Cody Dunne

Northeastern University

INTERACTION, ANIMATION

Checking In

Goals for Today: Learn…

- how to use basic Jupyter Widget + Altair interactions
- when and why to use interaction.
- the basic interactive functions for visualizations
- common illusions that can occur

In-class programming—Altair interactive

~40 min total

INTERACTION

Visualizing big data

Interaction best practices

“Overview first, zoom and filter, and details on demand.”

- Ben Shneiderman

“The Shneiderman Mantra”

Interaction best practices

Shneiderman Mantra:

- Overview—provide high-level view/summary
- Zoom and Filter—enable data discovery and exploration, support search/tasks
- Details on Demand—do not overwhelm the viewer. Provide extra information as needed

Based on Slide by Miriah Meyer

There are many visual design guidelines but the basic principle might be summarized as the Visual Information Seeking Mantra:

Overview first, zoom and filter, then details-on-demand
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Overview first, zoom and filter, then details-on-demand

Each line represents one project in which I found myself rediscovering this principle and therefore wrote it down it as a reminder. It proved to be only a starting point in trying to characterize the multiple information-visualization innovations occurring at university, government, and industry research labs.

Shneiderman, 1996

“Search, show context, expand on demand”

- van Ham & Perer

van Ham & Perer, 2009

Interaction best practices

van Ham & Perer approach:

- Search—pick subset of data to focus on.
- Show context—show connected or relevant data for the user's current interests.
- Expand on demand—user chooses to expand the context in a direction of interest.

van Ham & Perer, 2009

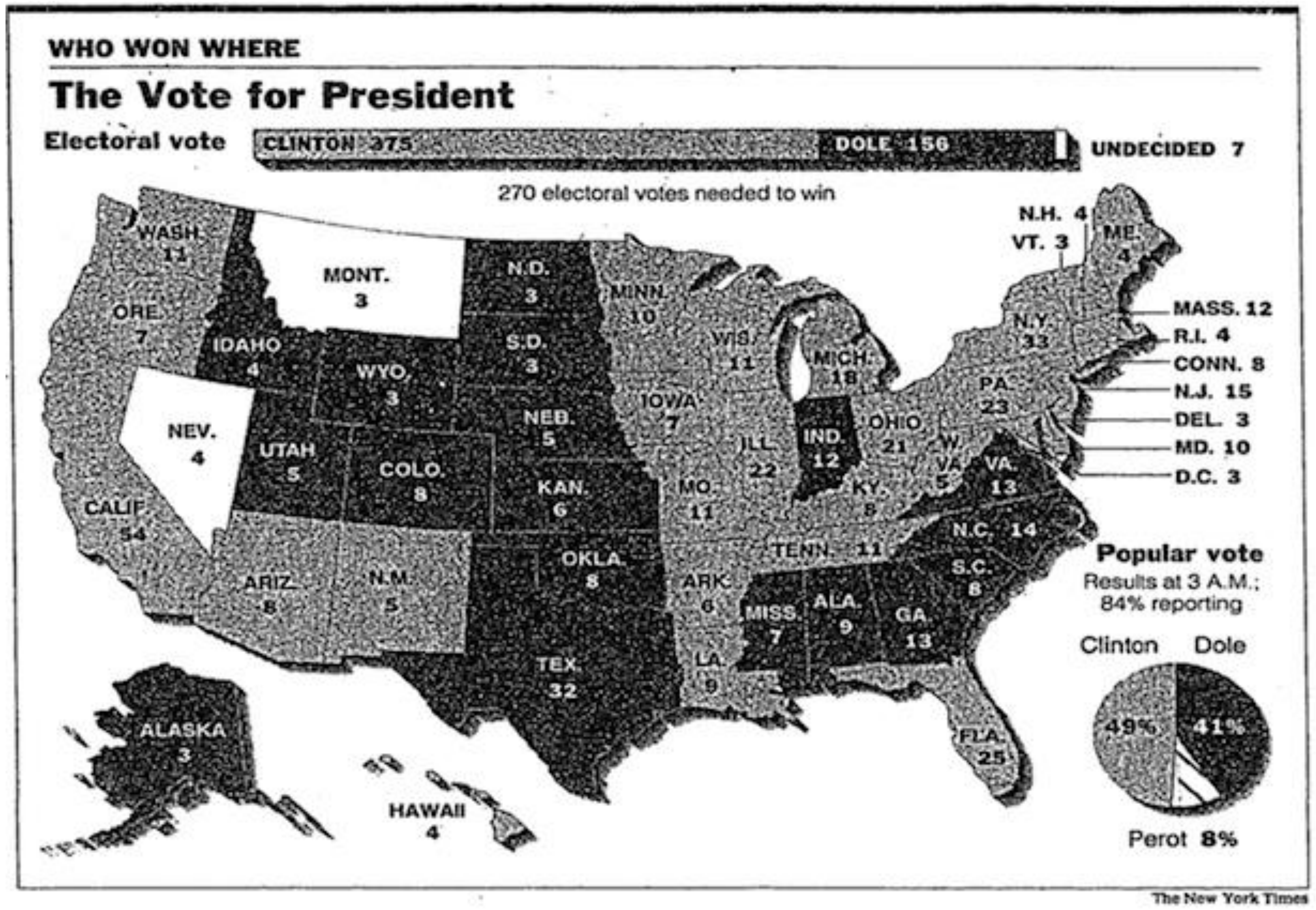
Approaches for visualizing big data

1. Dimensional Reduction—Reduce amount of attributes visualized
2. Interactions—Let user manipulate a single view
3. Faceting—Split data into multiple views
4. Aggregate and Filter—Reduce amount of data visualized
5. Focus+Context—Embed focused information

Interaction has benefits

- Enables visualization of large amounts of data
- Amplifies user cognition (supports sensemaking)
- Increases engagement (vis becomes personal to user)
- Increases deep learning and learning transfer

Interaction to expose details at the user's pace

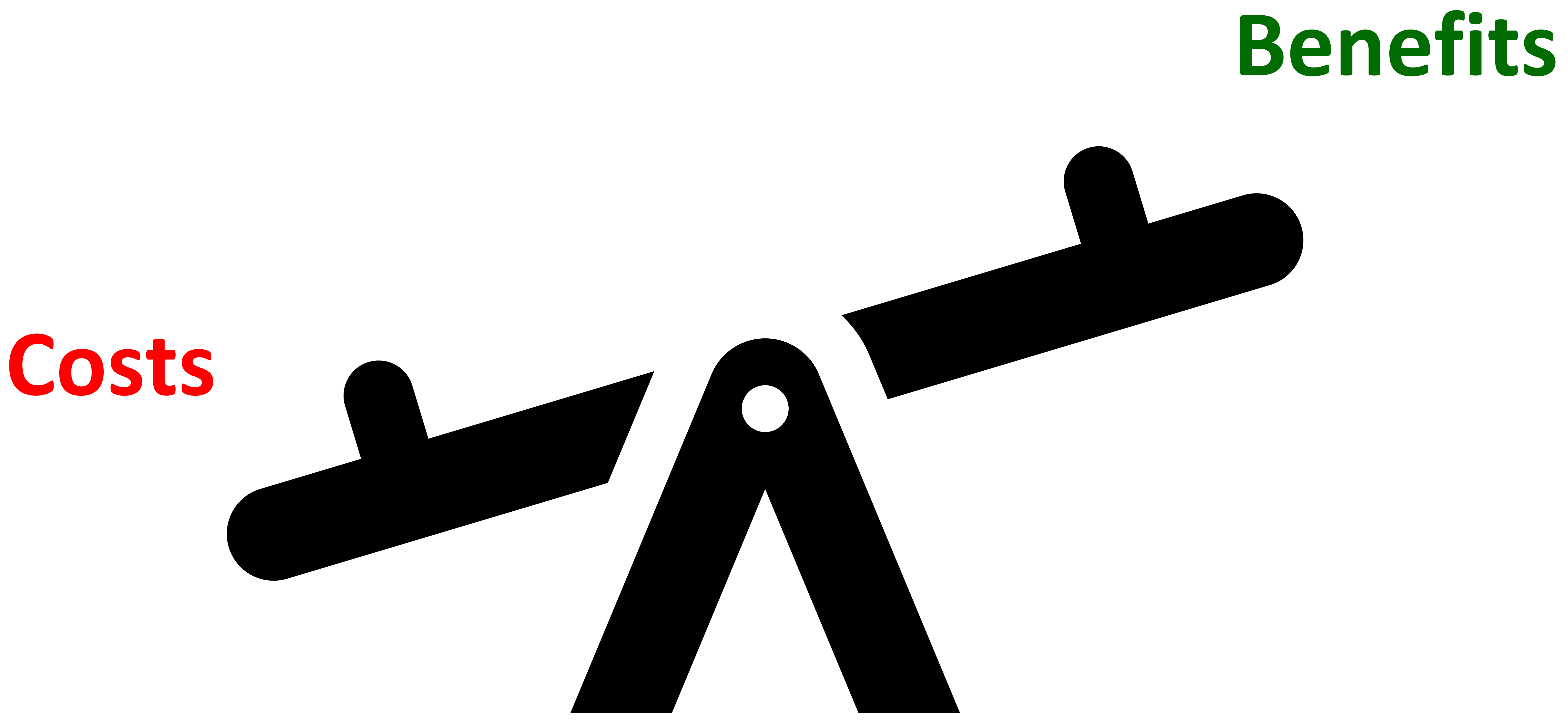


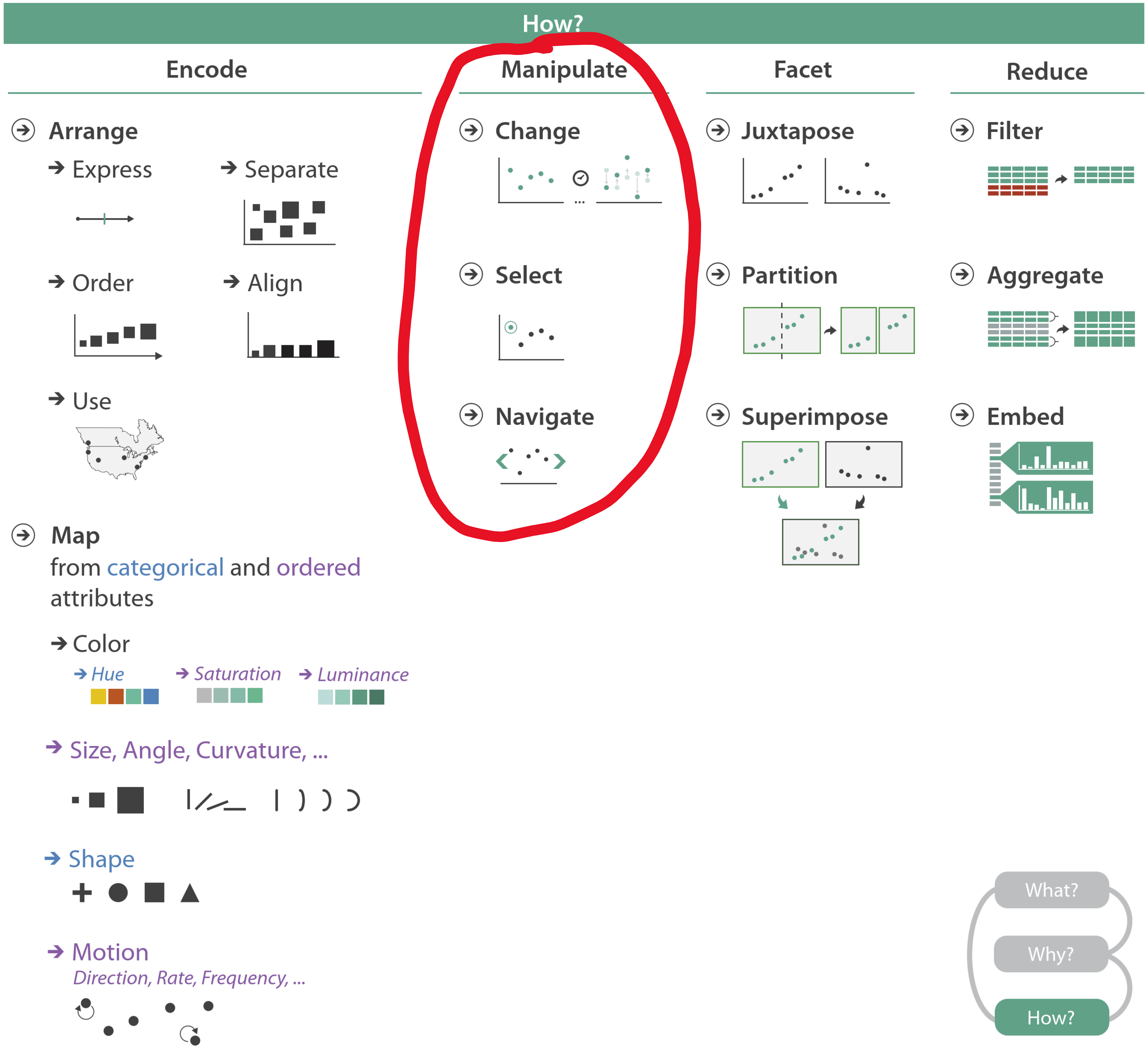
New York Times, 1996 [via Megan Garber, 2012]
[New York Times, 2020]

Interaction has drawbacks

- Requires human time and attention
- Increase perceptual and exploration costs (van Wijk 2005)
- Interaction costs (Lam 2008)
- Multiple user studies find no increase in performance in specific situations (Ragan et al. 2012, Theis et al. 2016, Mosca et al., 2021)

Weigh the tradeoffs when designing!

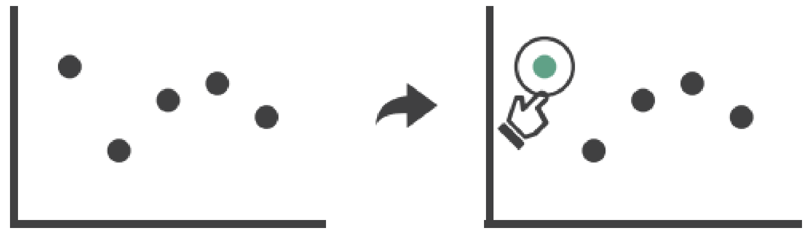



How?
Encode
Manipulate
Facet
Reduce
Arrange
Express
Separate
Order
Align
Use
Map
from categorical and ordered attributes
Color
Hue
Saturation
Luminance
Size, Angle, Curvature, ...
Shape
Motion
Direction, Rate, Frequency, ...
Change
Select
Navigate
Juxtapose
Partition
Superimpose
Filter
Aggregate
Embed
What?
Why?
How?

Manipulate

Change over Time

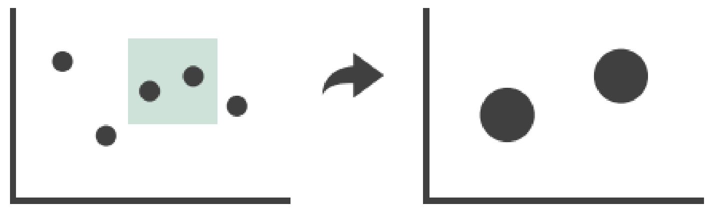
Select



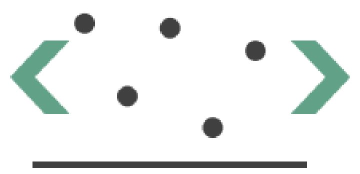
Navigate

Item Reduction

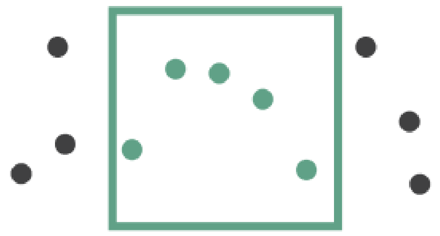
Zoom
Geometric or *Semantic*



Pan/Translate



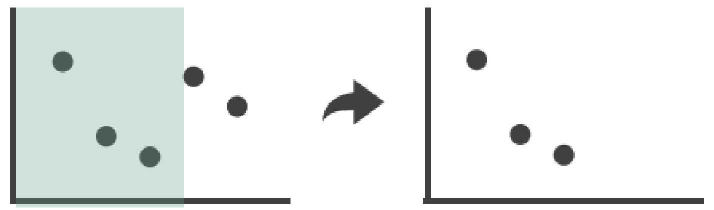
Constrained



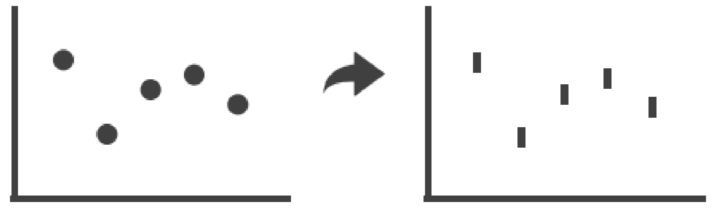
Attribute Reduction

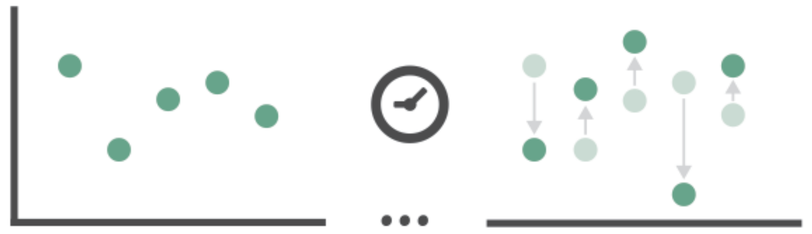
Slice

Cut



Project





Showing changing data

[Gapminder, 2018]

Change over Time

Showing changing encodings

flexible transitions

Mike Bostock, 2011

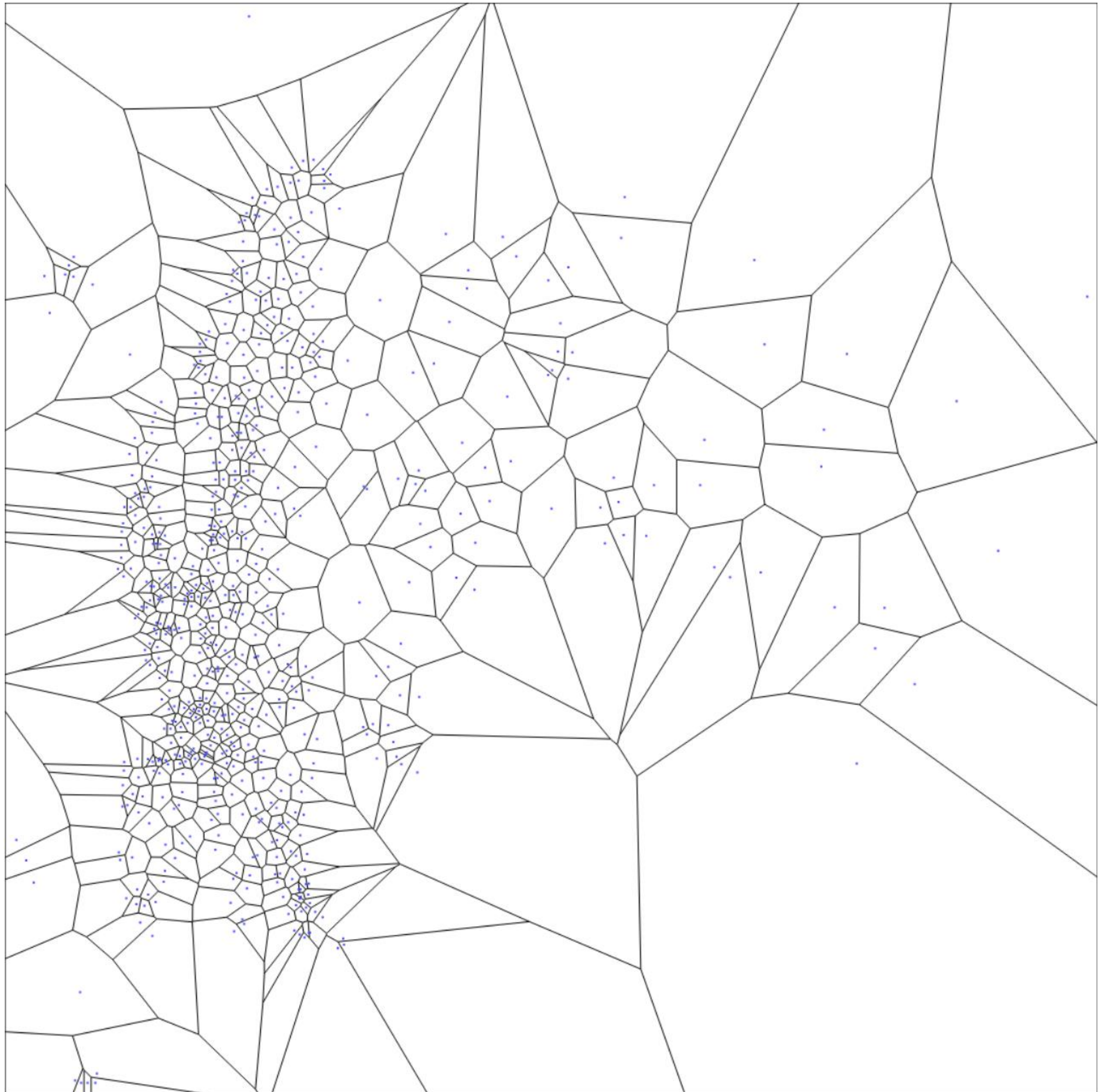
Explaining algorithms

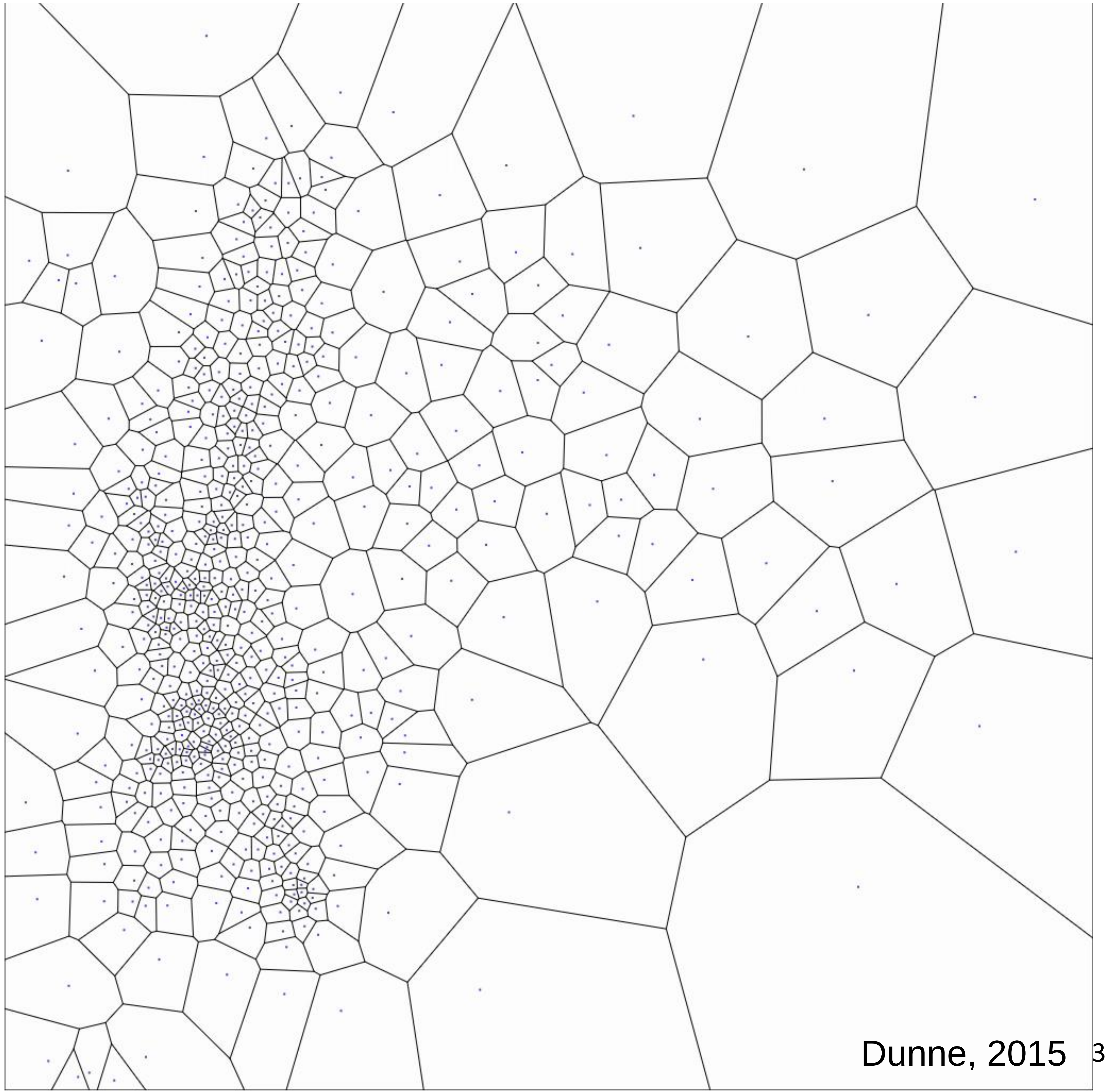
D3 General **Enter**, **Update**, **Exit** Pattern

abcdefghijklmnopqrstuvwxyz

Mike Bostock, 2016
(can use *selection.join* to simplify)

Explaining algorithms: CVT



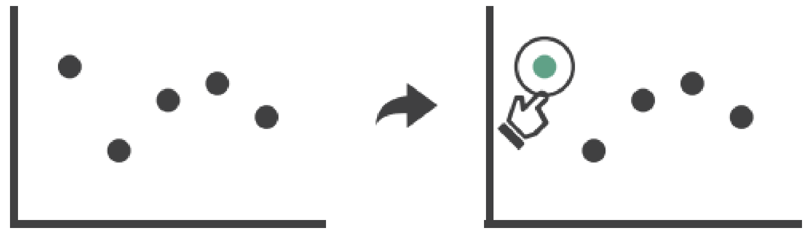


Dunne, 2015

Manipulate

Change over Time

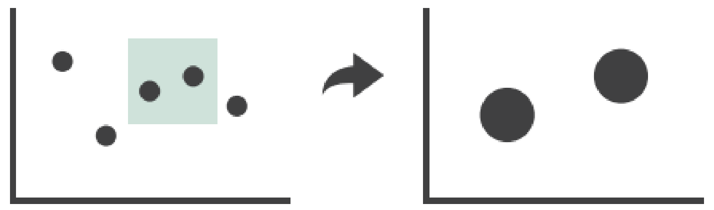
Select



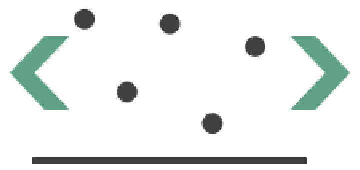
Navigate

Item Reduction

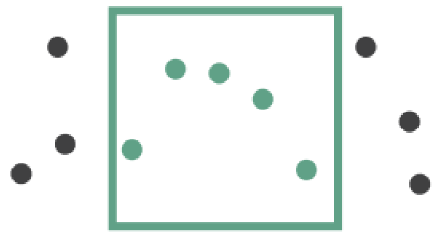
Zoom
Geometric or *Semantic*



Pan/Translate



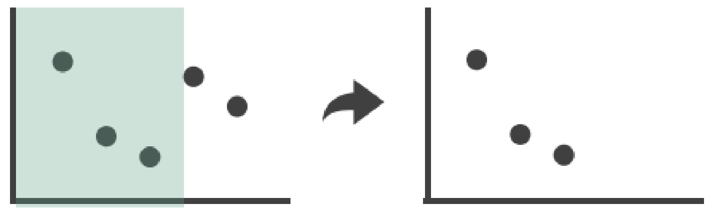
Constrained



Attribute Reduction

Slice

Cut



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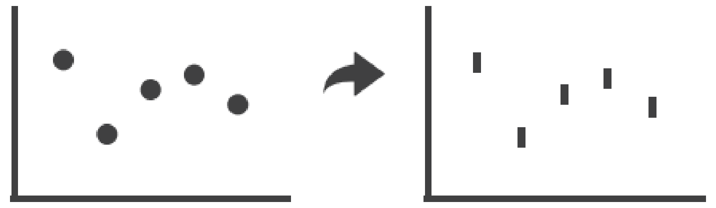
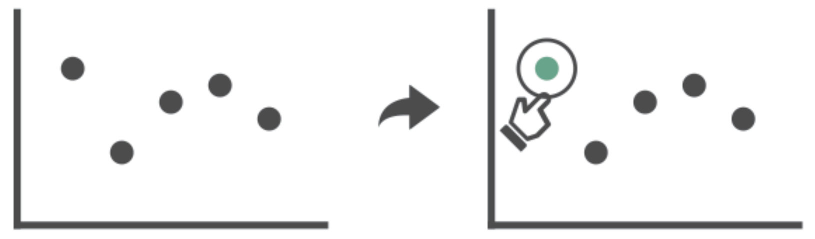
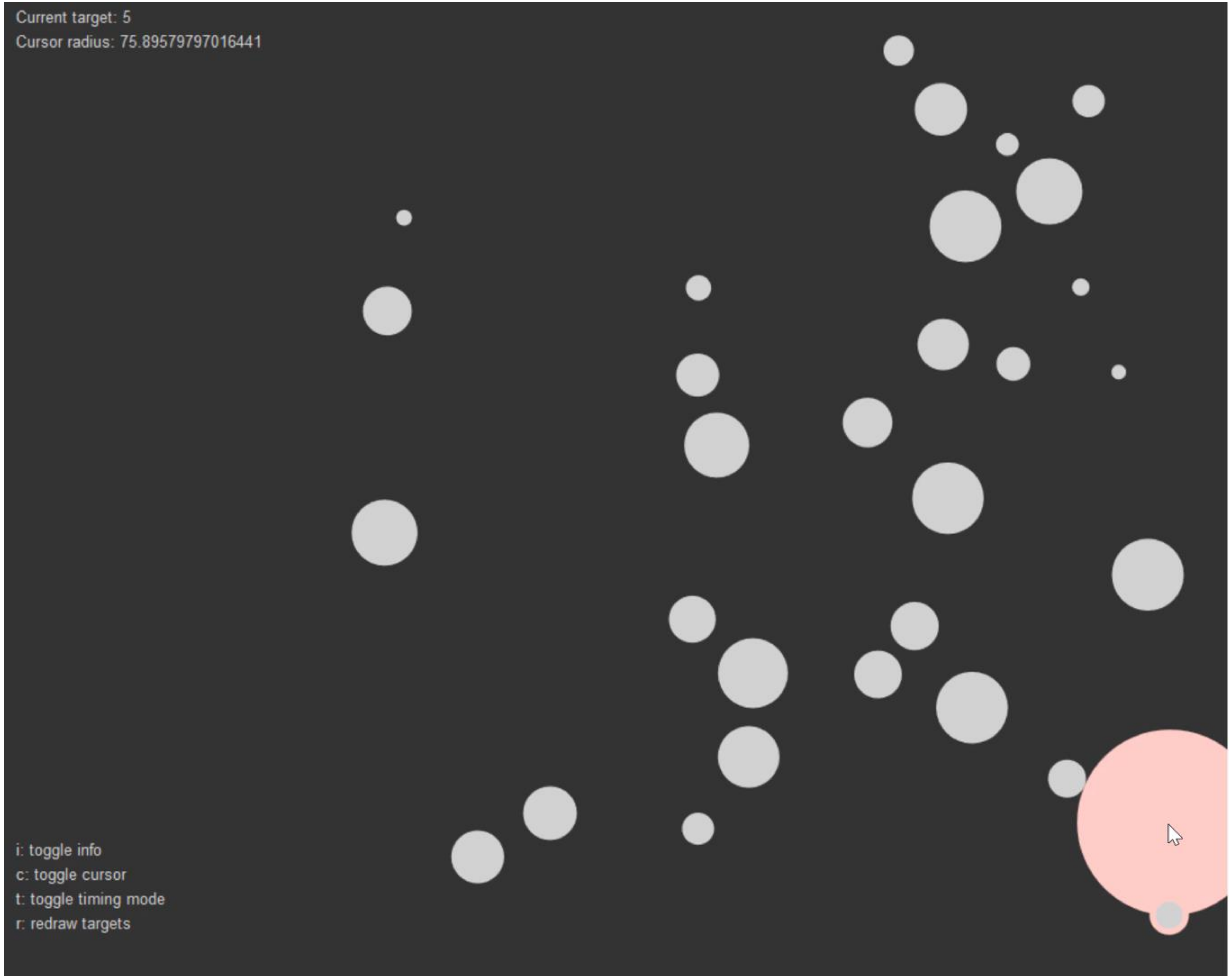


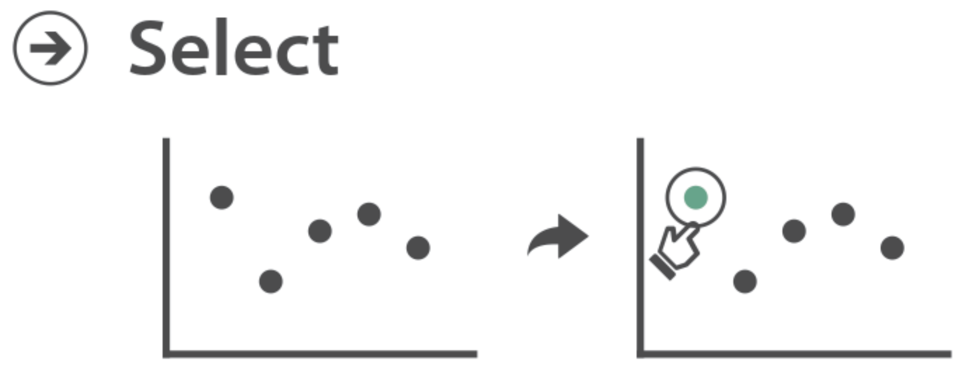


Select

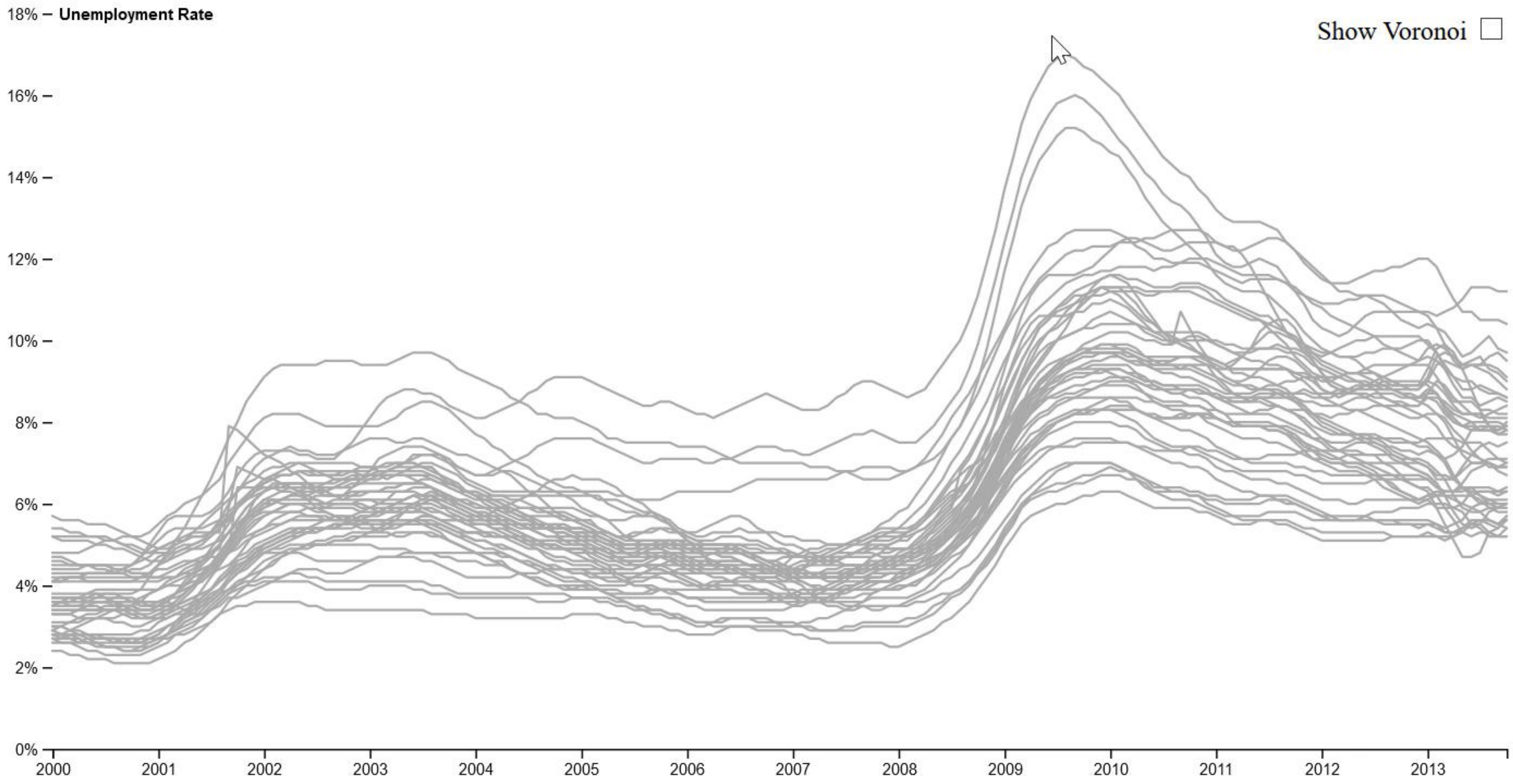
Easier picking via Bubble Cursors



Grossman and Balakrishnan, 2005; Anand Kulkarni, 2010



Easier picking via Voronoi Cursors

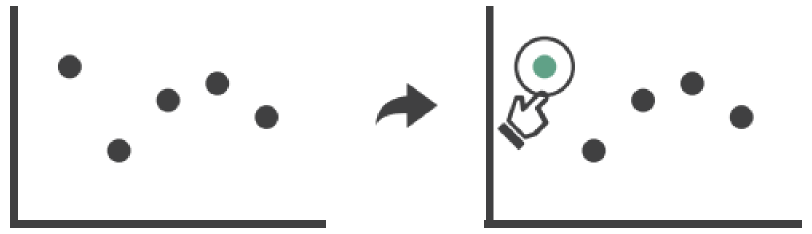


Mike Bostock, 2019

Manipulate

Change over Time

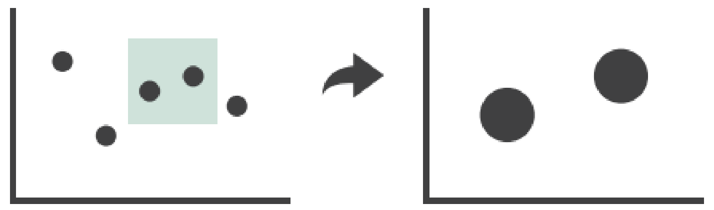
Select



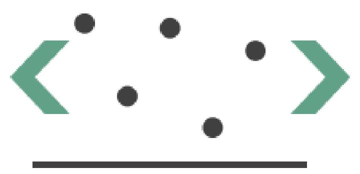
Navigate

Item Reduction

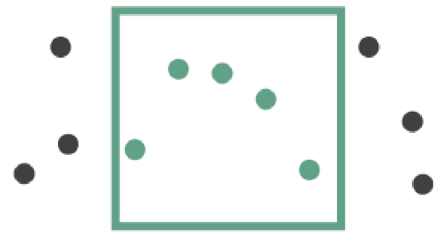
- *Zoom*
  Geometric or *Semantic*



- *Pan/Translate*



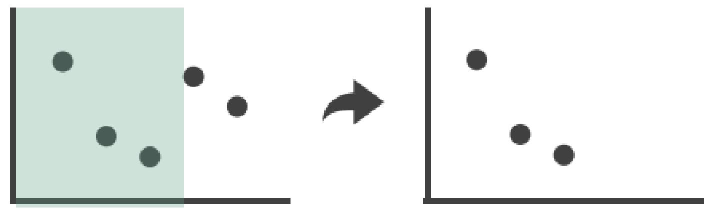
- *Constrained*



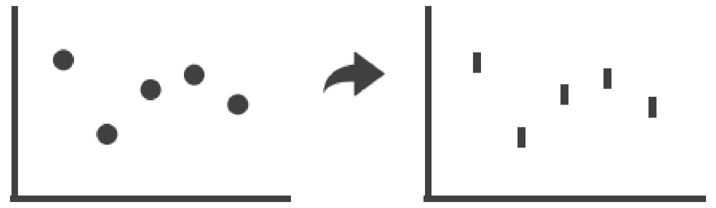
Attribute Reduction

- *Slice*

- *Cut*



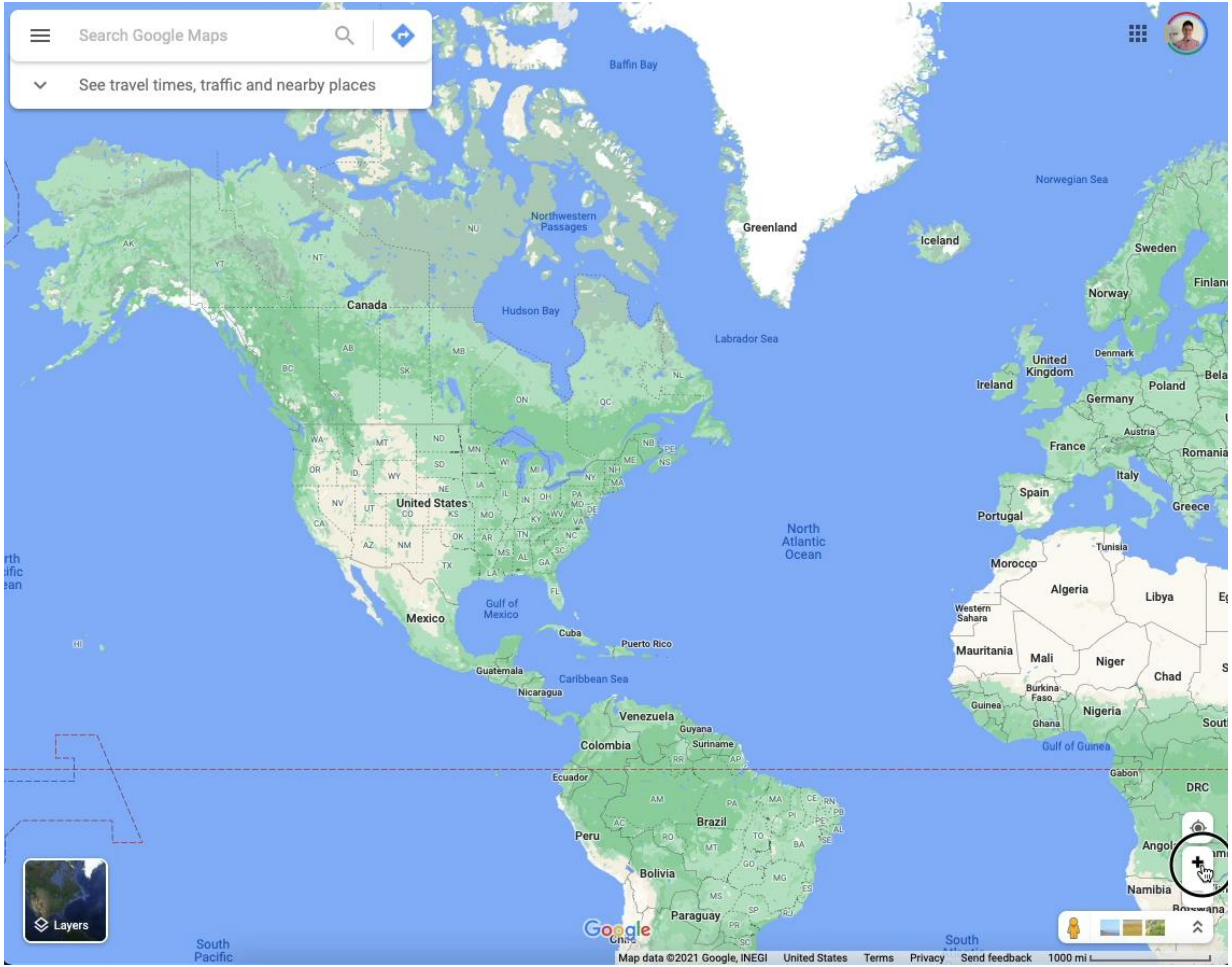
- *Project*



Navigate

→ Item Reduction

→ *Zoom*
Geometric or *Semantic*

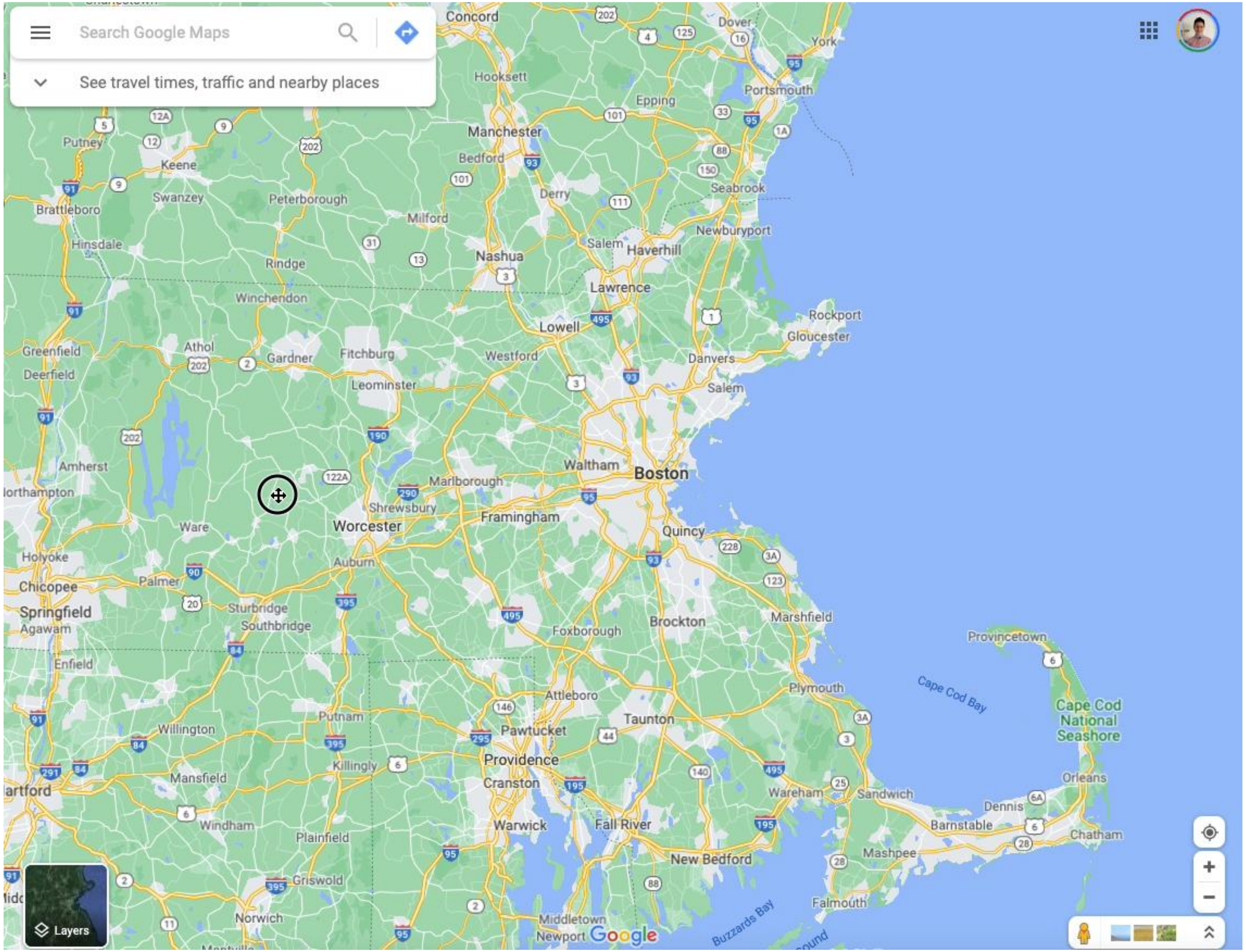


Ab Mosca, Google Maps, 2021

Navigate

→ Item Reduction

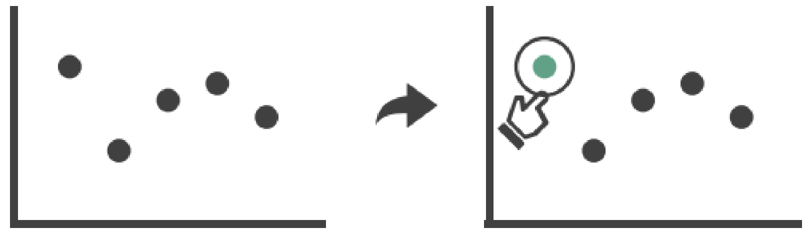
→ *Pan/Translate*



Manipulate

Change over Time

Select



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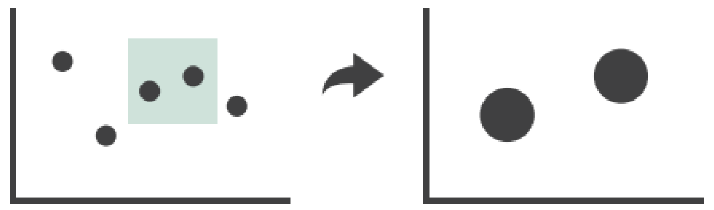

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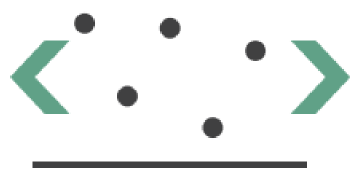

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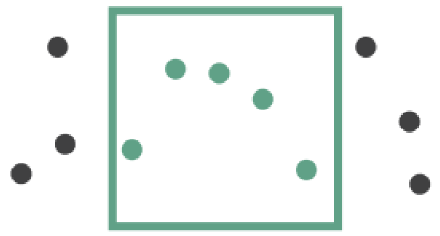

Attribute Reduction

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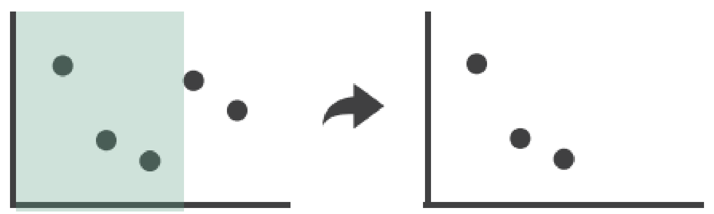

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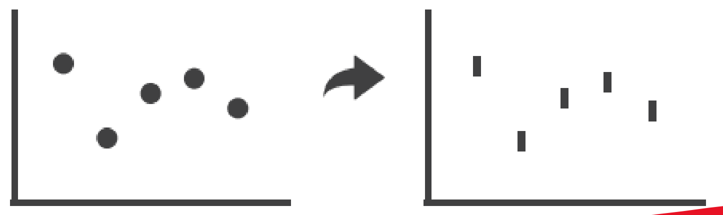
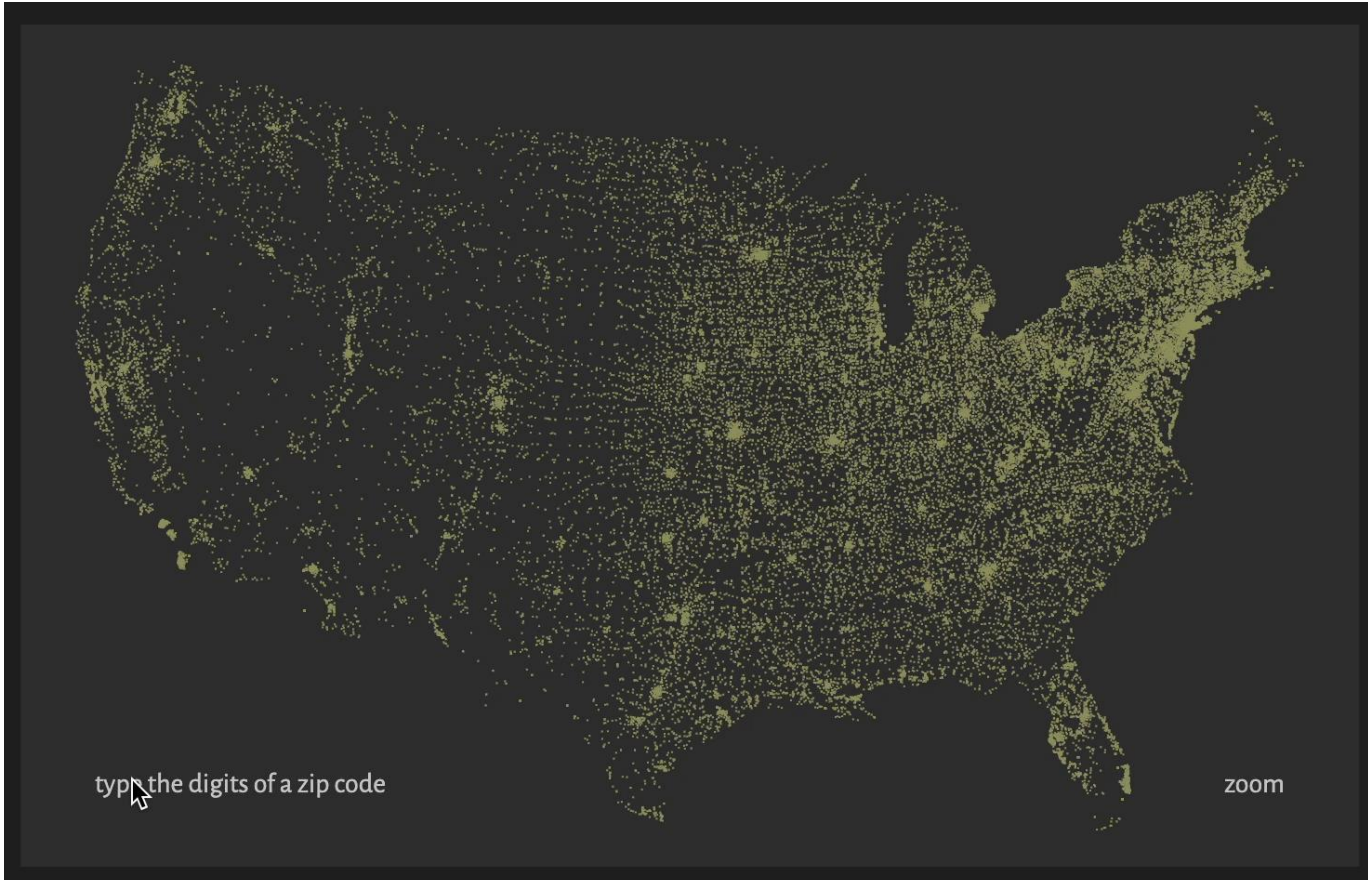


Navigate

→ Attribute Reduction

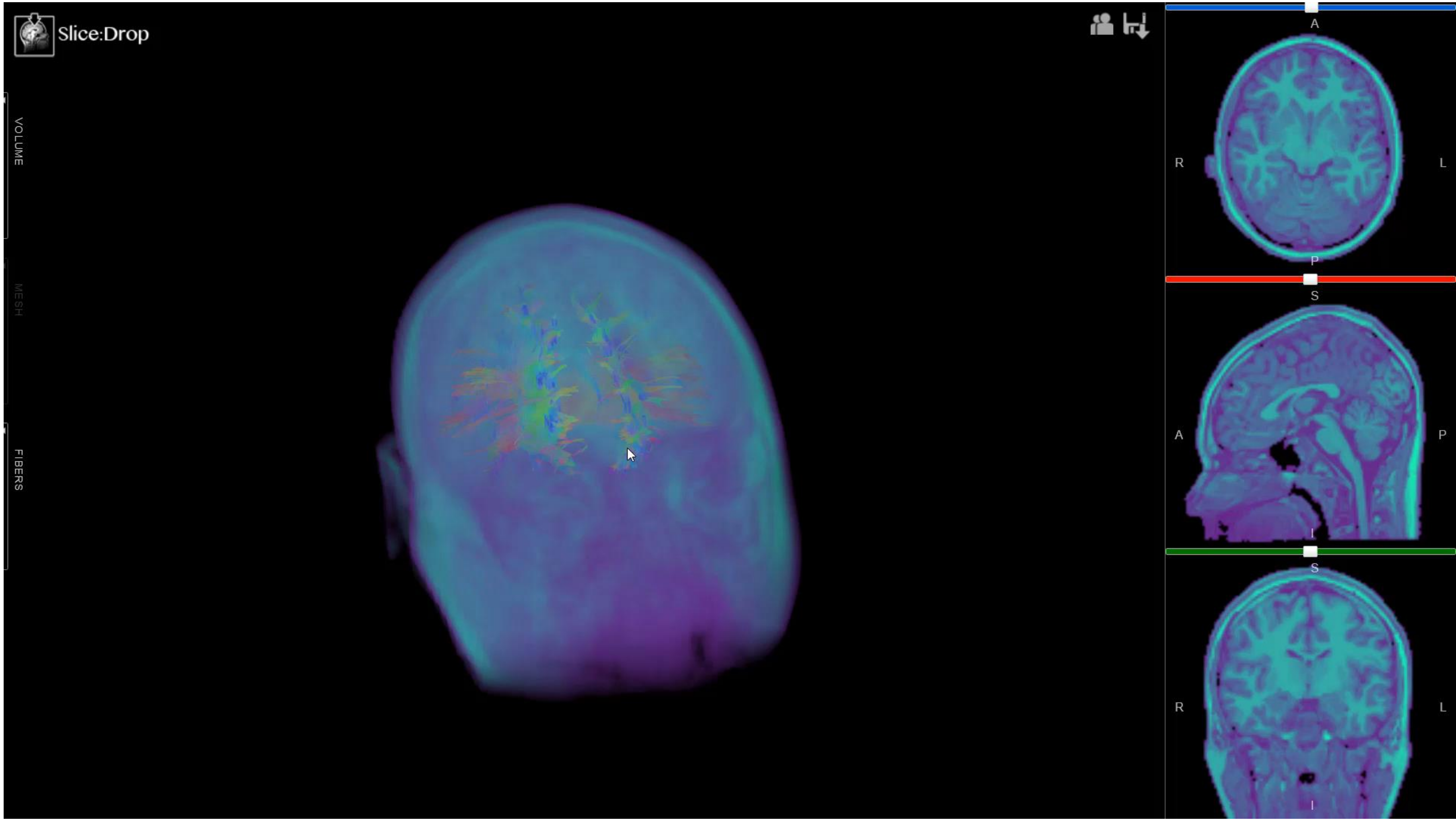
→ *Slice*



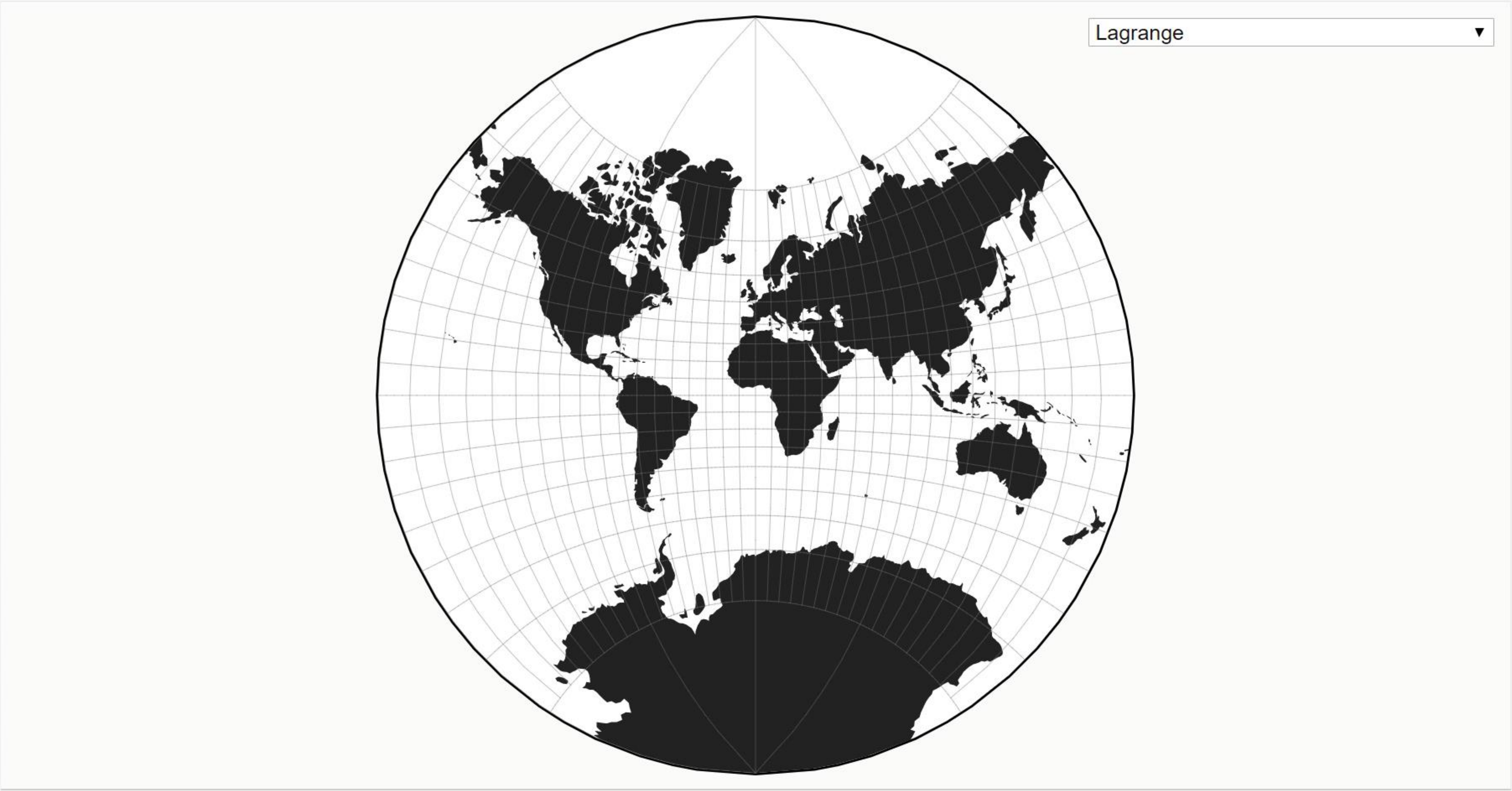
Navigate

→ Attribute Reduction

→ *Cut*



Projection Transitions



[Bostock, 2020](#)

Navigate

→ Attribute Reduction

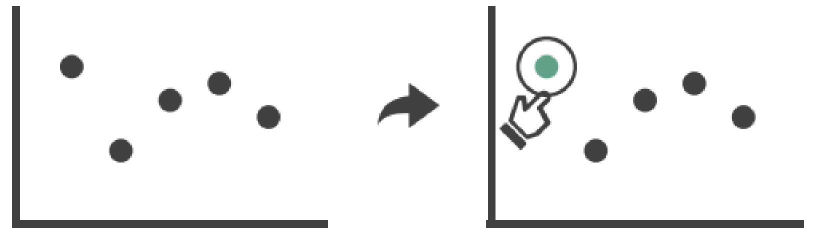
→ *Project*

[Pandey et al. (inc. Dunne, Borkin), 2019](#)

Manipulate

Change over Time

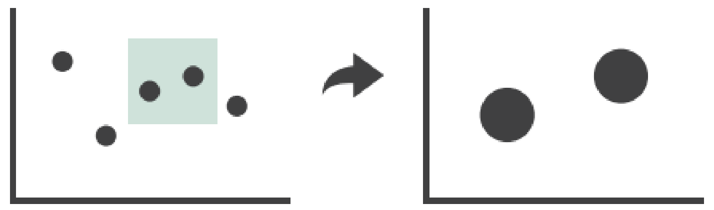
Select



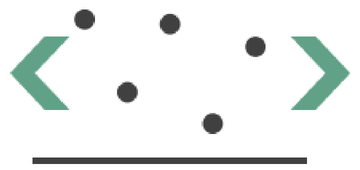
Navigate

Item Reduction

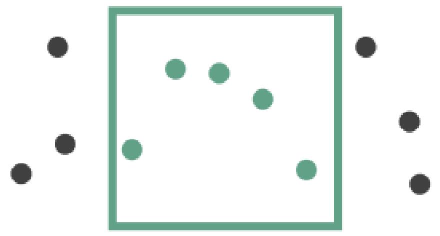
Zoom
Geometric or *Semantic*



Pan/Translate



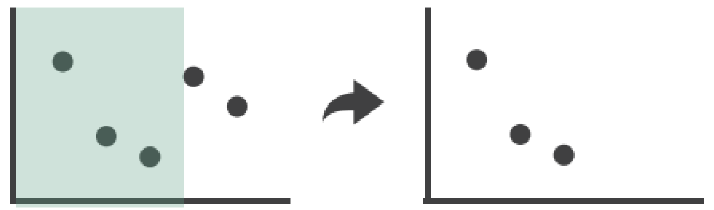
Constrained



Attribute Reduction

Slice

Cut



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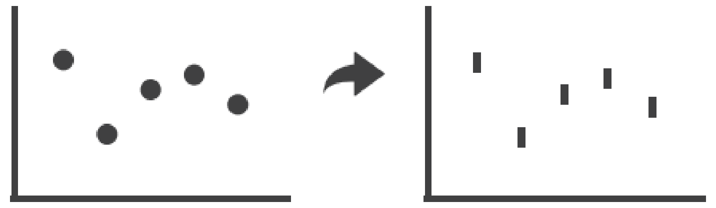
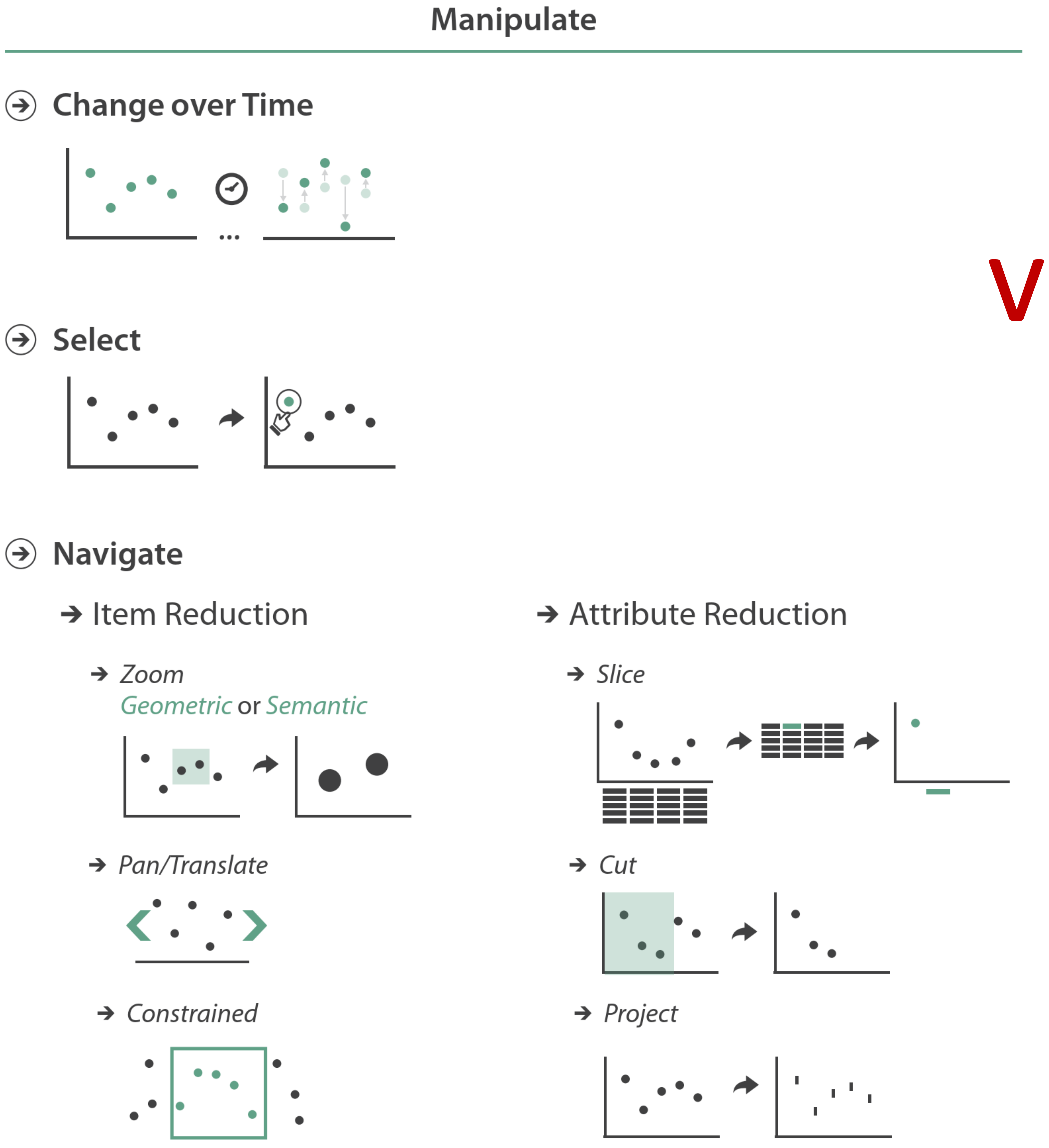


Other interaction taxonomies exist



VS.

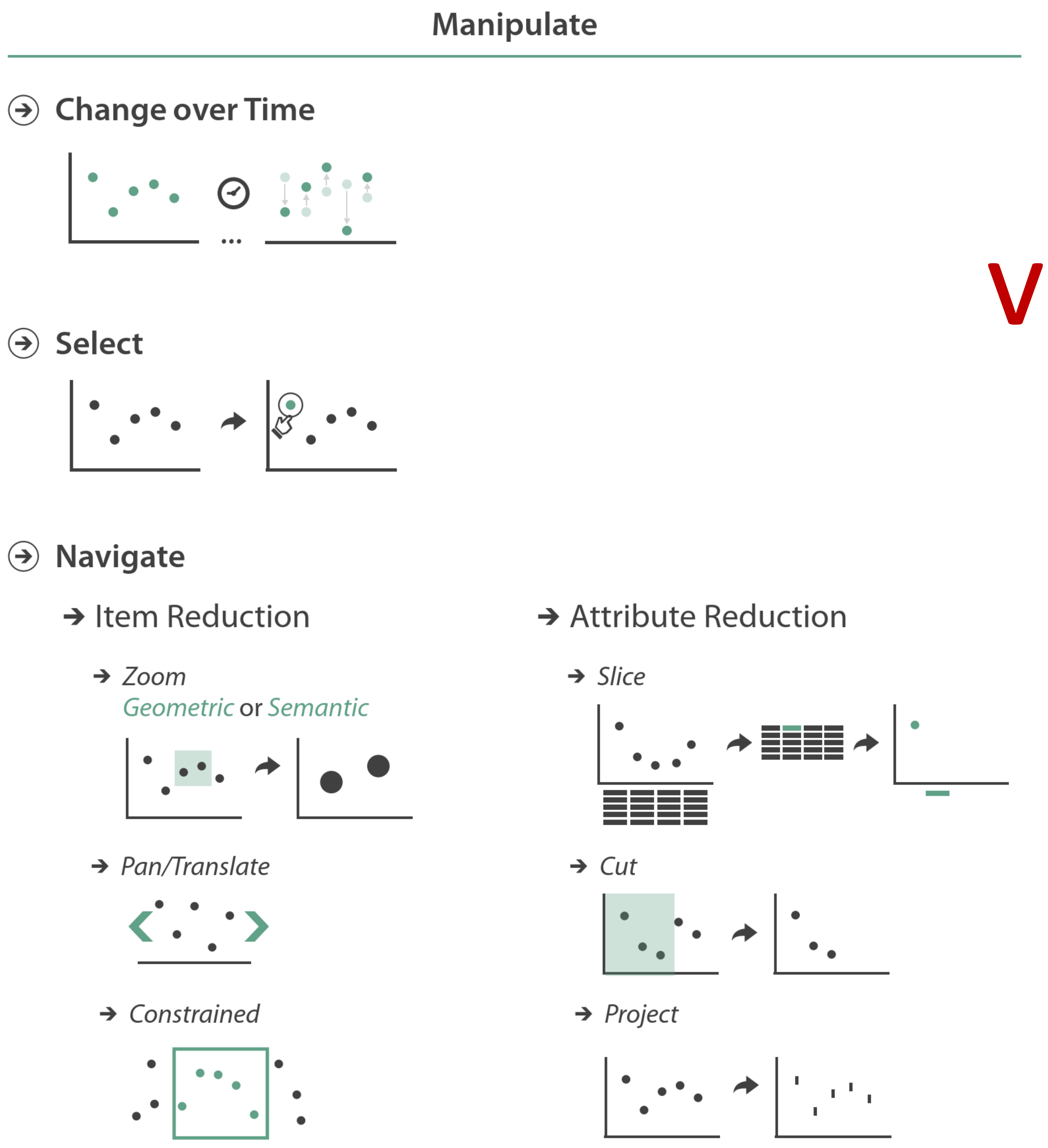
Toward a Deeper Understanding of the Role of Interaction in Information Visualization

Ji Soo Yi, Youn ah Kang, John T. Stasko, *Member, IEEE*, and Julie A. Jacko

- *Select*: mark something as interesting
- *Explore*: show me something else
- *Reconfigure*: show me a different arrangement
- *Encode*: show me a different representation
- *Abstract/Elaborate*: show me more or less detail
- *Filter*: show me something conditionally
- *Connect*: show me related items

Yi et al., 2007

Other interaction taxonomies exist



VS.

Toward a Deeper Understanding of the Role of Interaction in Information Visualization

Ji Soo Yi, Youn ah Kang, John T. Stasko, *Member, IEEE*, and Julie A. Jacko

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Compare and contrast. Can you think of situations one is more useful than the other?

Yi et al., 2007

In-Class Exercise: Slicing

In-Class Exercise: Slicing

15m

Slice:Drop

INSTRUCTIONS:

- Go to *http://slicedrop.com/*
- Click on the first example dataset in the top-right gallery “A 14 year old healthy male brain.”
- Explore the different views of the data using the hidden toolbars along the left side of the image:
- VOLUME: Explore the 2D and 3D view options.
- VOLUME: Experiment with the brightness/contrast (“Window level”) and data range (“Threshold”) sliders. Also try to change the colors.
- FIBERS: Experiment with the fiber threshold (i.e. data range).
- While in the 2D view, explore the slicing sliders. Also try dragging inside the small visualizations in this panel.

For Next Time

neu-ds-4200-f23.github.io/schedule/

Look at the upcoming assignments and deadlines

- Textbook, Readings, & Reading Quizzes—Variable days
- In-Class Activities—If due, they are due 11:59pm the same day as class

Everyday Required Supplies:

- 5+ colors of pen or marker
- White paper
- Laptop and charger

Use Slack for general questions, email codydunne-and-tas@ccs.neu.edu for questions specific to you.

Week 5: Interaction and Animation, Reduce and Embed

Tue, Oct 03 *Interaction, Animation (offset by 1 lecture)* Required Readings: 1 VAD Chapter 13—Reduce Items and Attributes 2 VAD Chapter 14—Embed: Focus + Context	**Fri, Oct 06** *Reduce and Embed (offset by 1 lecture)* 4—Altair basic charts due at 11:59pm

Week 6: Networks and Trees; Spatial, 3D, and SciVis

Tue, Oct 10 *Networks and Trees* Required Readings: 1 VAD Chapter 9—Arrange Networks and Trees	**Fri, Oct 13** *Spatial, 3D, and scientific visualization* Required Readings: 1 VAD Chapter 8—Arrange Spatial Data

A5