Data Driven Guides:

Supporting expressive design for Information graphics

Nam Wook Kim
Harvard

Eston Schweickart
Cornell

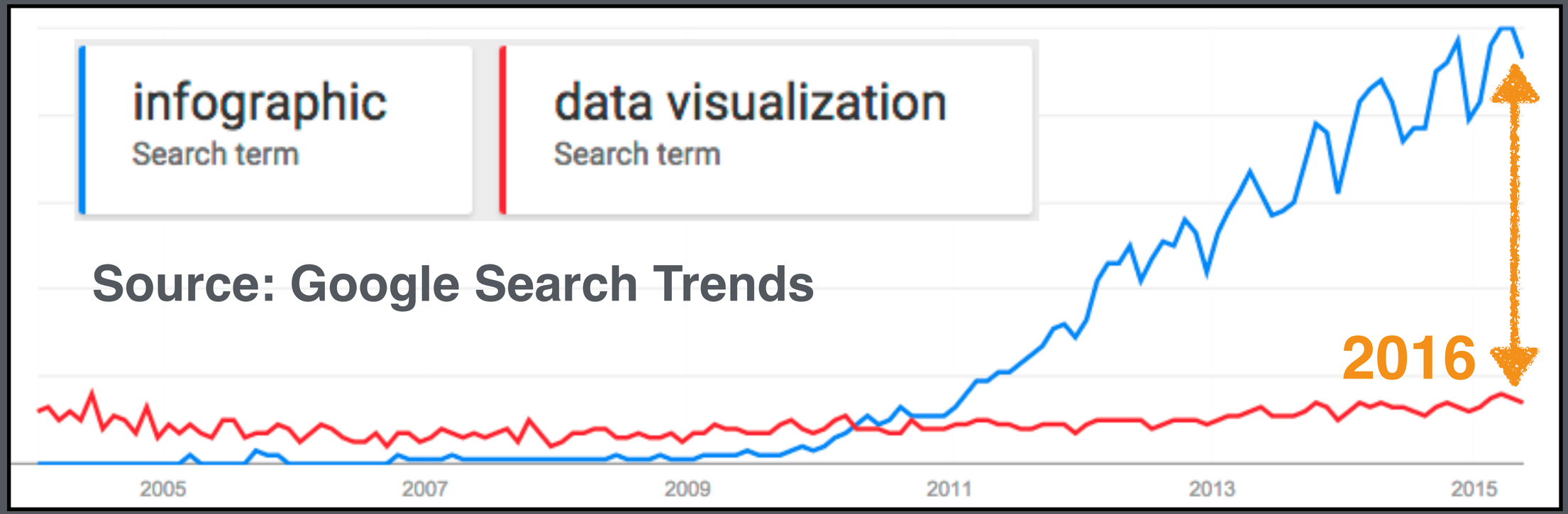
Zhicheng Leo Liu
Adobe

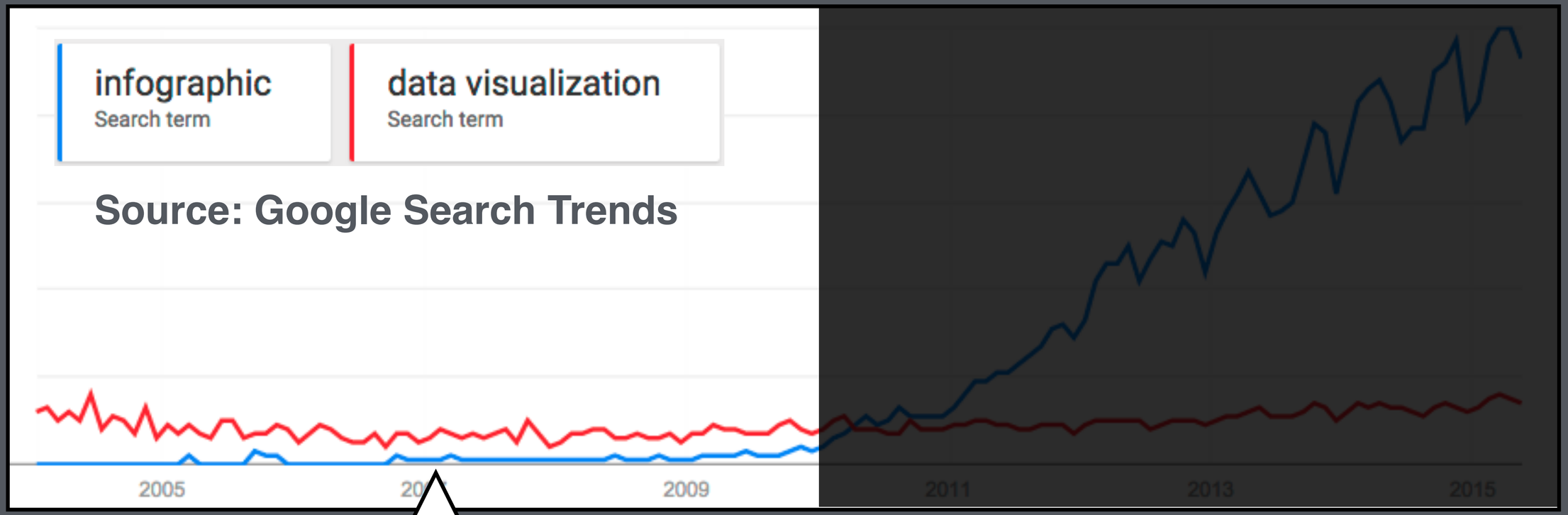
Mira Dontcheva
Adobe

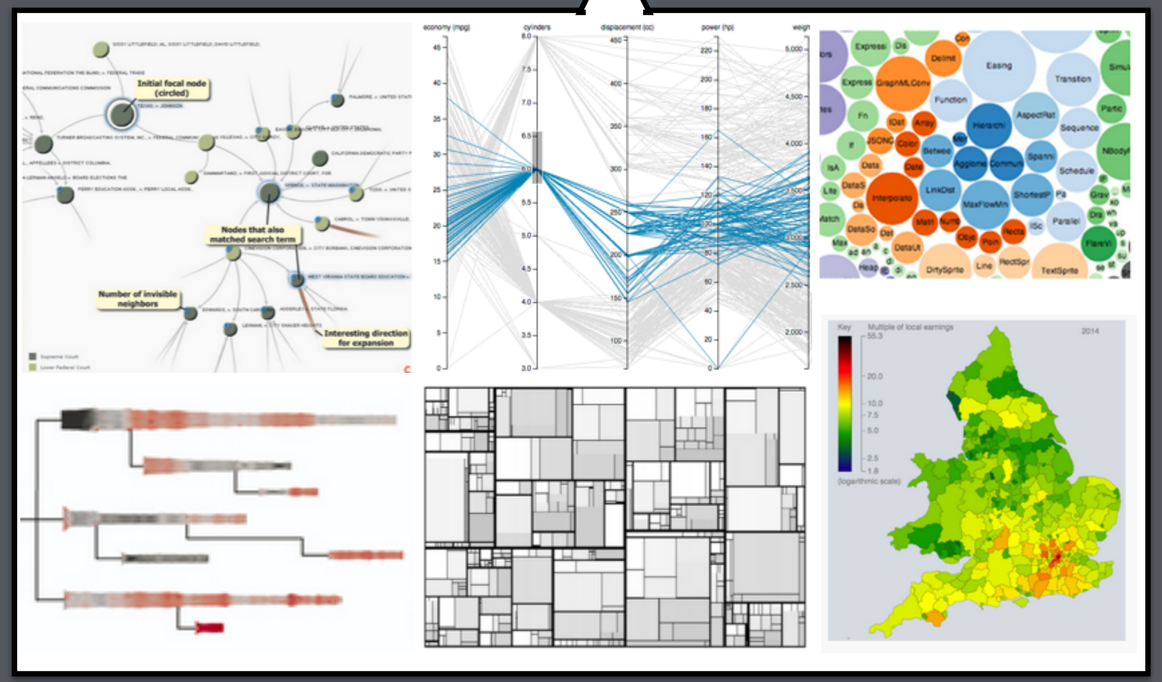
Wilmot Li
Adobe

Jovan Popović
Adobe

Hanspeter Pfister
Harvard


infographic
Search term
data visualization
Search term
Source: Google Search Trends
2016
2005
2007
2009
2011
2013
2015



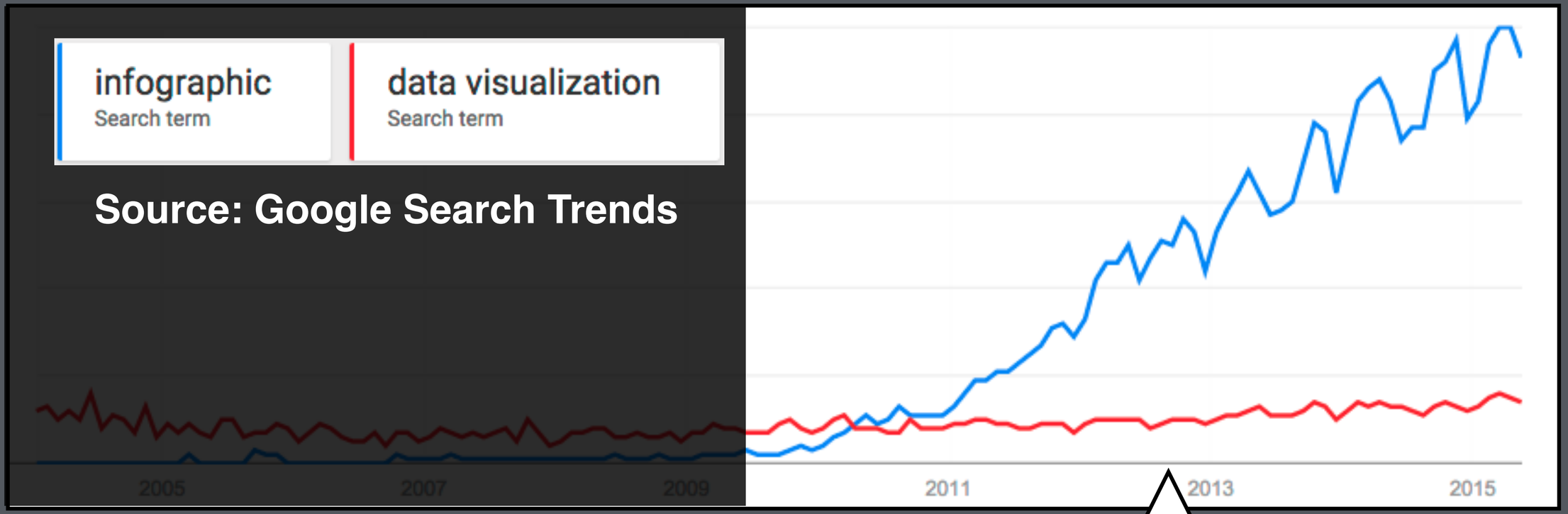


Analysts & Researchers

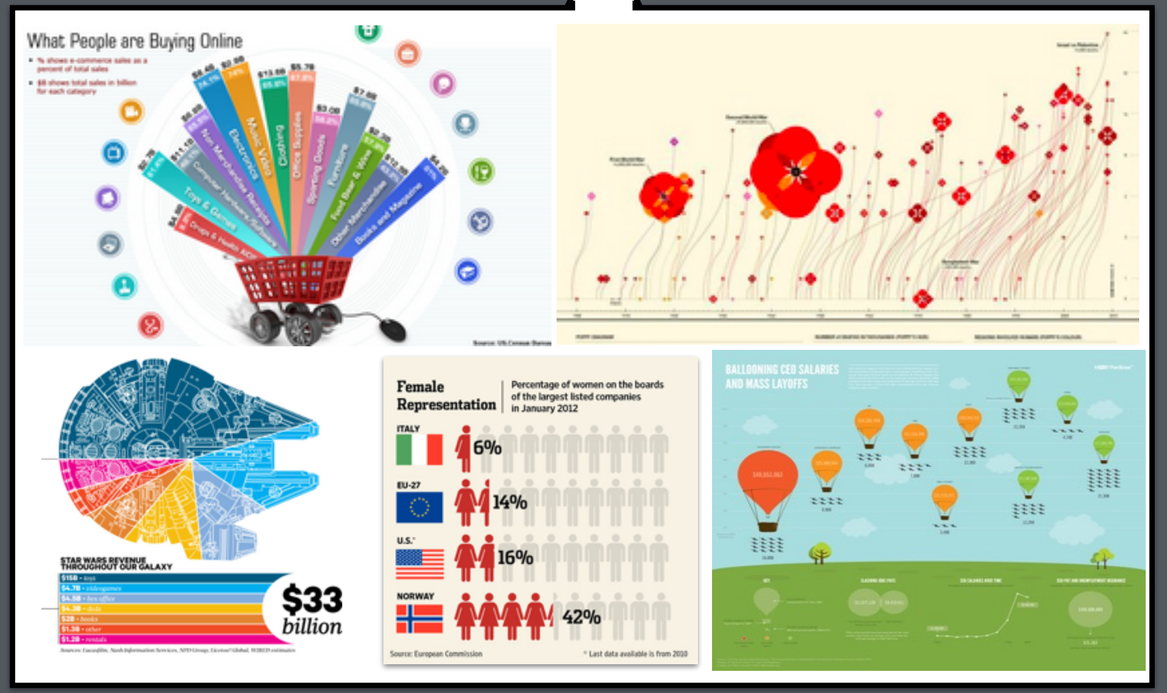
infographic
Search term

data visualization
Search term

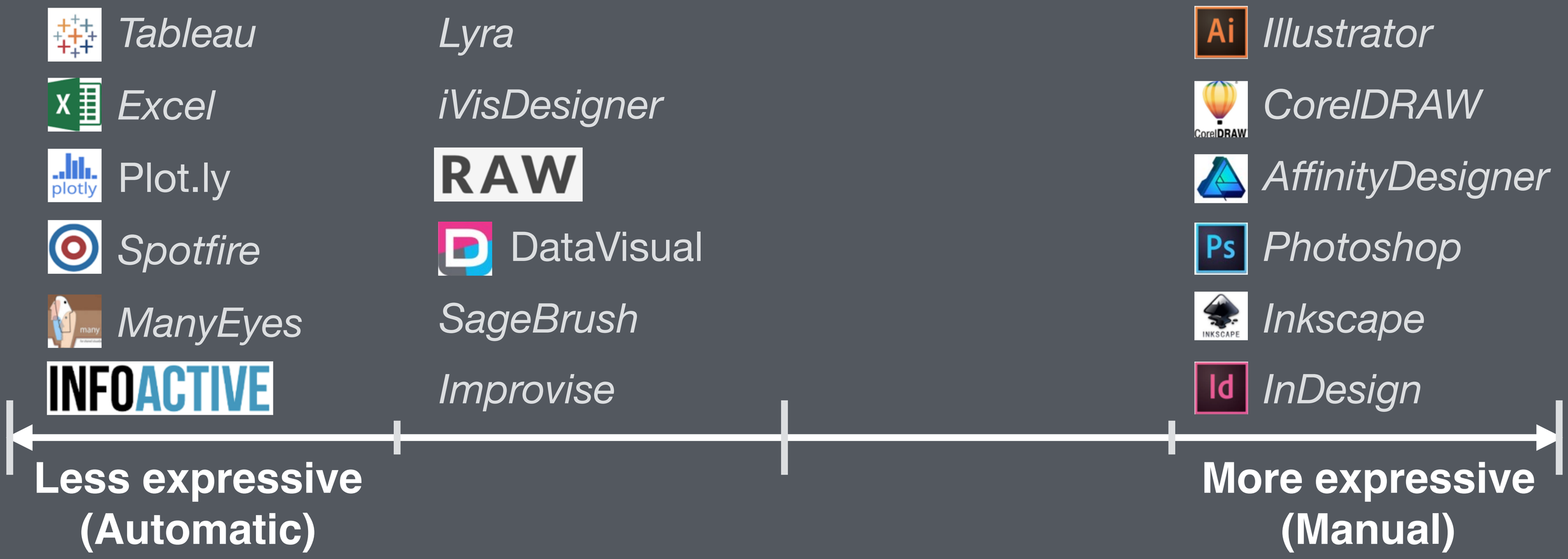
Source: Google Search Trends



Artists,
Journalists,
Bloggers,
Designers



Visualization Design Tools



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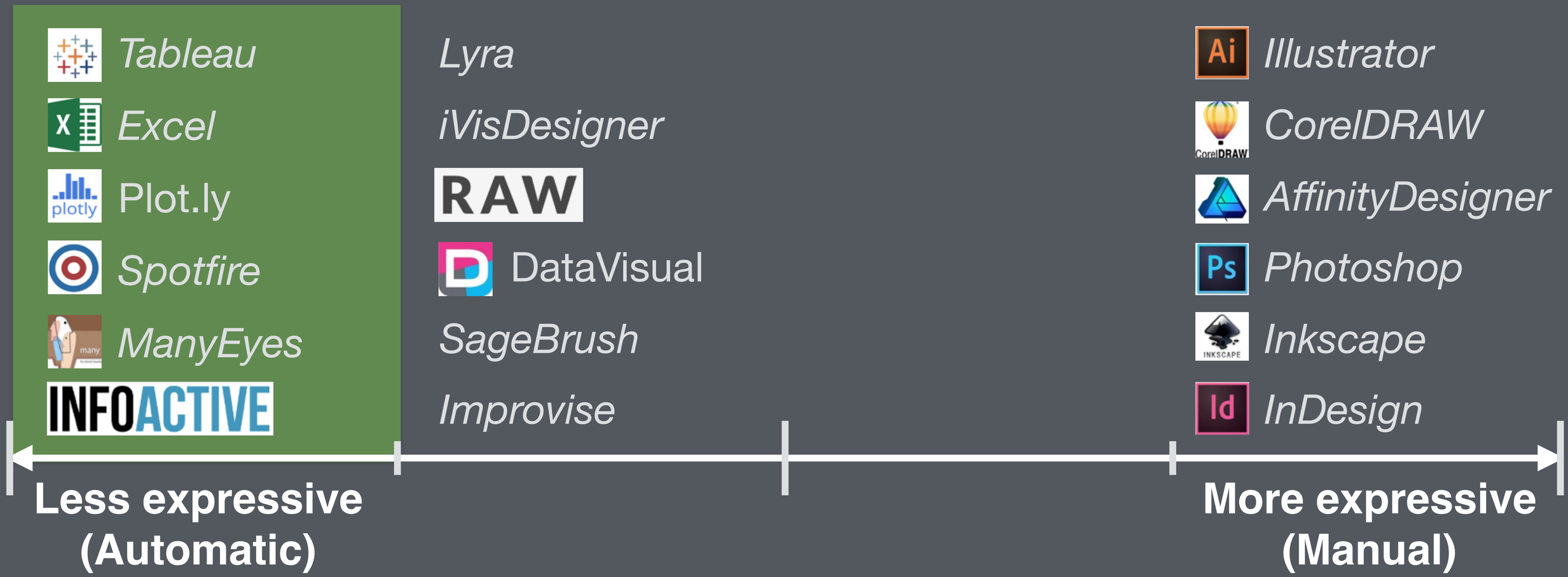

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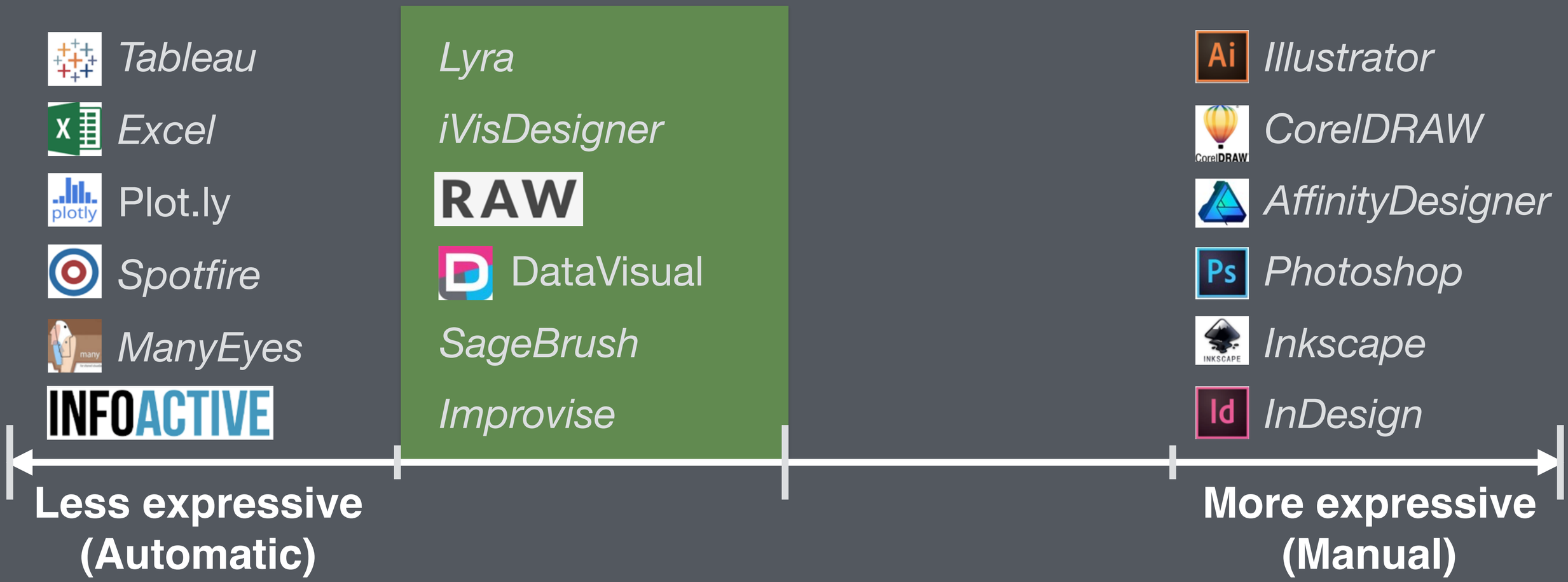

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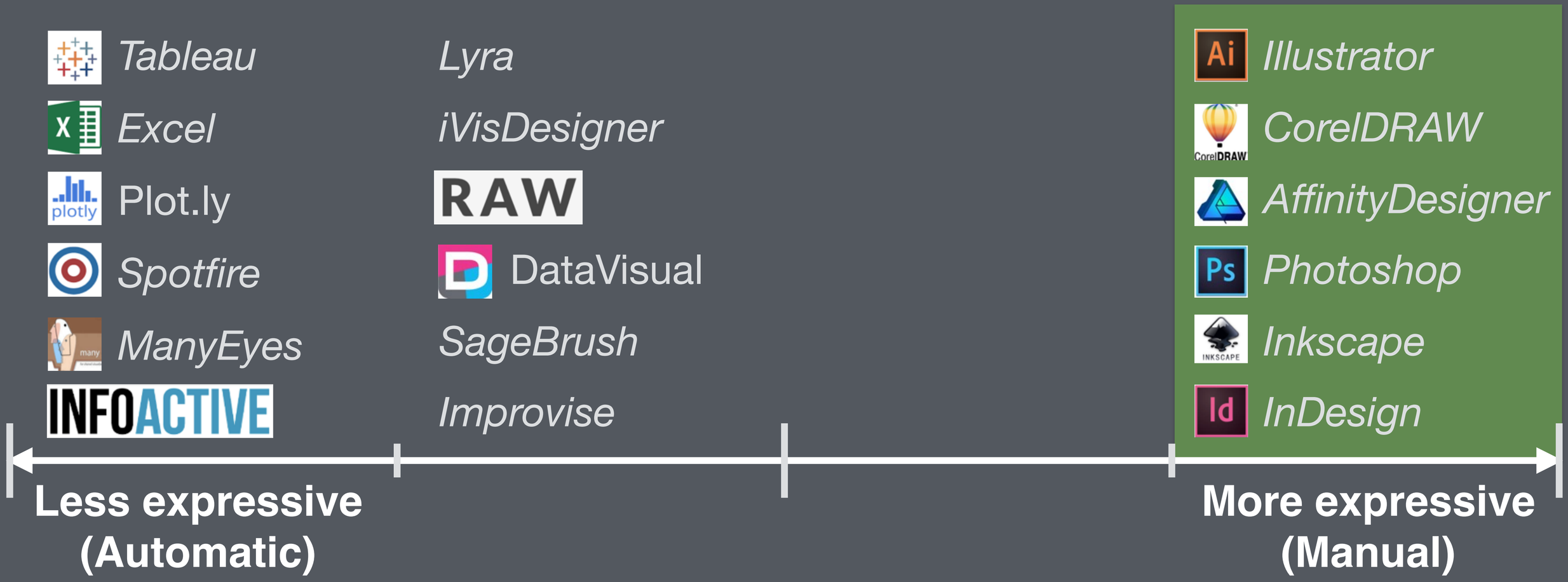

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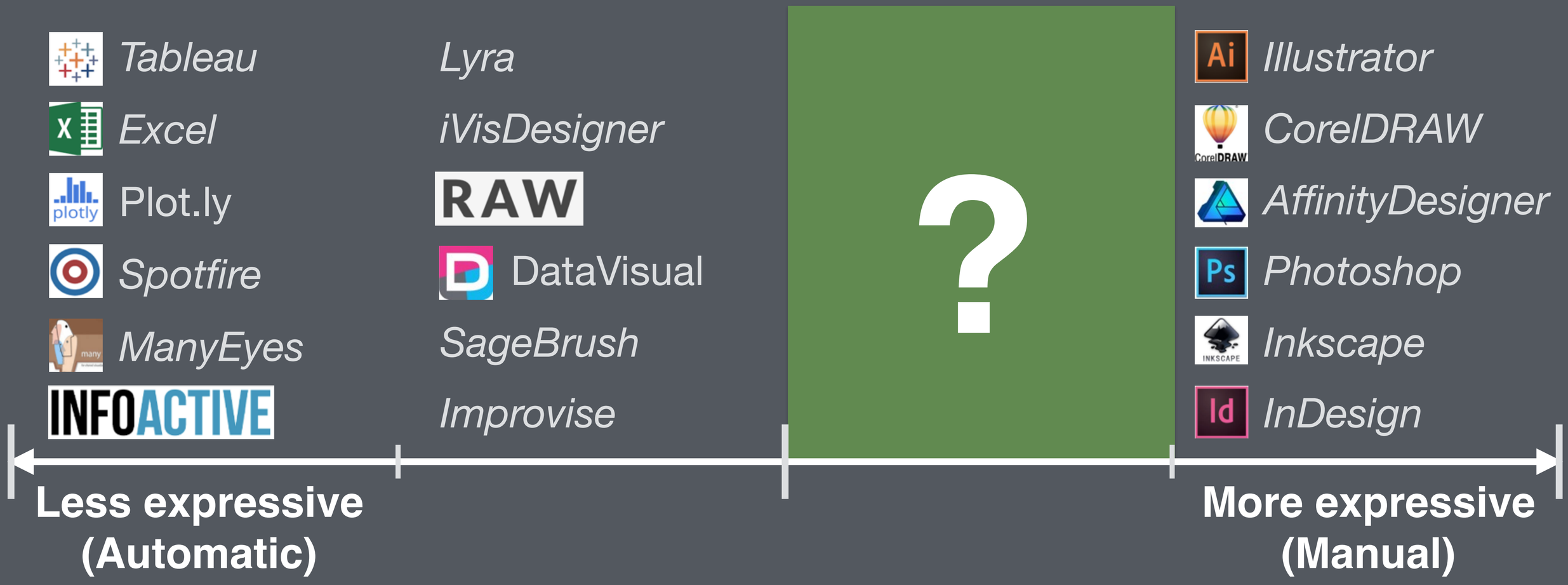

Interviews with infographic designers.

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Participants

- 2 professional designers
  3 master student designers
  1 visualization researcher.

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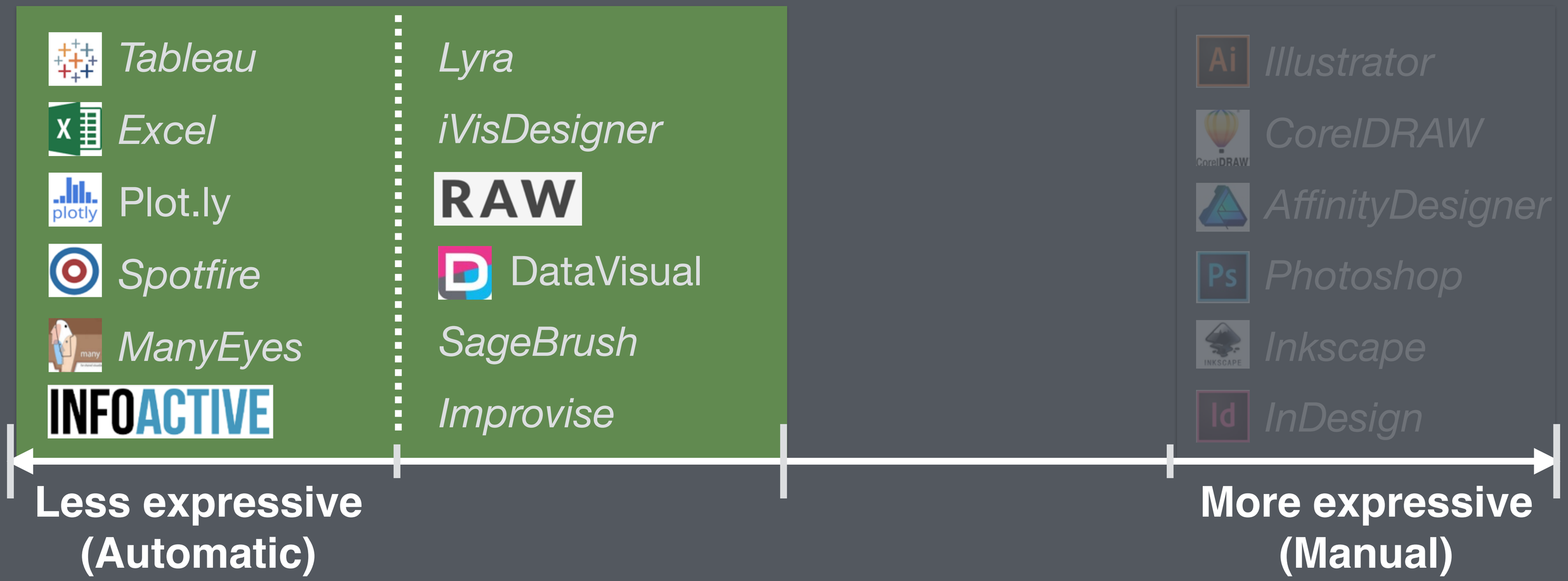
Related work

Bigelow et al (AVI, 2014).

1. Lack of flexible design in visualization construction tools

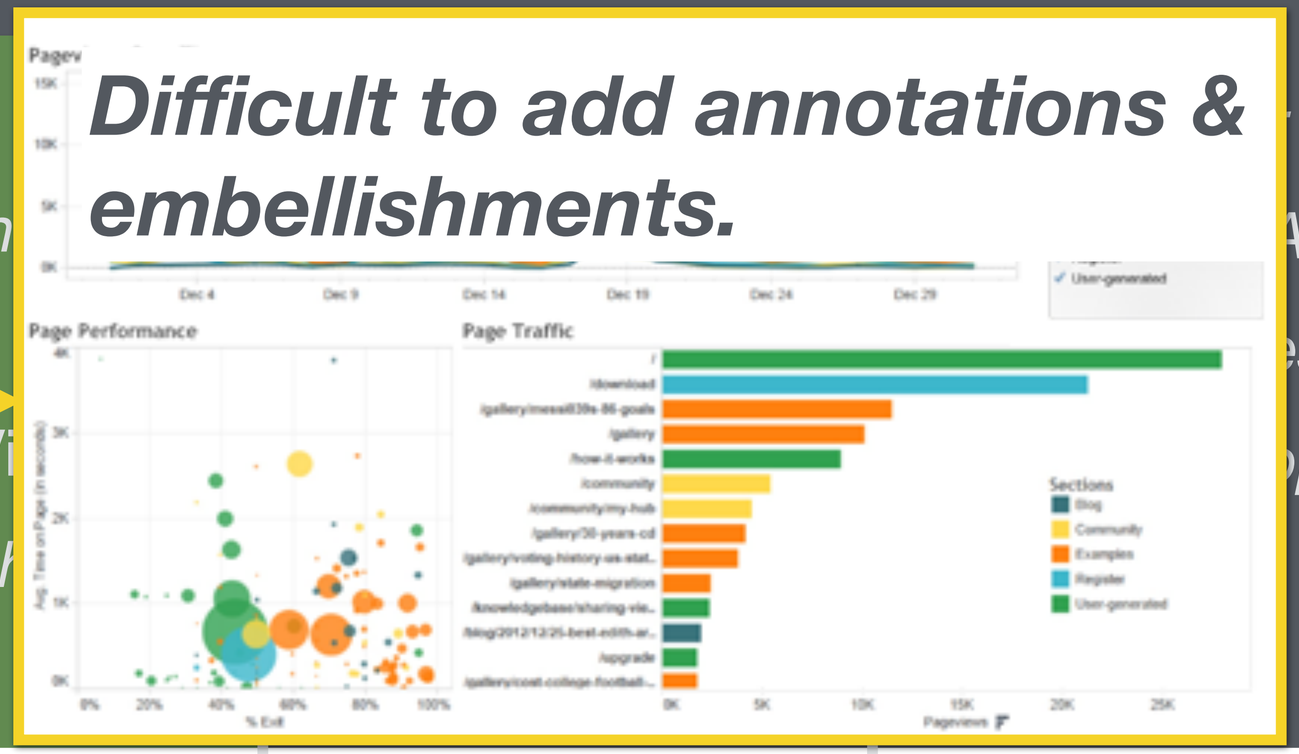


1. Lack of flexible design in visualization construction tools

Tableau
Excel
Plot.ly
Spotfire
ManyEyes
INFOACTIVE

Lyra
iVisDesign
RAW
DataVi
SageBrush
Improvise

AW
esigner
op



Difficult to add annotations & embellishments.

Less expressive (Automatic)

More expressive (Manual)

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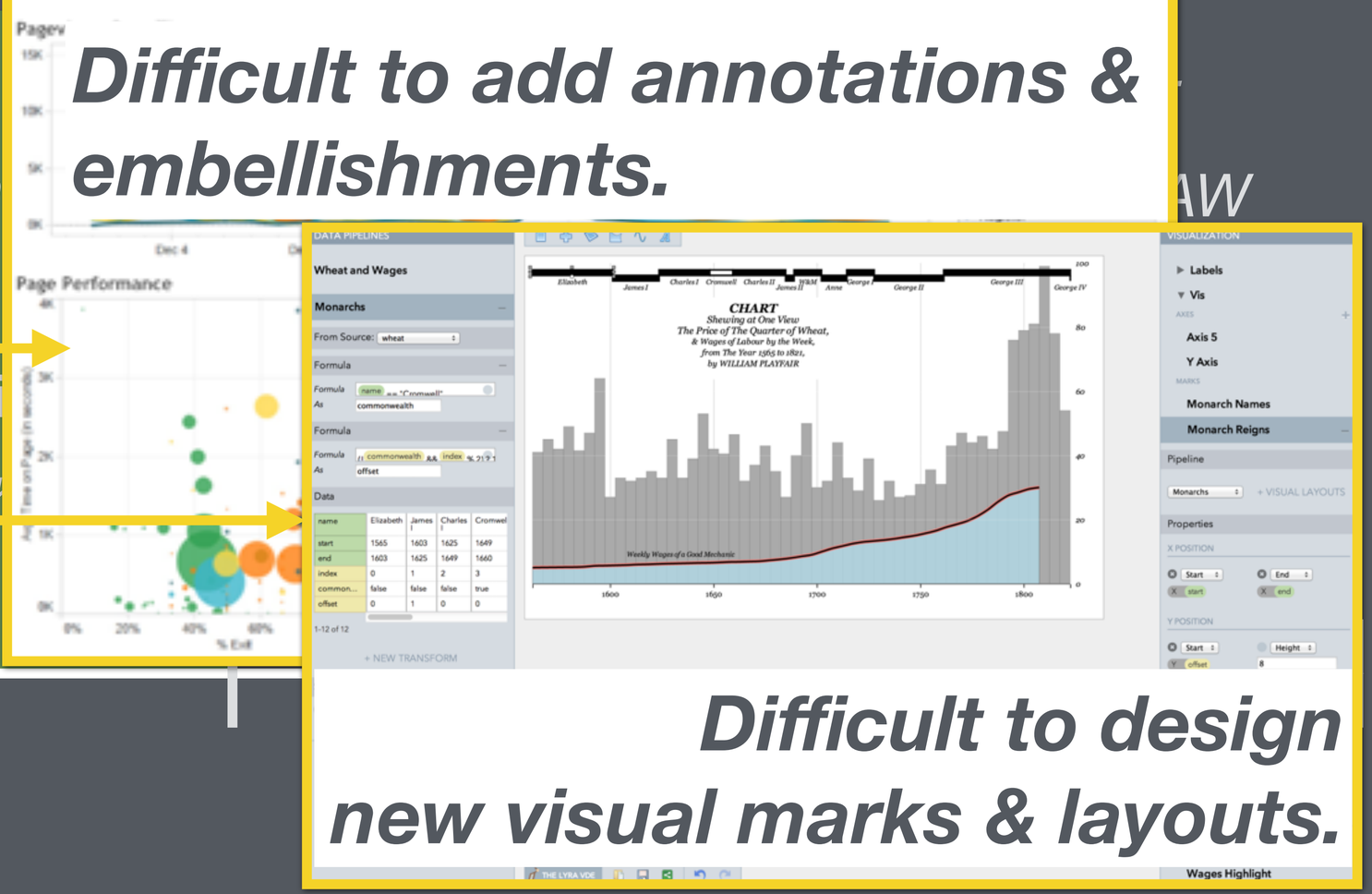
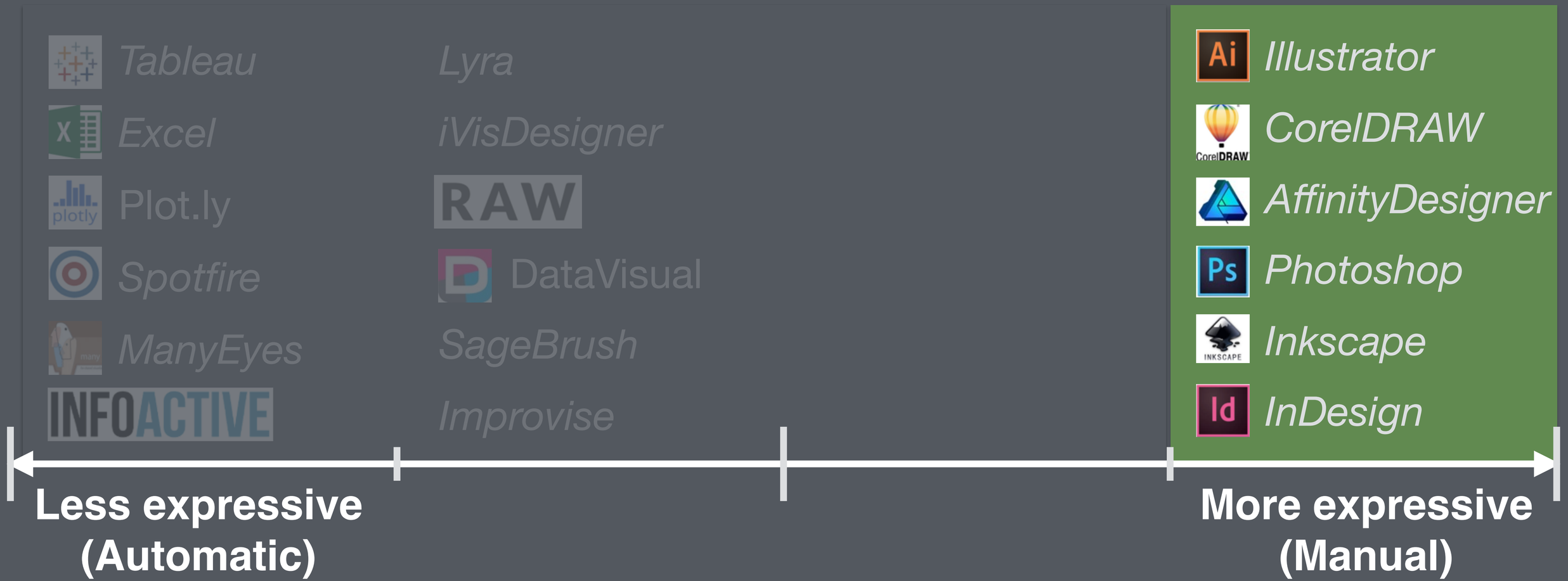


Difficult to design new visual marks & layouts.

Less expressive (Automatic)

2. Tedious manual encoding required in graphic design tools



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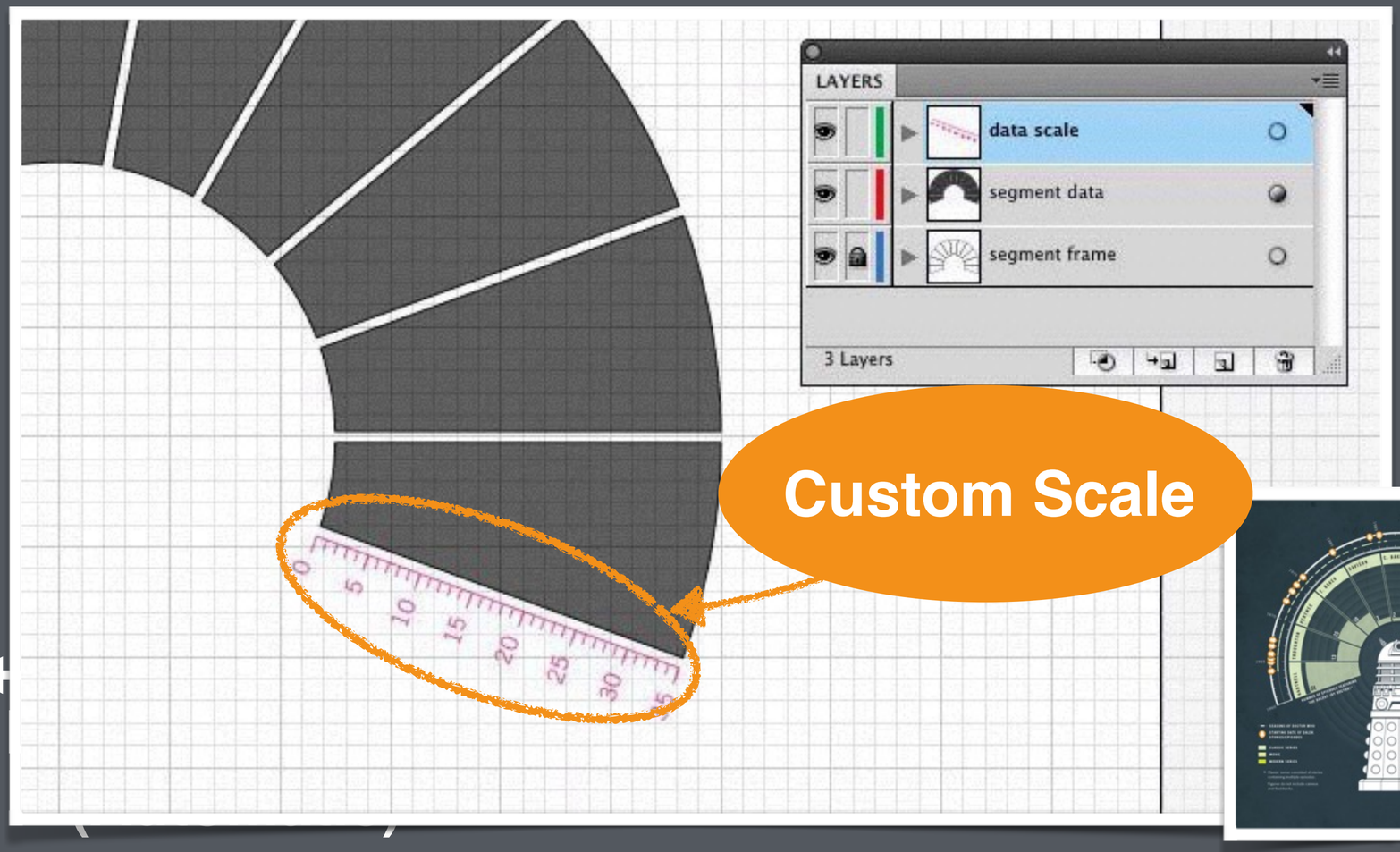
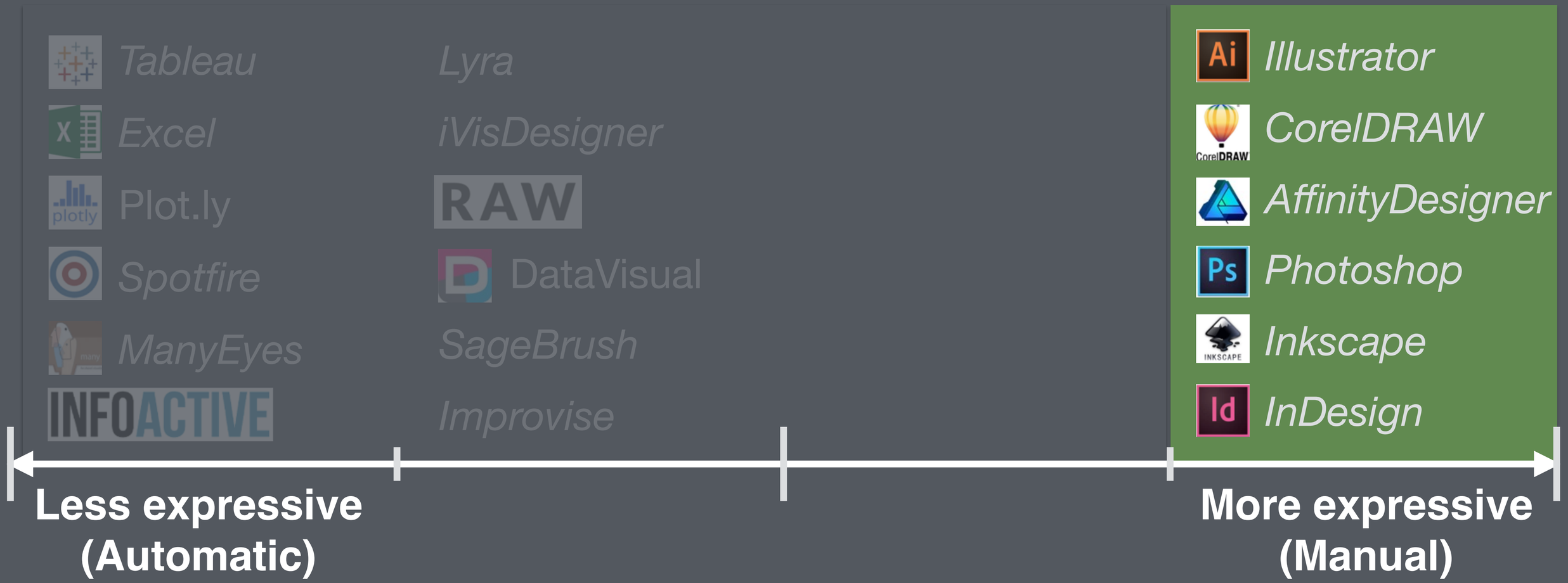


- *Illustrator*
- *CorelDRAW*
- *AffinityDesigner*
- *Photoshop*
- *Inkscape*
- *InDesign*

More expressive (Manual)

3. Absence of data binding for custom/imported charts in graphic design tools



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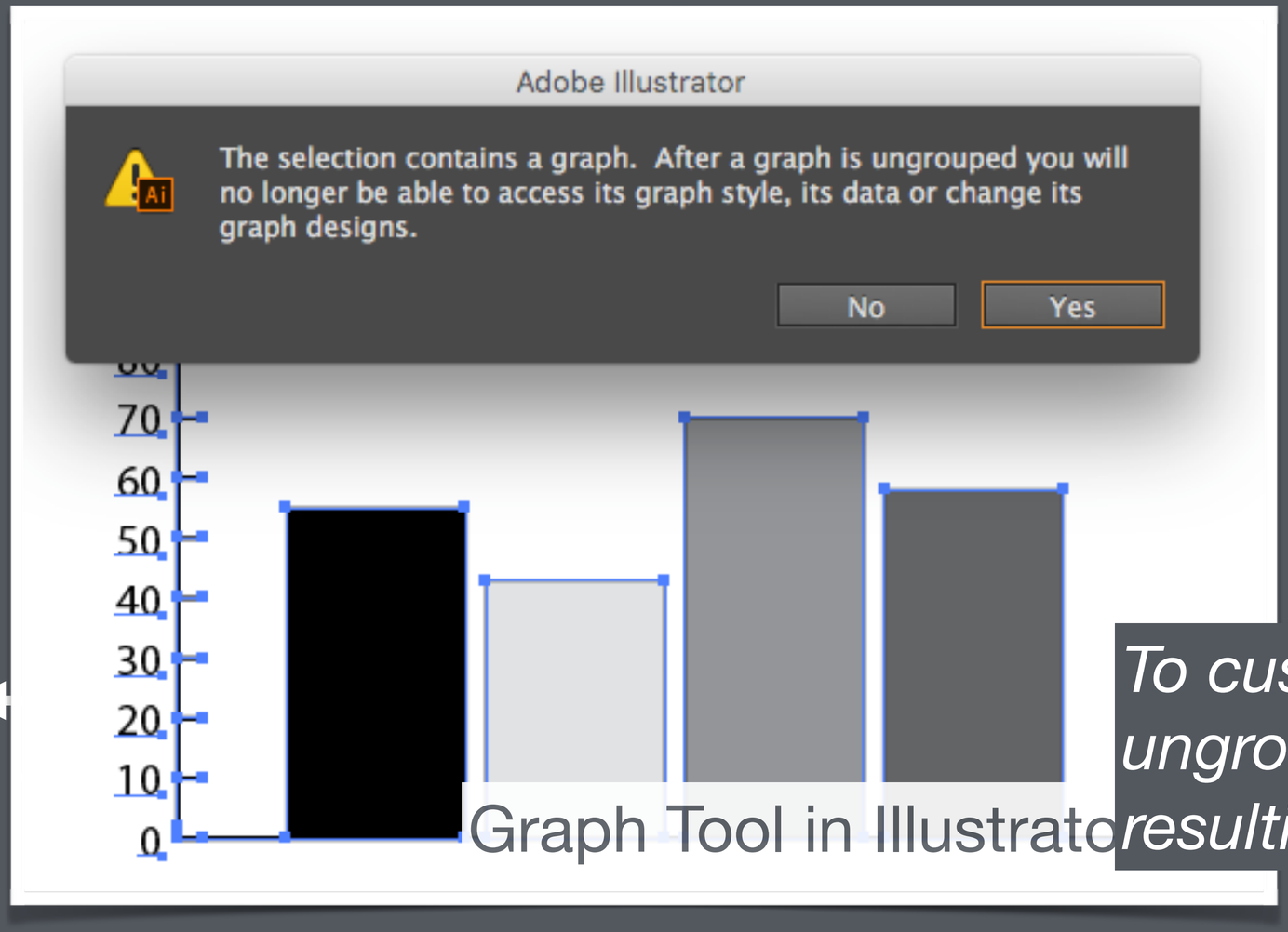

Graph Tool in Illustrator

- *Illustrator*
- *CorelDRAW*
- *AffinityDesigner*
- *Photoshop*
- *Inkscape*
- *InDesign*

To customize this chart, ungrouping is required resulting in ***loss of data binding****.*

Design Goals

Design Goals

1. Maintain **flexibility** in the design process.

e.g., not enforcing a predefined outcome
or specific order of operations.

Design Goals

1. Maintain **flexibility** in the design process.

2. Provide methods for accurate **data-driven drawing**.

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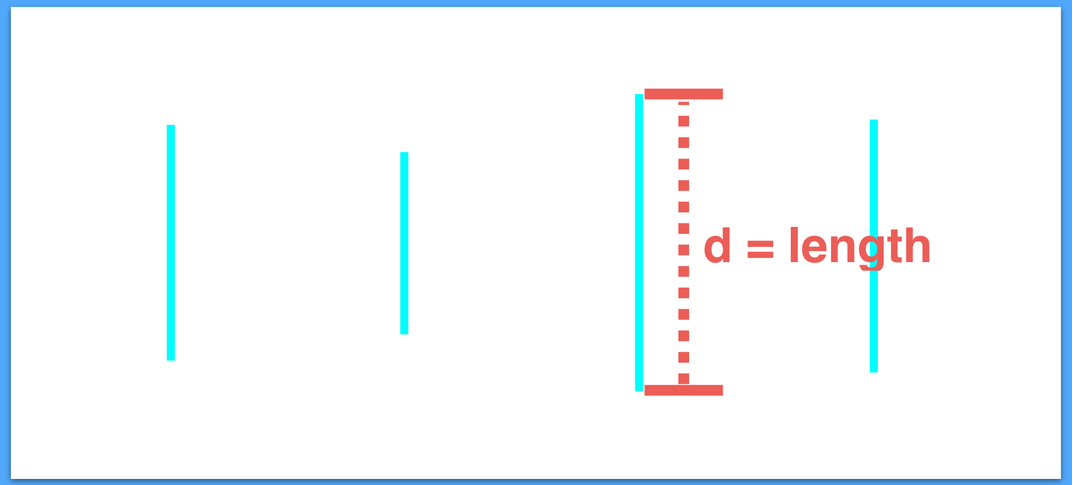
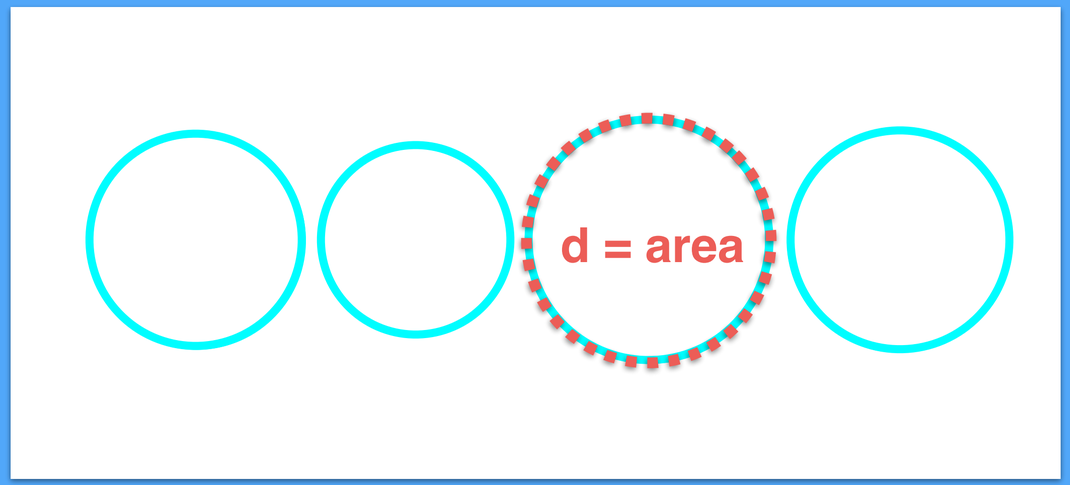
1. Maintain **flexibility** in the design process.

2. Provide methods for accurate **data-driven drawing**.

3. Support persistent **data binding** for freeform graphics.



Length guide



Area guide

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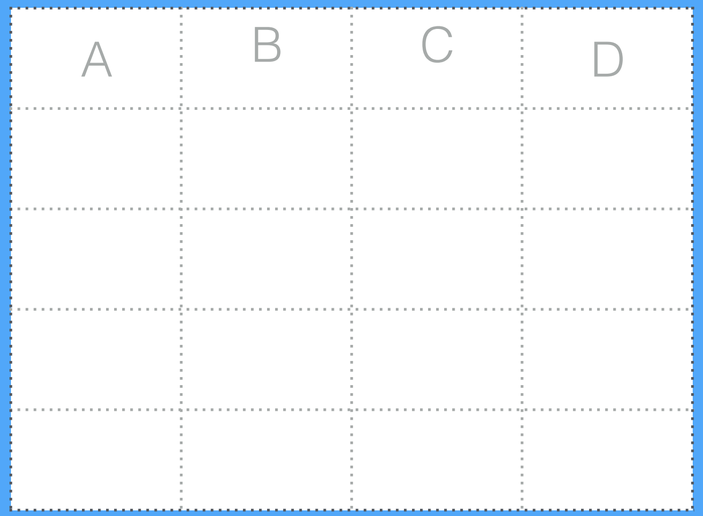
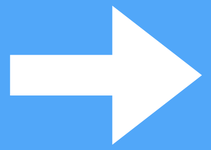
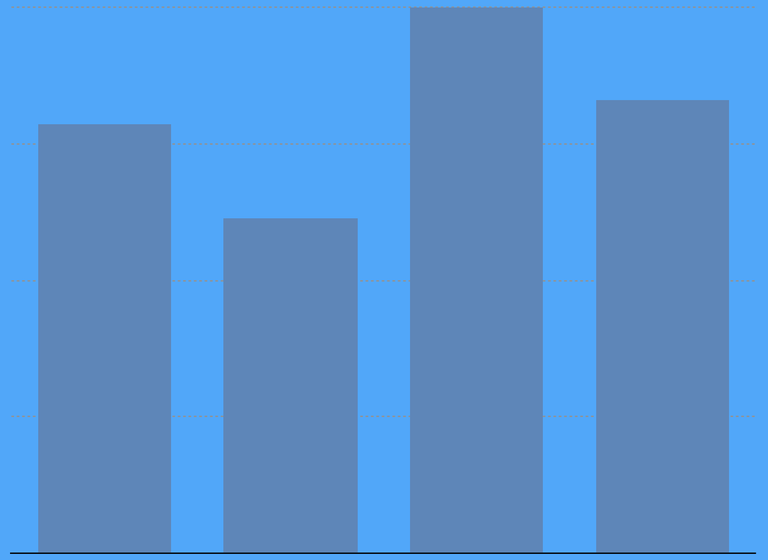


Data Table

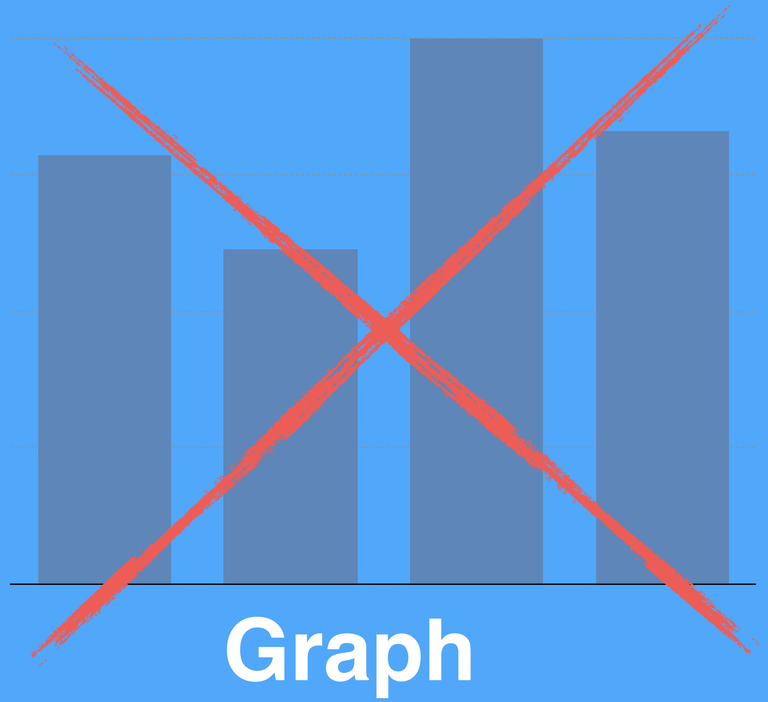




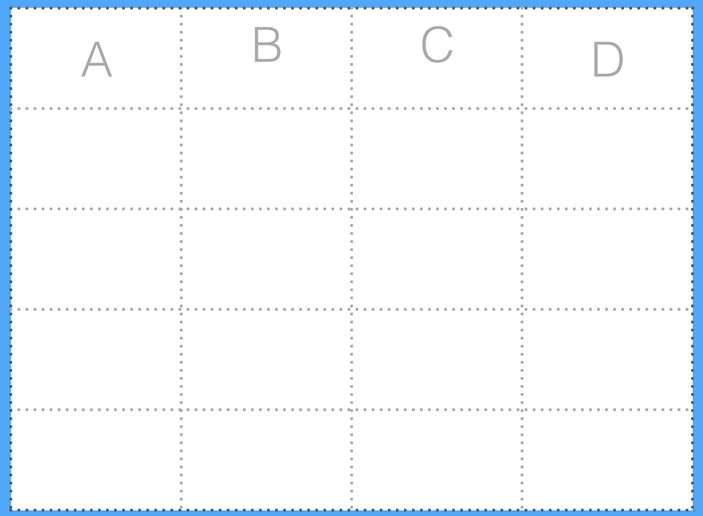
Graph

A	B	C	D

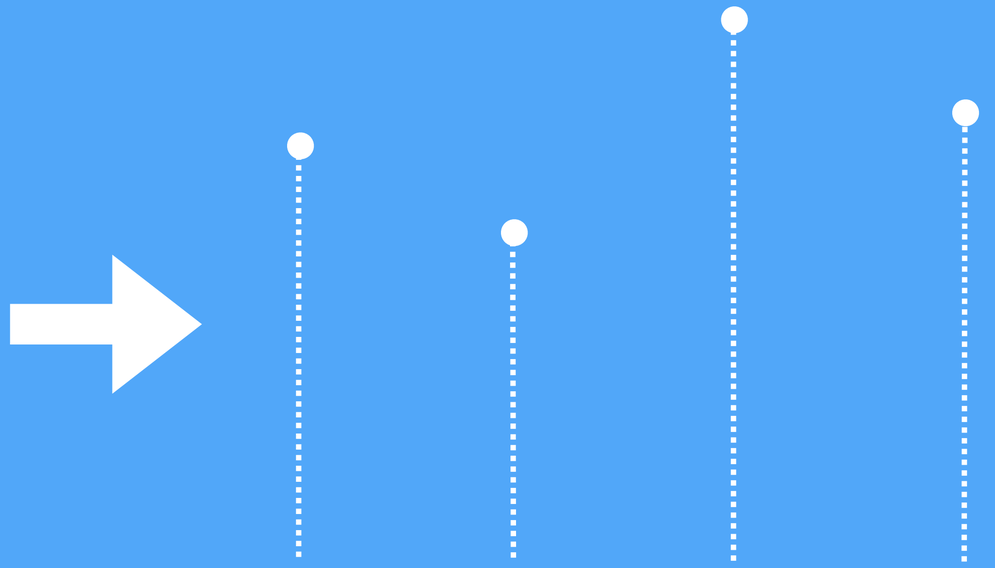
Data Table



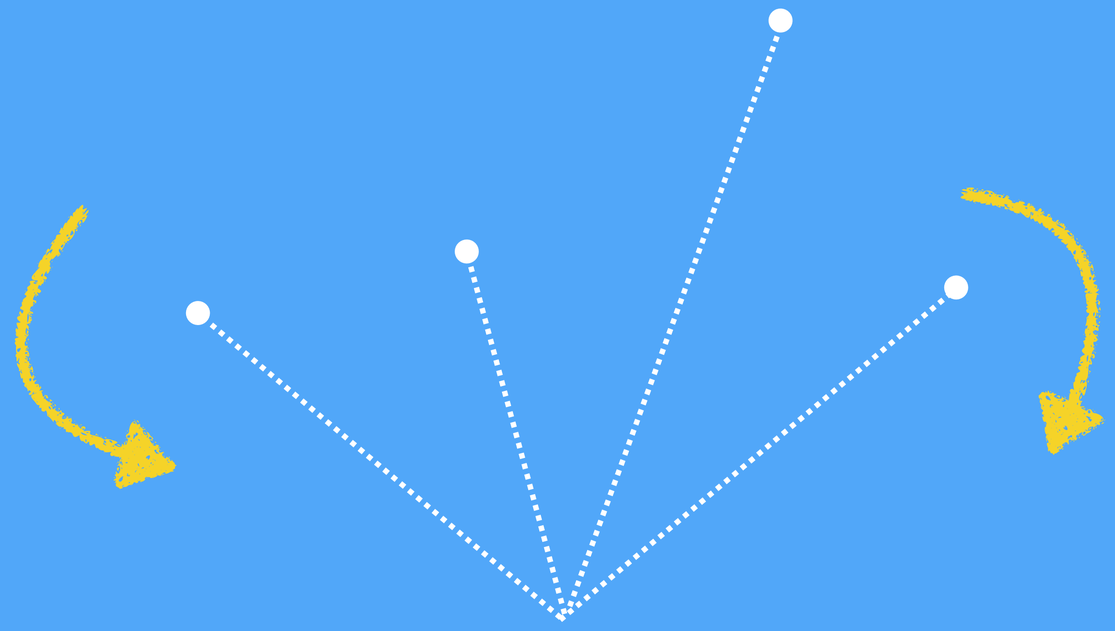
Graph



Data Table

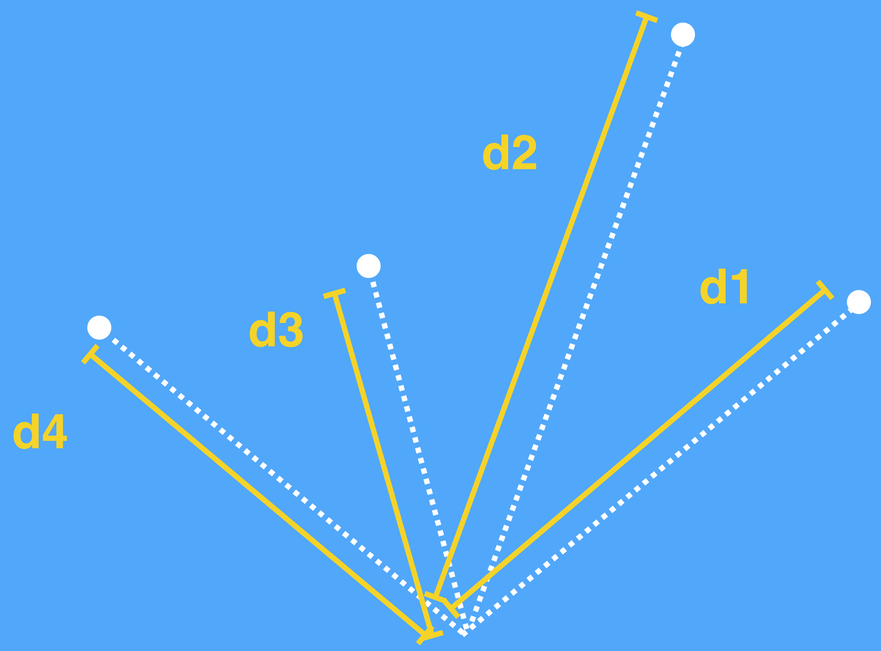


Data-Driven Guides



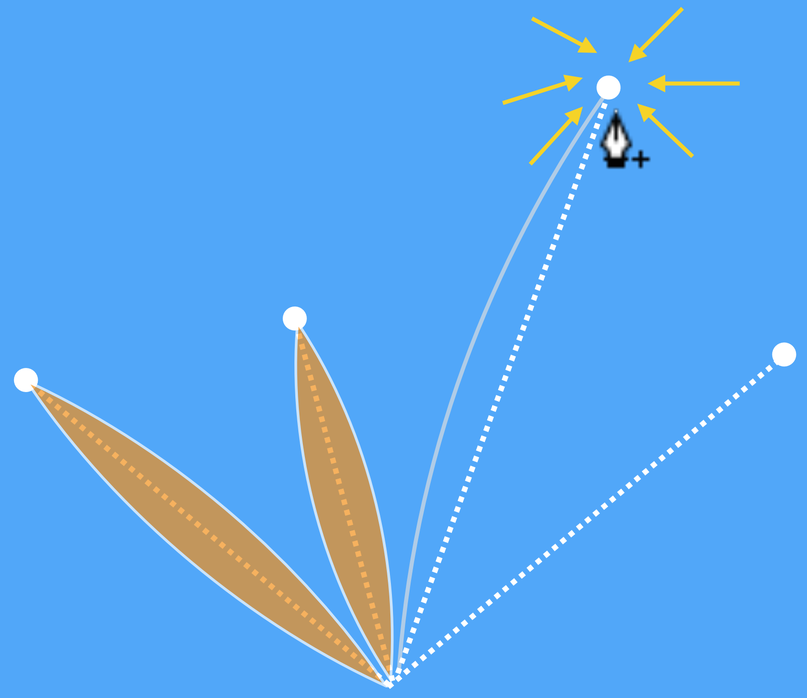
Flexible direct manipulation

To manipulate to create a custom layout



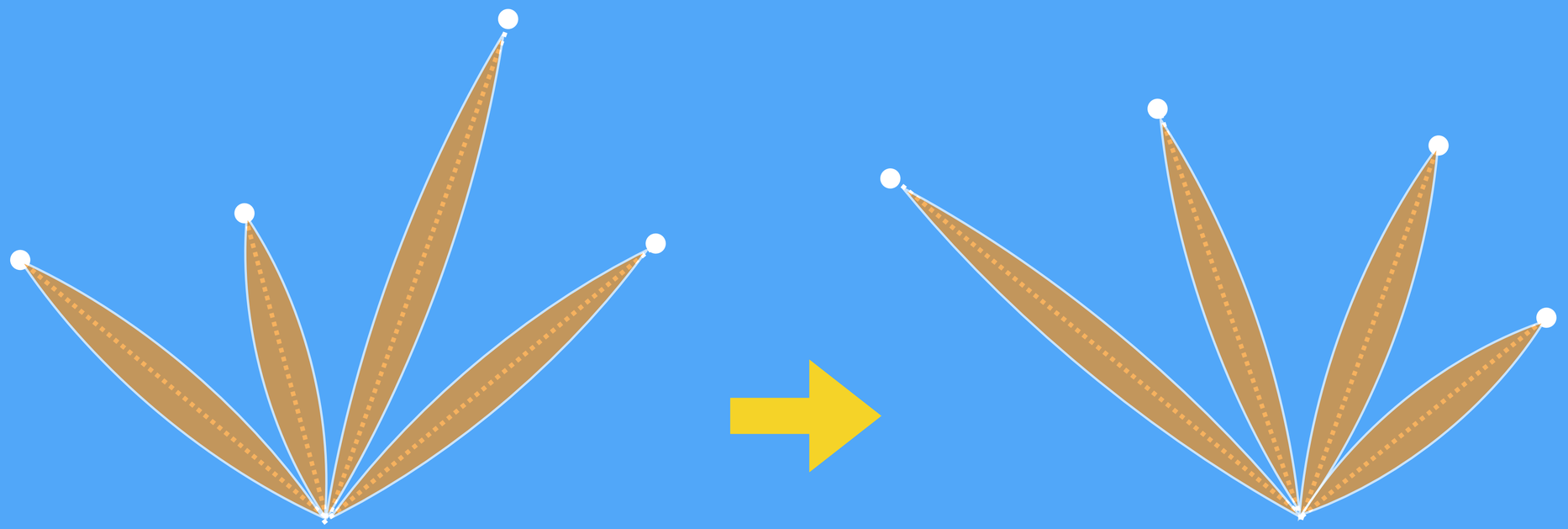
Maintain proportional lengths

To preserve data integrity



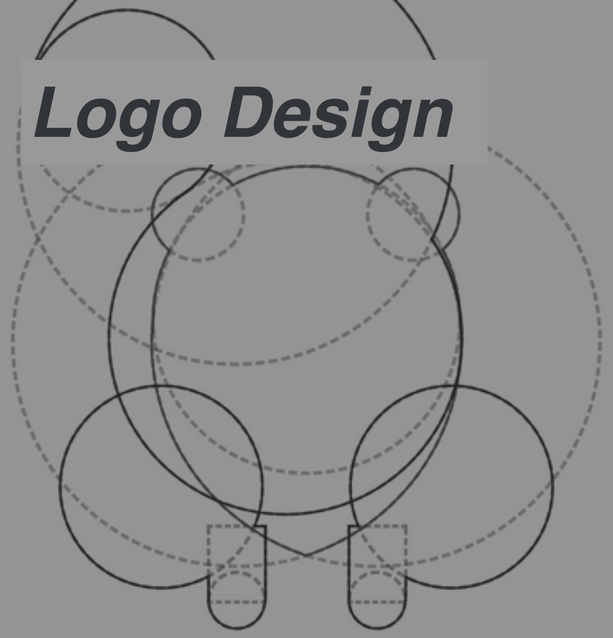
Snap to a guide

To support accurate data-driven drawing

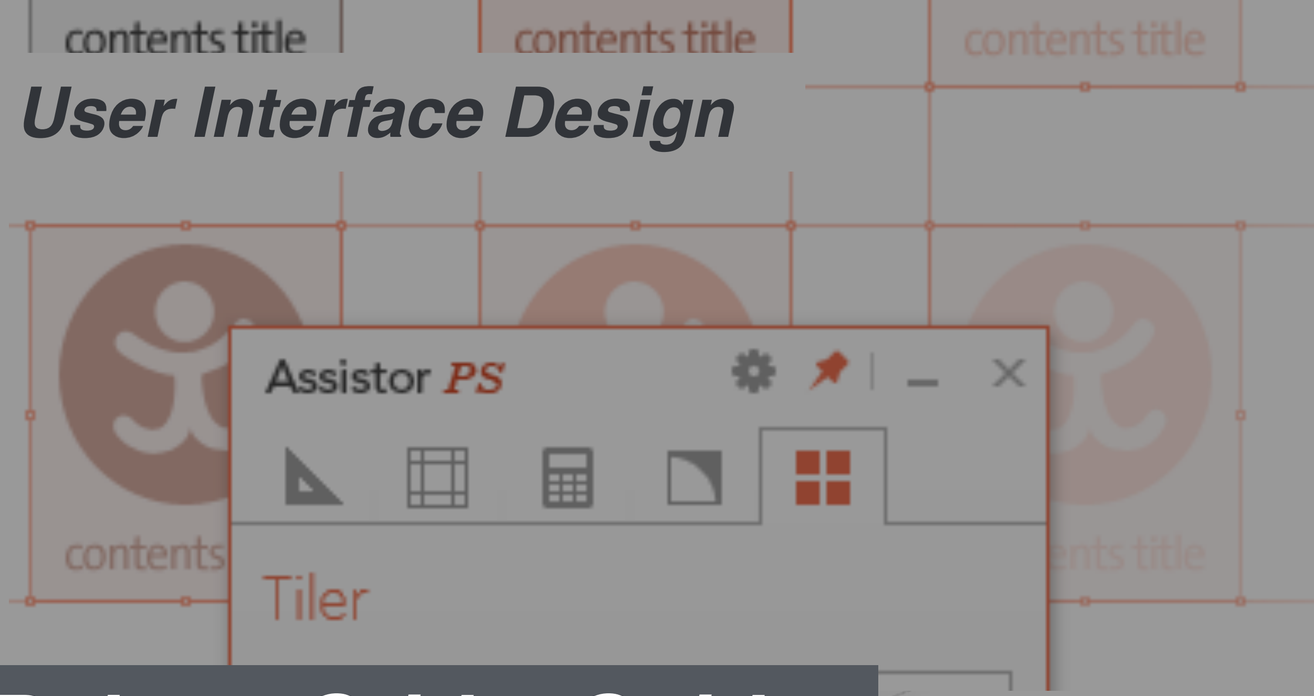


Data-binding using guides
as the backbone of associated shapes.
(2D deformation for vector graphic)

Logo Design

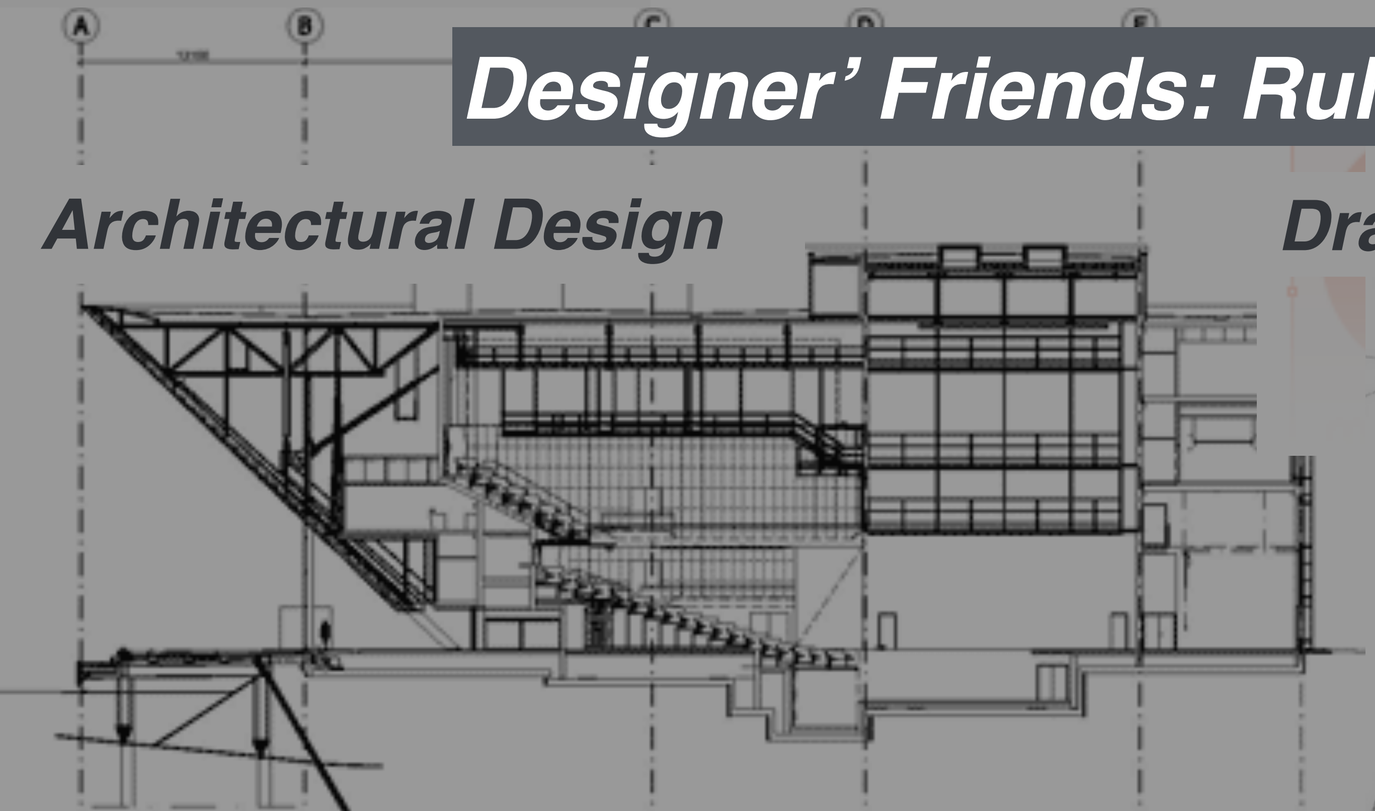


User Interface Design

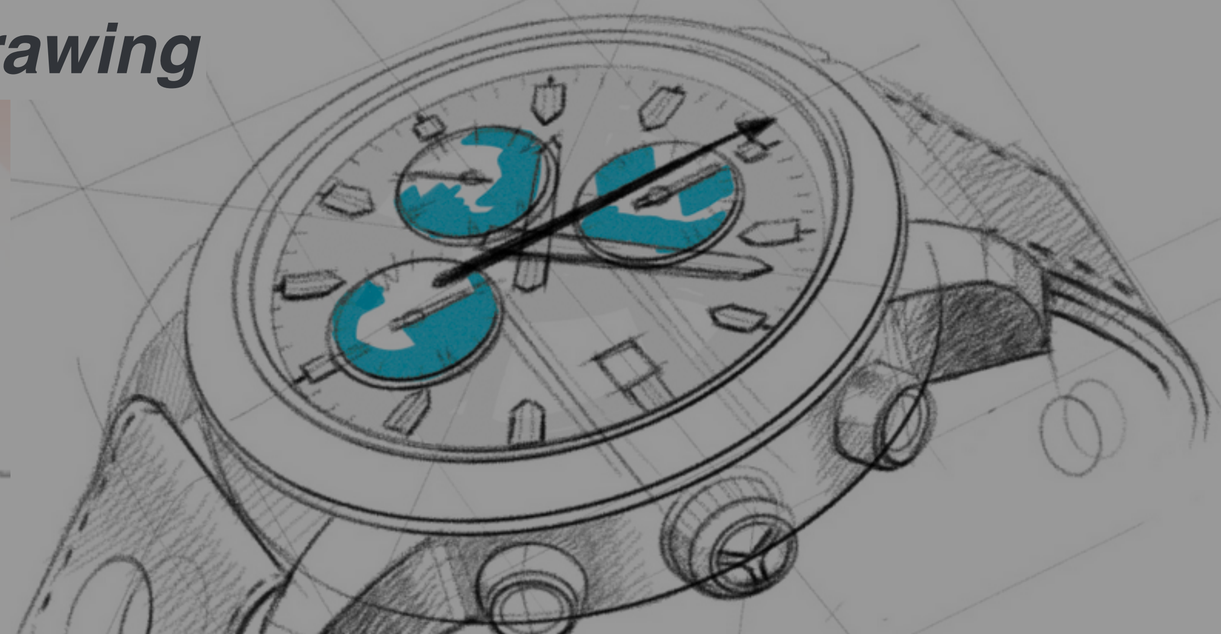


Designer' Friends: Rulers, Grids, Guides

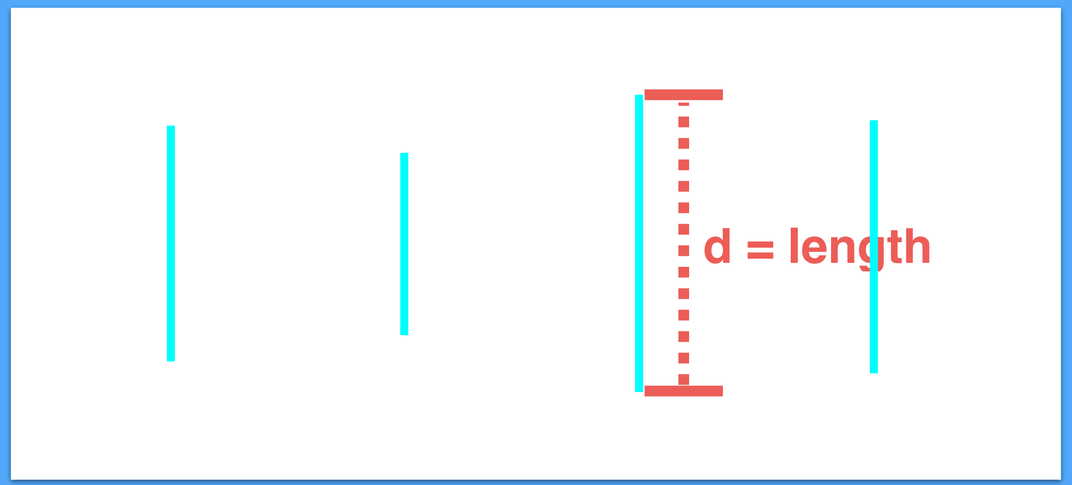
Architectural Design



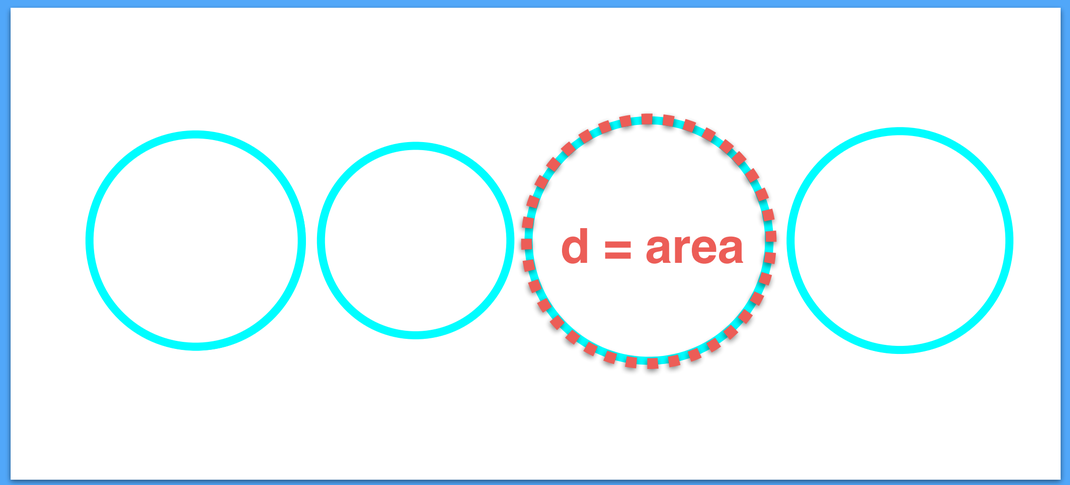
Drawing



Default guide color: Cyan



Length guide

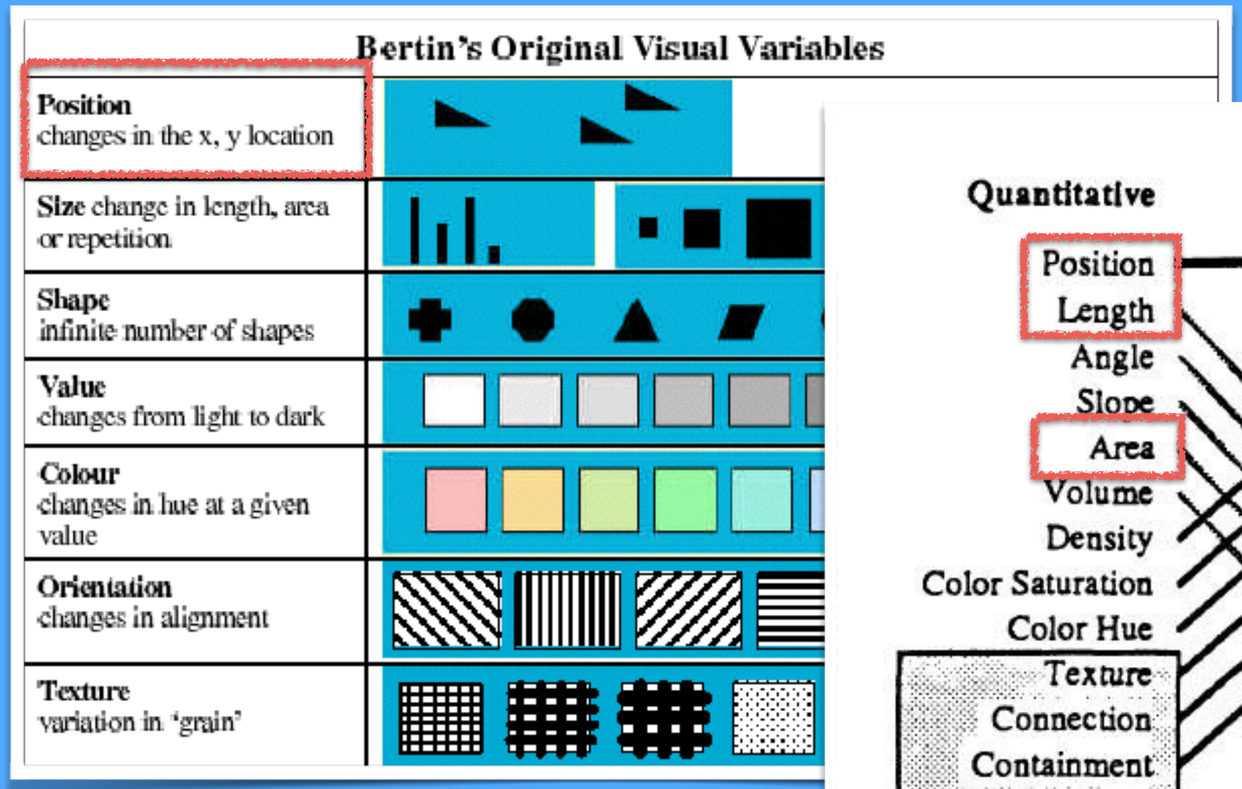


Area guide

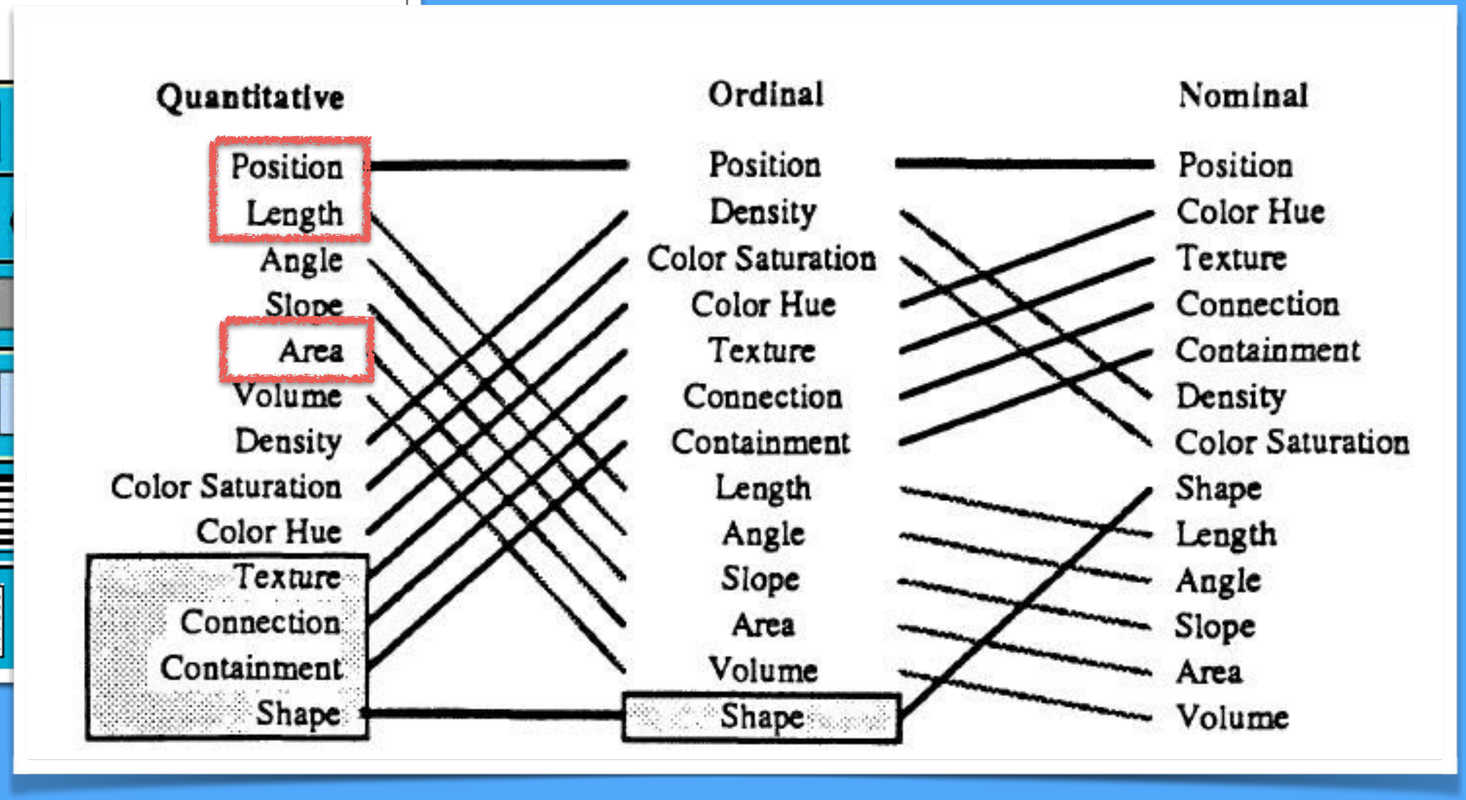
Length and area guides can also be used as a **Position guide**.

Visual variables

Fundamental channels for encoding information .



J. **Bertin**.,1983.



Rankings of visual variables by J. **Mackinlay**.,1986.

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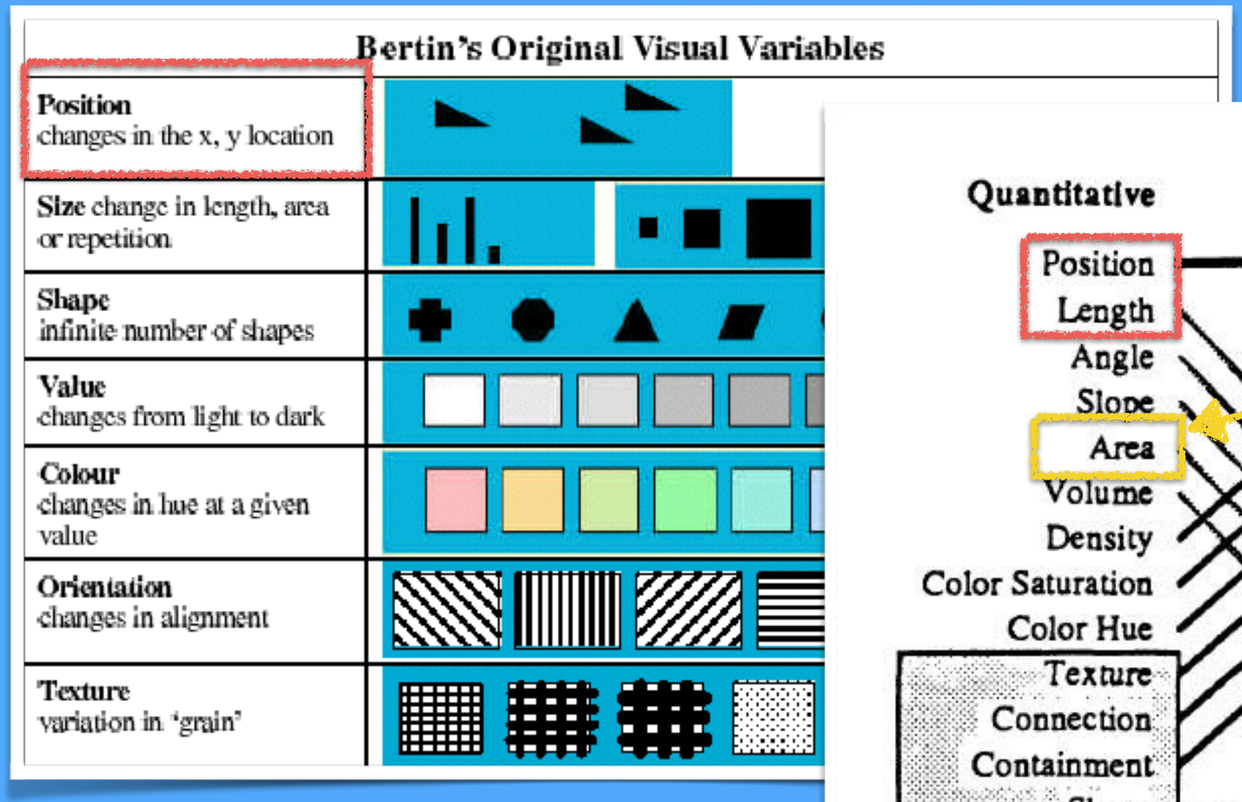
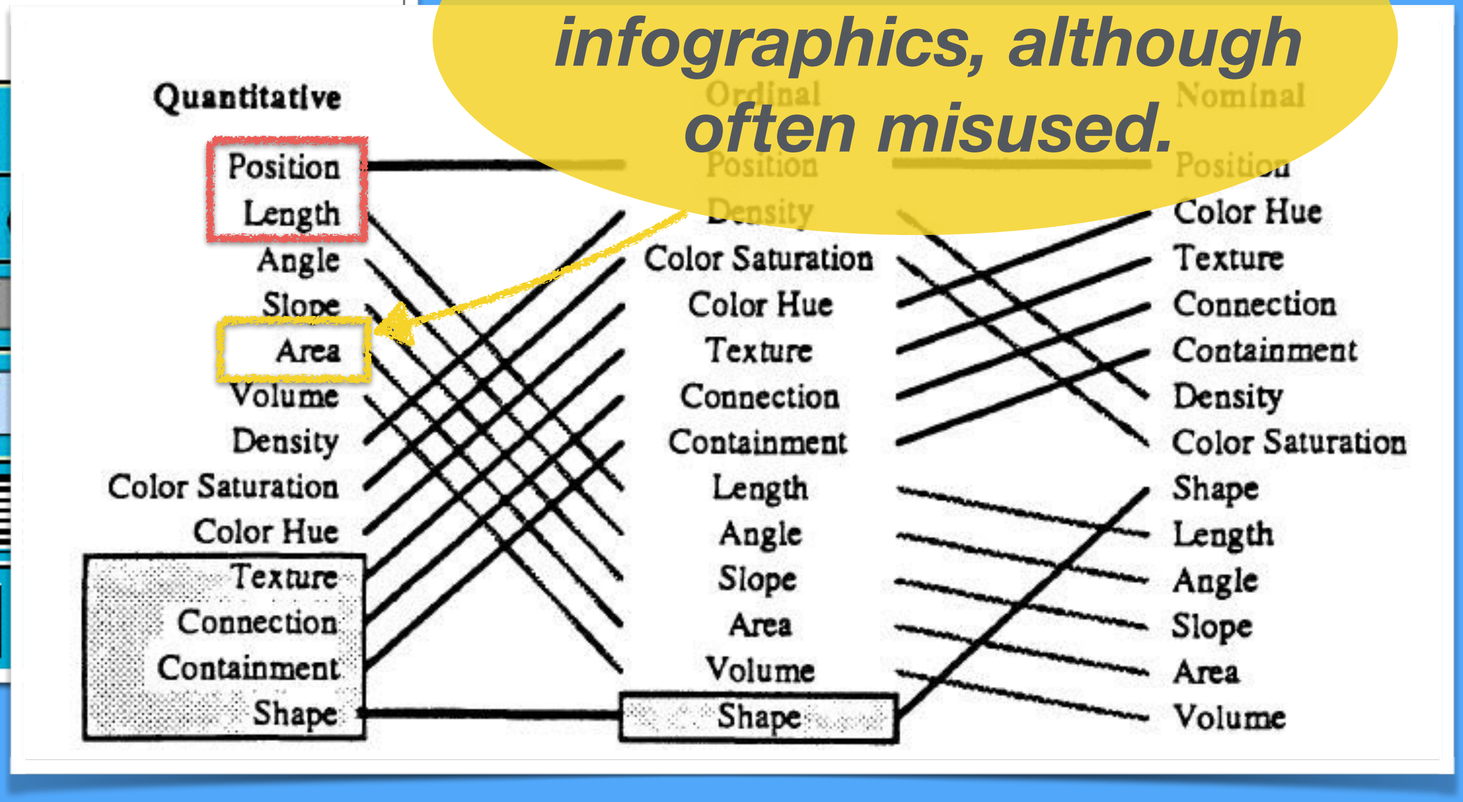


J. Bertin.,1983.

Frequently used in infographics, although often misused.

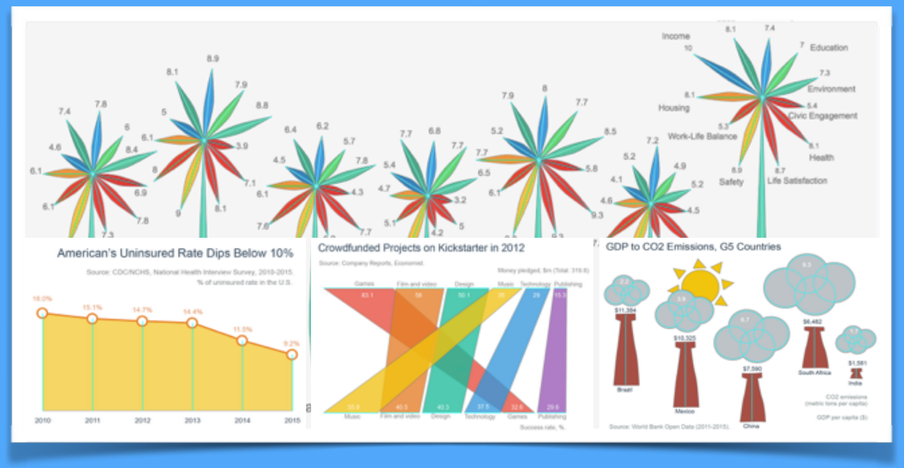


Rankings of visual variables by J. Mackinlay.,1986.

Use Cases

Use cases

1. **Drawing** data-driven graphics

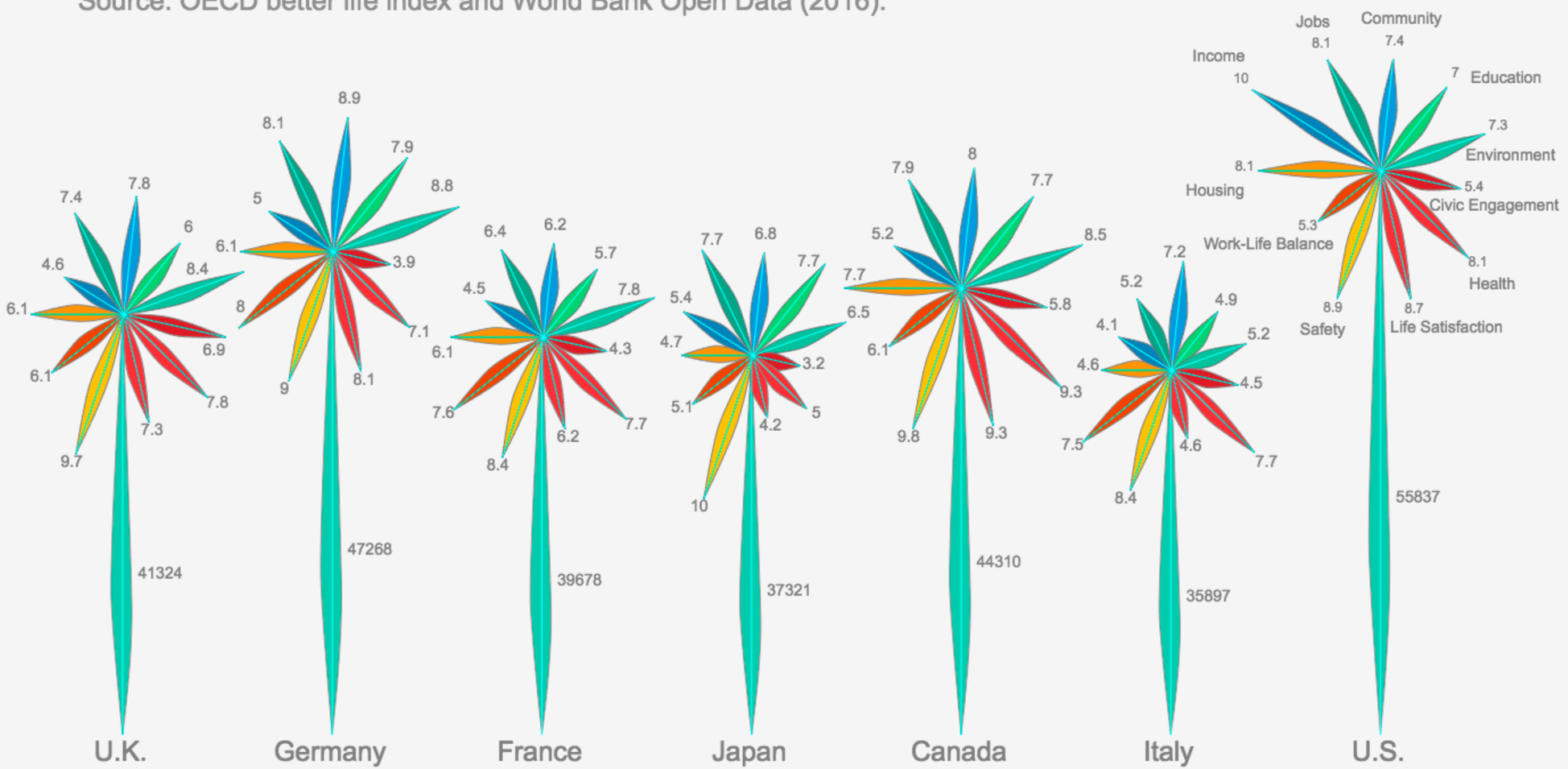


penTool
x: 249, y: 738

Select
Control
PanZoom
Pen
Text
Shape
DataGuide

OECD Better Life Index by GDP of G7 Countries.

Source: OECD better life index and World Bank Open Data (2016).



Link Style Text Layer

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Stroke Width 1

Opacity 1

Cyan: Data-Driven Guides

File Edit Arrange Align Boolean DataGuide Help

penTool
x: 249, y: 738

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PanZoom
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DataGuide

Link Style Text Layer

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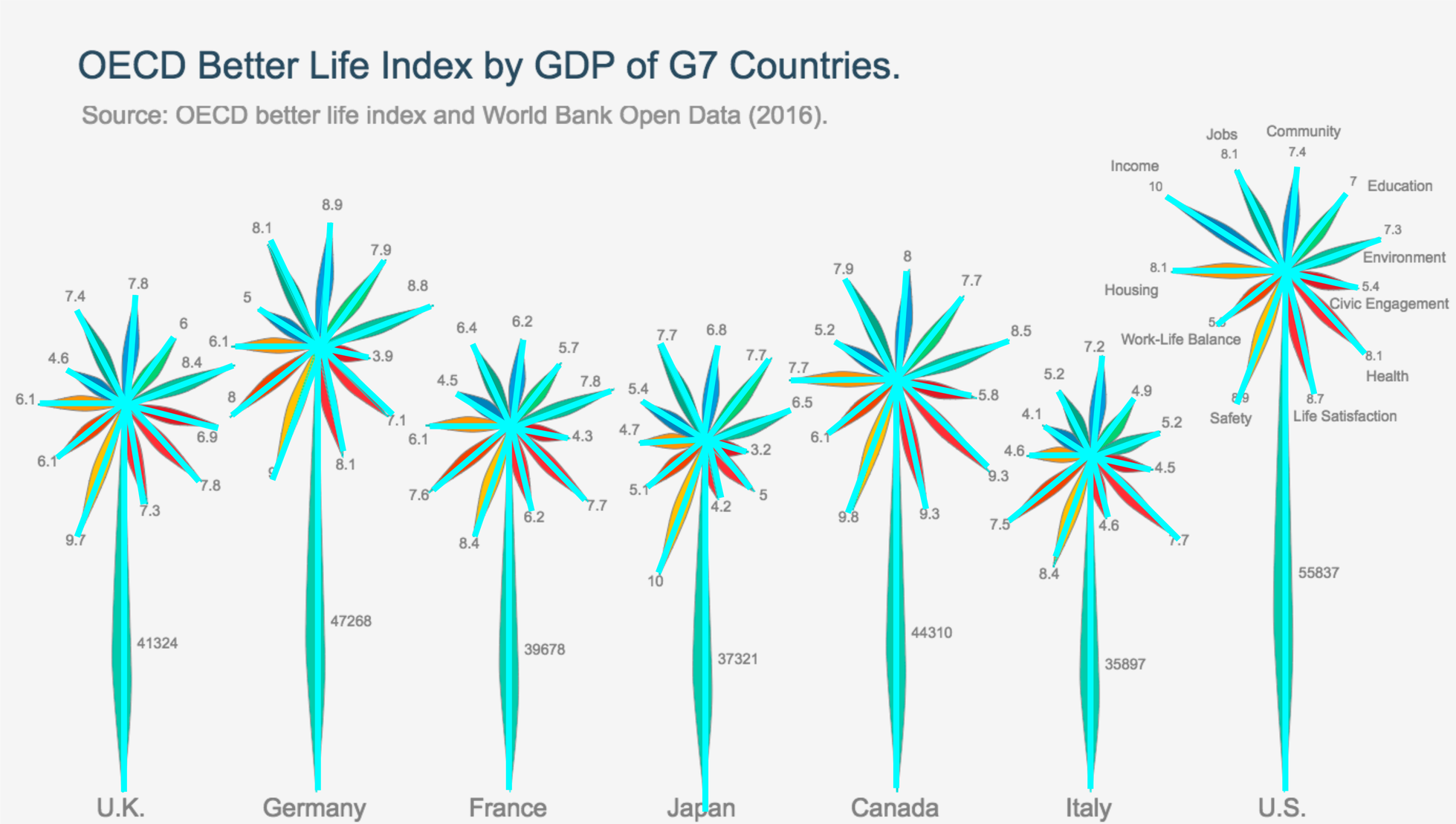
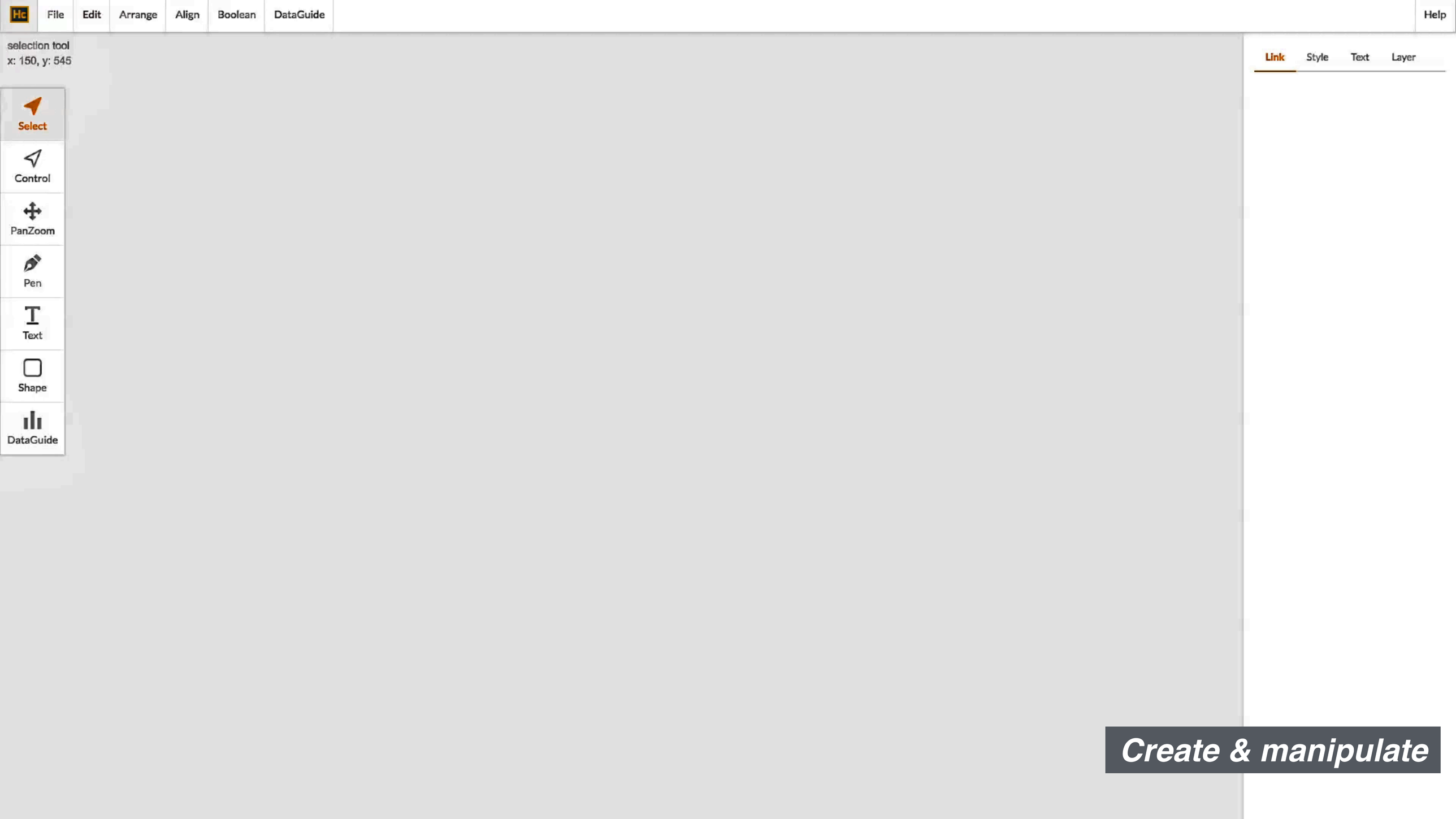


Cyan: Data-Driven Guides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Shape
DataGuide
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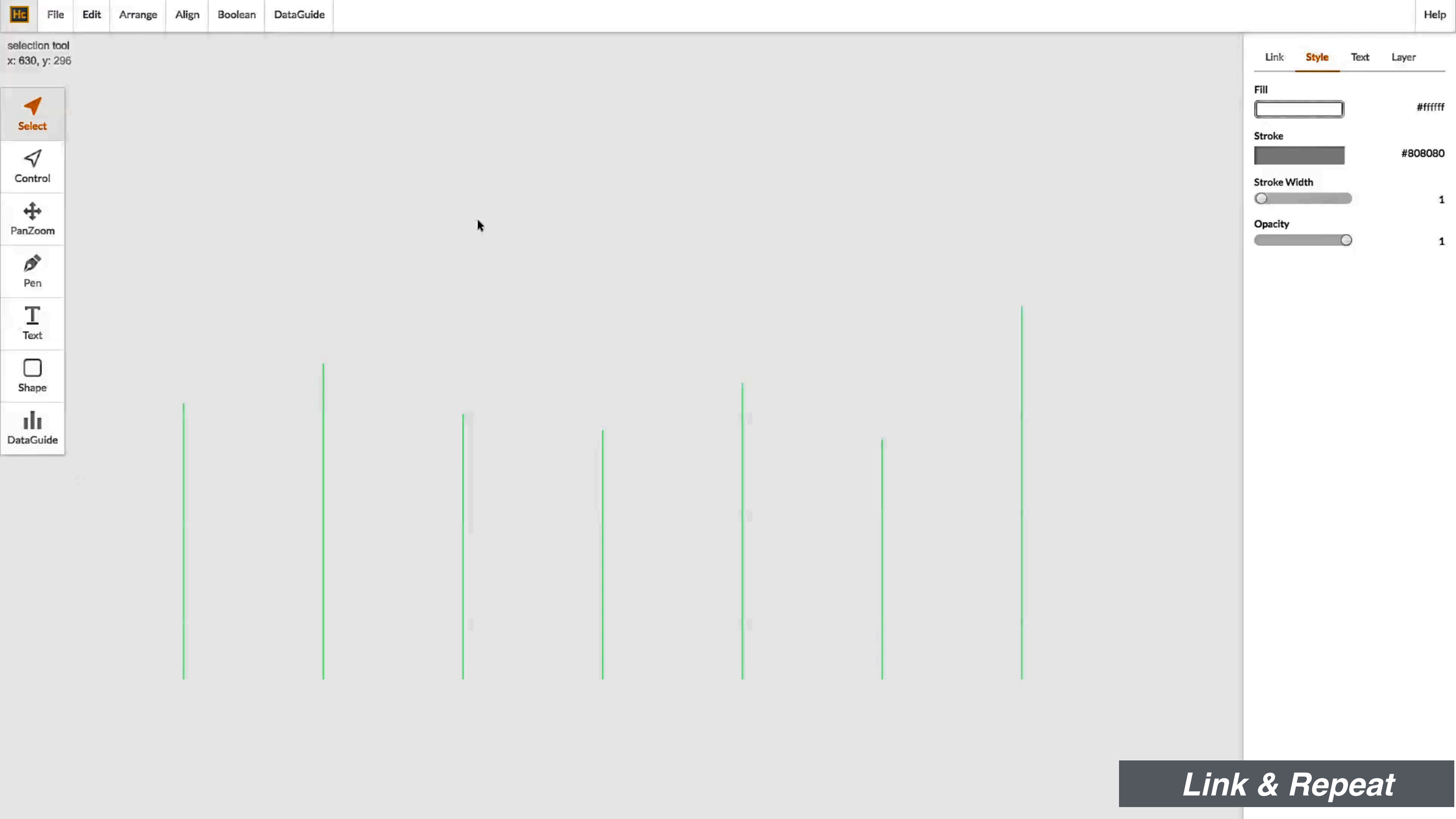
Style
Text
Layer
Create & manipulate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selection tool
x: 630, y: 296
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Style
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Layer
Fill
#ffffff
Stroke
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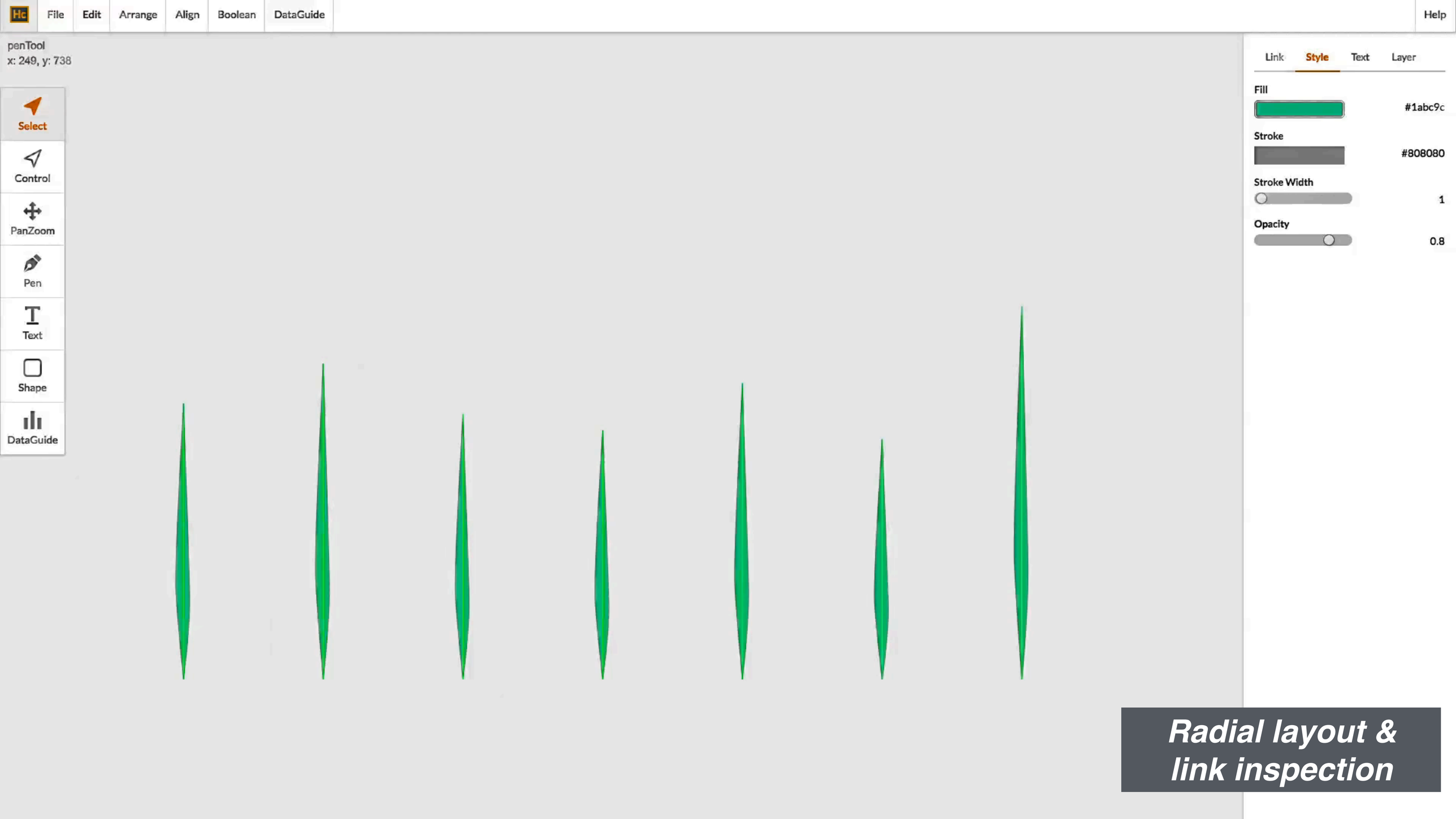

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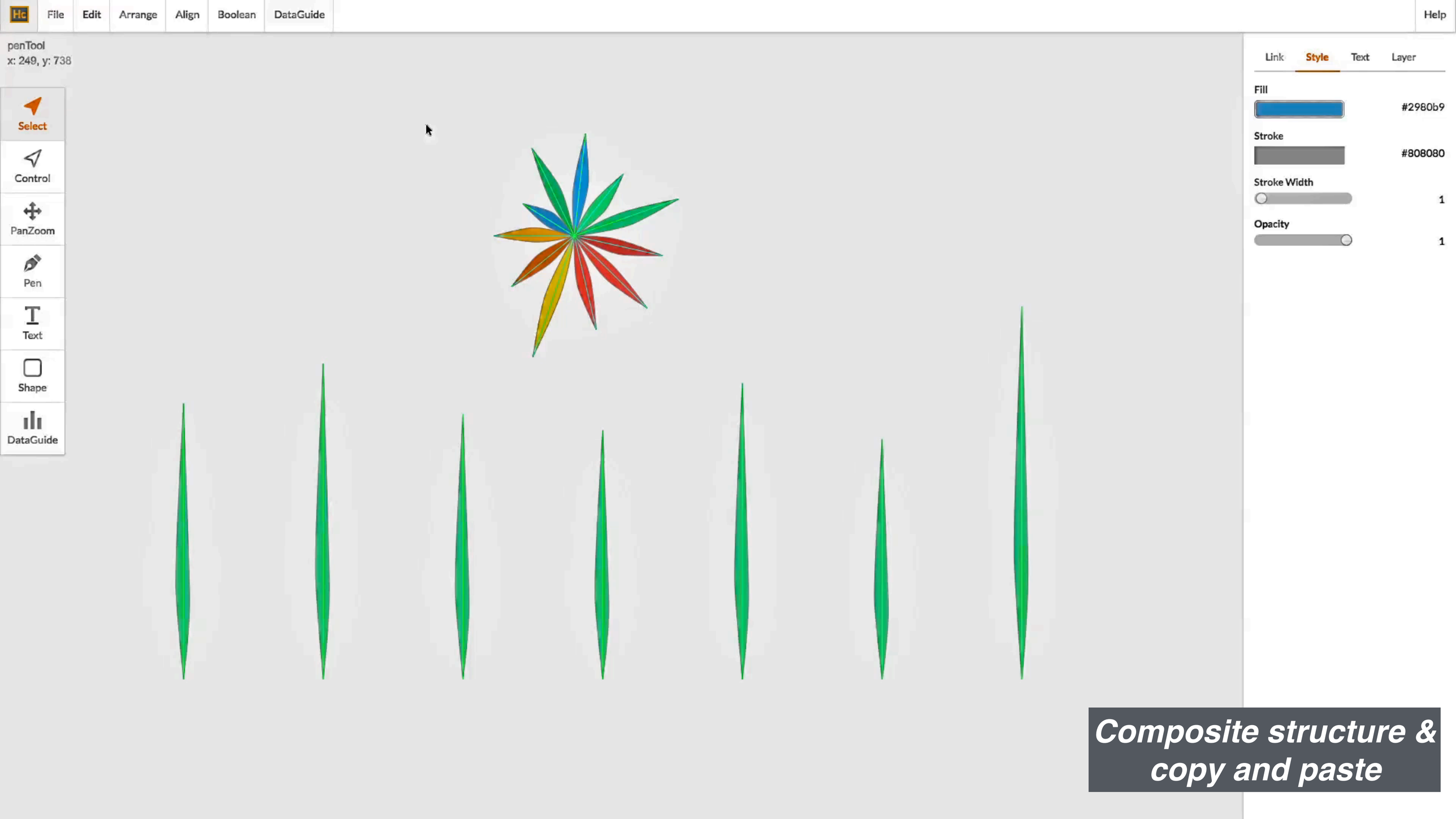
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Composite structure &
copy and paste

File Edit Arrange Align Boolean DataGuide Help

penTool
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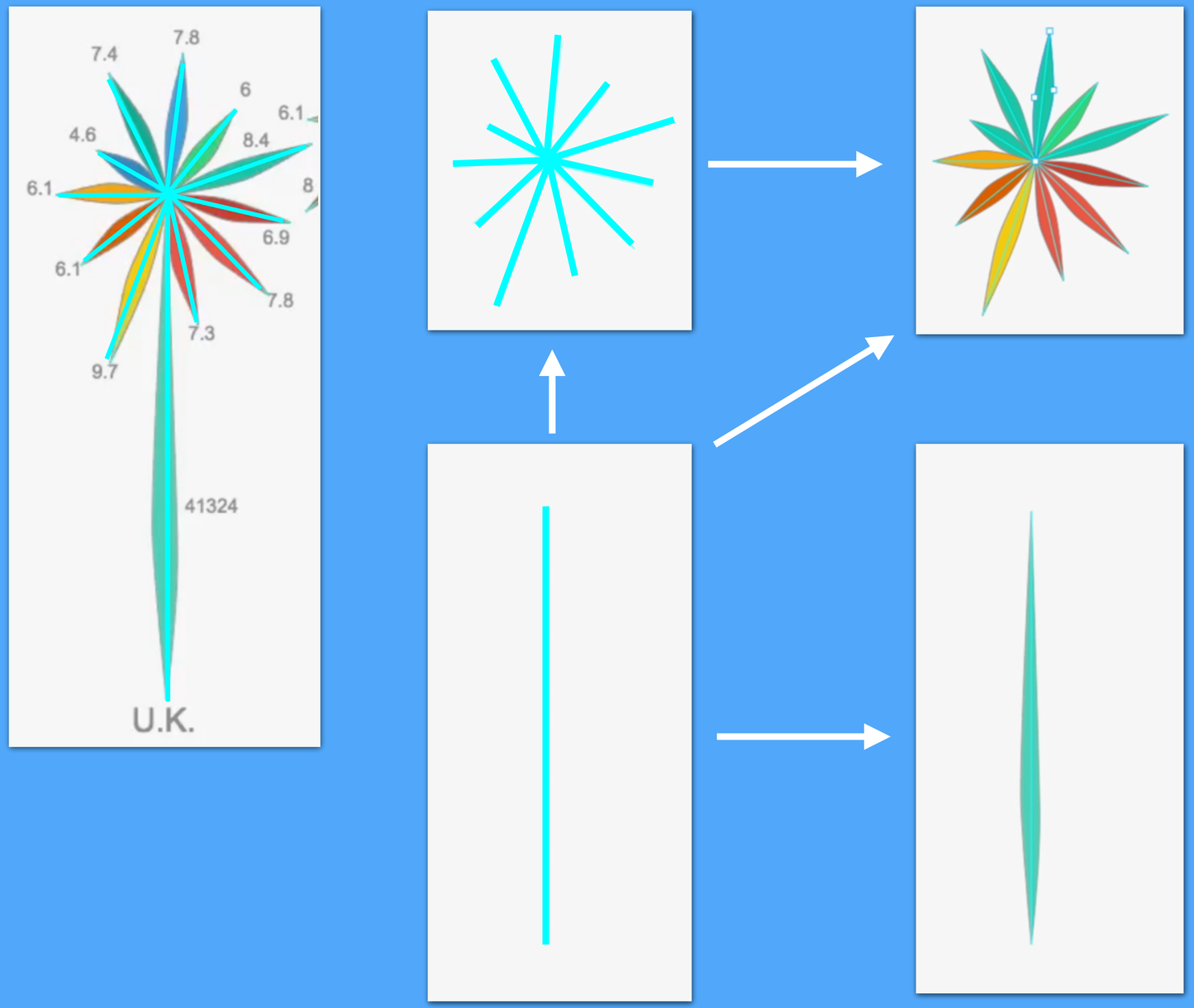
Label generation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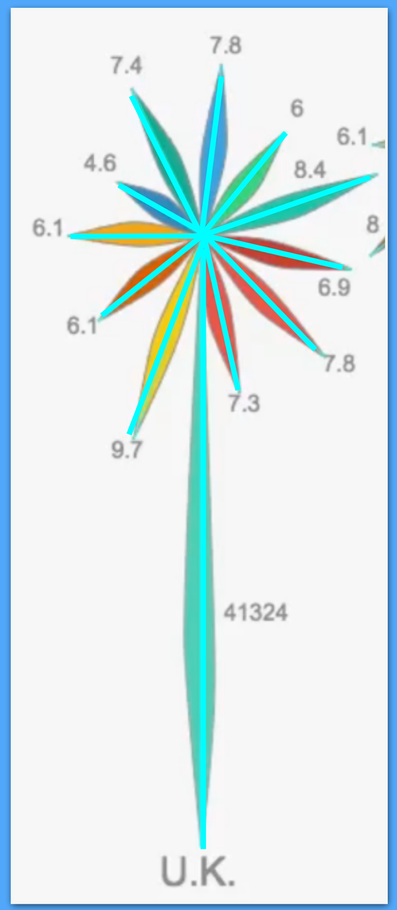
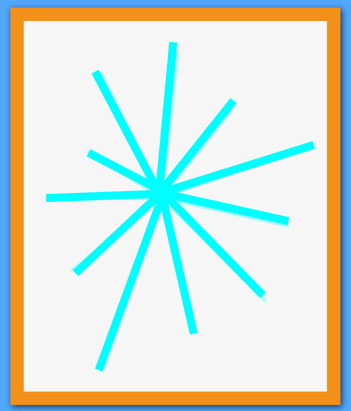
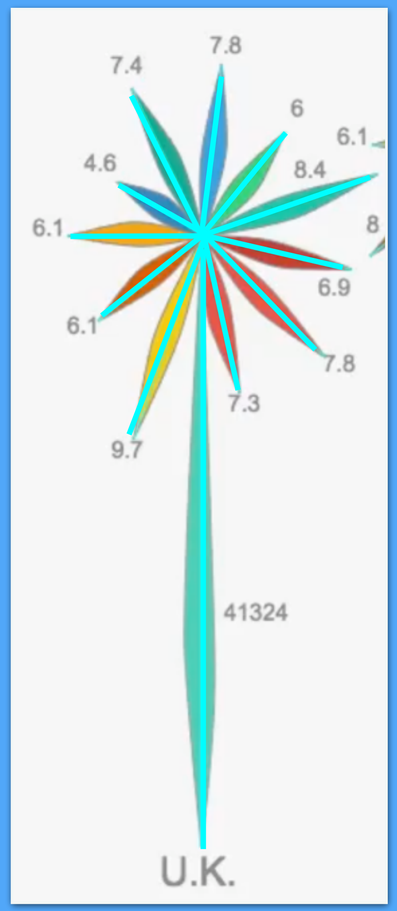
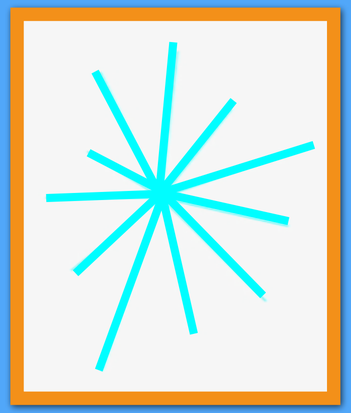




Deforms



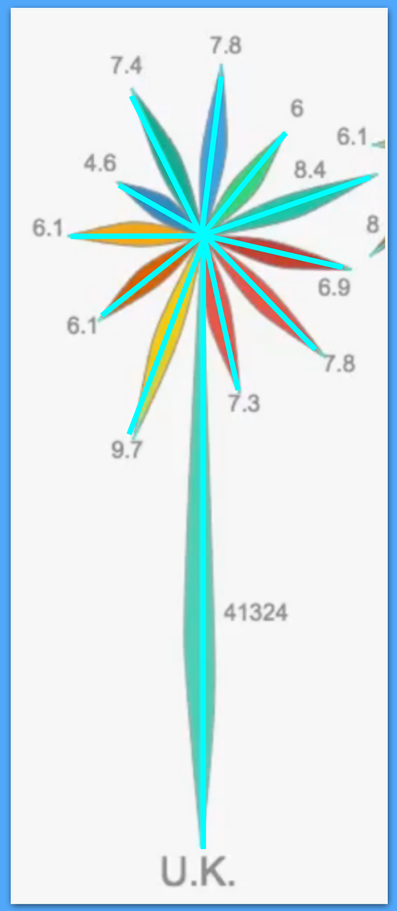


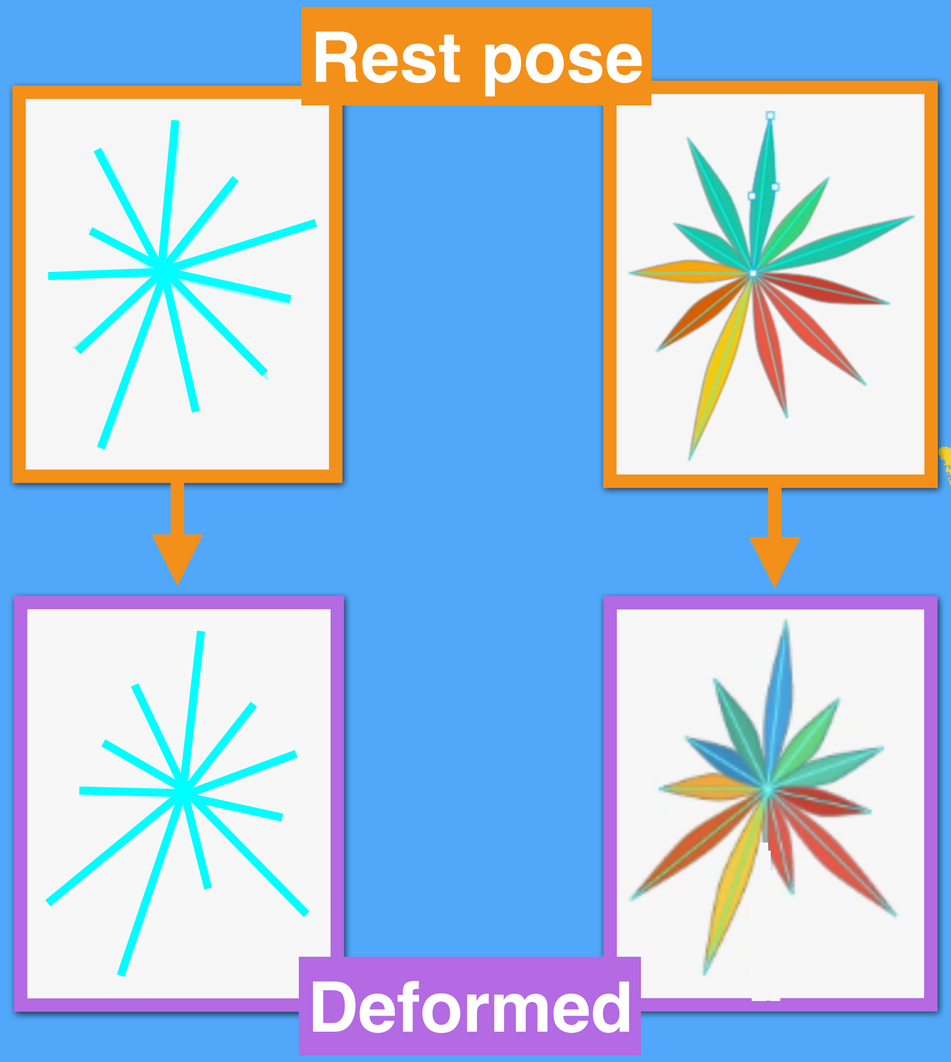
$$p_i' = \sum_{j=1}^{m} w_{ij} T_j p_i,$$

Linear blend skinning

Related Work

1. Bounded biharmonic weights for real-time deformation. Jacobson, Alec, et al. ACM Trans. Graph., 2011
2. Skinning cubic Bézier splines and Catmull-Clark subdivision surfaces. Liu, Songrun, et al. ACM Trans. Graph., 2014.





Old point in a shape.

$$p_i' = \sum_{j=1}^{m} w_{ij} T_j p_i$$

Linear blend skinning

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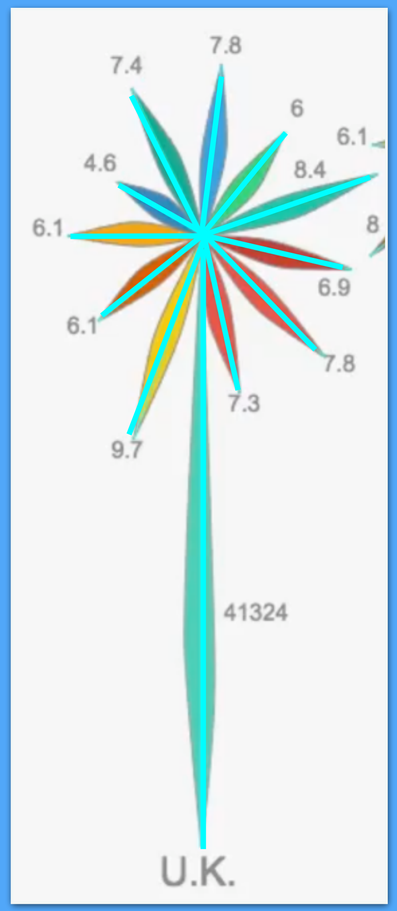

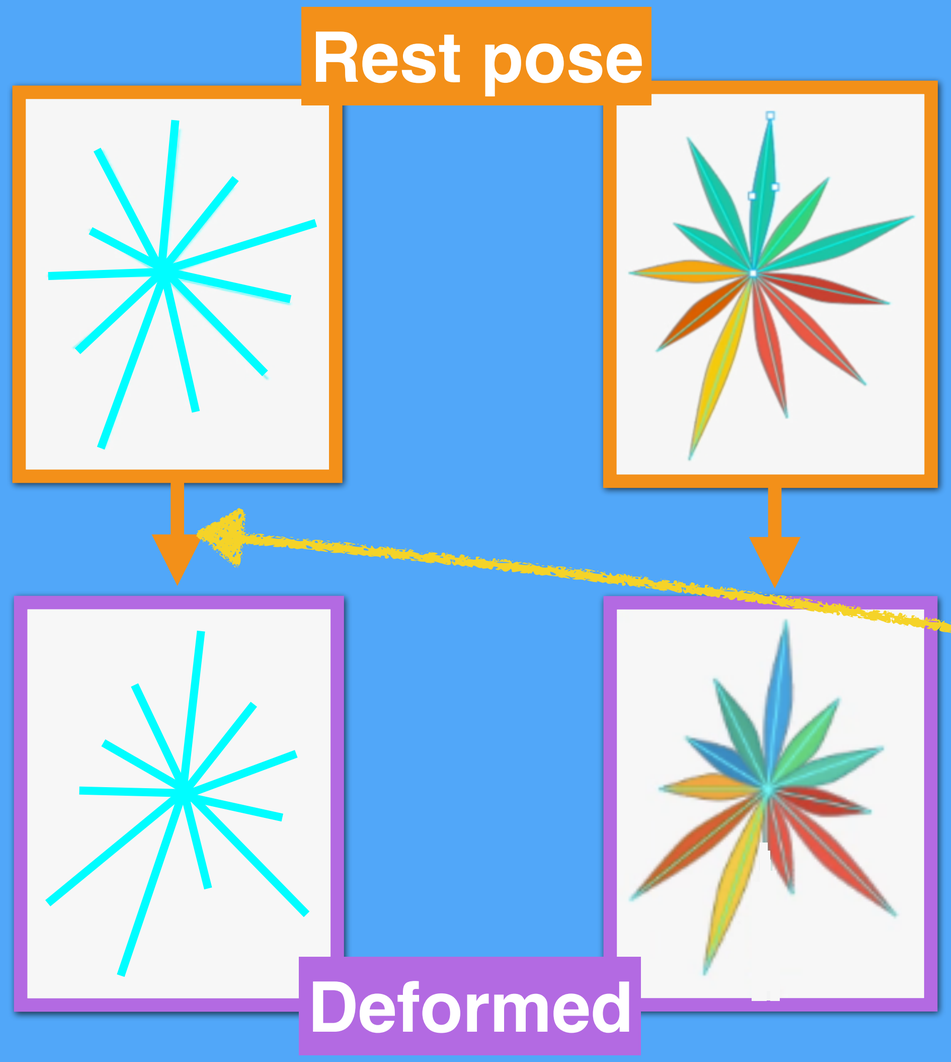

Spatial Transformations (changes in guides)

$$p_i' = \sum_{j=1}^{m} w_{ij} T_j p_i,$$

Linear blend skinning

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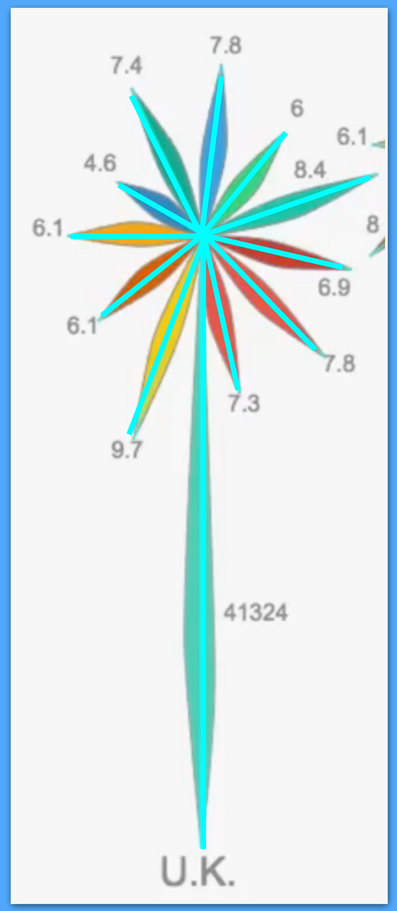

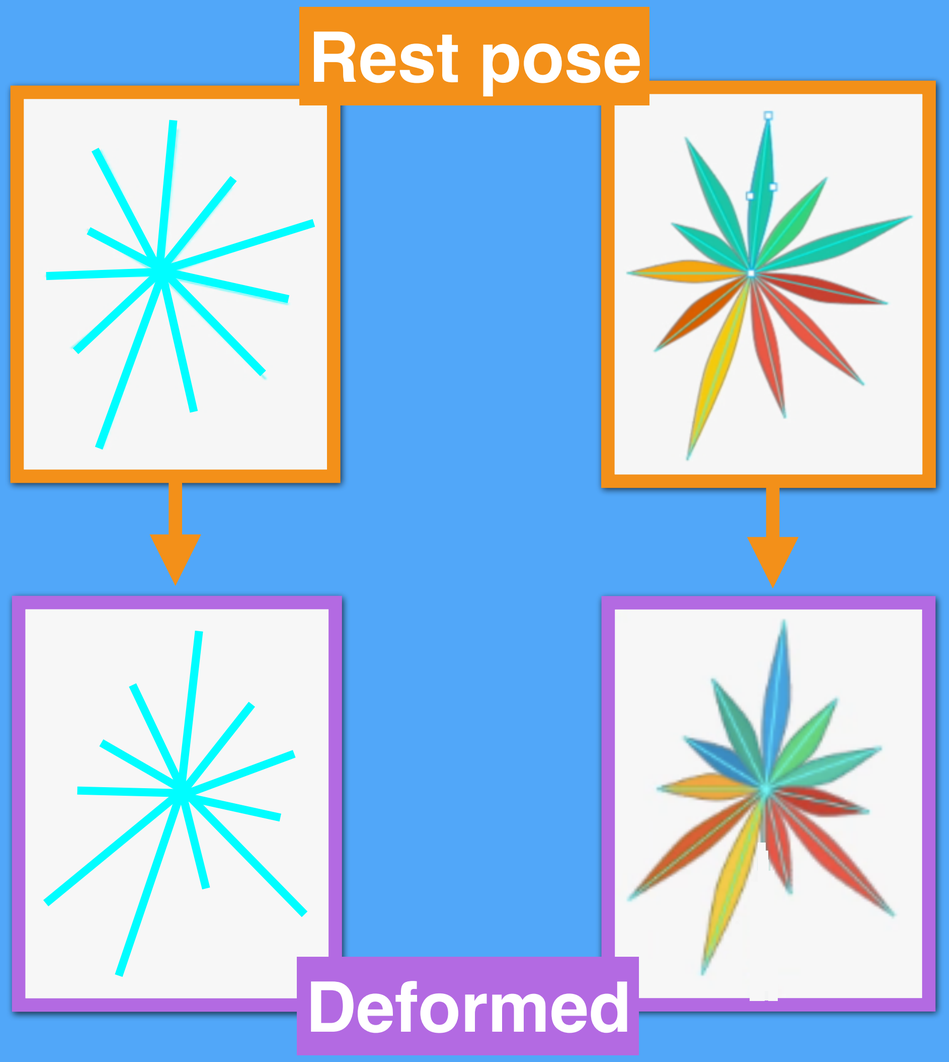

Skinning weight (Transformation amount)

$$p_i' = \sum_{j=1}^{m} w_{ij} T_j p_i,$$

Linear blend skinning

Related Work

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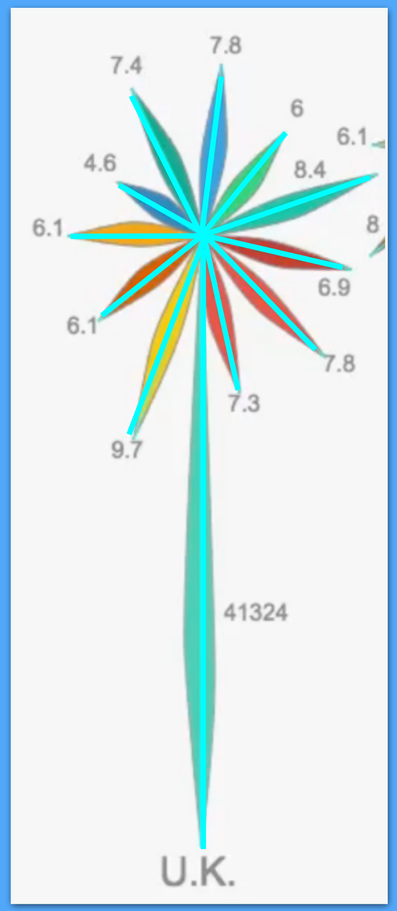
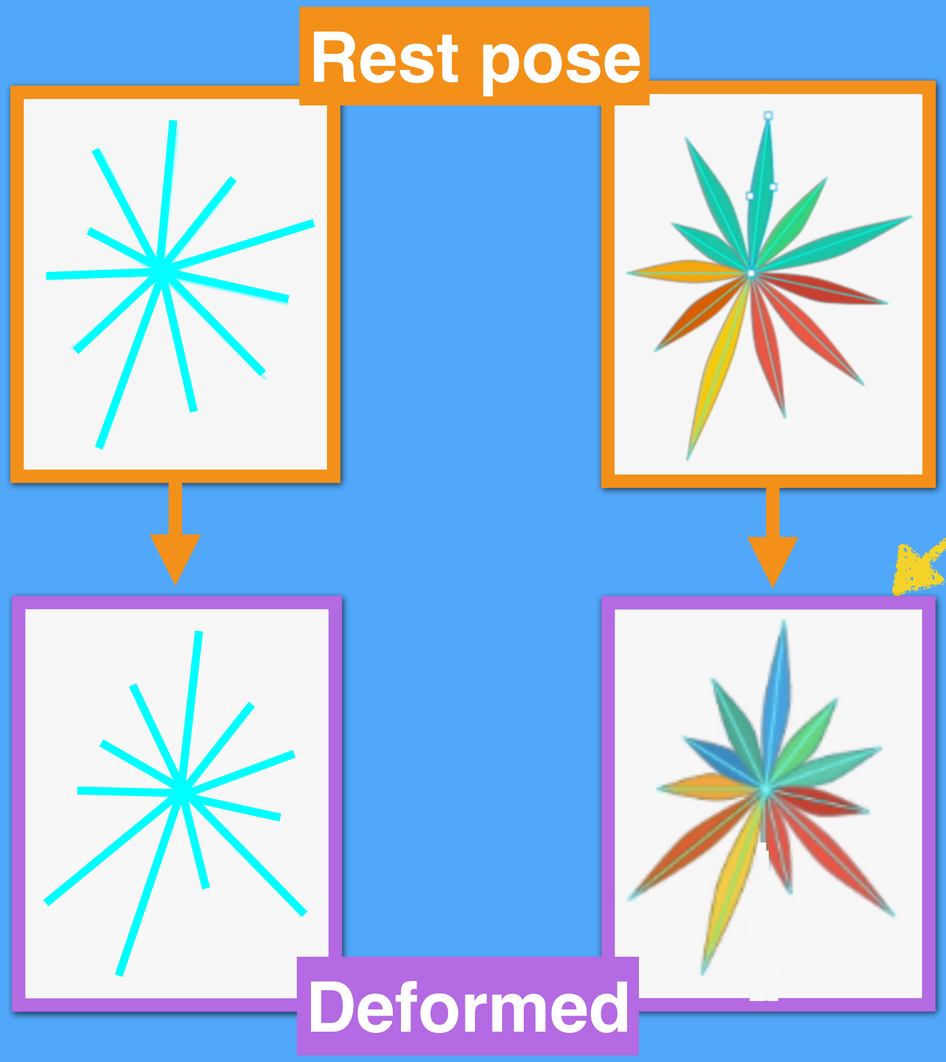
2. Skinning cubic Bézier splines and Catmull-Clark subdivision surfaces. Liu, Songrun, et al. ACM Trans. Graph., 2014.





New points in a shape.

$$p_i' = \sum_{j=1}^{m} w_{ij} T_j p_i,$$

Linear blend skinning

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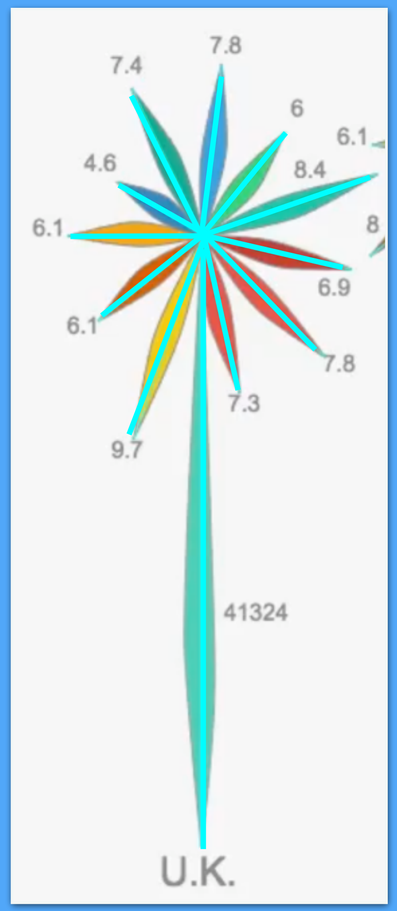
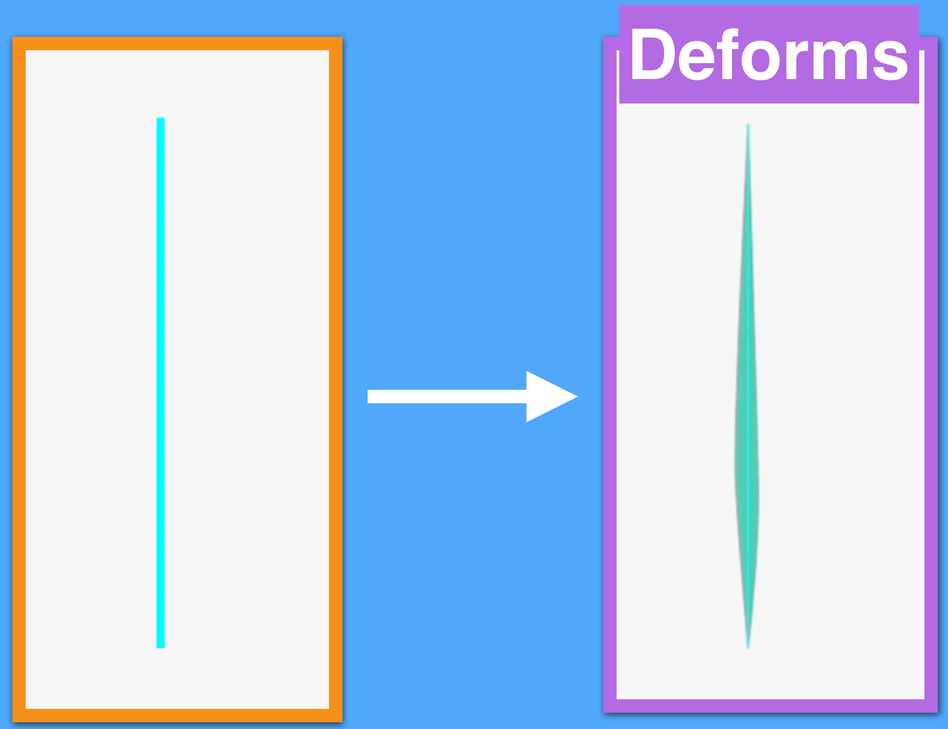
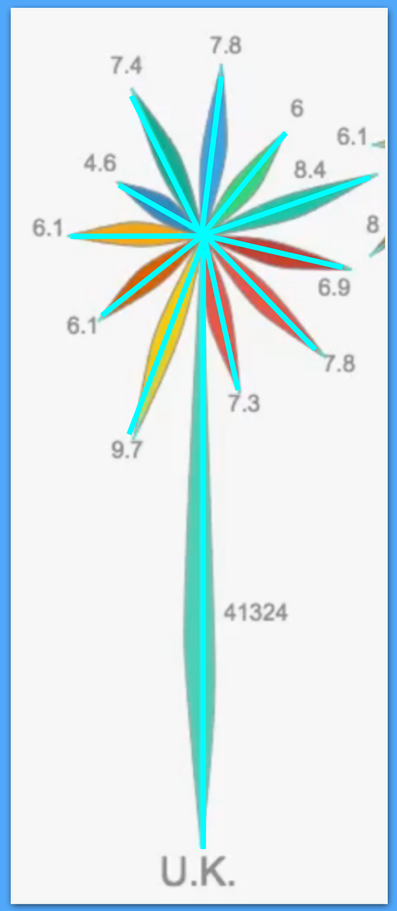
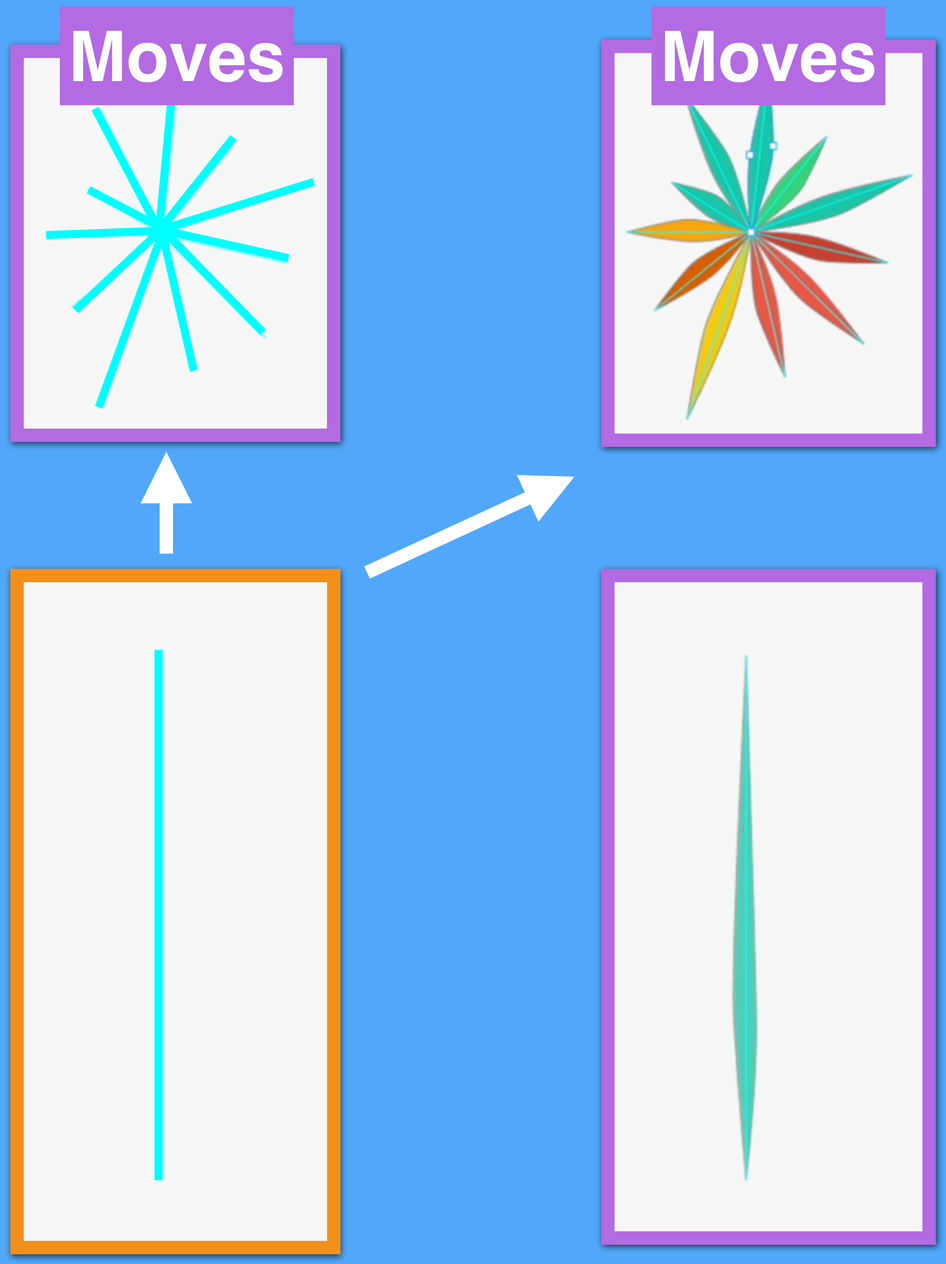




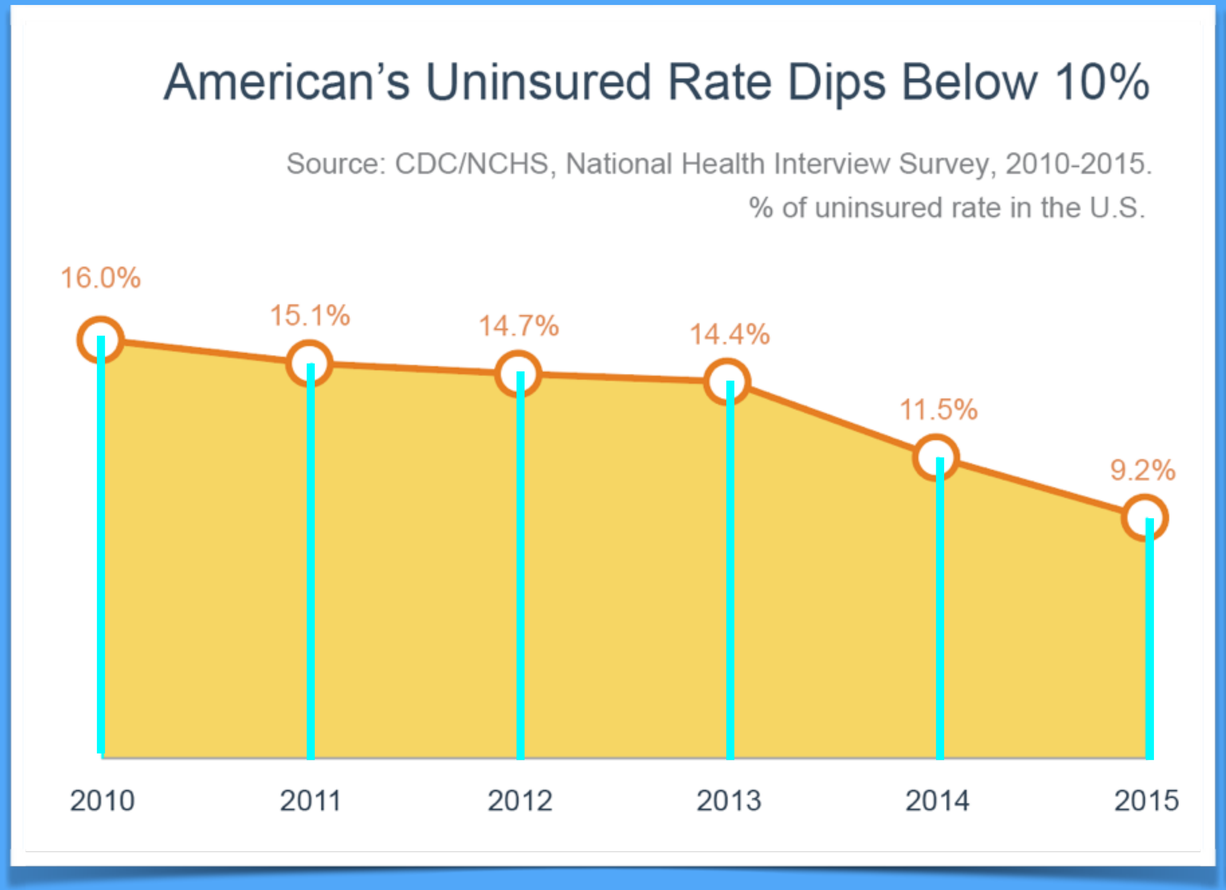
Deforms

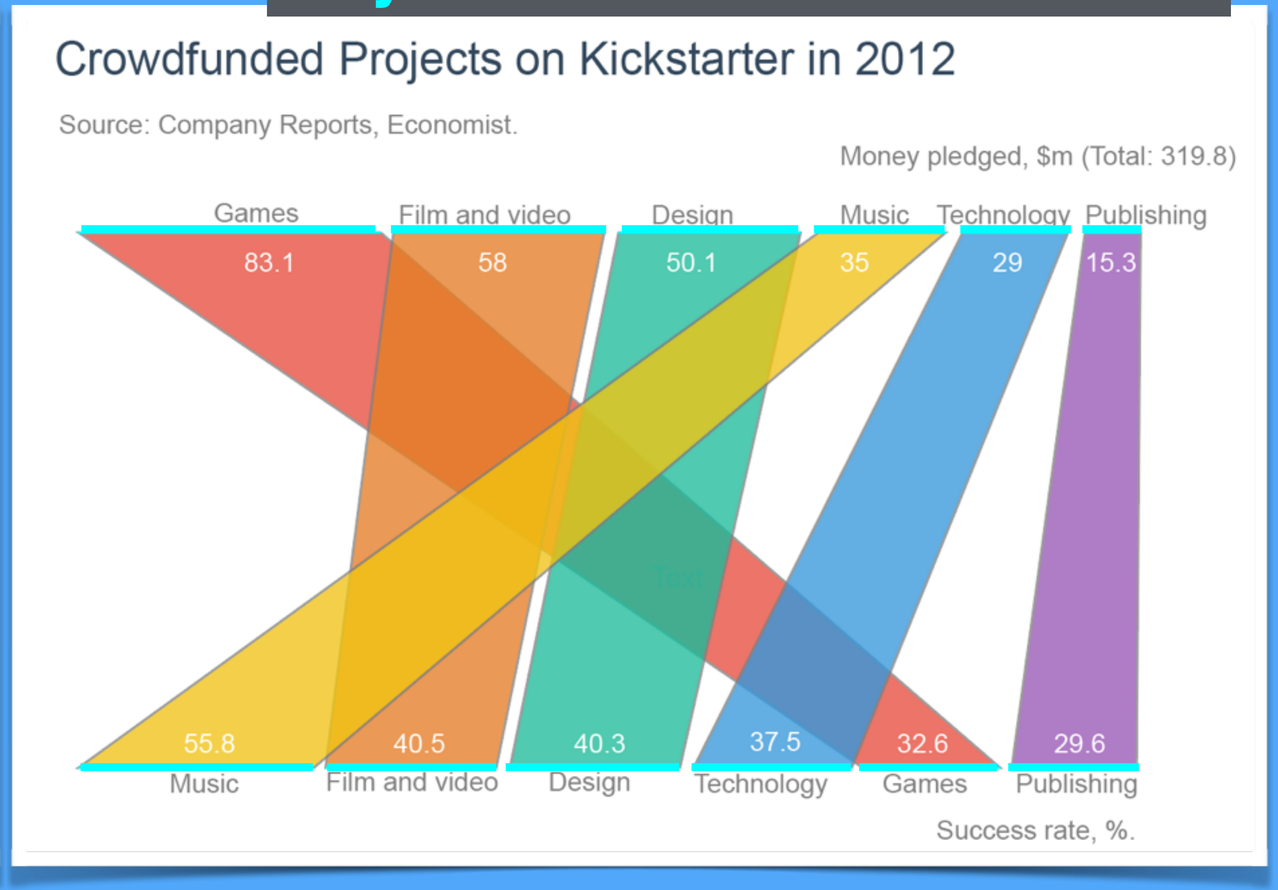




Used as a
Position Guide

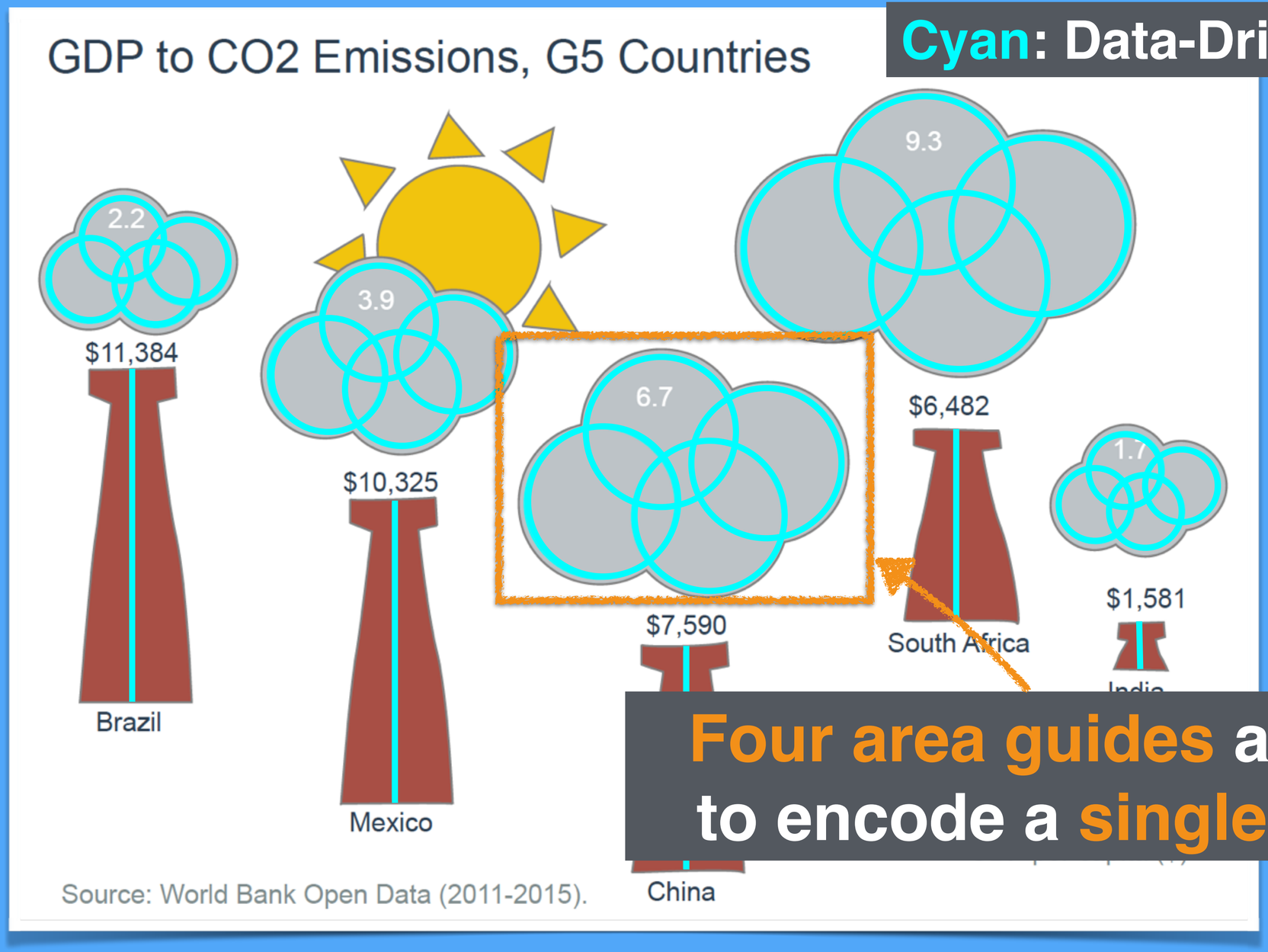
Cyan: Data-Driven Guides





Used as flexible rulers.

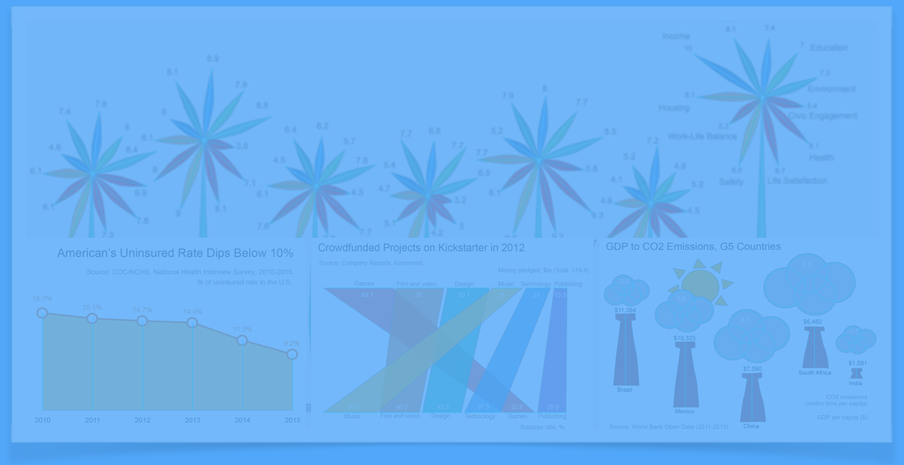
Cyan: Data-Driven Guides



Four area guides are used to encode a single shape.

Use cases

1. Drawing data-driven graphics



2. Retargeting existing artworks

File Edit Arrange Align Boolean DataGuide Help

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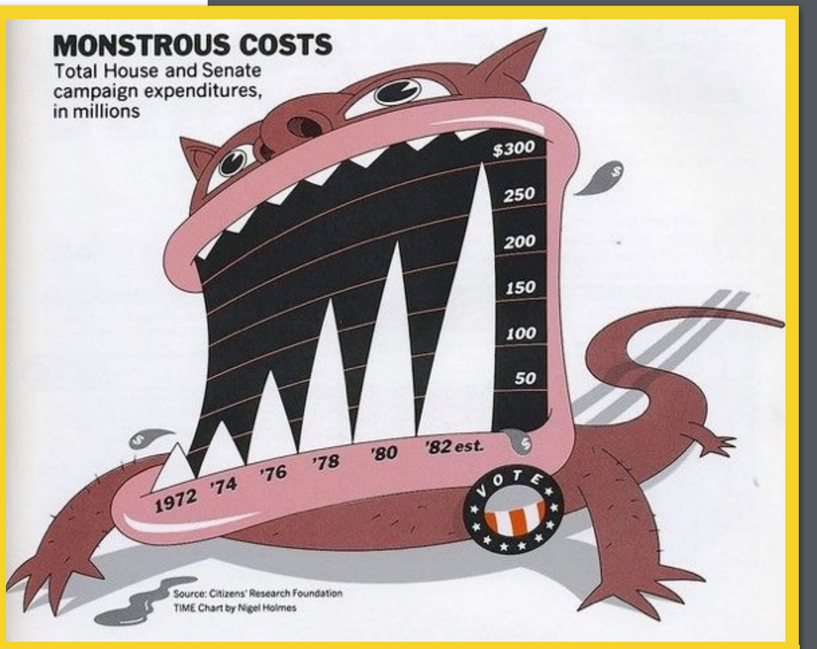
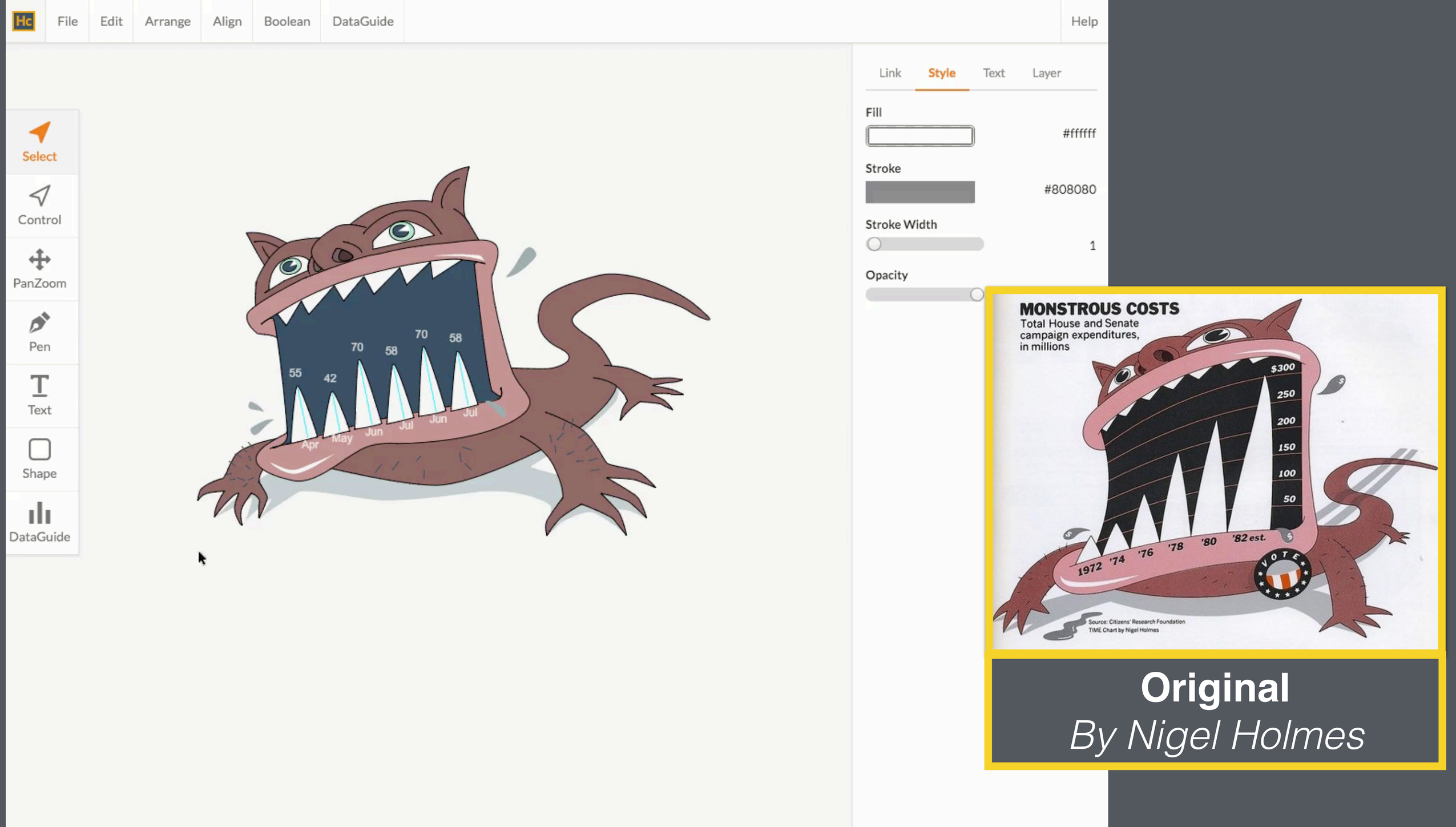


Original

By Nigel Holmes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May
Jun
Jul
Jun
Jul
MONSTROUS COSTS
Total House and Senate campaign expenditures, in millions
$300
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200
150
100
50
1972
'74
'76
'78
'80
'82 est.
VOTE
Source: Citizens' Research Foundation
TIME Chart by Nigel Holmes
Original
By Nigel Holmes

Use cases

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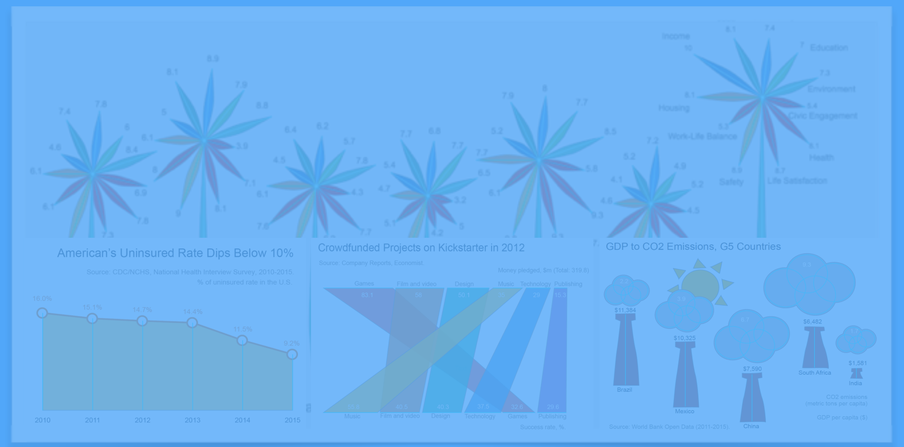


2. Retargeting existing artworks

3. Proofreading existing infographics

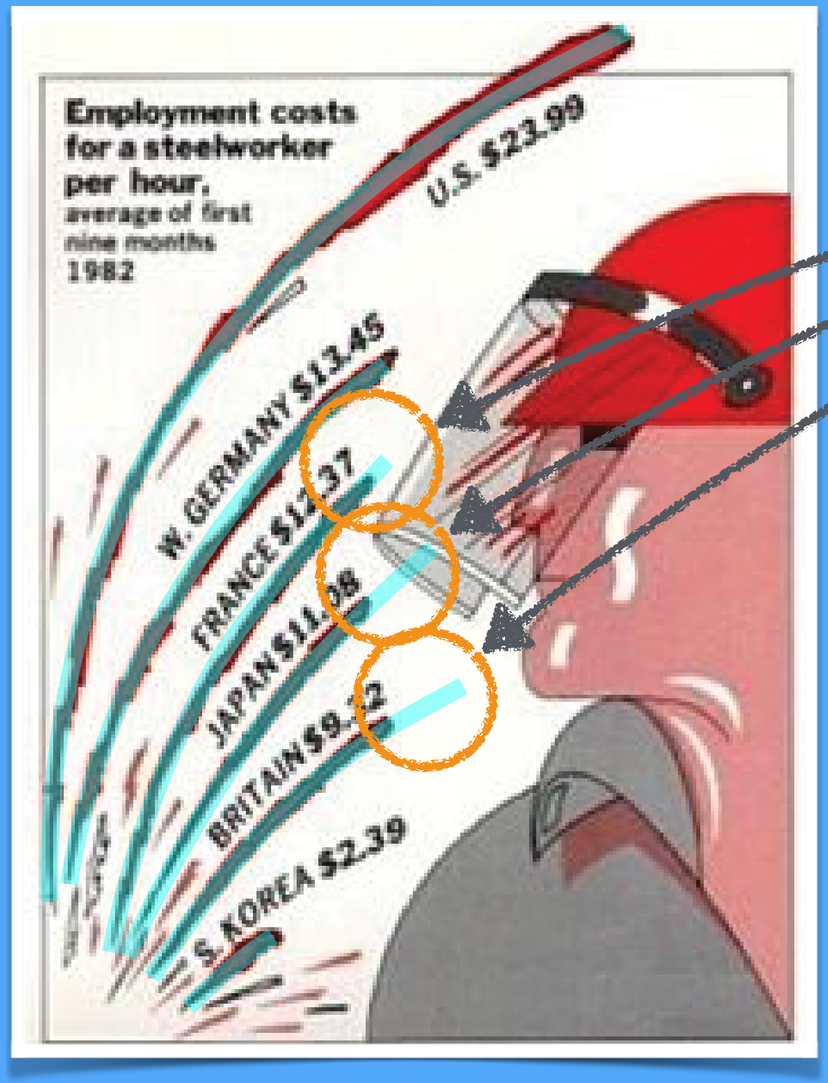
Proofreading existing infographics

Cyan: Data-Driven Guides

By Nigel Holmes.

By Tiffany Farrant-Gonzalez.

Proofreading existing infographics



The length of marks do not match the length of guides (curved).

Original

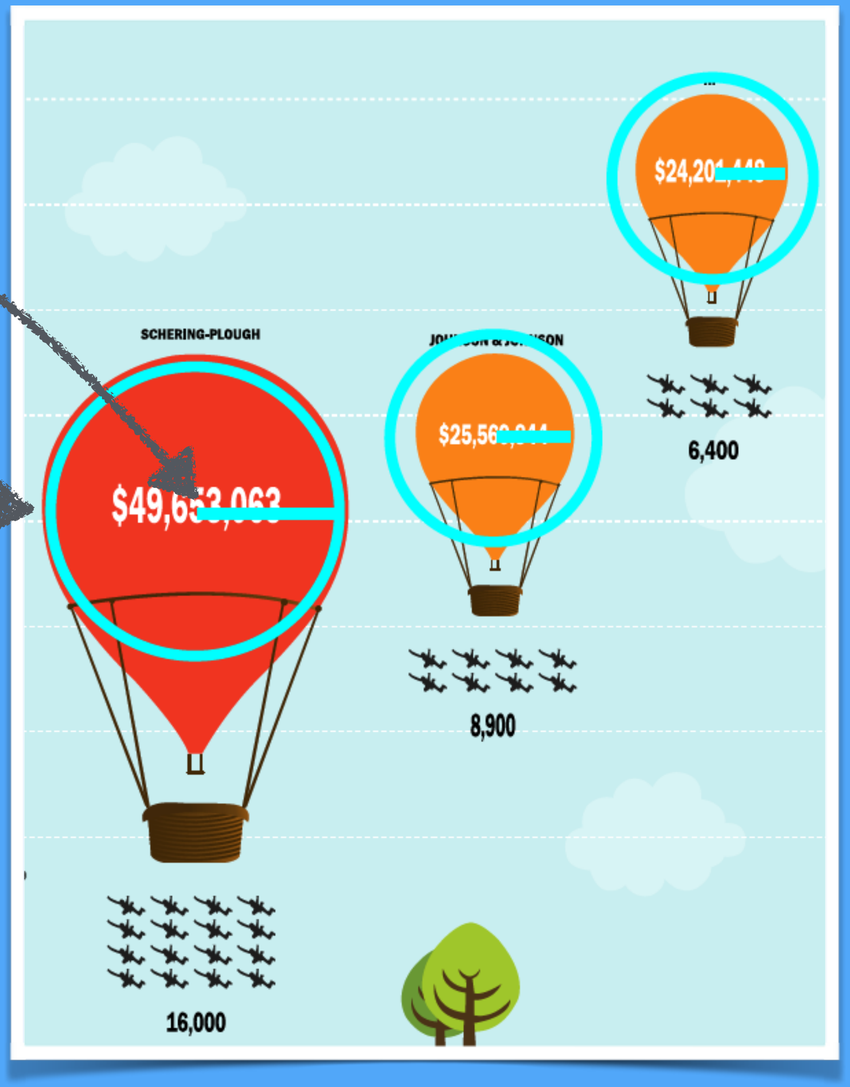
By Nigel Holmes.

Proofreading existing infographics

Length guide (Radius)

Area guide

Original



By Tiffany Farrant-Gonzalez.

Informal usability evaluation with designers.

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- 13 master student designers (architecture, urban planning, and infographic design etc)

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Procedure

- A 60 min session with a 15 min tutorial

Informal usability evaluation with designers.

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- Pre-task and post-task surveys

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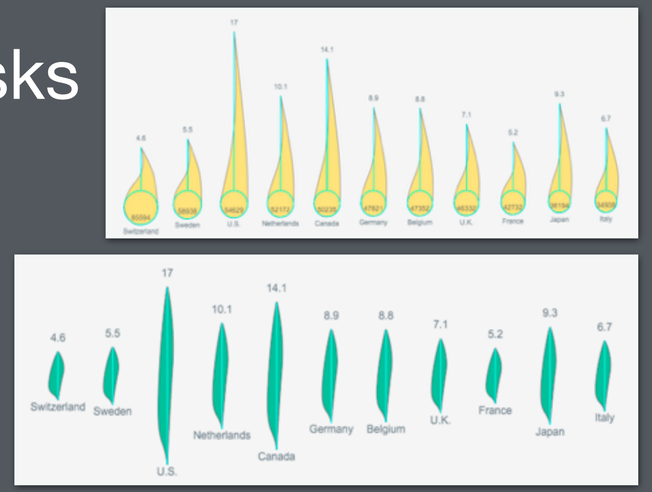
Procedure

- A 60 min session with a 15 min tutorial
- Pre-task and post-task surveys
- 2 replication tasks
- 1 creative task

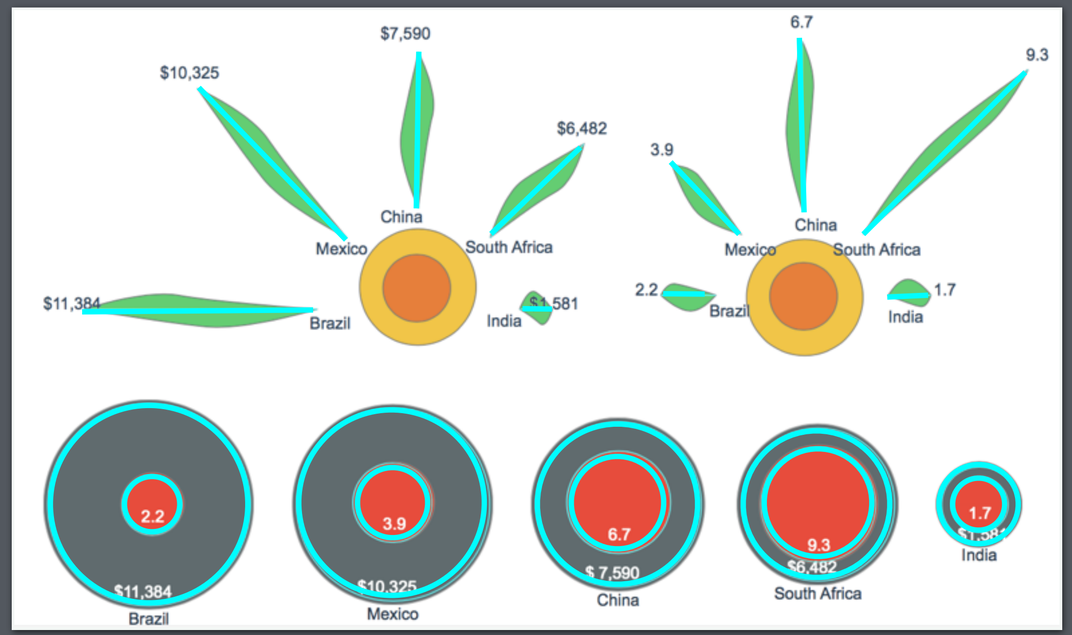


* We did not measure time

Results

Creative Tasks

- Two selected infographics created by participants.



Data: GDP of G5 Countries.

Results

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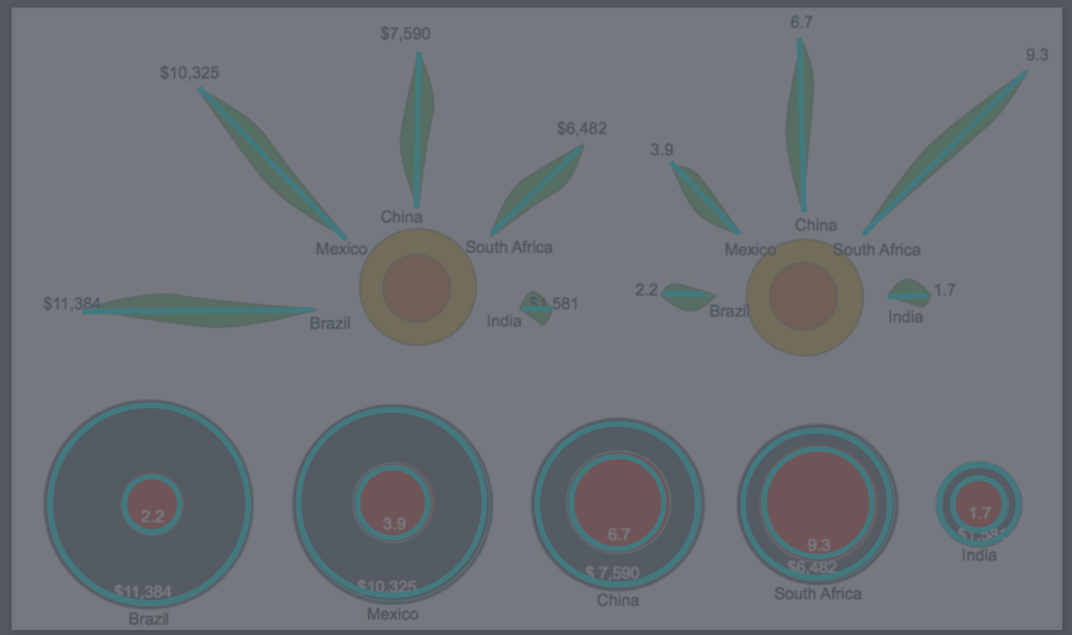

Data: GDP of G5 Countries.

Post-task surveys (5-point Likert scale)

1. Interactions with DDG were intuitive. *(μ=4.0, σ=0.71)*

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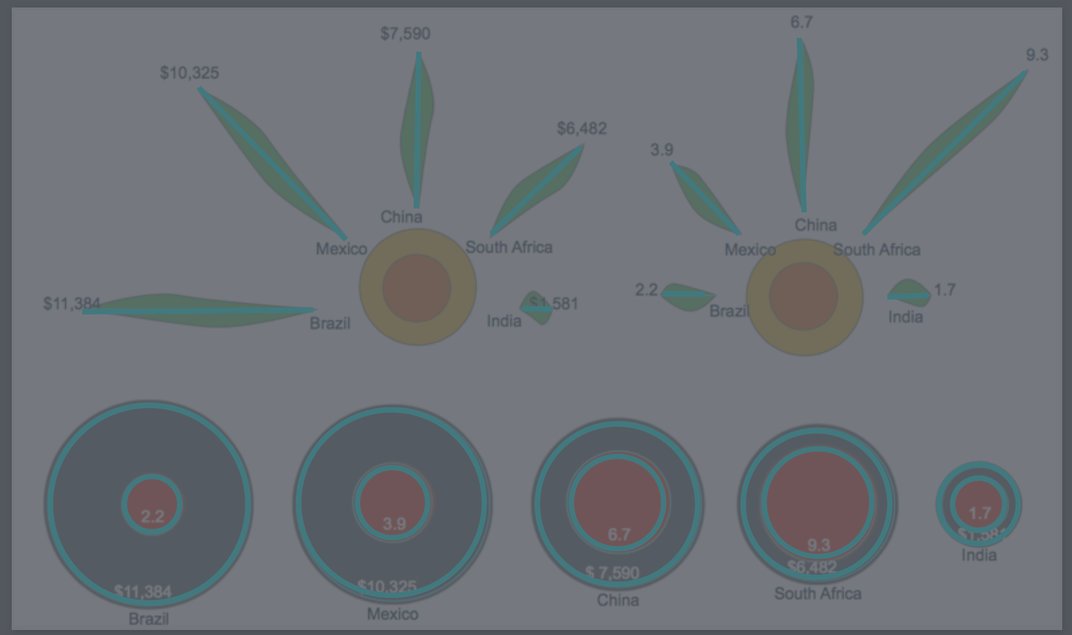

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Results

Creative Tasks

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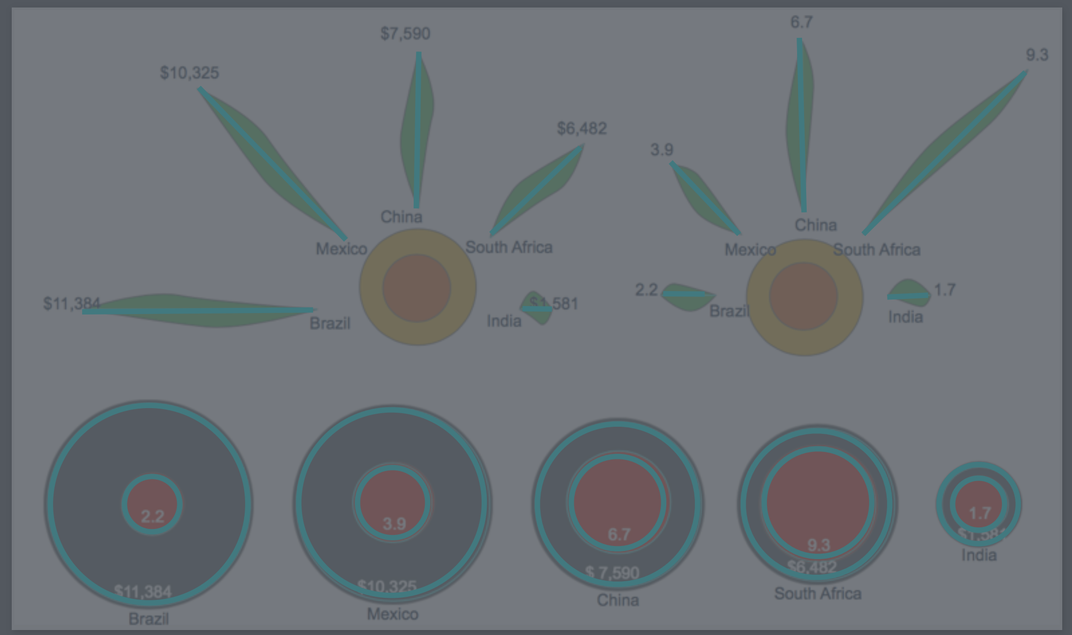

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1. Interactions with DDG were intuitive. *(μ=4.0, σ=0.71)*

2. DDG is useful for positioning and measuring custom shapes based on data compared to rulers or grids. *(μ=4.7, σ=0.63)*

3. DDG is useful for designing creative and expressive infographics *(μ=4.9, σ=0.38)*

Results: qualitative feedback

“Currently, I need a calculator to make data graphic, which is pretty arduous. This tool makes it much easier to try things out and experiment with the graphics.” - P10.

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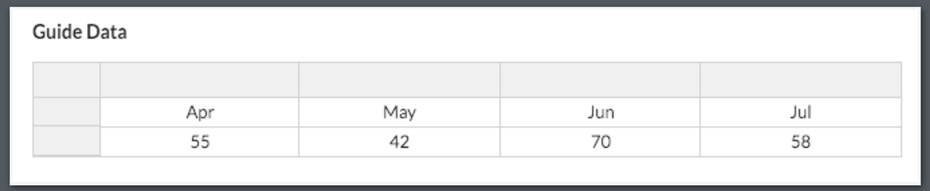
“Currently, I need a calculator to make data graphic, which is pretty arduous. This tool makes it much easier to try things out and experiment with the graphics.” - P10.

“I think that this would be a wonderful aid in creating graphics for architectural representations.” - P3.

“I usually do very analytical infographics, using traditional forms like bars or circles. Because of that, I’m not quite sure if data guides might be very useful” - P5.

Limitations

1. Data-driven guides currently works with a tabular dataset.



Guide Data

	Apr	May	Jun	Jul
	55	42	70	58

Limitations

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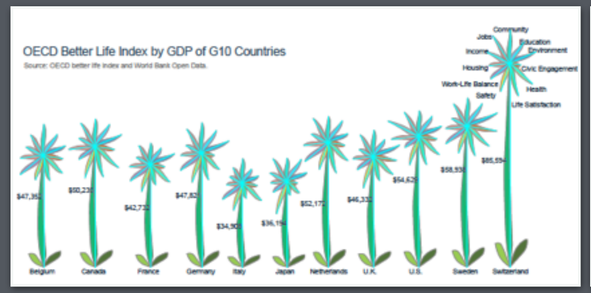
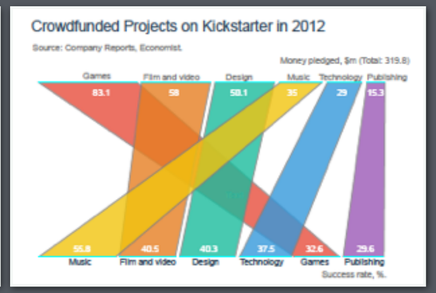
Guide Data

	Apr	May	Jun	Jul
	55	42	70	58

2. Difficult to generate guide elements such as axes and legends.





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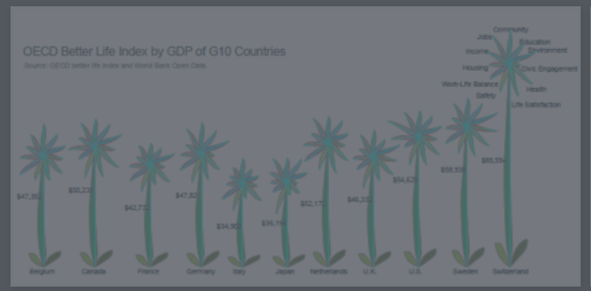
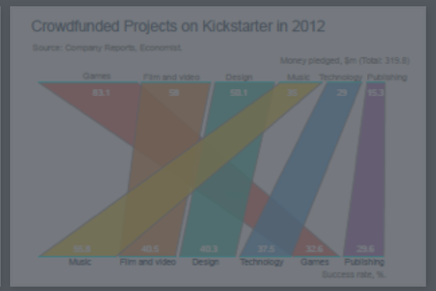
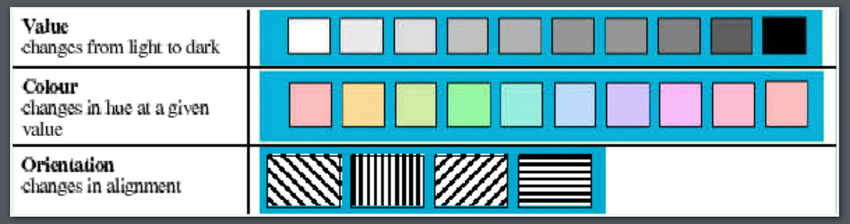


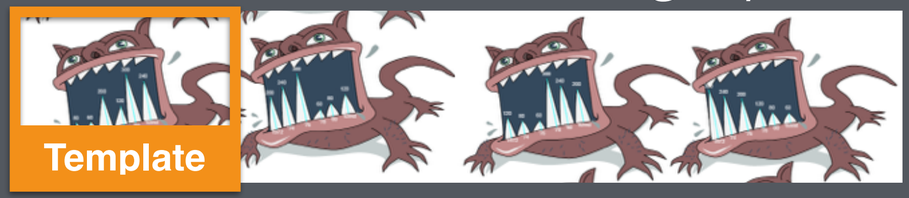


3. Other visual variables have to be manually encoded such color or angle.



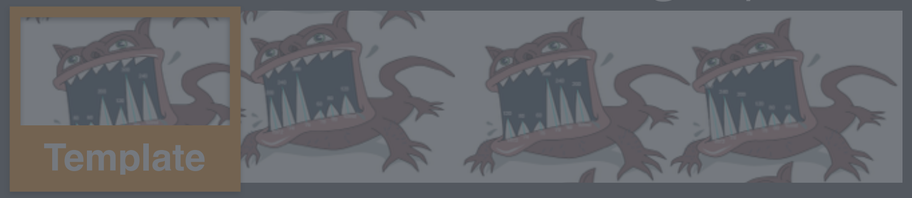
Future work

1. *Reusable creative infographic templates.*

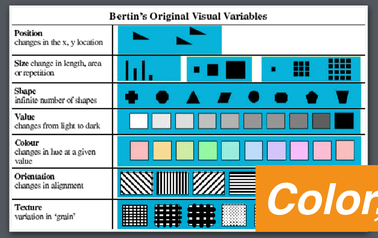


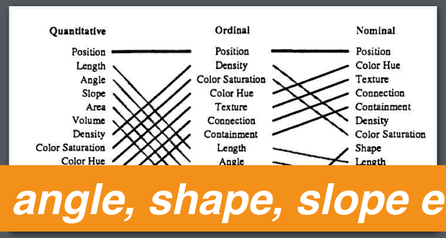
Future work

1. *Reusable creative infographic templates.*



2. *Data-driven guides for other visual variables.*





Color, angle, shape, slope etc.

Future work

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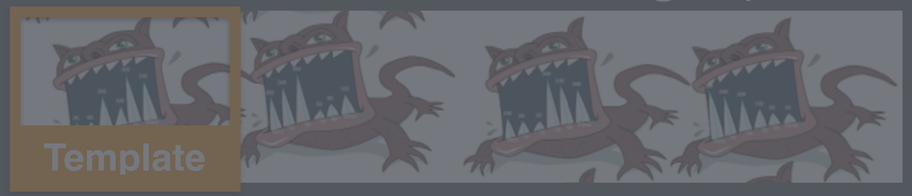
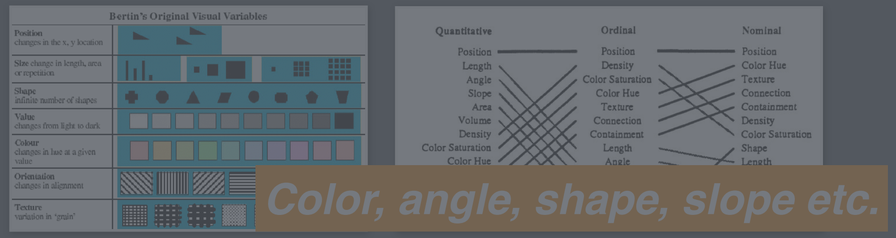
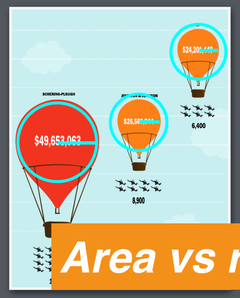


2. *Data-driven guides for other visual variables.*



3. *Intelligent systems for automatically providing design feedback.*



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