

# Bibliografia

- Visualization Analysis and Design. Munzner. Cap. 7
- **The Functional Art . Alberto Cairo, 2012 (Cap. 5-6)**

Coordenadas paralelas: <https://eagereyes.org/techniques/parallel-coordinates>

Coordenadas paralelas en D3: [@d3/parallel-coordinates](https://observablehq.com/@d3/parallel-coordinates)

Mosaic plots: <http://www.pmean.com/definitions/mosaic.htm>

Stacked barcharts: <https://blog.datawrapper.de/divergingbars/>

Radar graphs: <http://www.thefunctionalart.com/2012/11/radar-graphs-avoid-them-999-of-time.html>

## Inspiración

- <http://www.thefunctionalart.com/>
- <https://eagereyes.org/>
- <http://flowingdata.com/>
- <http://fivethirtyeight.com/>
- <http://truth-and-beauty.net/>

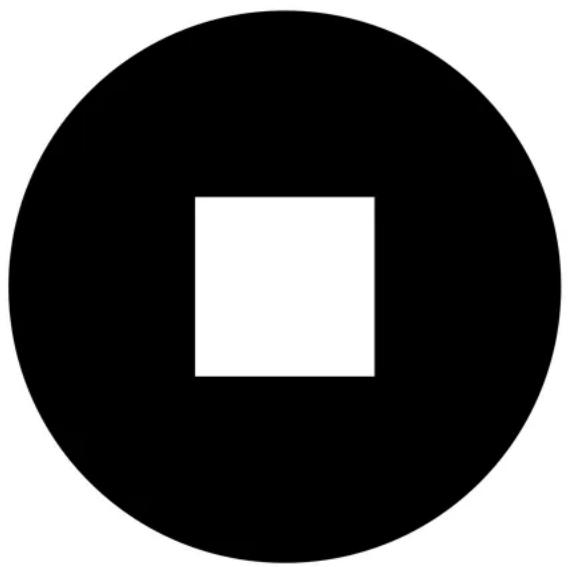


## 4. Diseño de la Información

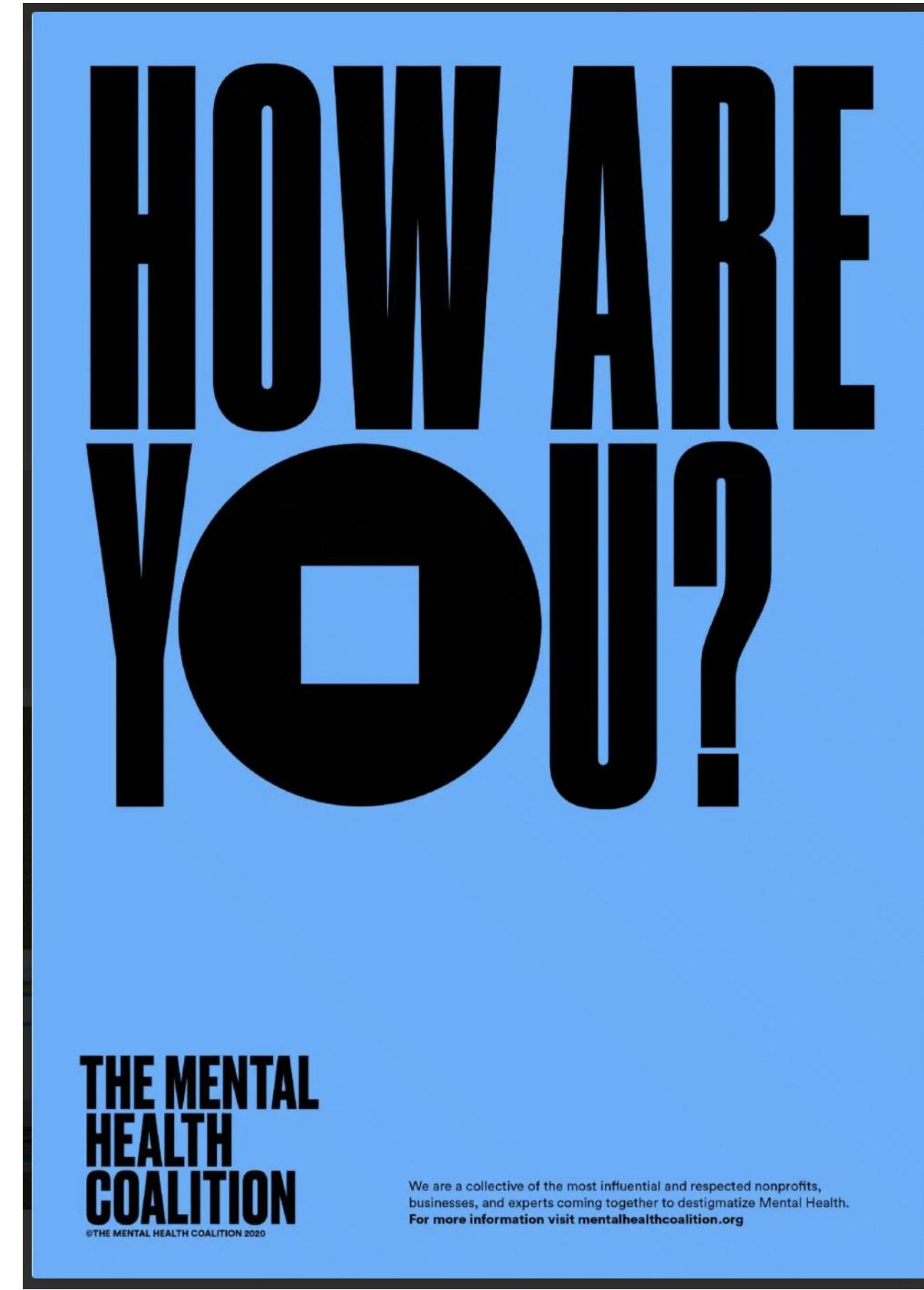
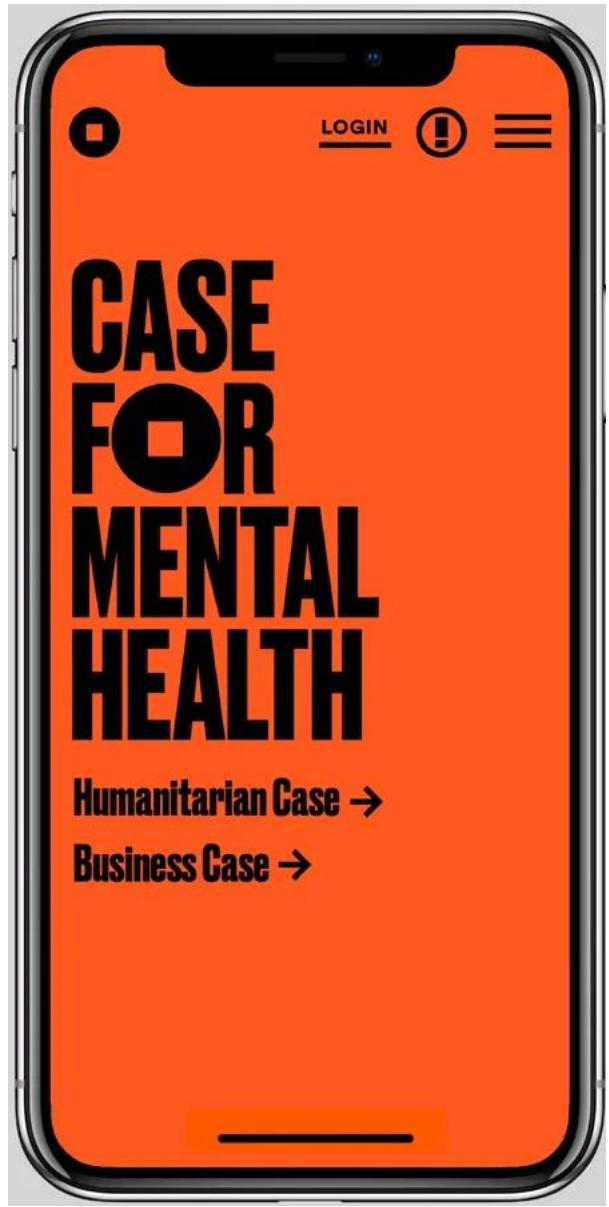
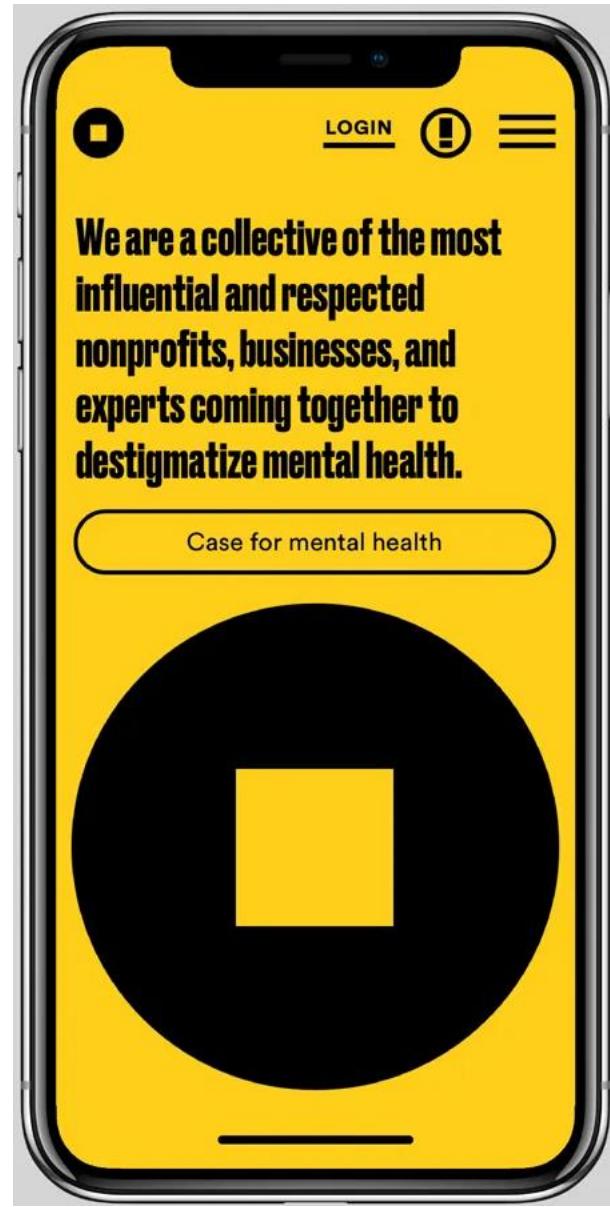
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**Sol Bucalo**  
[sol.bucalo@uab.cat](mailto:sol.bucalo@uab.cat)

**Guillermo Marin**  
[guillermo.marin@uab.cat](mailto:guillermo.marin@uab.cat)

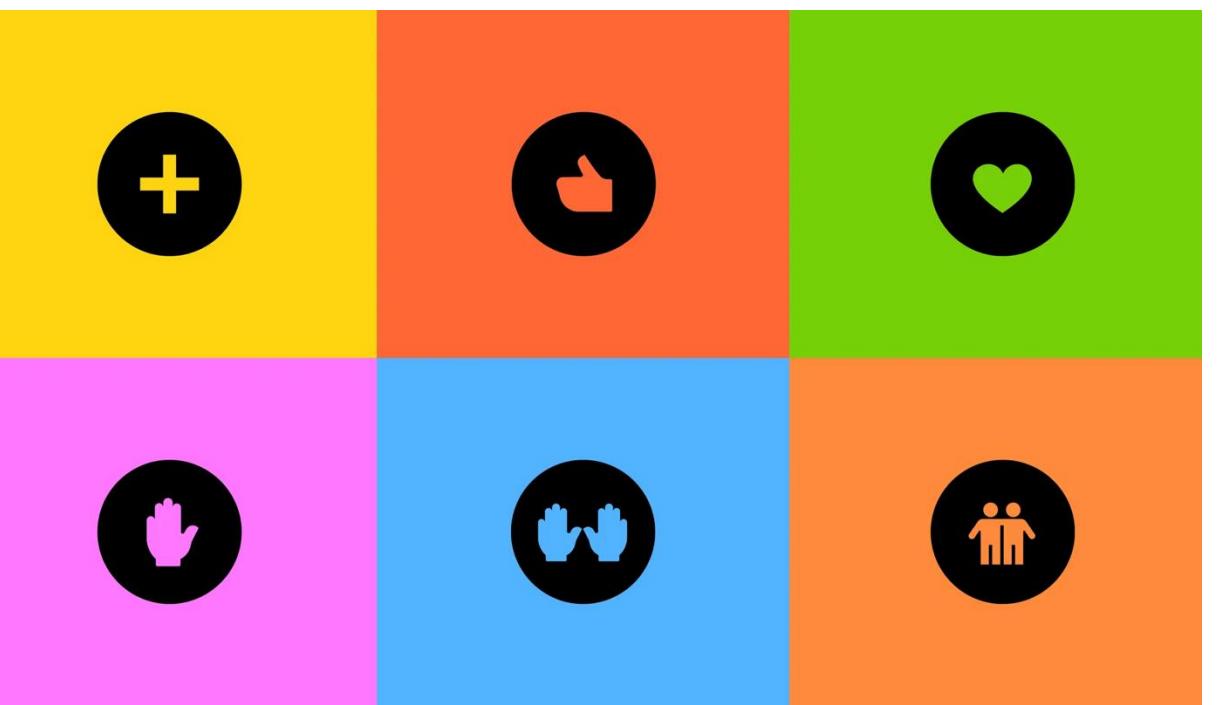


THE MENTAL  
HEALTH  
COALITION



HOW  
ARE YOU  
REALLY?

HOW  
ARE YOU  
REALLY?



Design is not just about aesthetics



Instituto de Estudos Orientais.



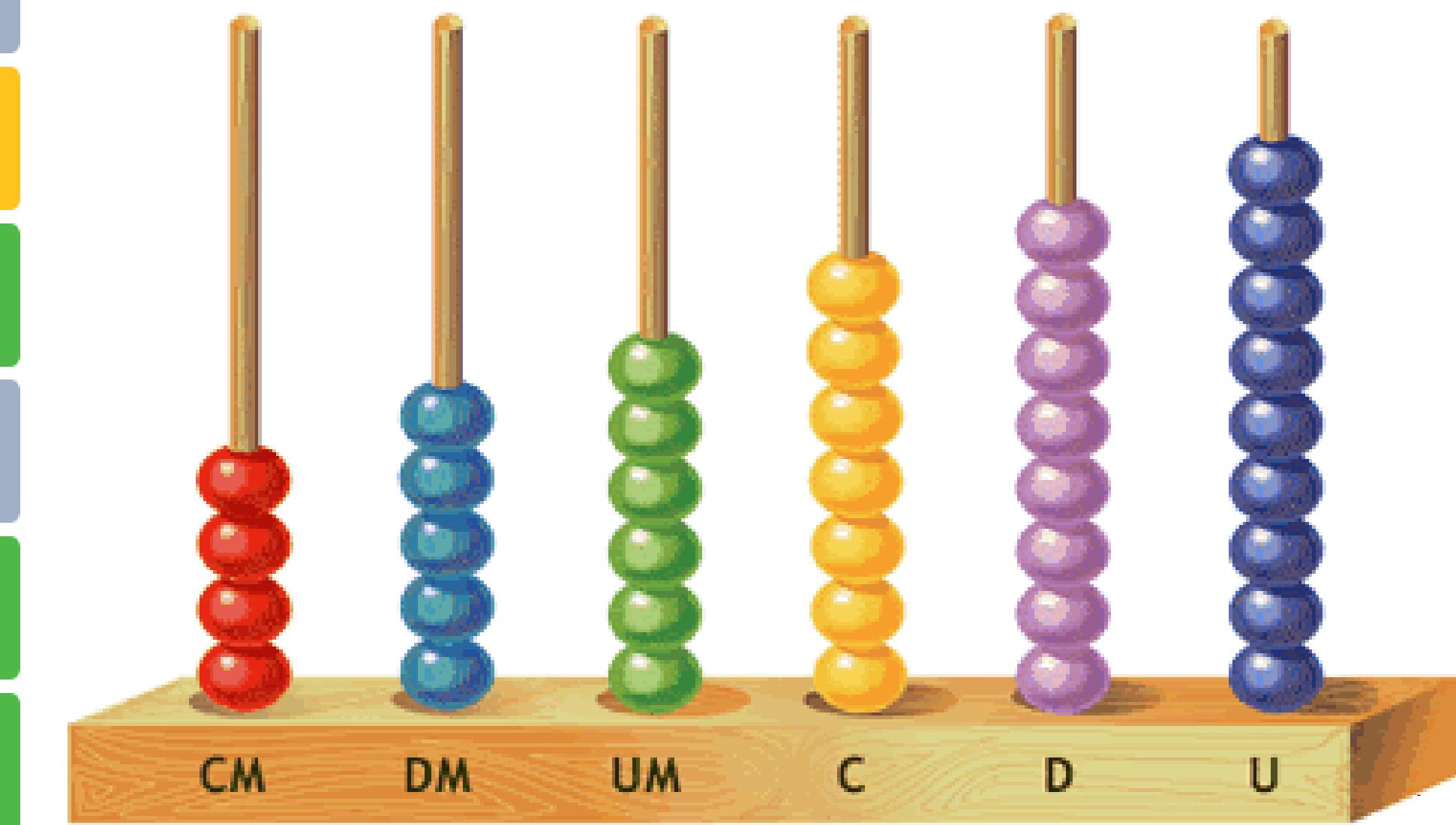
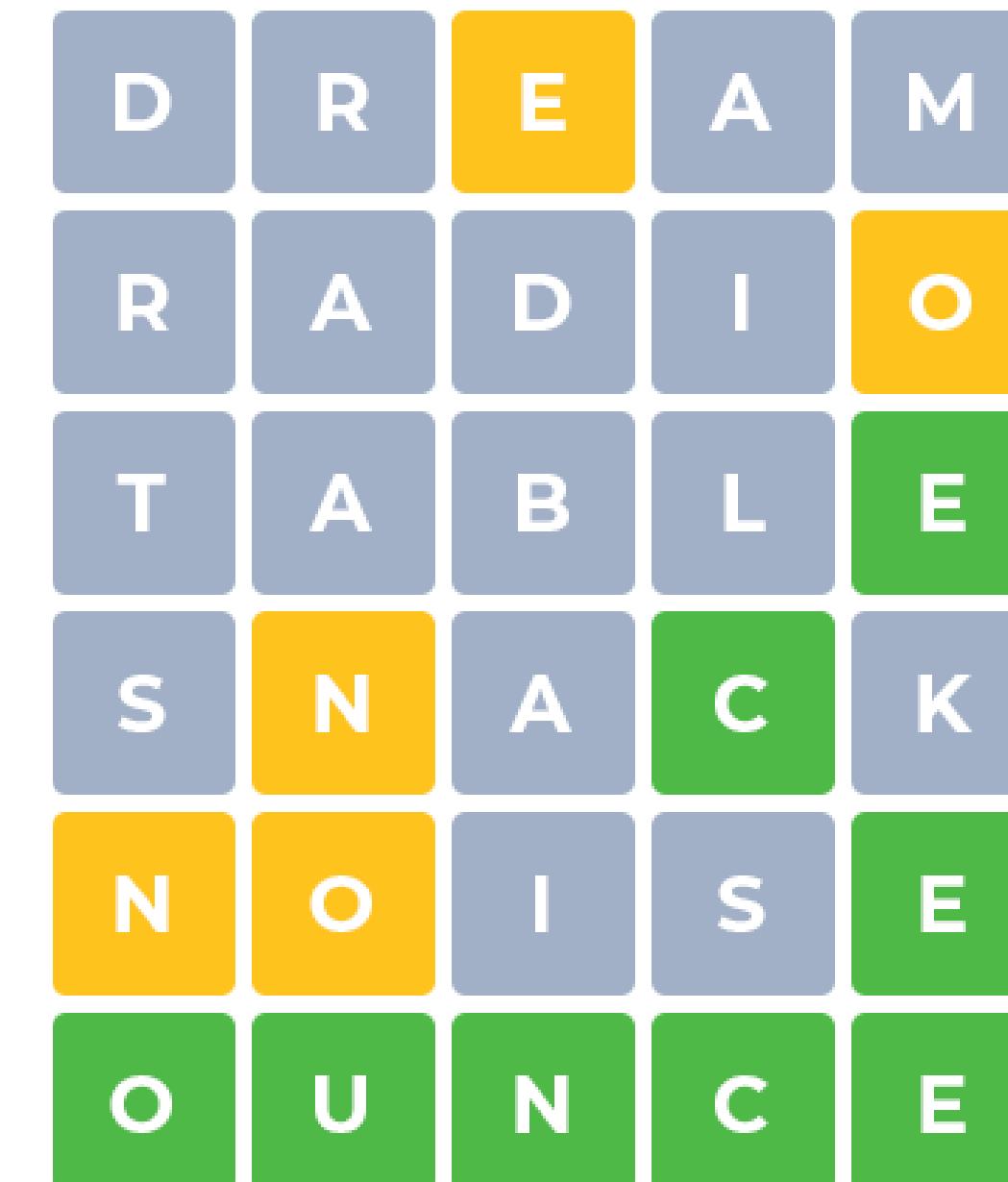
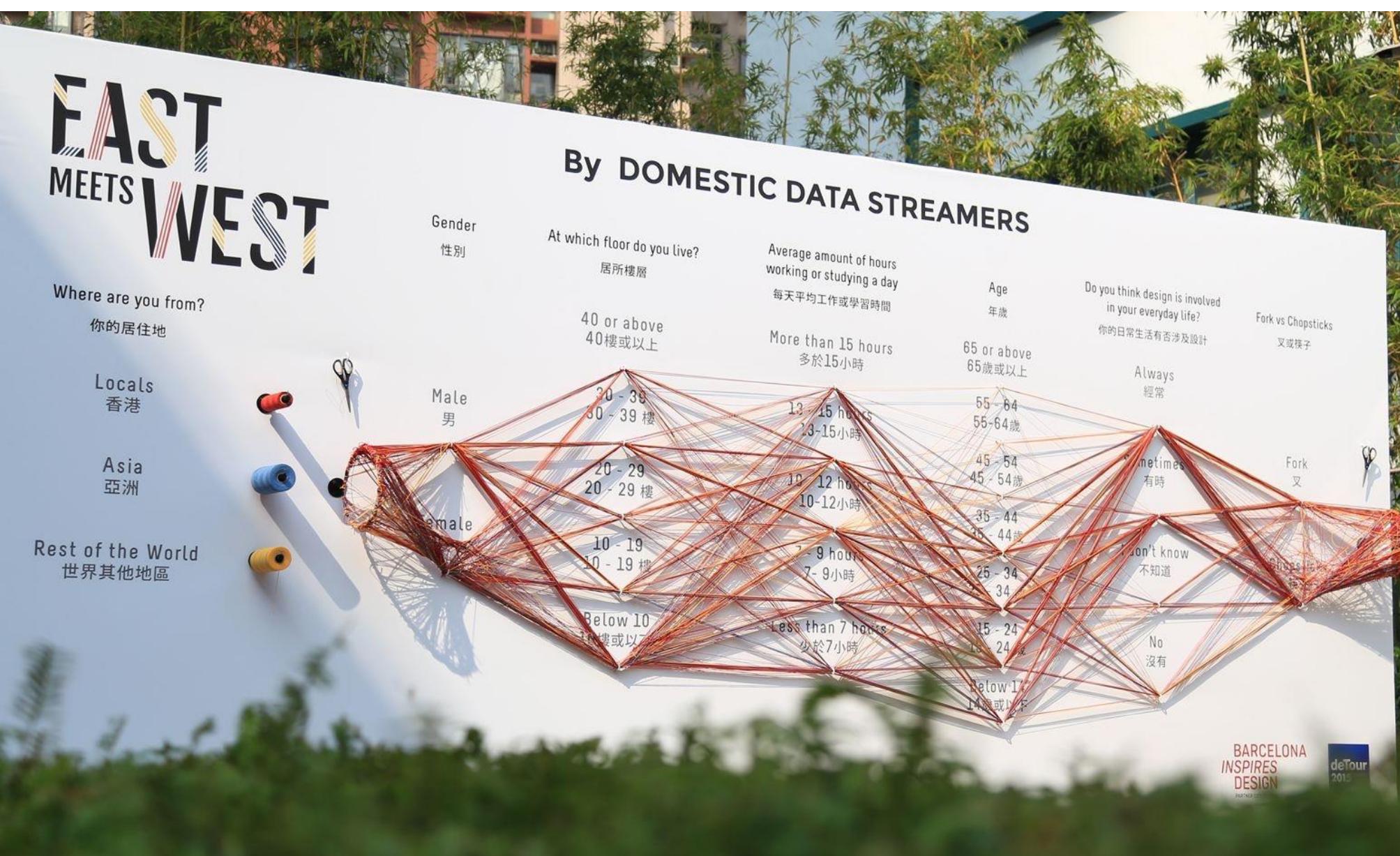
Design is not just about aesthetics



Design is not just about aesthetics

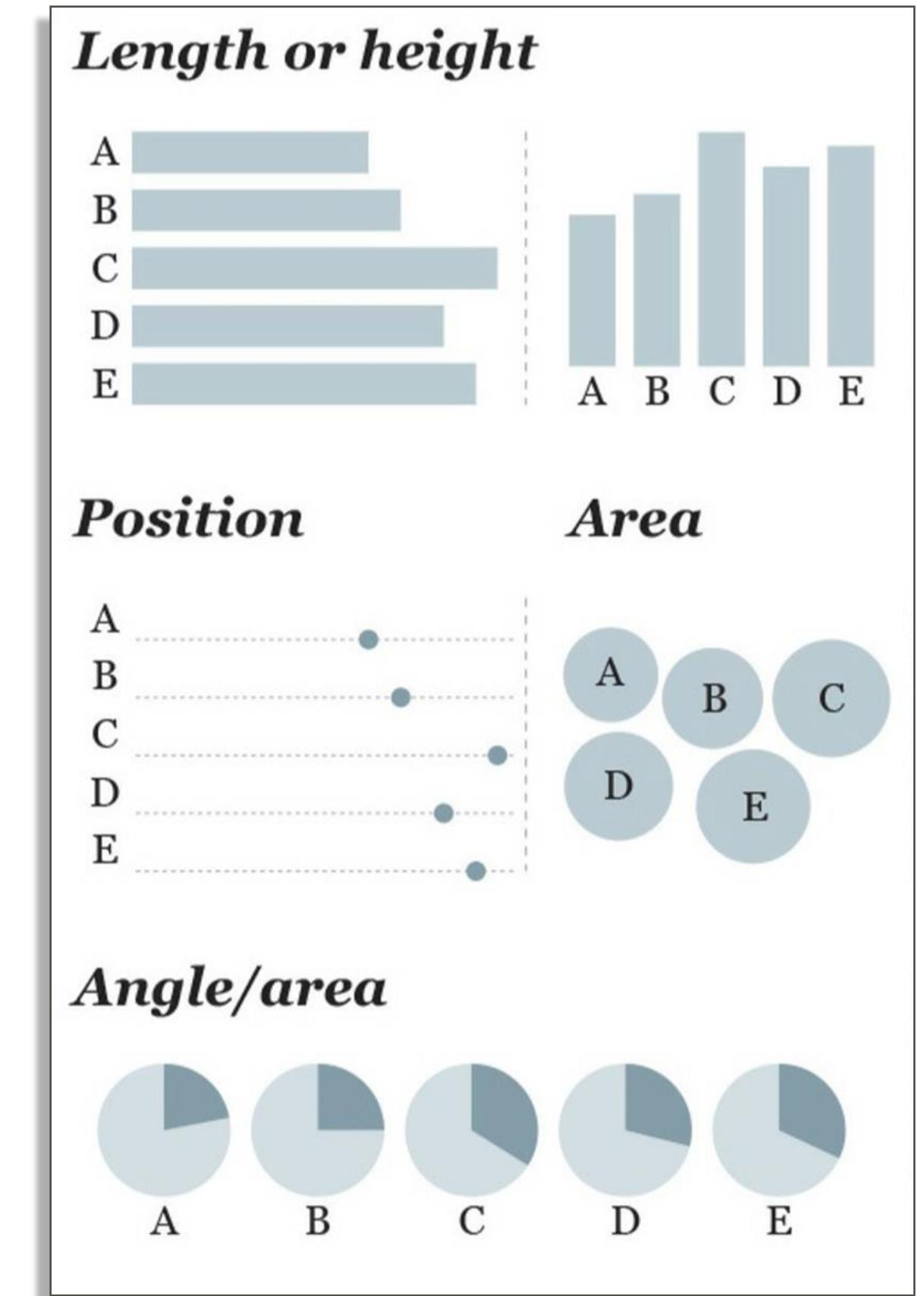
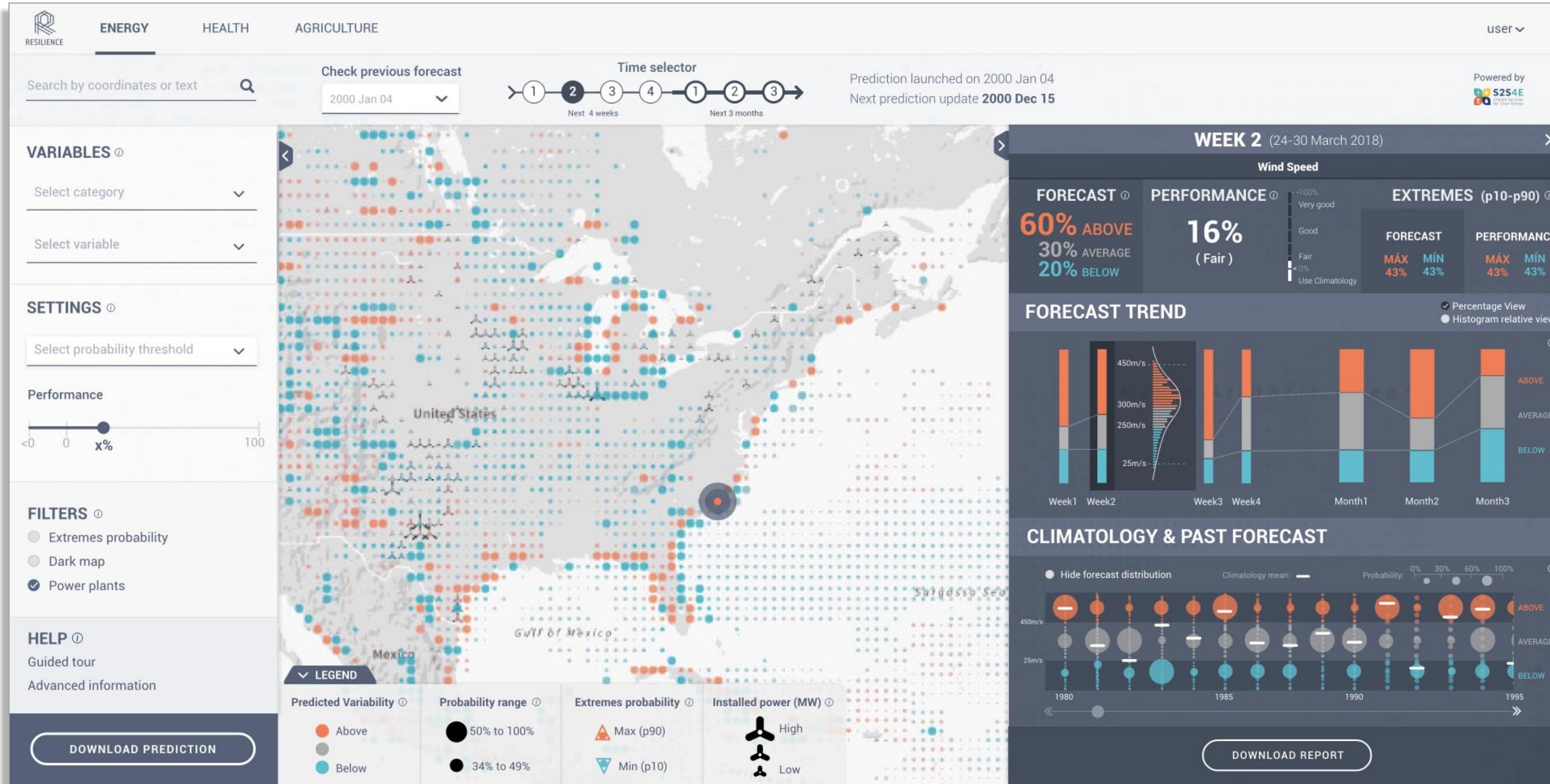
# Data Visualization

- Son DISEÑOS que contienen INFORMACIÓN
- Su función es AUMENTAR NUESTRAS CAPACIDADES para superar nuestras limitaciones cognitivas
- Herramientas cognitivas que AYUDEN A PENSAR



# Percepción Visual

- Mecanismos cognitivos.
- Como afectan al diseño y consumo de visualizaciones de datos.
- Su relación con la efectividad de los canales visuales
- **Diseñar teniendo en cuenta cómo funciona nuestra percepción visual**





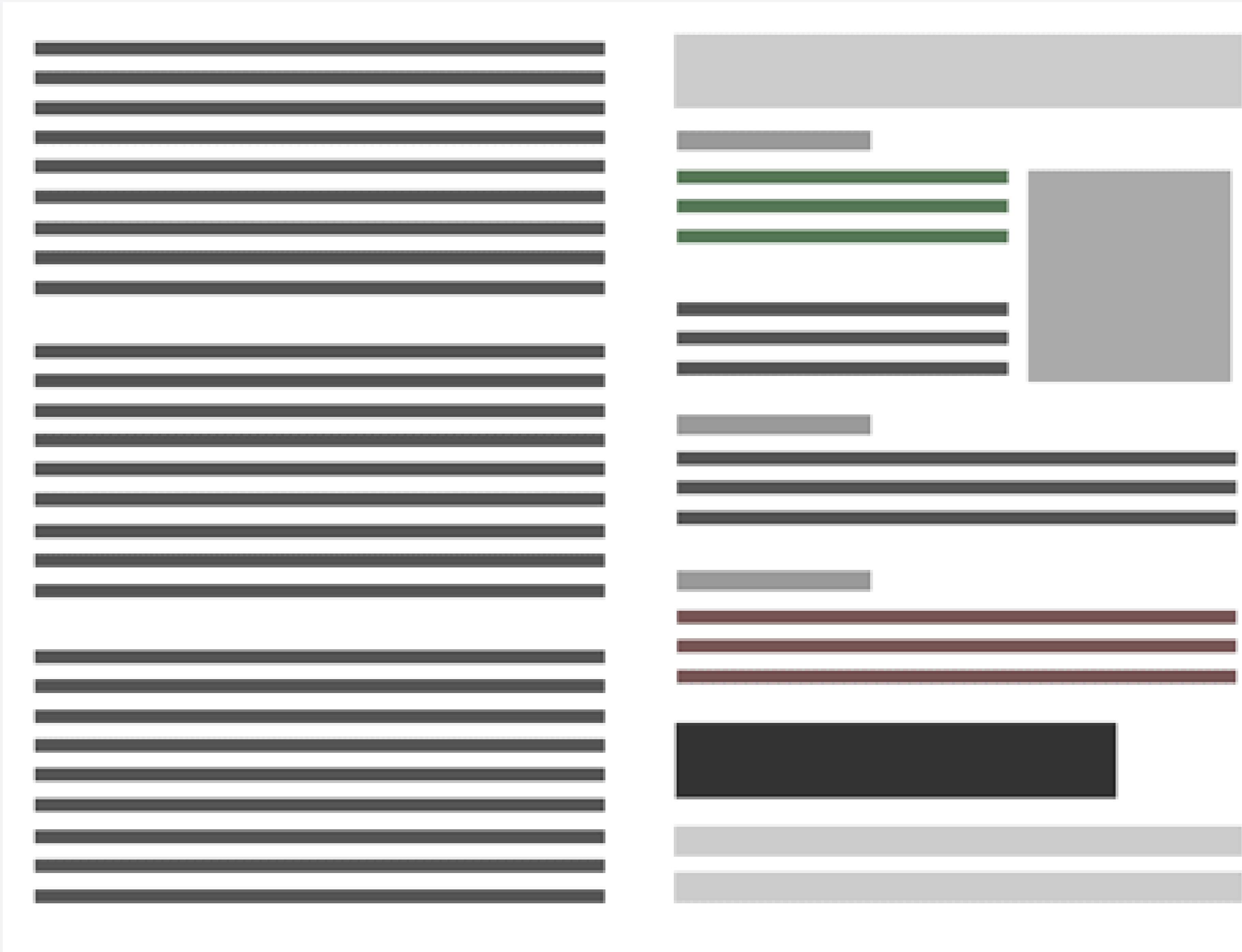
## 4.2. Jerarquía visual

---

Para diseñar una visualización de datos  
necesitamos organizar la información.

# Jerarquía visual

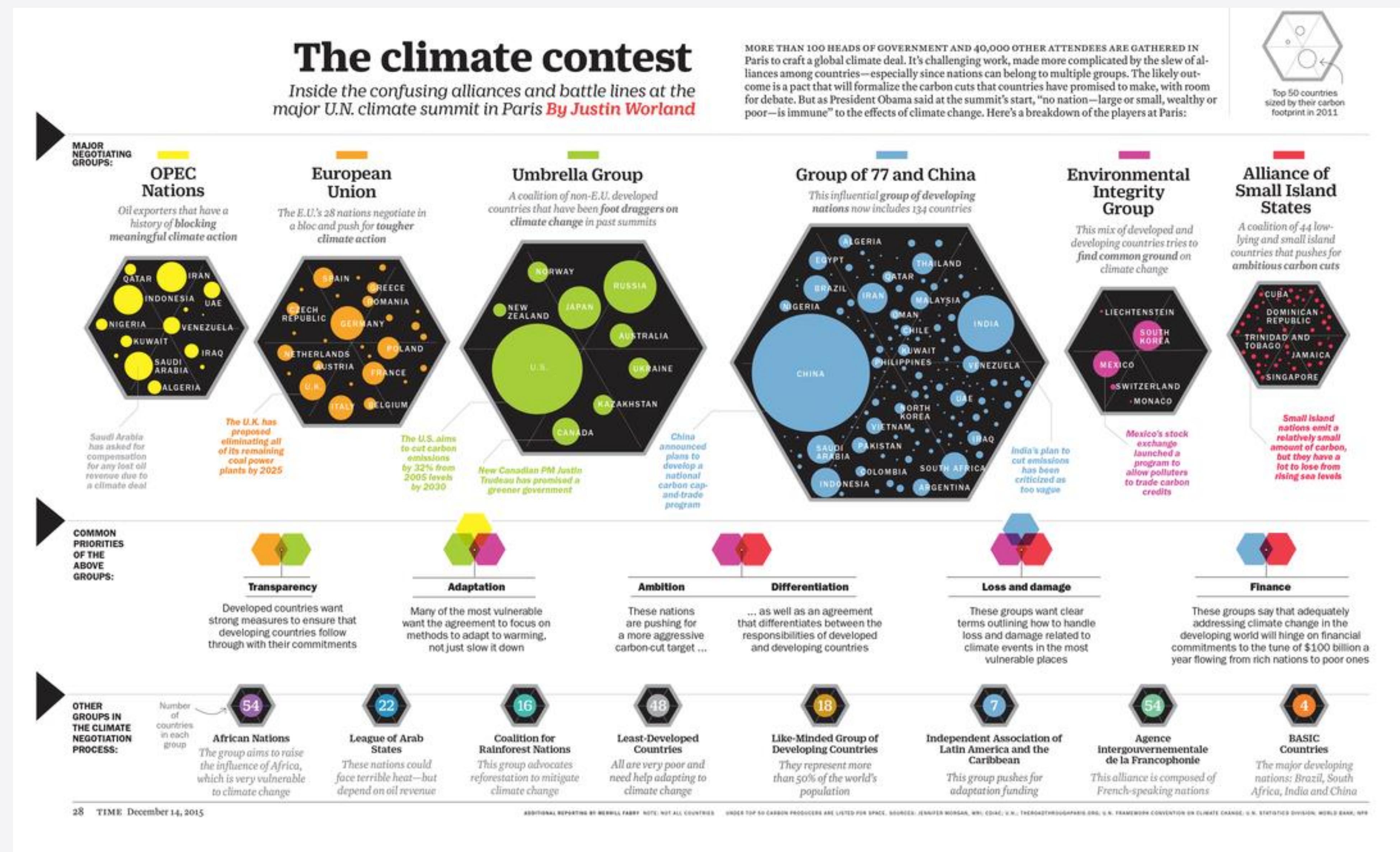
- ¿Lo que estoy buscando esta en esta visualización?
- ¿Dónde?
- ¿Cómo completo mi tarea?



La importancia visual no se puede aplicar  
a demasiados elementos de diseño,  
de lo contrario todo se vuelve igual.

# **Los 5 pilares de la jerarquía visual**

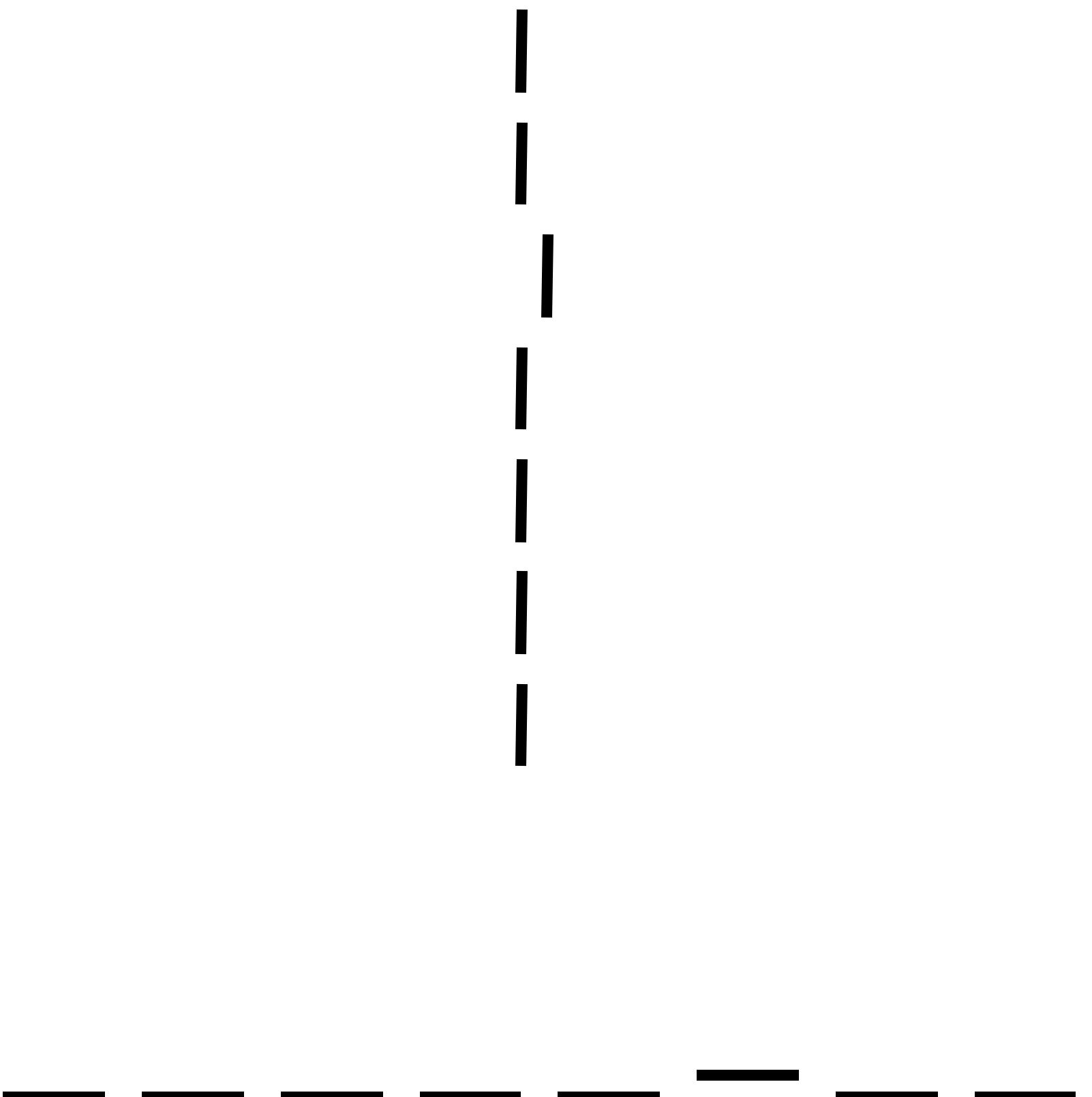
# 1. Tamaño: Cuanto más grande, más se nota (pero no siempre es mejor)



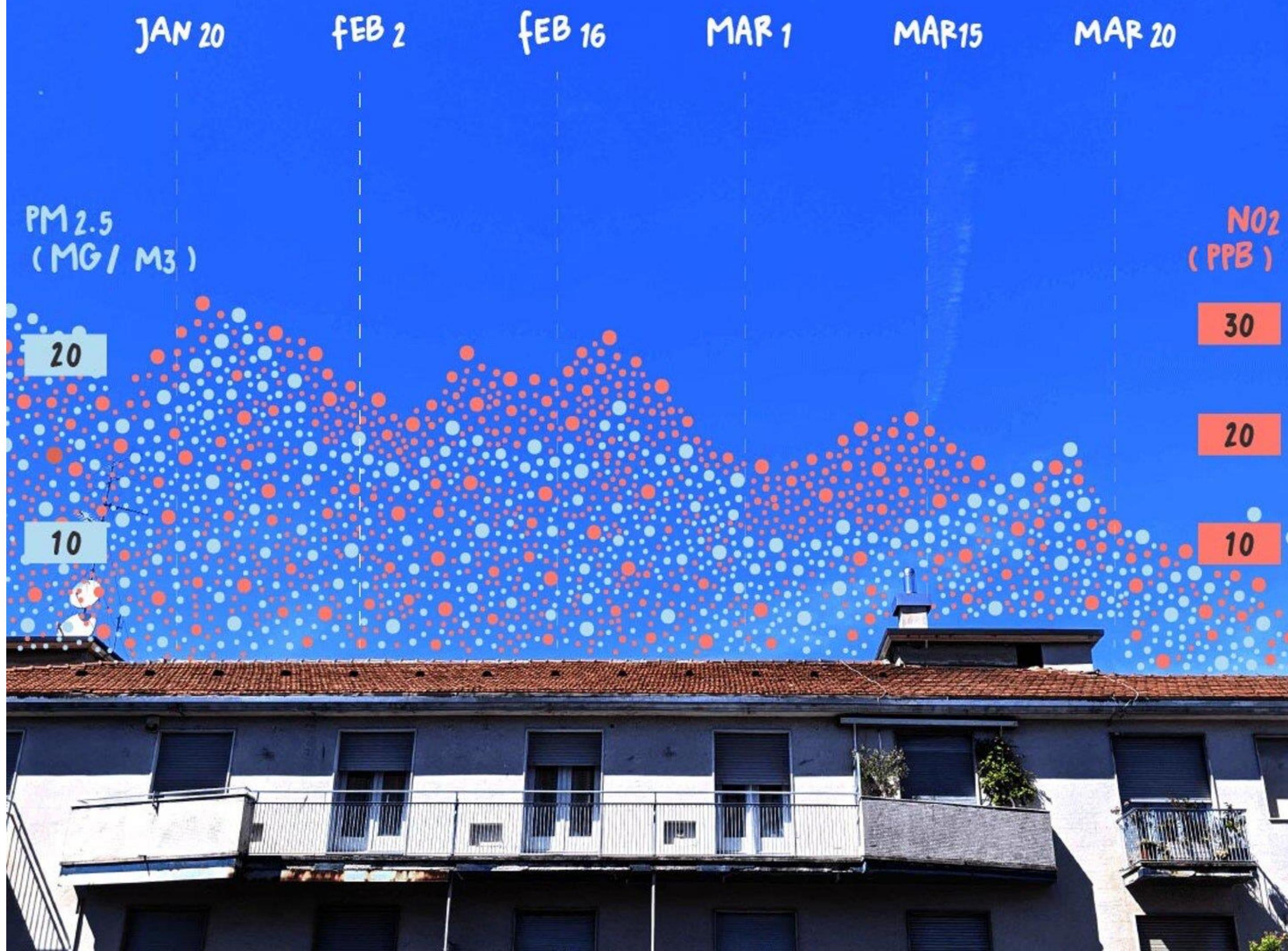
El contraste muestra la importancia relativa

## 2. Composición

- Una parte esencial de organizar los elementos pasa por **alinearlos**
- Somos muy sensibles a pequeñas diferencias en alineación
- Alinear los elementos ayuda a crear orden
- Estructura la información y ayuda a predecir donde encontrar información -> donde seguir mirando



# AIR POLLUTION LEVELS IN ITALY ARE DECREASING



# AIR POLLUTION LEVELS IN ITALY ARE DECREASING

JAN 20 FEB 2 FEB 16 MAR 1 MAR 15 MAR 20

PM 2.5  
( MG / M<sup>3</sup> )

20

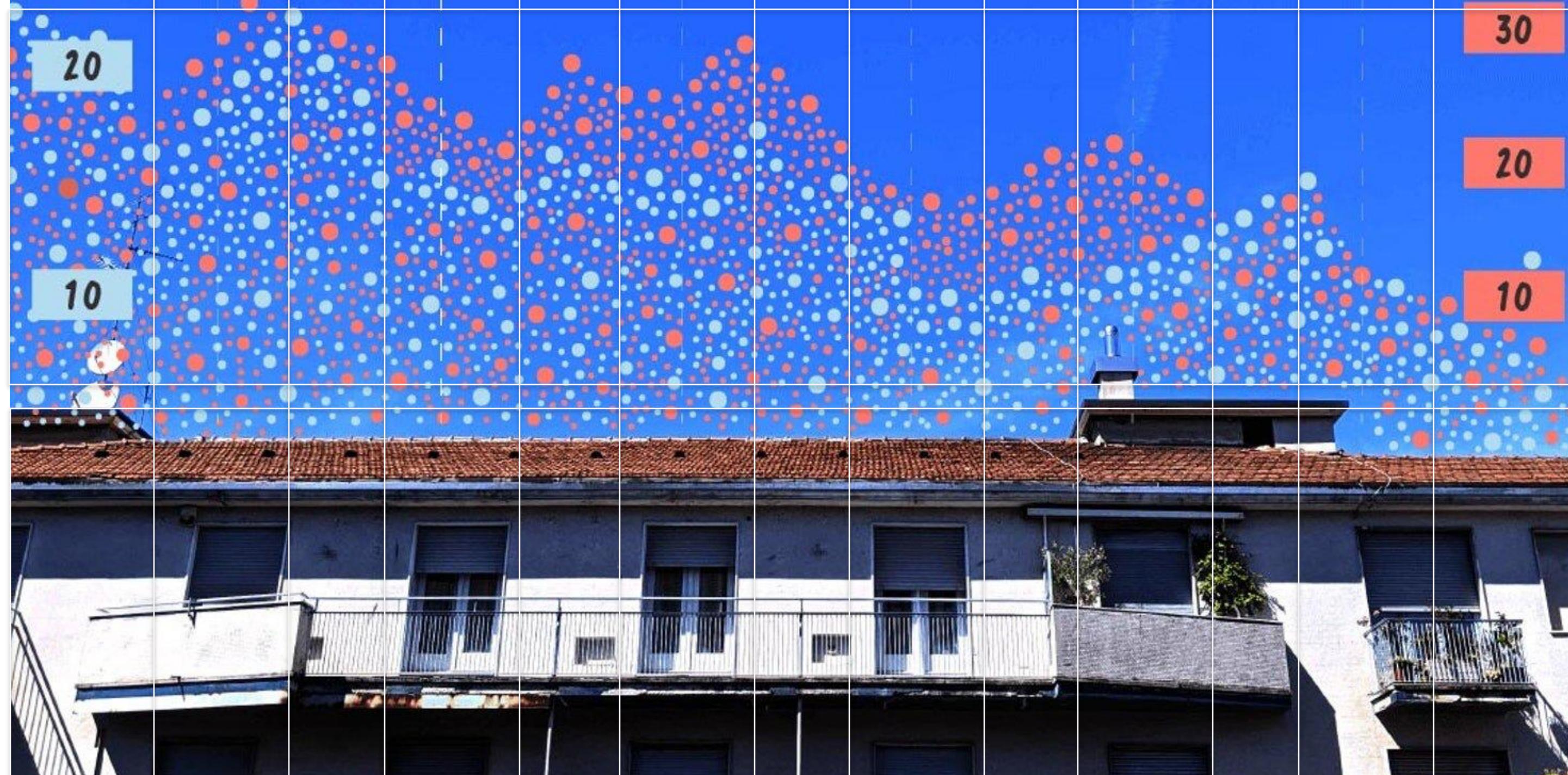
10

NO<sub>2</sub>  
( PPB )

30

20

10



# Columnas o sistemas modulares

**The Grid System**

The ultimate resource in grid systems.

"The grid system is an aid, not a guarantee. It permits a number of possible uses and each designer can look for a solution appropriate to his personal style. But one must learn how to use the grid; it is an art that requires practice."

Josef Müller-Brockmann

Search

Articles	Tools	Books	Templates	Blog	Inspiration
<b>Compose to a Vertical Rhythm</b> On the Web, vertical rhythm is contributed to by three factors: font size, line height and margin or padding. All of these factors must be calculated with care in order that the rhythm is maintained. <b>04.Dec.2008</b>	<b>960 Grid System</b> An effort to streamline web development workflow by providing commonly used dimensions, based on a width of 960 pixels. There are two variants: 12 and 16 columns, which can be used separately or in tandem. <b>04.Dec.2008</b>	<b>Geometry of Design</b> The book focuses on the classic systems of proportioning, such as the golden section and root rectangles, as well as systems such as the Fibonacci Series. <b>04.Dec.2008</b>	<b>InDesign 8.5x11 Grid System (12)</b> Adobe InDesign file with a grid system for an 8.5"x11" page that is divided into 12 columns and rows using the Rule of Thirds (Golden Ratio). Includes a 12pt baseline grid. <b>29.Nov.2008</b>	<b>UX Magazine</b> A well designed collaborative site, with a very nice grid structure, that focuses on user experience. <b>02.Dec.2008</b>	Ace Jet 170 AisleOne Athletics BBDK Blanka Build Corporate Risk Watch David Airey Dirty Mouse Experimenta Experimental Jetset Form Fifty Five Grafik Magazine Grain Edit Graphic Hug Helvetica Film I Love Typography Lamosca magCulture Mark Boulton Minimal Sites Monocle Neubau NewWork OK-RM Original Linkage Robin Uleman SampsonMay Schmid Today September Industry Sonifyer Souellis Subtraction Swiss Legacy Thinking for a Living This Studio Toko Visuelle Xavier Encinas Year of the Sheep
<b>Incremental leading</b> In editorial design, there is a technique used for sidenotes and boxouts that aligns to the baseline grid, or vertical rhythm. It's called incremental leading. <b>03.Dec.2008</b>	<b>Graph Paper by Konigi</b> This graph paper is made for visual designers, interaction designers, and information architects. You'll find styles for wireframing, story boarding, plotting values and for drafting sitemaps. <b>03.Dec.2008</b>	<b>The Typographic Grid</b> We consider this to be the academic part two to "Grid Systems." Hans Rudolf Bosshard tackles a deeper understanding of the complex grid. <b>30.Nov.2008</b>	<b>InDesign 11x17 Grid System (12)</b> Adobe InDesign file with a grid system for an 11"x17" page that is divided into 12 columns and rows using the Rule of Thirds (Golden Ratio). Includes a 12pt baseline grid. <b>29.Nov.2008</b>	<b>Doane Paper Utility Notebook</b> A portable notebook featuring a patent pending Grid+Lines stationery design that combines the benefits of grid and ruled lines onto a single sheet of paper. <b>28.Nov.2008</b>	
<b>Applying Divine Proportion to Your Web Designs</b> This article explains what is the Divine proportion and what is the Rule of Thirds and describes how you can apply both of them effectively to your designs. <b>01.Dec.2008</b>	<b>Syncotype</b> Syncotype is a simple tool to help align your text to a baseline grid. Enter your line height and offset in pixels in the Syncotype control box and click "Syncotype it" to overlay a baseline grid in red. <b>01.Dec.2008</b>	<b>Grid Systems</b> Grid Systems provides a rich, easy-to-understand overview and demonstrates a step-by-step approach to typographic composition. <b>21.Nov.2008</b>	<b>Photoshop 975px Grid System (12)</b> Adobe Photoshop file with a grid system for a 975px wide page that is divided into 12 columns and rows using the Rule of Thirds (Golden Ratio). Includes a 16px baseline grid. <b>29.Nov.2008</b>	<b>Replica Typeface</b> Replica is a new typeface by Norm that was designed on a strict grid system. Available in the following weights: Regular, Italic, Light, Light Italic, Bold and Bold Italic. <b>21.Nov.2008</b>	

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# Our Design Project



**Lorem Ipsum**  
Lorem ipsum dolor sit amet, consectetur adipiscing elit. In eu diam non ante condimentum malesuada lacinia eu sit amet ligula.

**Lorem Ipsum**  
Lorem ipsum dolor sit amet, consectetur adipiscing elit. In eu diam non ante condimentum malesuada lacinia eu sit amet ligula. Suspendisse posuere dolor vitae laoreet varius. Vivamus eget felis rutrum, venenatis felis.

**Lorem Ipsum**  
Lorem ipsum dolor sit amet, consectetur adipiscing elit. In eu diam non ante condimentum malesuada lacinia eu sit amet ligula.

**Canva**

# Las cuadrículas proporcionan consistencia y flexibilidad

1 column vertical grid



2 column vertical grid



2 column vertical grid



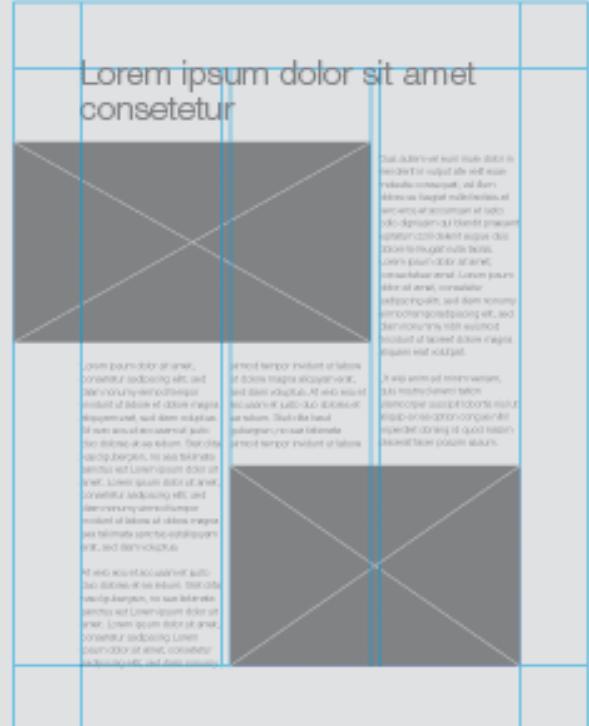
1 column landscape grid



2 column landscape grid



3 column vertical grid



3 column vertical grid



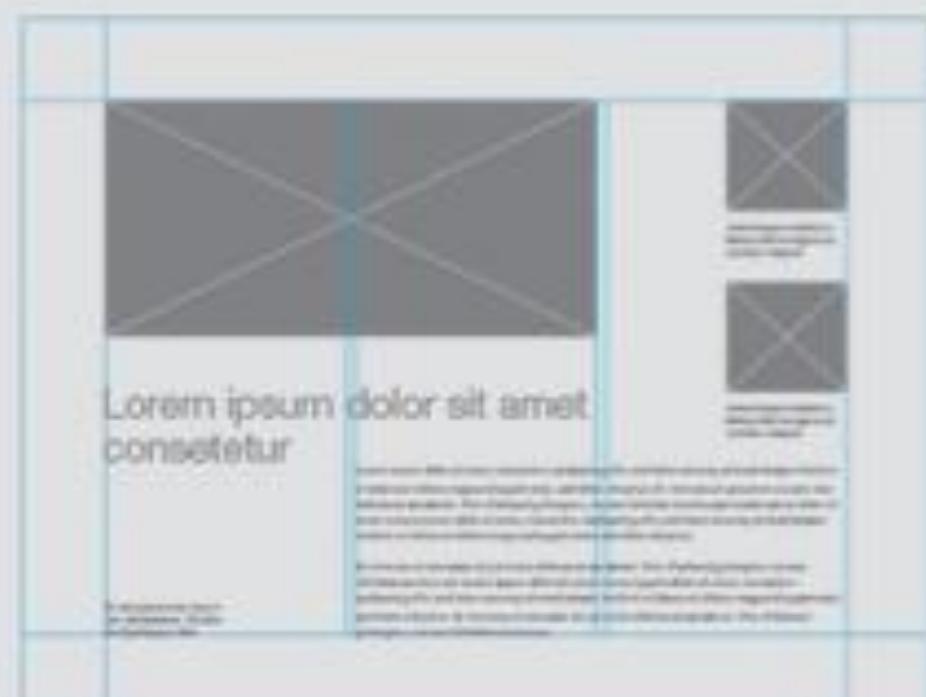
3 column vertical grid



3 column landscape grid



3 column landscape grid



### 3. Espacio

#### \*Gestalt:

Proximidad / Similaridad

agrupa elementos dentro de una jerarquía y crea nuevas subjerarquías.

#### \*Ritmo:

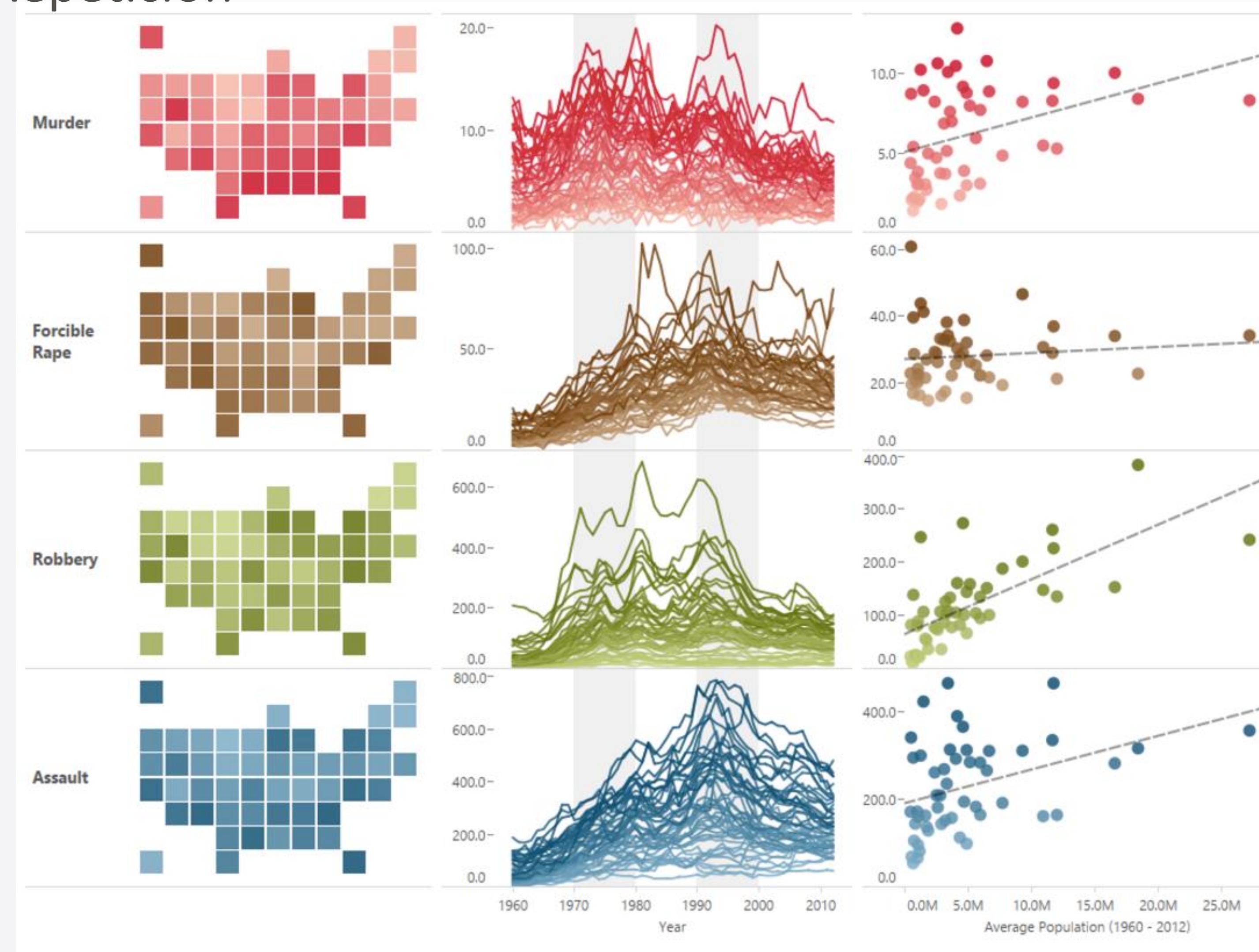
Repetición genera un ritmo visual que puede ser continuo o discontinuo, creciente o descendiente.

#### \*Espacio negativo o vacío:

Cuento menos elementos tengas, más potente.

Además, el espacio positivo pesa más que el espacio negativo

### 3. Espacio: Repetición



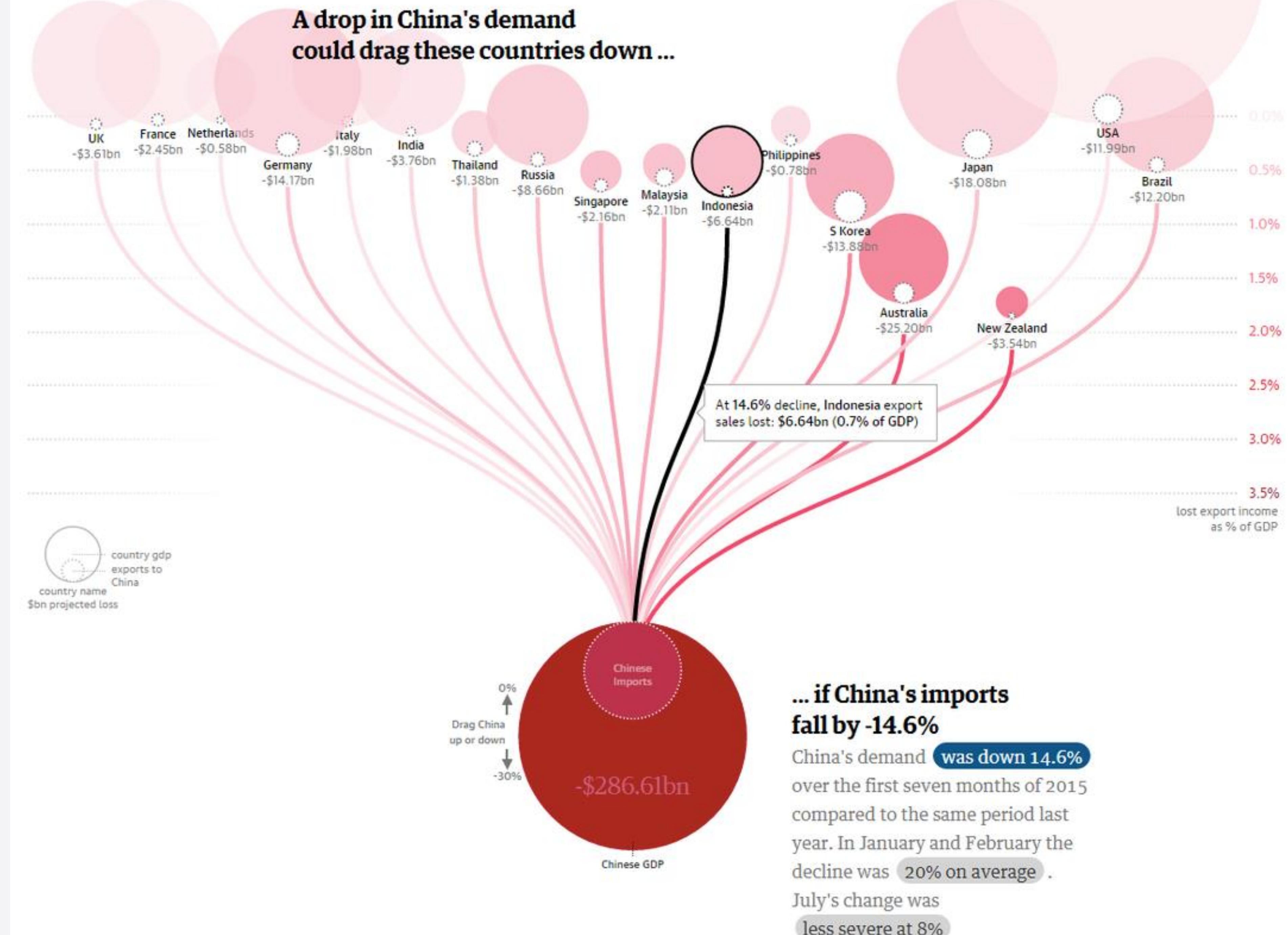
La repetición otorga significado a los nuevos elementos: están en el mismo nivel en la jerarquía  
La alineación crea orden. Permite conectar rápidamente elementos en toda la página  
Un solo elemento que rompe la alineación llama la atención sobre sí mismo y su importancia

### 3. Espacio: Elemento central



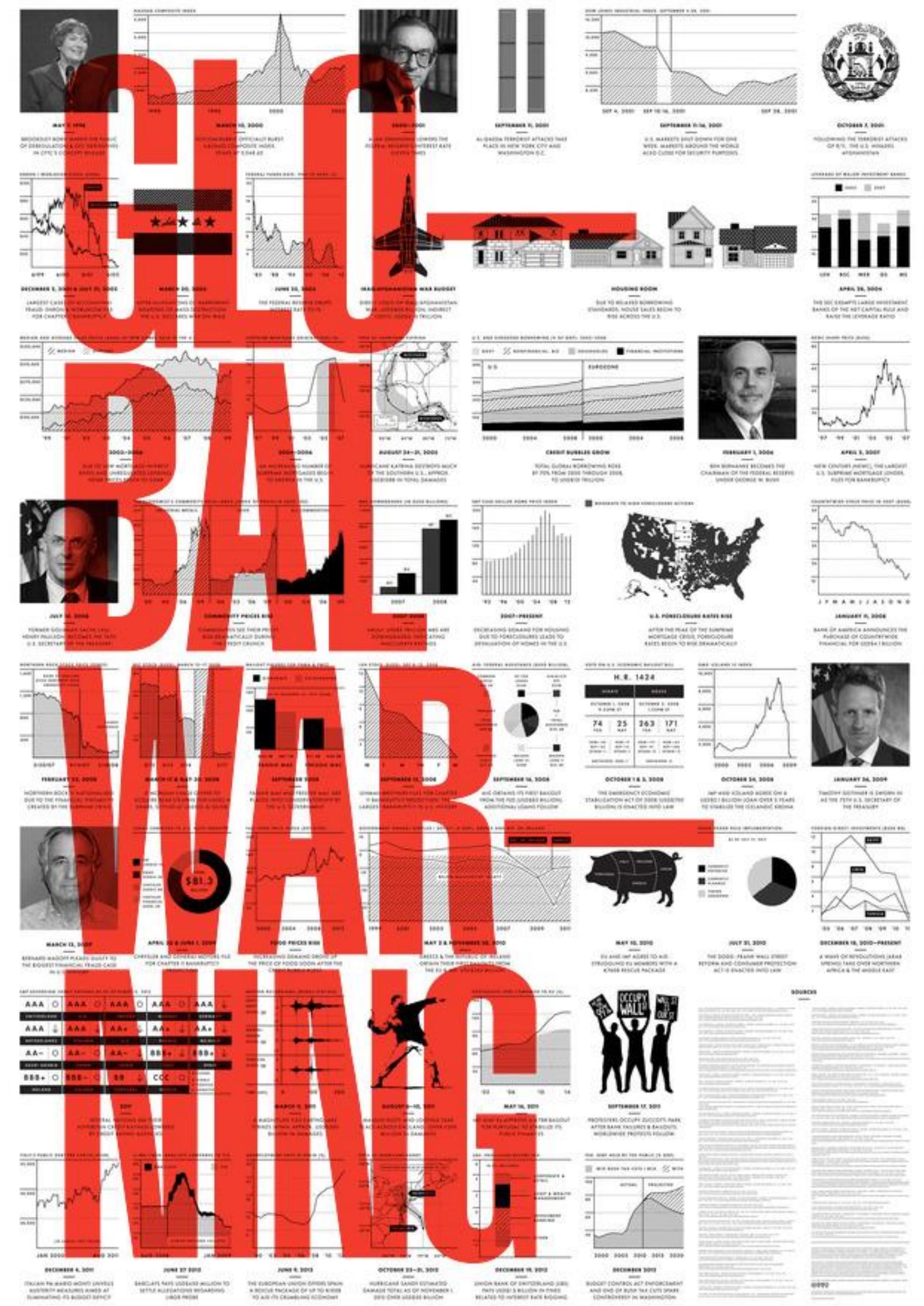
### 3. Espacio:

#### Espacio negativo



# 4. Color

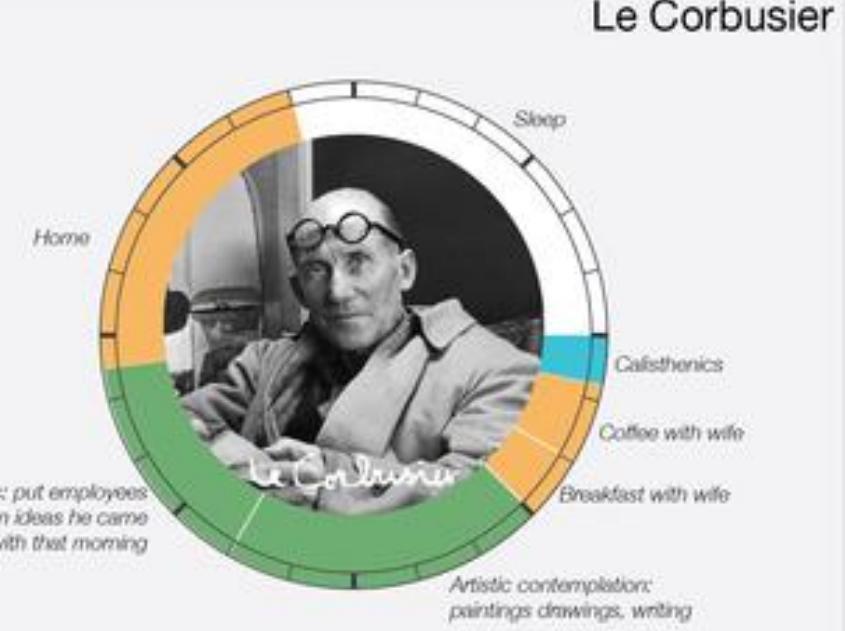
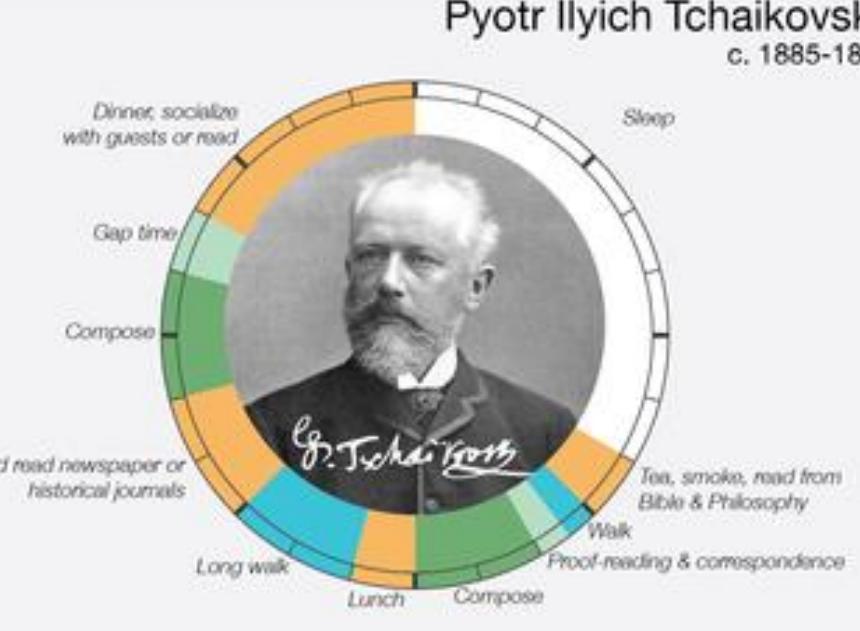
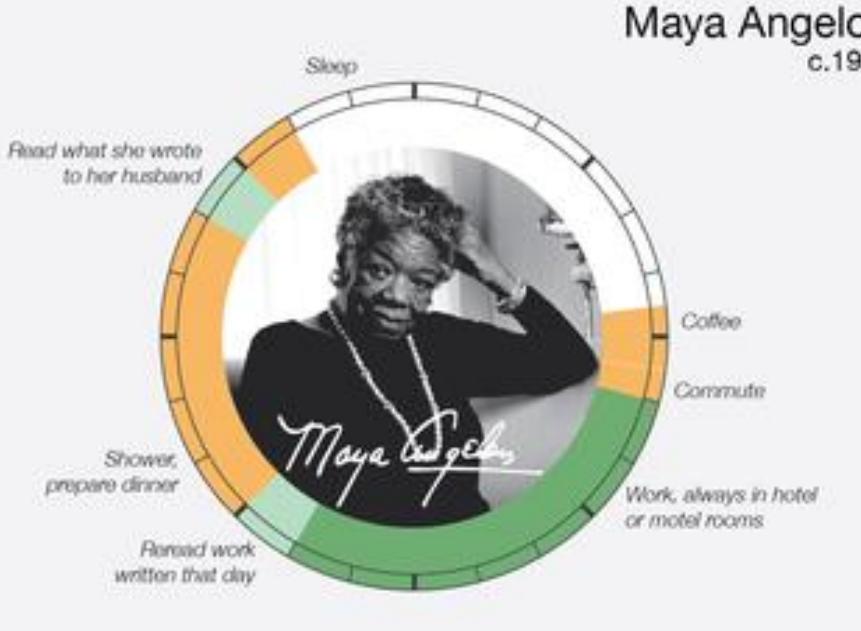
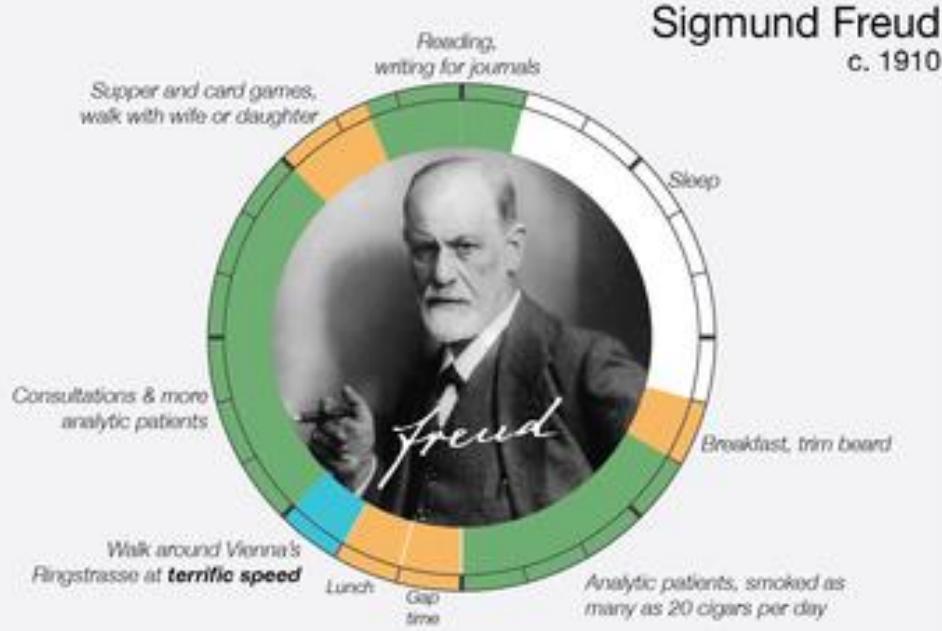
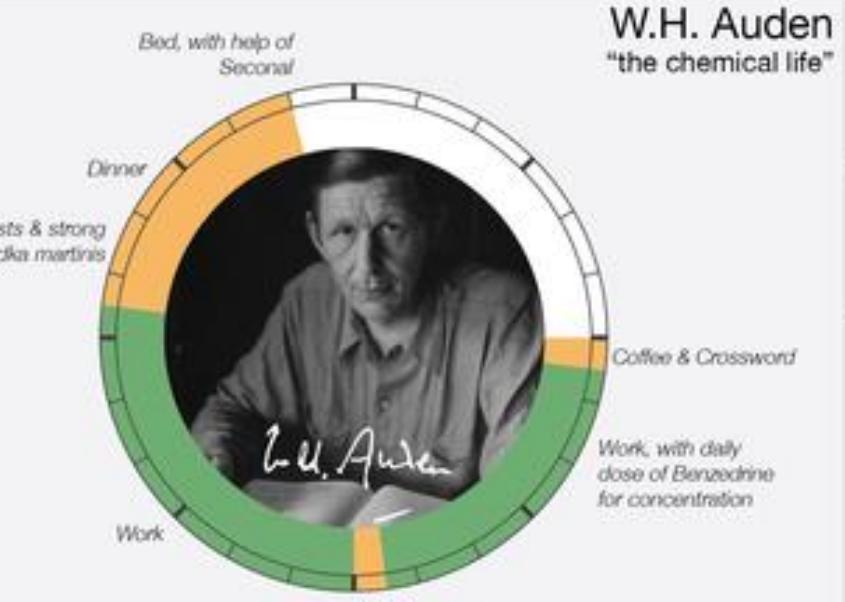
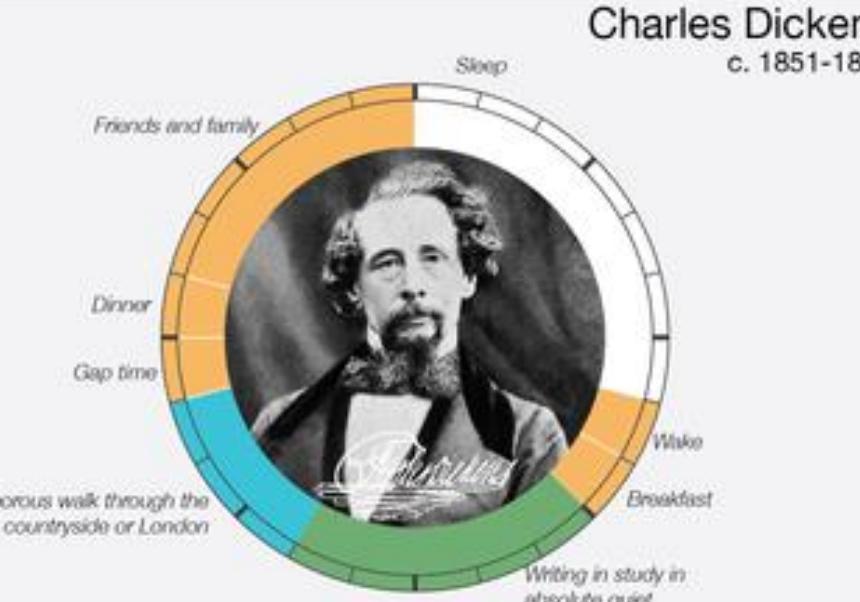
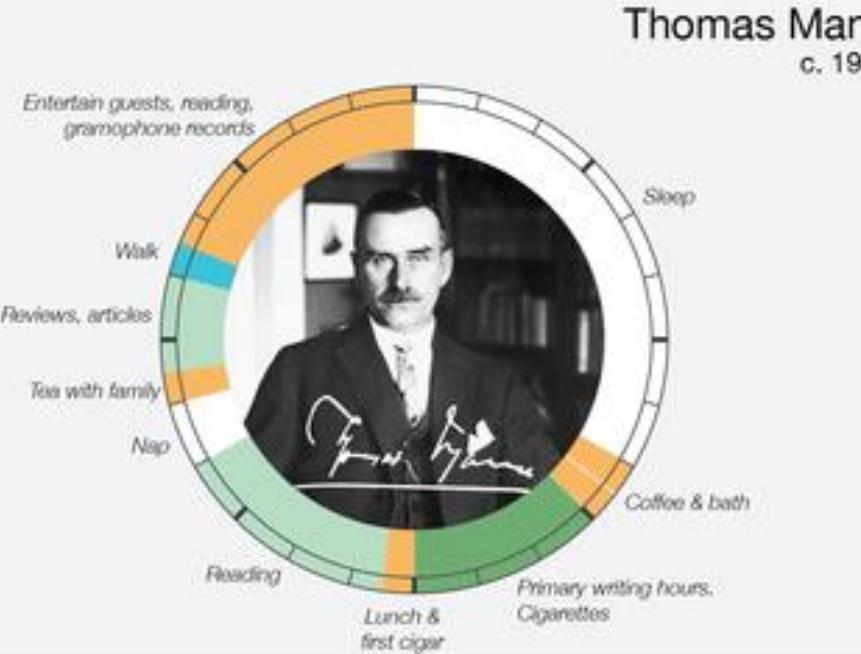
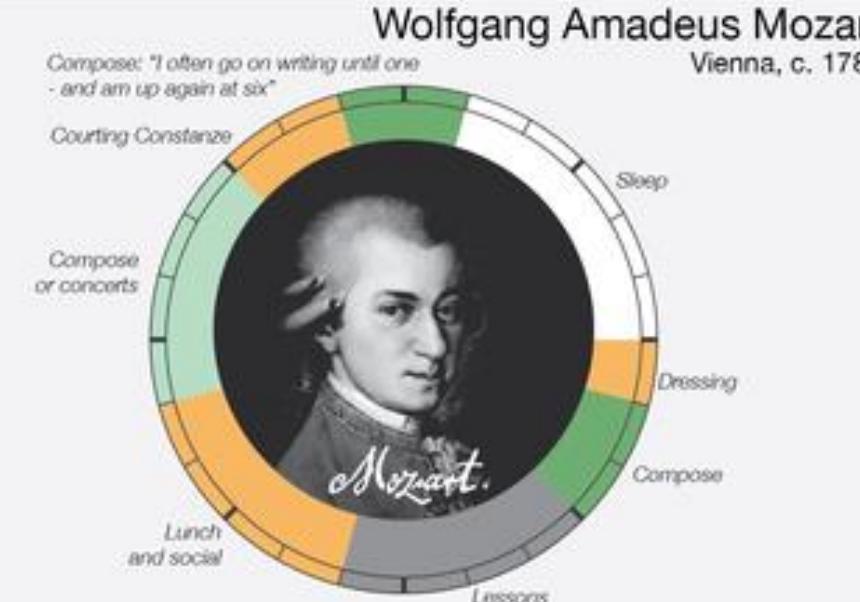
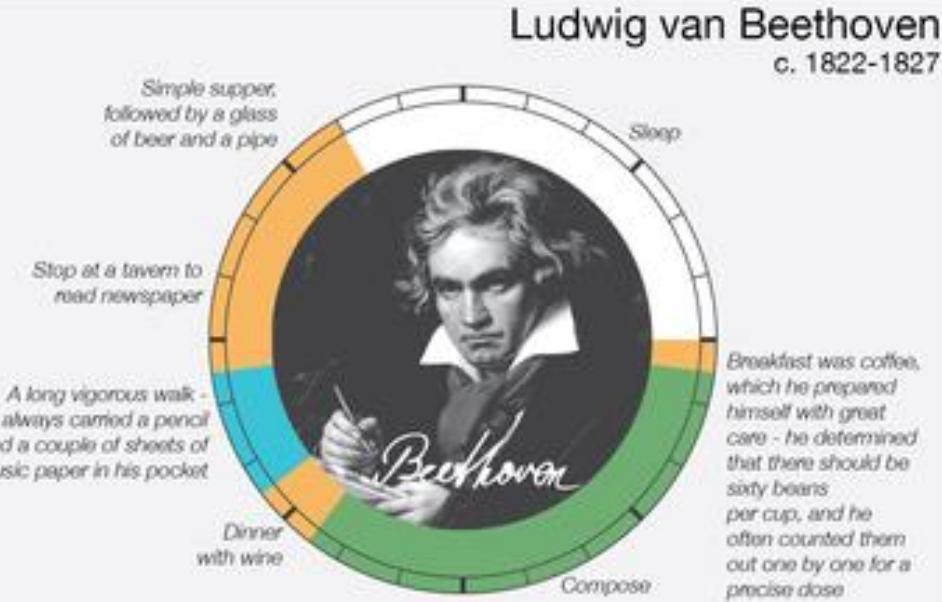
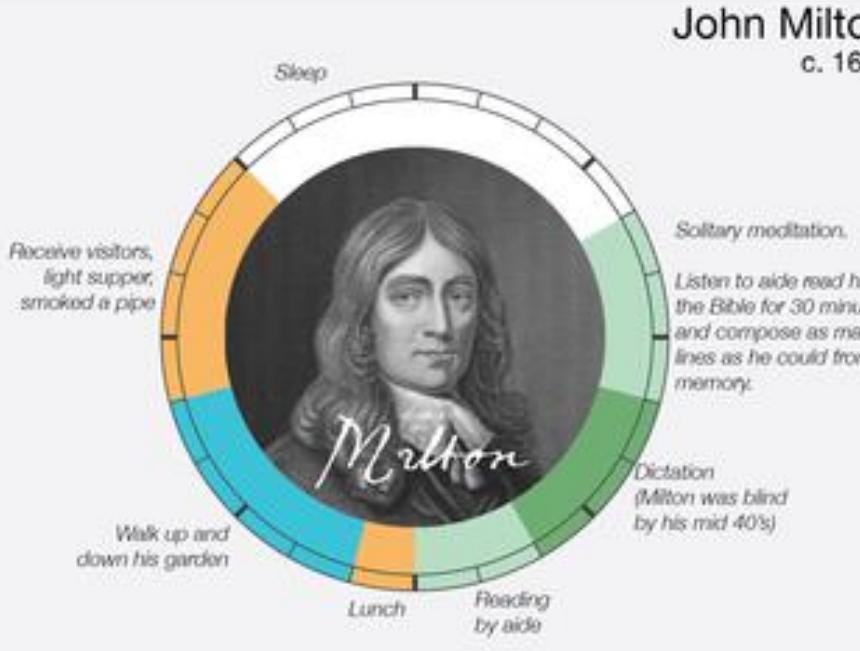
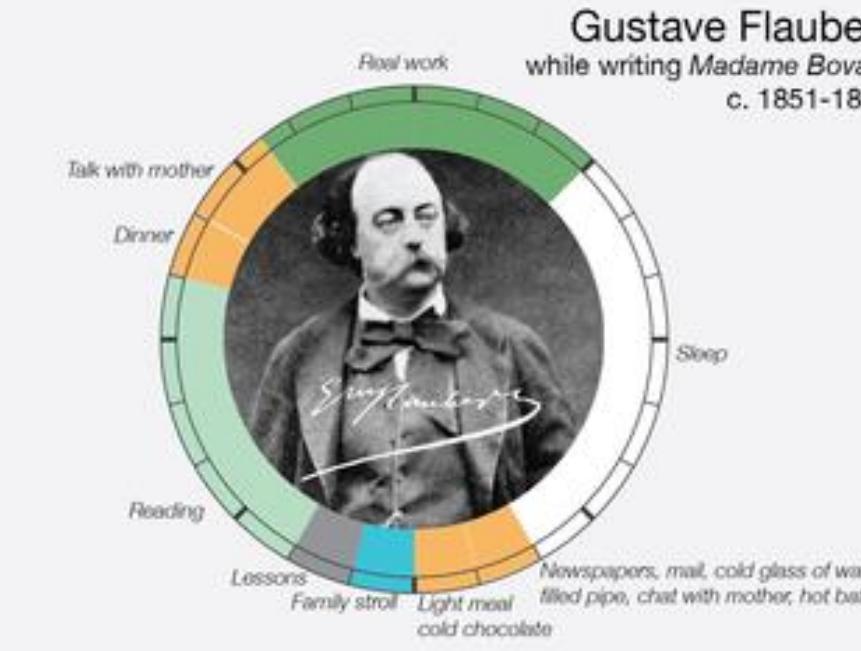
# CONTRASTE



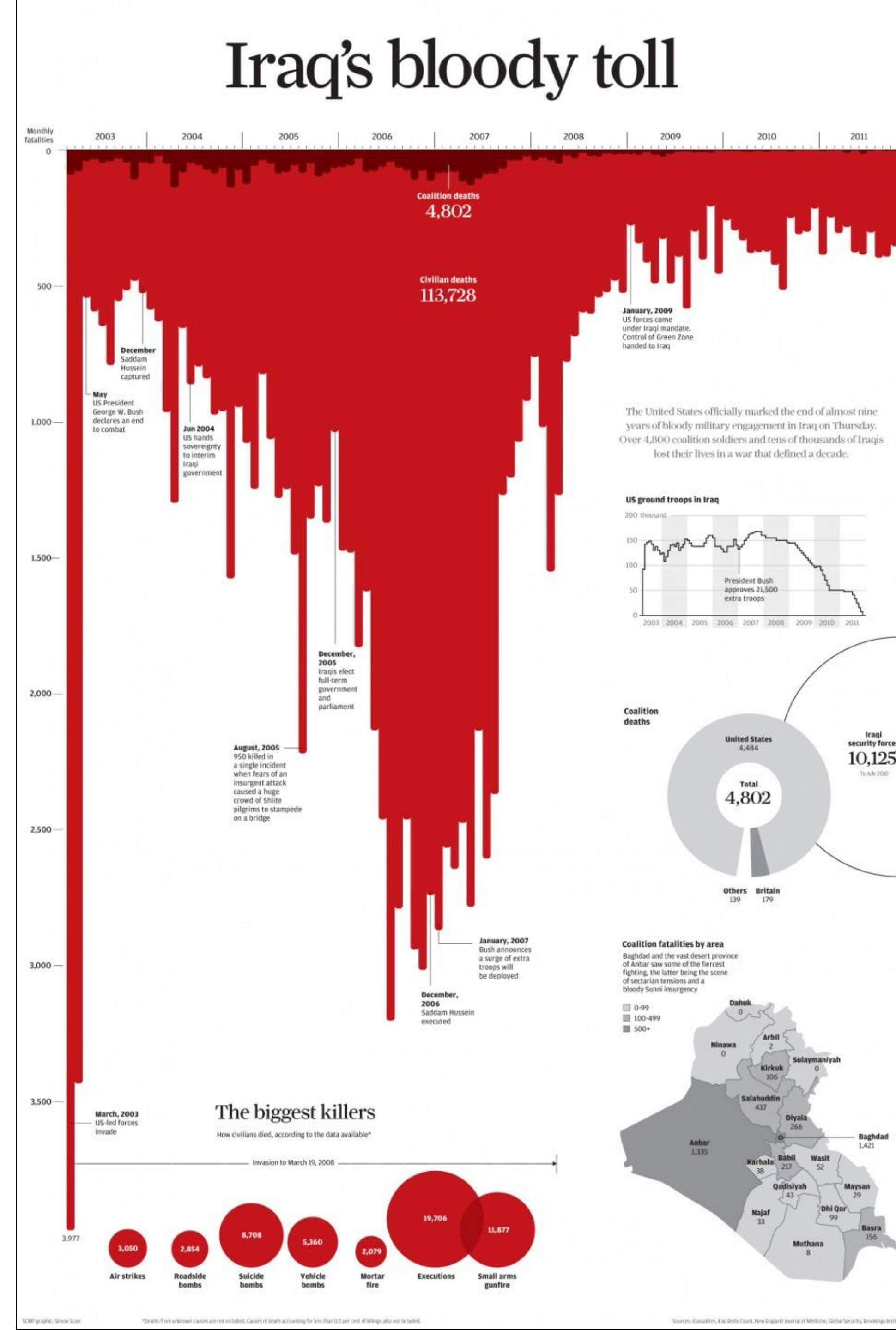
# 4. Color: SIMILITUD

## CREATIVE ROUTINES

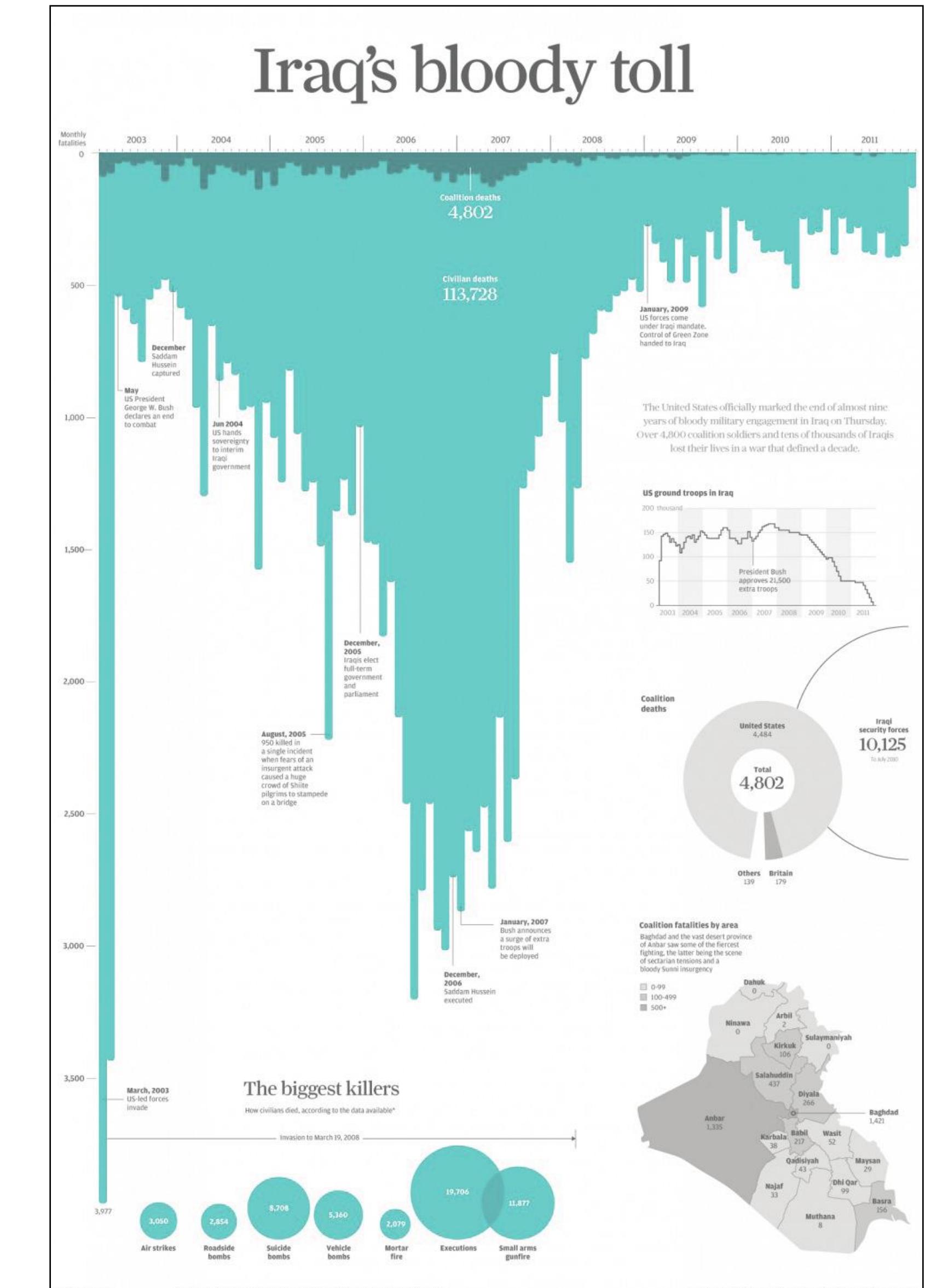
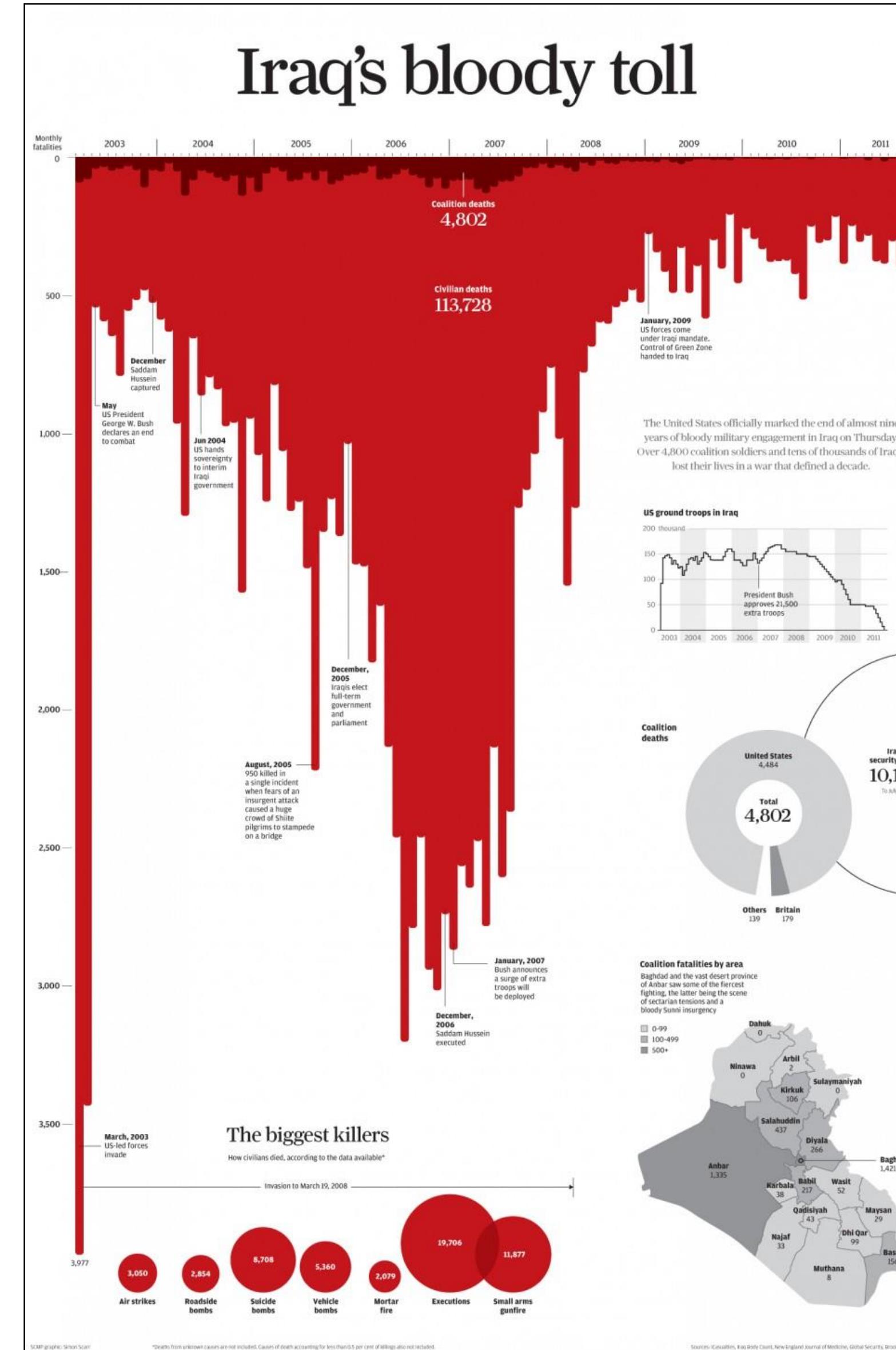
"In the right hands, it can be a finely calibrated mechanism for taking advantage of limited resources... a solid routine fosters a well-worn groove for one's mental energies...." - Mason Currey, author of the inspiring book, DAILY RITUALS



# 4. Color: SEMÁNTICA



# 4. Color: SEMÁNTICA



## 5. Flujo Visual

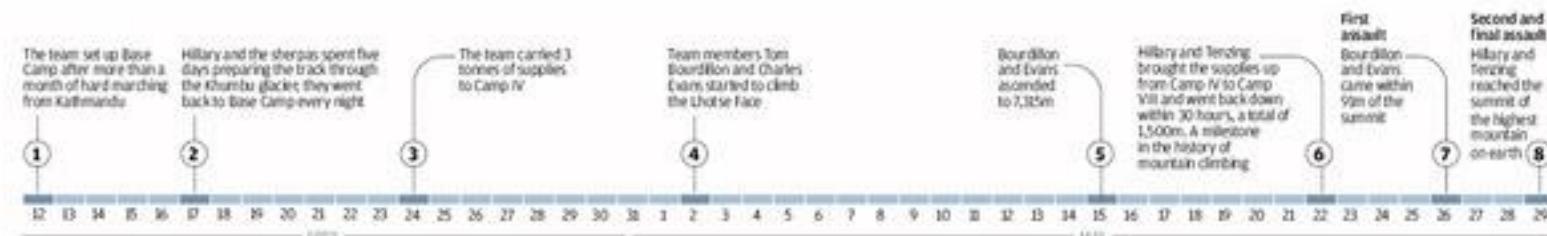
Podemos crear flujo visual con cualquiera de los elementos anteriores, y también con ojos, manos, líneas, triángulos y flechas sutiles o explícitas.

# 5. Flujo Visual

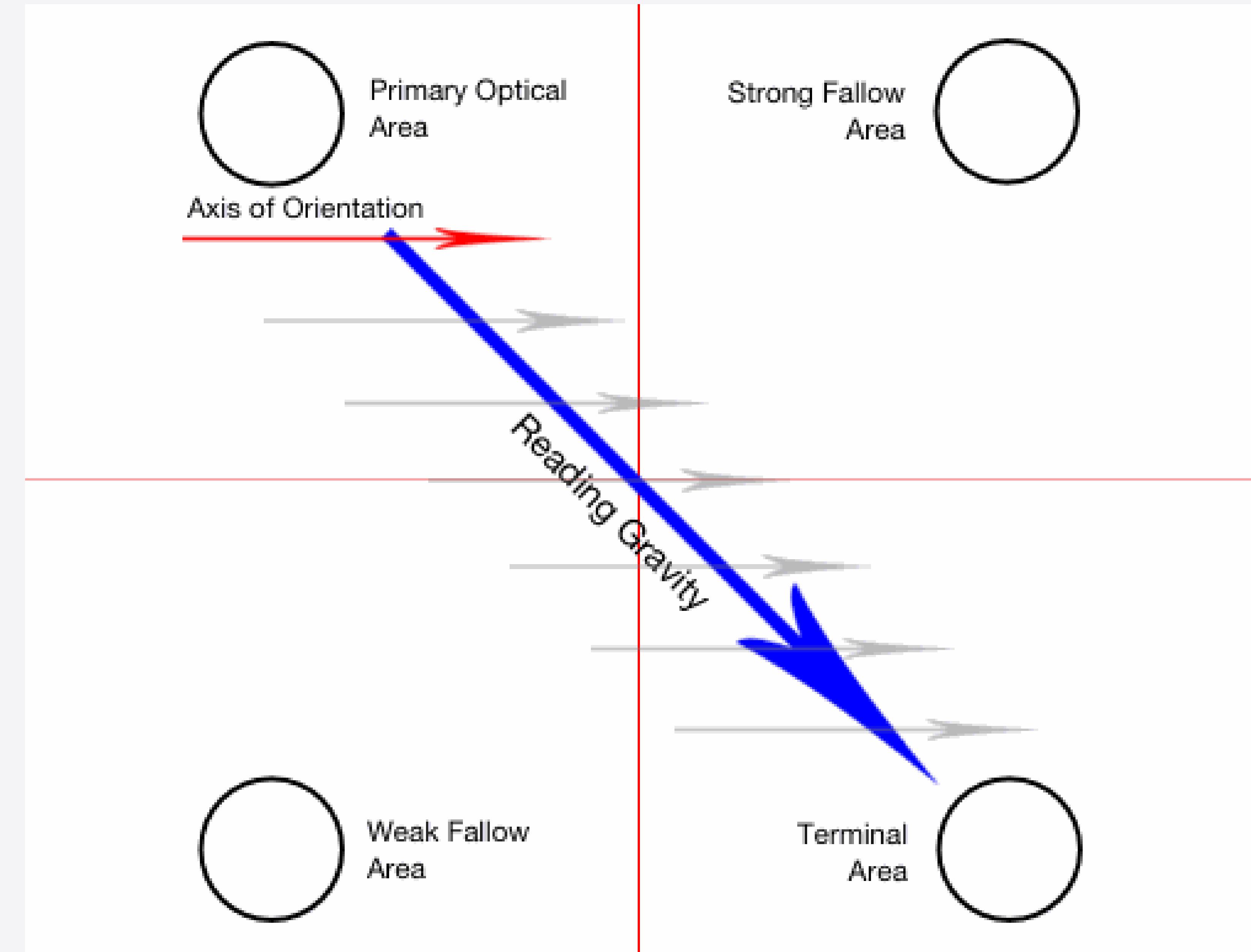
## Mount Everest

Sixty years ago, Edmund Hillary and Tenzing Norgay became the first climbers to reach the summit of Mount Everest, known as Qomolangma in China and Chomolungma in Tibet. Their bravery and resilience set an example for many other adventurers in the following decades.

The challenge of scaling Everest still attracts thousands of people from all walks of life who want to push themselves to the limit.



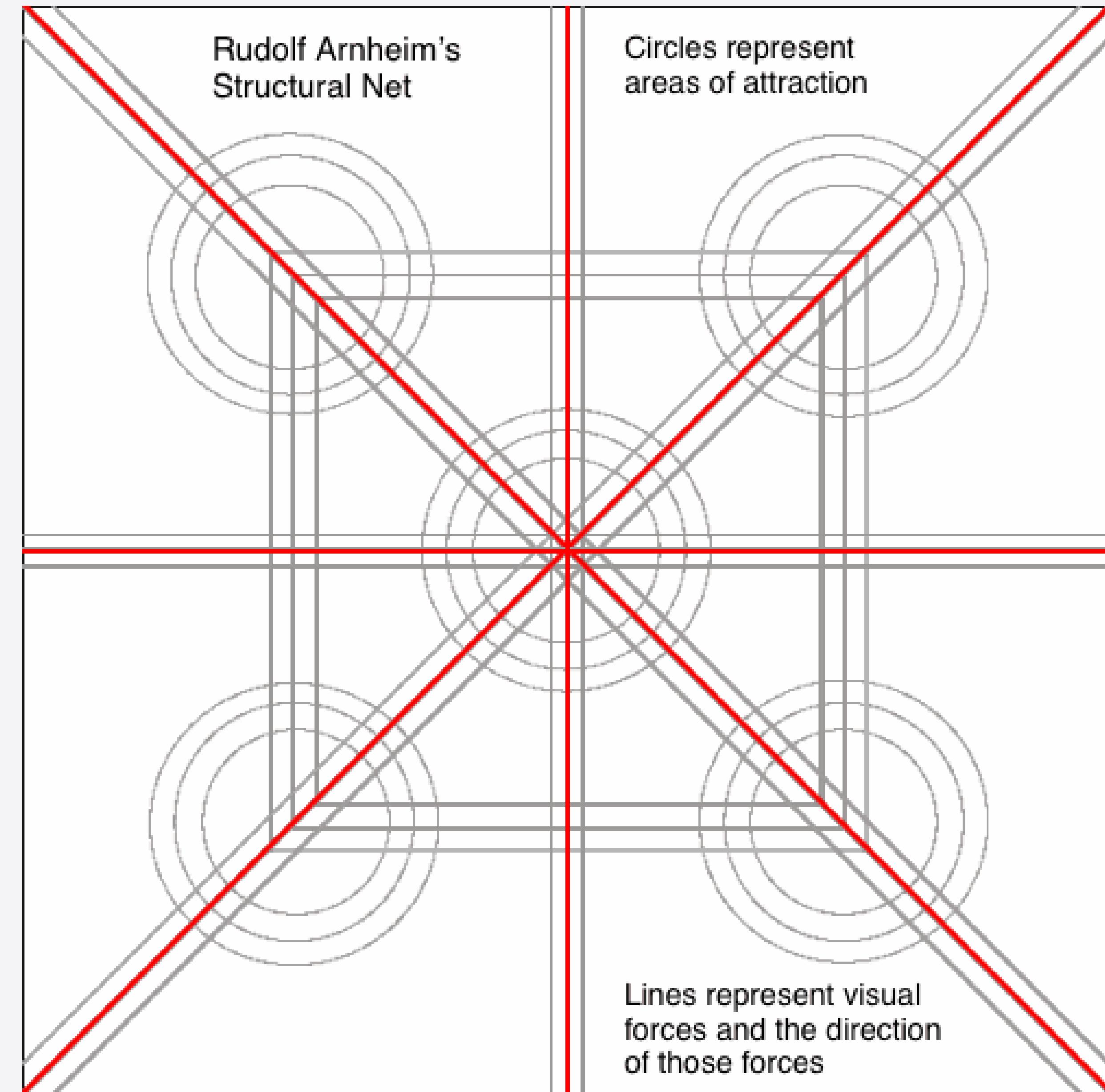
## 5. Flujo Visual



Cuando el diseño no está presente

# 6. Flujo Visual

Puntos naturales de atracción  
Y líneas de flujo



# 6. Estilo Gráfico



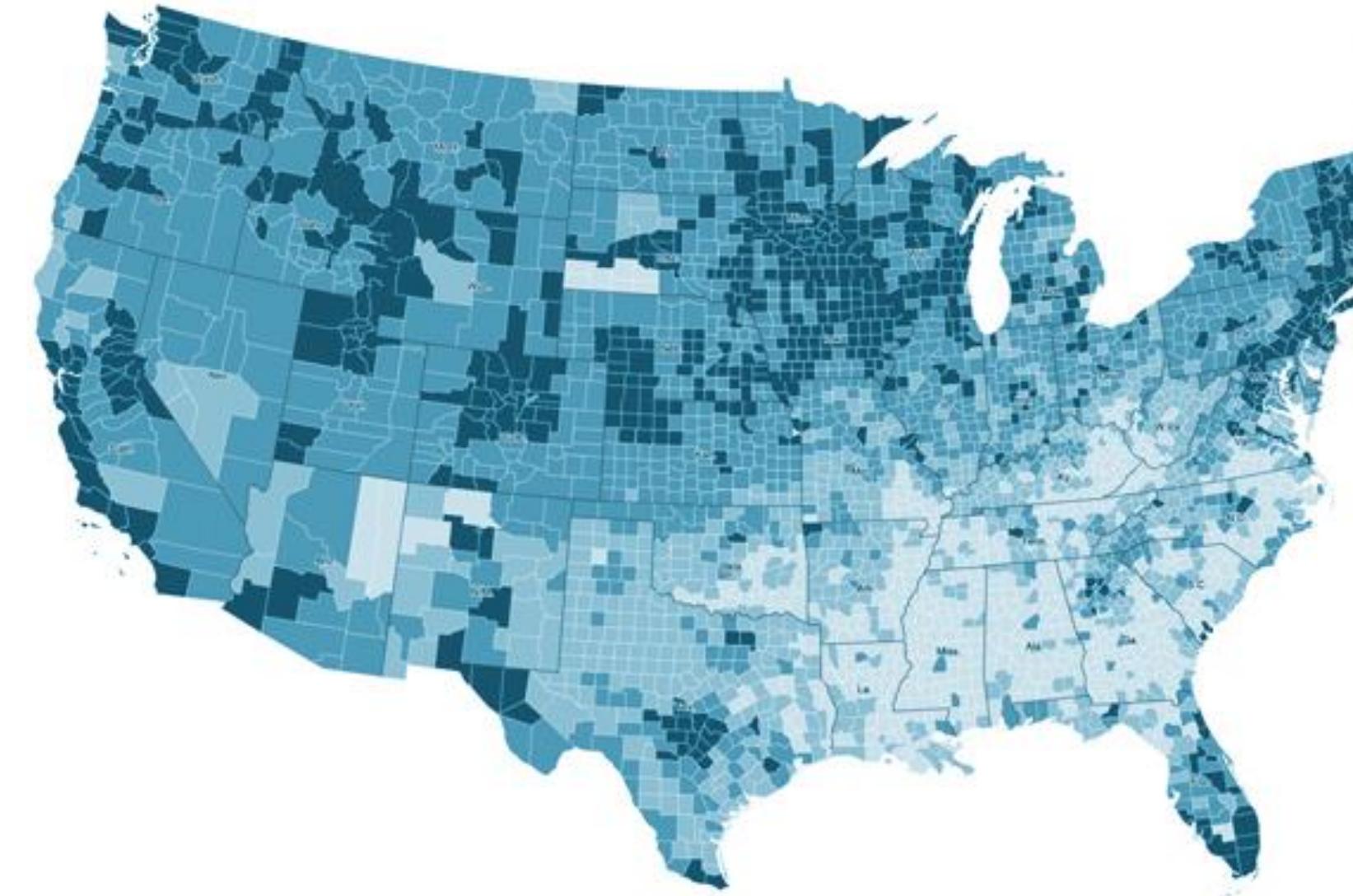
Recomendación: no usar más de 3 niveles de jerarquía tipográfica  
Valor: un objeto más oscuro tendrá más peso que un objeto más claro

# Life Expectancy in the US

Comparing life expectancy across our nation and the State of Virginia

Created by Boost Labs using US Census Bureau Data available as of June, 2011

US Male Life Expectancy by County



Legend

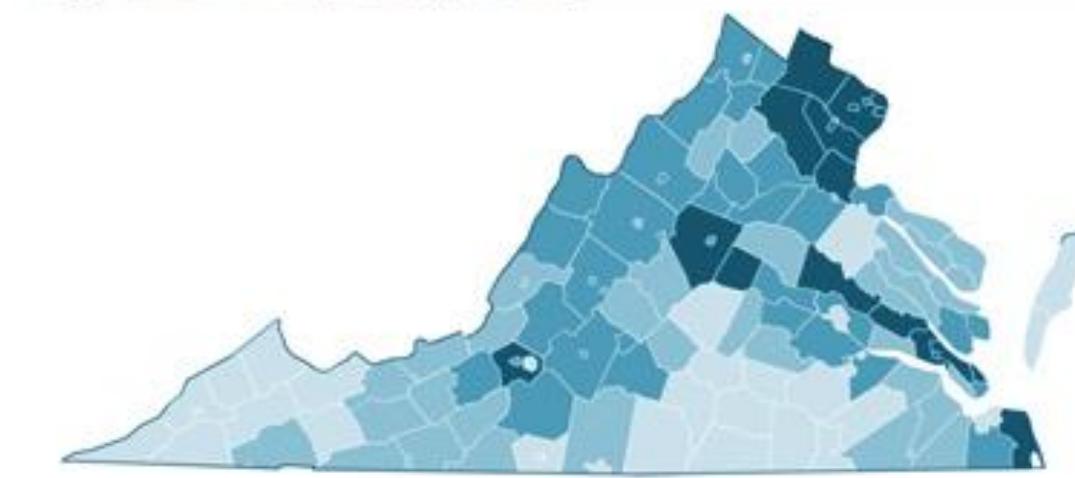
Male Life Expectancy

- 70–72 yrs
- 72–74 yrs
- 74–76 yrs
- 76–78 yrs

Female Life Expectancy

- 78–79 yrs
- 79–80 yrs
- 80–82 yrs
- 82–84 yrs

Virginia Male Life Expectancy by County



US Quick Stats

US Average Life Expectancy in Years

**78.7**

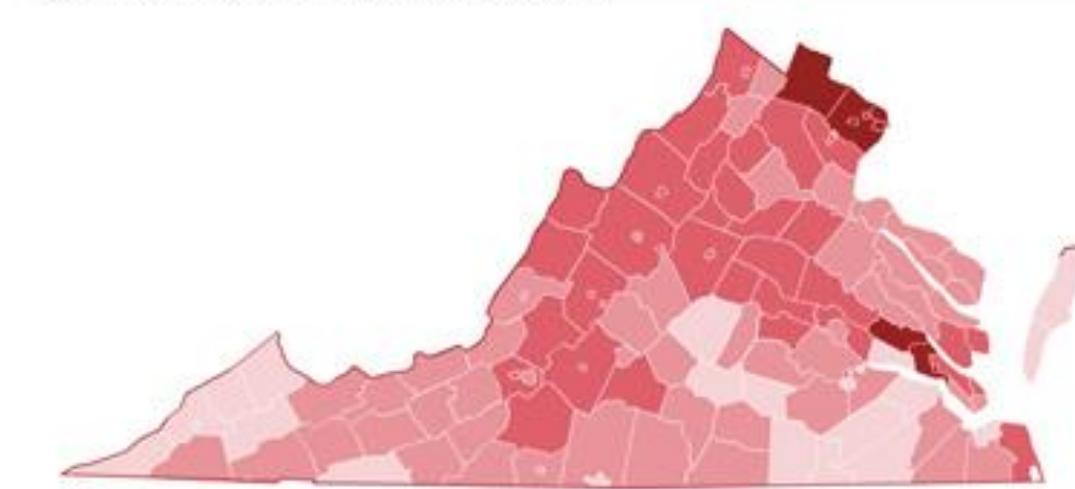
Males

**75.9**

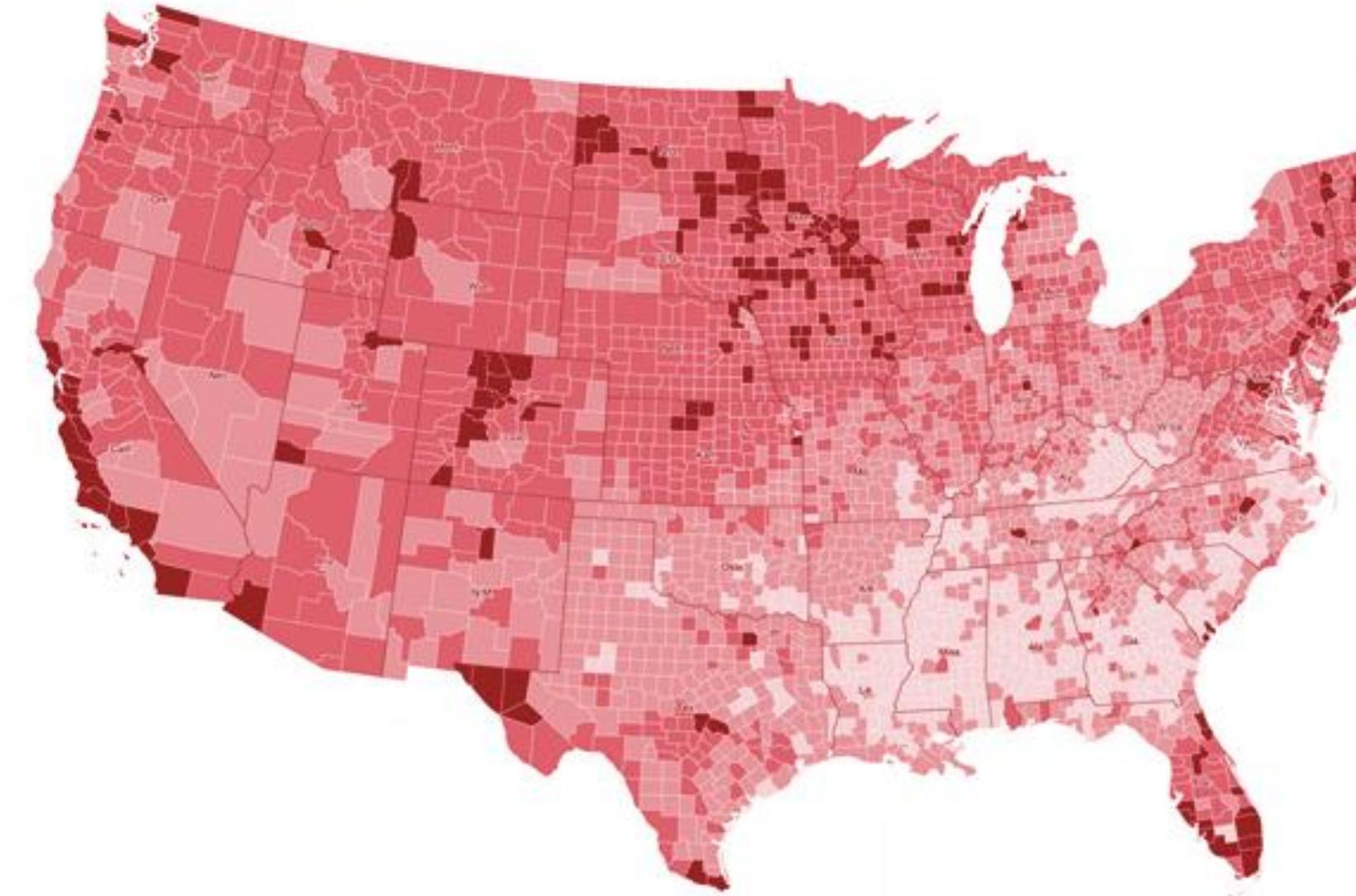
Females

**81.1**

Virginia Female Life Expectancy by County



US Male Life Expectancy by County



Virginia Quick Stats

US Average Life Expectancy in Years

**78.6**

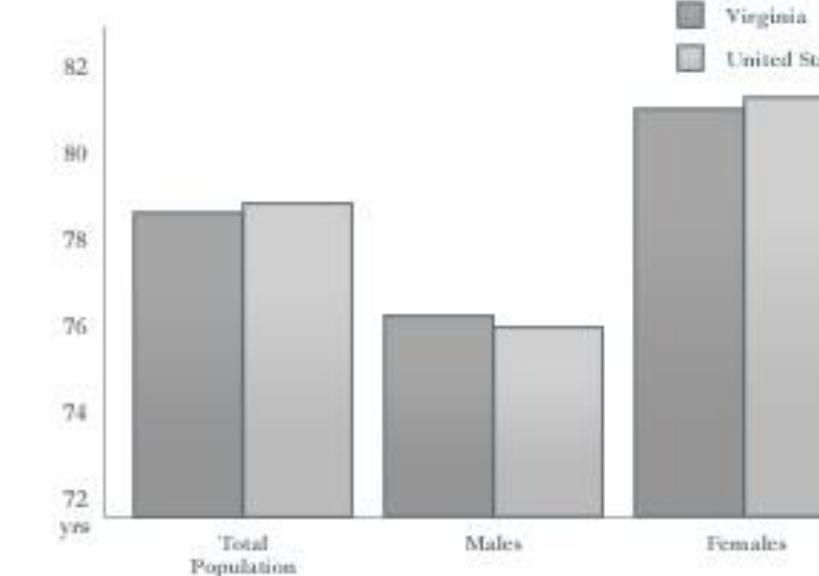
Males

**76.1**

Females

**80.9**

Estimated Life Expectancy at Birth by Gender



US Population Stats

US Total Population

**308,745,538**

Female persons

**50.7%**

White persons

**72.4%**

Persons under 18 years old

**24.3%**

Persons 65 years old and over

**12.9%**

Virginia Population Stats

Virginia Total Population

**8,001,024**

Female persons

**50.8%**

White persons

**68.6%**

Persons under 18 years old

**23.4%**

Persons 65 years old and over

**12.2%**

Estimated Life Expectancy at Birth by Year



# WAKE UP

Mohamad Waked

Forward

Textbox

Forward

Backward

Textbox

# Wake Up

## The Tragedy of US School Shootings

By Mohamad Waked

For the best experience, view this project on a laptop or large screen with a 16:10 aspect ratio. Use the buttons on the top left and right to navigate and interact.

[www.alhadaqa.com](http://www.alhadaqa.com)

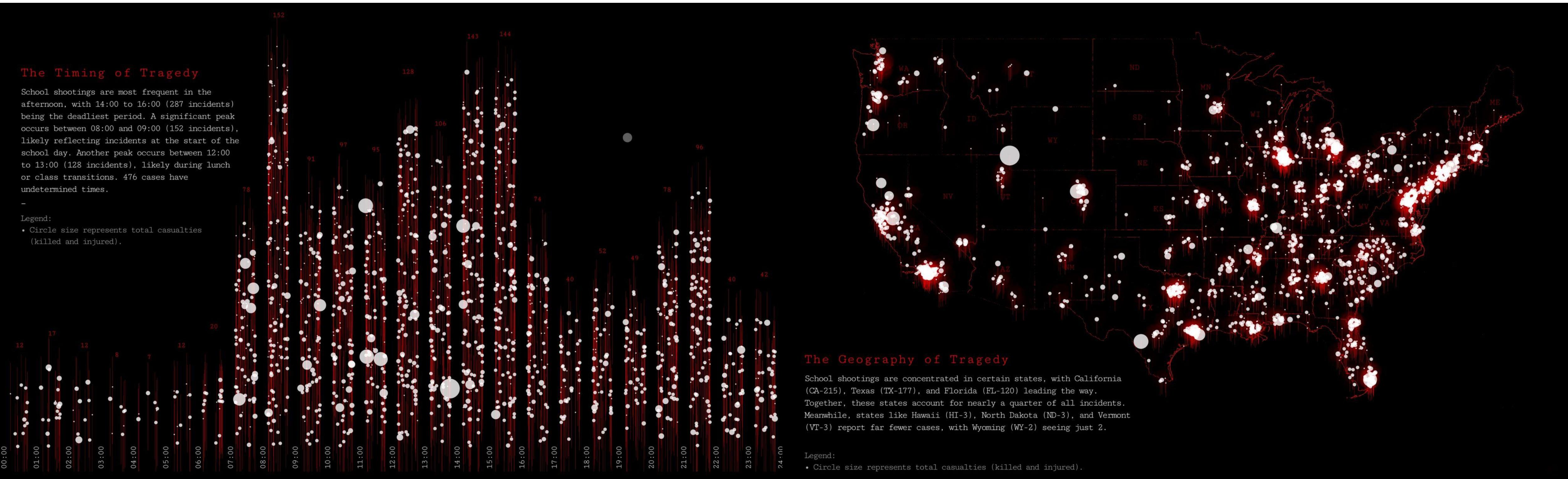
**The Last Morning Light**

"My boy, wake up."  
The sunlight spilled over his face, soft and warm.  
"Five more minutes," he murmured, pulling the blanket tight.  
"Not today," I said, brushing his messy hair.  
He sat up slowly, rubbing sleep from his eyes.  
"Do I really have to?" he asked, still half-dreaming.  
"Yes," I replied. "Every day is a gift, my boy."

<https://alhadaqa.github.io/wakeup/>

# WAKE UP

## Mohamad Waked



<https://alhadaqa.github.io/wakeup/>

# EJERCICIO 1

- Abrir *life\_expectancy.csv* o *.xlsx* (Excel, Preview de mac, GoogleSheets, Python, etc).
- Es necesario **formatear** antes de usarlo.
- Derivar dataset filtrando **un solo año**.
  
- Hacer gráficas para visualizar las preguntas:
  - ¿Top 20 países con mayor EV media?
  - ¿Top 20 países con mayor diferencia por sexo?
  
- Identificar tipos de datos: cuantitativos, ordinales o categóricos.
- Abrir la web [www.datawrapper.de](http://www.datawrapper.de)
- Hacer gráficas según el planteamiento anterior de Datos, Tareas y Codificación.
  - Ranking ordenado de Both Sexes por país.
  - ¿Qué gráfica mostraría más claramente la diferencia entre ambos sexos por país?

## EJERCICIO 2

- Abrir *life\_expectancy.csv* o *.xlsx*. **Necesario formatear antes de usar.**
- Queremos visualizar la **evolución temporal** de **Both Sexes** por país, para todos los países a la vez.
- ¿Cómo formatear los datos para hacer esa visualización? **Haz las operaciones necesarias**
- Se puede hacer en [www.datawrapper.de](http://www.datawrapper.de)
- ¿Qué gráfica sería más adecuada?
  - Cuantos atributos y de qué tipo?
  - Keys? Values?
  - Marcas: ?
  - Canales: ?
  - Tareas:
    - Acción: Identificar tendencias en el tiempo
    - Objetivo: Variable Both Sexes, país y año
  - Escalable a ~200 países

# EJERCICIO 2

- Abrir *life\_expectancy.csv* o *.xlsx* (Excel, Preview de mac, GoogleSheets, Python, etc). **Necesario formatear antes de usar.**
  - Queremos visualizar la evolución temporal de Both sexes por país, para todos los países.
  - ¿Cómo formatear los datos para hacer esa visualización?
  - **Haz las operaciones necesarias para transformar los datos**

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Row Labels	Afghanistan	Albania	Algeria	Andorra	Angola	Antigua and	Argentina	Armenia	Australia	Austria	Azerbaijan	Bahamas
2	2000	54,8	72,6	71,3		45,3	73,6	74,1	72	79,5	78,1	66,6	72,6
3	2001	55,3	73,6	71,4		45,7	73,8	74	72,6	79,9	78,6	67,5	72,9
4	2002	56,2	73,3	71,6		46,5	74	74,1	72,6	79,9	78,7	67,8	73,1
5	2003	56,7	72,8	71,7		46,8	74,2	74,1	72,7	80,3	78,8	67,8	73,2
6	2004	57	73	72,3		47,1	74,4	74,7	73	80,6	79,3	68,4	73,8
7	2005	57,3	73,5	72,9		47,4	74,6	74,9	73	81	79,4	68,4	74,1
8	2006	57,3	74,2	73,4		47,7	74,8	75,2	72,9	81,2	79,8	69,2	74,2
9	2007	57,5	75,9	73,8		48,2	75	74,8	73,5	81,3	80,1	70,3	74,4
10	2008	58,1	75,3	74,1		48,7	75,2	75,4	73,2	81,3	80,4	70,3	74,5
11	2009	58,6	76,1	74,4		49,1	75,4	75,6	73,3	81,7	80,2	70,8	74,6
12	2010	58,8	76,2	74,7		49,6	75,6	75,5	73,5	81,9	80,4	71,1	75
13	2011	59,2	76,6	74,9		50,1	75,7	75,7	73,9	82	80,8	71,6	75
14	2012	59,5	76,9	75,1		50,6	75,9	75,9	74,4	82,3	80,8	71,9	74,9
15	2013	59,9	77,2	75,3		51,1	76,1	76	74,4	82,5	81,1	72,2	74,8
16	2014	59,9	77,5	75,4		51,7	76,2	76,2	74,6	82,7	81,4	72,5	75,4
17	2015	60,5	77,8	75,6		52,4	76,4	76,3	74,8	82,8	81,5	72,7	76,1

# EJERCICIO 3

- Abrir *life\_expectancy.csv* o *.xlsx* (Excel, Preview de mac, GoogleSheets, Python, etc).
- Queremos visualizar la **correlación** entre Male y Female para todos los países en el año 2015.
- Haz las operaciones necesarias para transformar los datos
- ¿Qué gráfica sería más adecuada?
- Abrir [www.datawrapper.de](http://www.datawrapper.de)
  - Cuantos atributos y de qué tipo?
  - Keys? Values?
  - Marcas: ?
  - Canales: ?
  - Tareas:
    - Encontrar patrones y tendencias, Analizar distribución e identificar outliers
    - Objetivos: Todo el dataset.
    - Debe ser escalable a ~200 paises