

# Data Visualization Foundations: Composition and Layout

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May 8, 2017

## Composition and layout

[The design process](#) – December 2011

Use good design to balance self-expression with the need to satisfy an audience in a logical manner



[Layout](#) – October 2011

Proper layout reveals the hierarchical relationship of informational elements

[Gestalt principles \(Part 1\)](#) – November 2010

[Gestalt principles \(Part 2\)](#) – December 2010

Exploit perceptual phenomena to meaningfully arrange elements on the page

[Negative space](#) – January 2011

Whitespace is a powerful way of improving visual appeal and emphasizing content

[Salience to relevance](#) – November 2011

Ensure that viewers notice the right content by making relevant information most noticeable

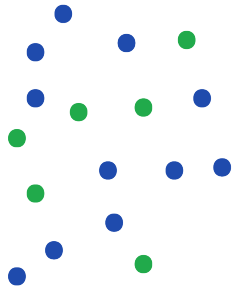
[Elements of visual style](#) – May 2013

Translate the principles of effective writing to the process of figure design

[Storytelling](#) – August 2013

Relate your data to the world around them using the age-old custom of telling a story

<http://blogs.nature.com/methagora/2013/07/data-visualization-points-of-view.html>

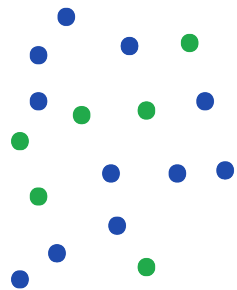


Data Collection

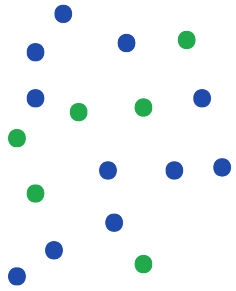
A lot can happen in the space between

**A** → **B**

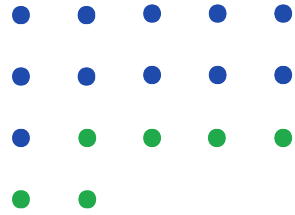
Interpretation



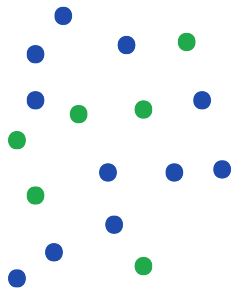
Data Collection



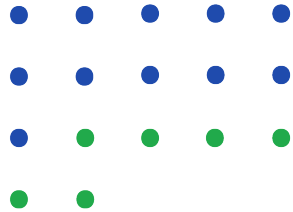
Data Collection



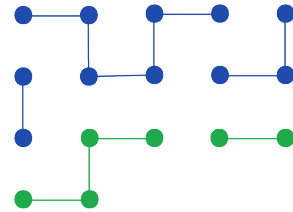
Structuring and Cleanup



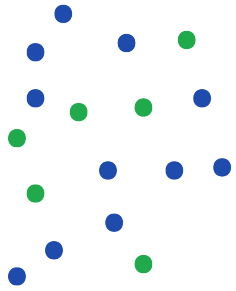
Data Collection



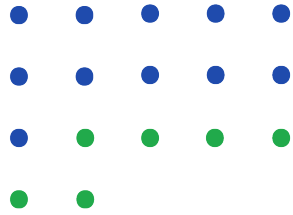
Structuring and Cleanup



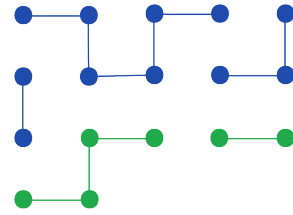
Analysis



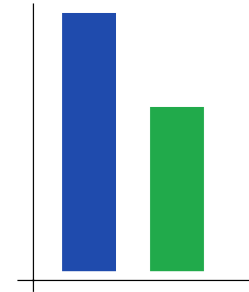
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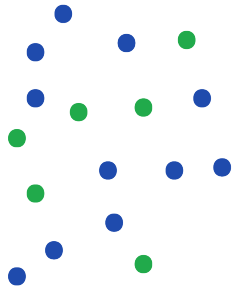
Structuring and Cleanup



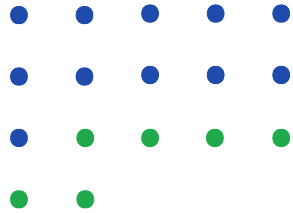
Analysis



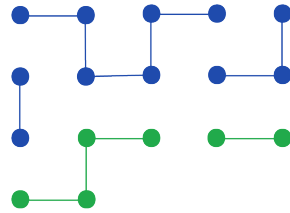
Visualization



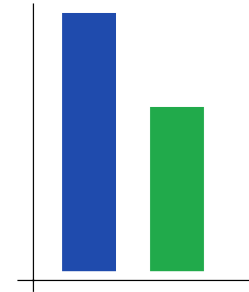
Data Collection



Structuring and Cleanup



Analysis

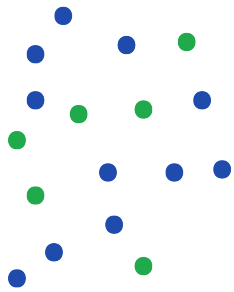


Visualization

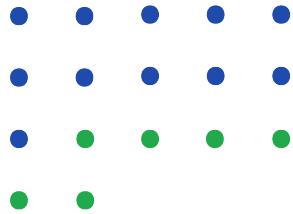
**A** → **B**

Interpretation

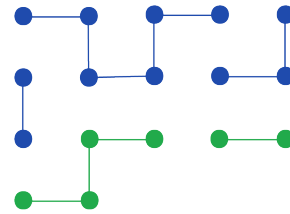




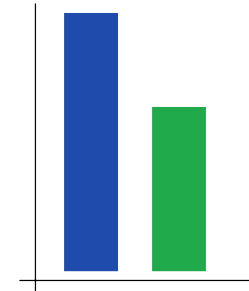
Data Collection



Structuring and Cleanup



Analysis



Visualization

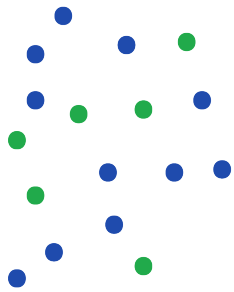
**A** → **B**

Interpretation

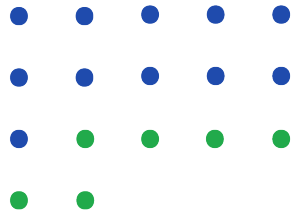
**well-defined**



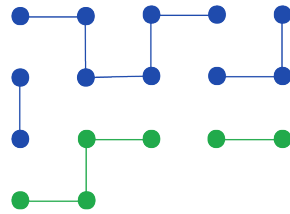
**ill-defined**



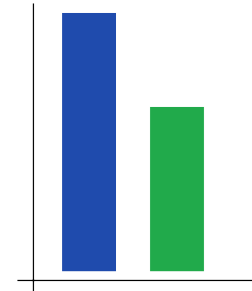
Data Collection



Structuring and Cleanup



Analysis



Visualization

**A → B**

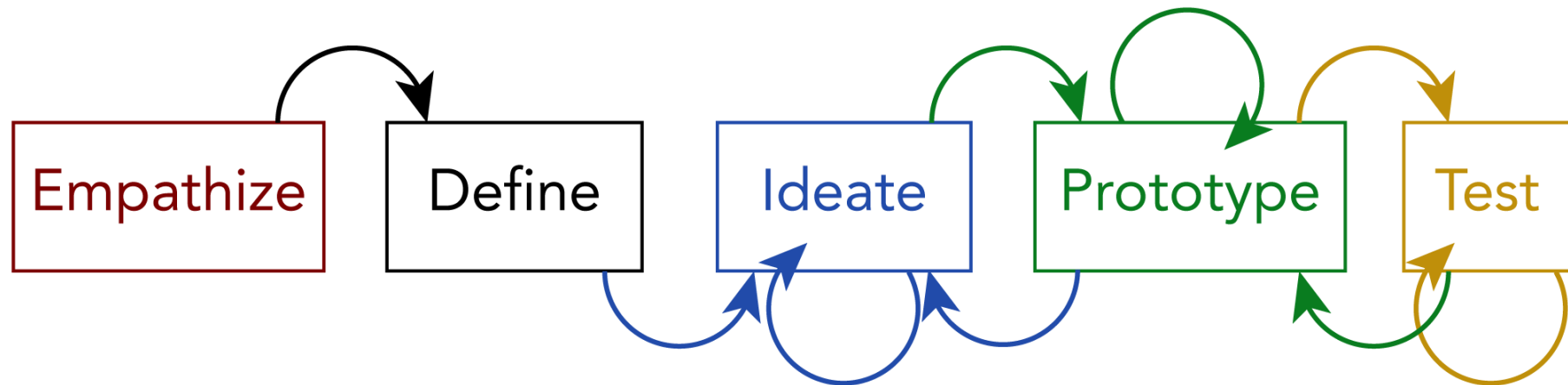
Interpretation

**well-defined**



**ill-defined**

## DESIGN THINKING PROCESS



*Stanford d.school*

Why do we visualize data?

Why do we visualize data?

To communicate information

Why do we visualize data?

To communicate information

To point attention

Why do we visualize data?

To communicate information

To point attention

To tell a story

How do we validate what is  
good visualization?



## THREE AXIOMS OF GOOD VISUALIZATION DESIGN

1

Data visualization is **intuitive**

2

Data visualization engages and invites the viewer to ask more **questions**

3

Data visualization facilitates **discovery**

Effective  
Design

Ethical  
Design

Universal  
Design

## THREE AXIOMS OF GOOD VISUALIZATION DESIGN

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Effective  
Design

Ethical  
Design

Universal  
Design

# EFFECTIVE DESIGN

# ELEMENTS OF EFFECTIVE VISUALIZATION

Composition and Layout

Plot Types

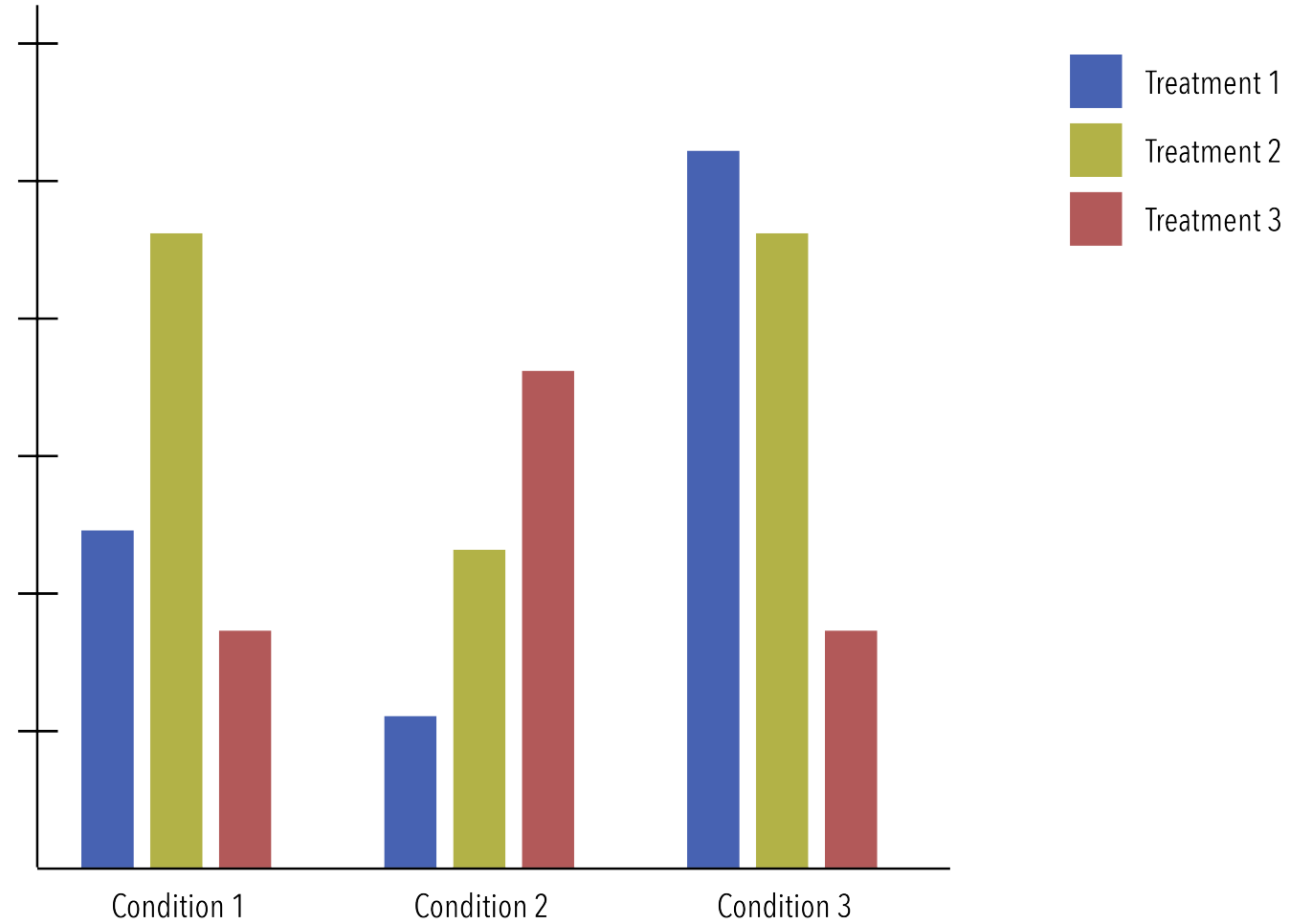
Color

Improving Figure Clarity

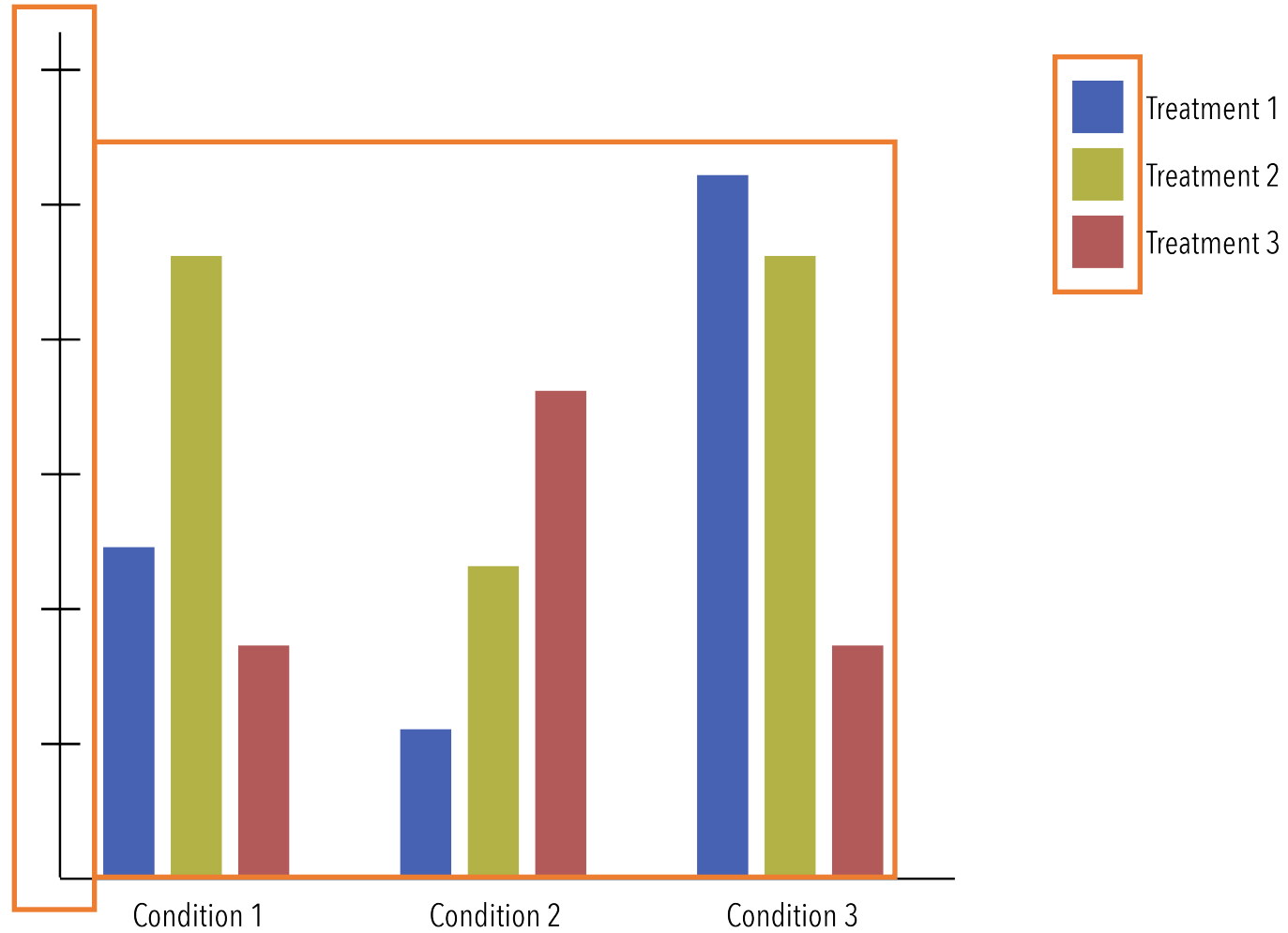
Multidimensional Data

Data Exploration and Linked Views

# Outcome of treatment per condition



## Outcome of treatment per condition



# Visual Encodings

## ELEMENTS OF A VISUALIZATION

### Marks

Basic graphical elements

### Channels

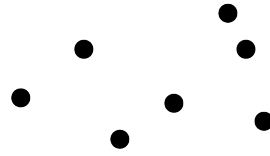
Ways to control mark appearance

### Attributes

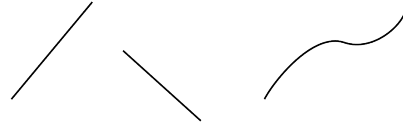
Dimensions of data



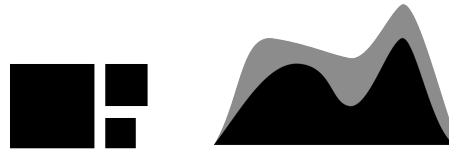
Points



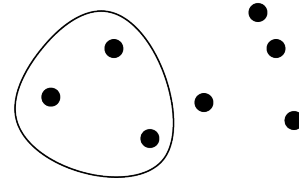
Lines



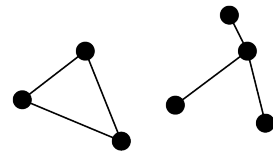
Areas



Containment



Links



CHANNELS

Color



Value/Gradation



Texture



Symbol



Sequence



Size + Scale



Orientation



Proximity/Density



Length



Area

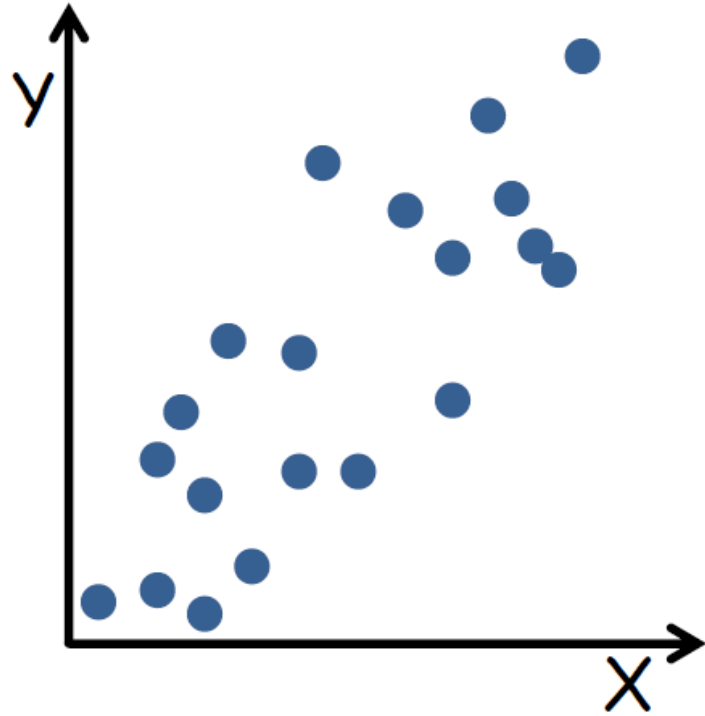


Proportion



Count

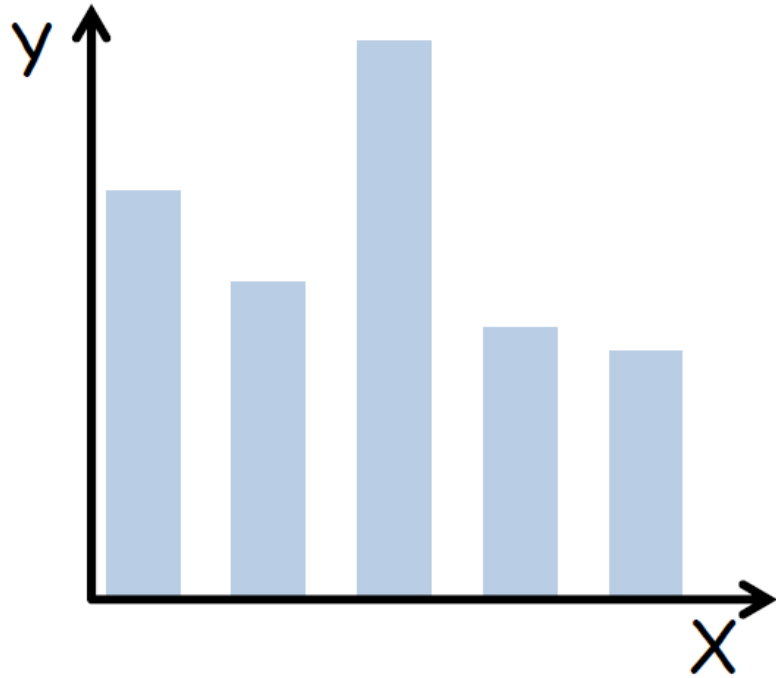




How many attributes are encoded?

What kinds of marks are used?

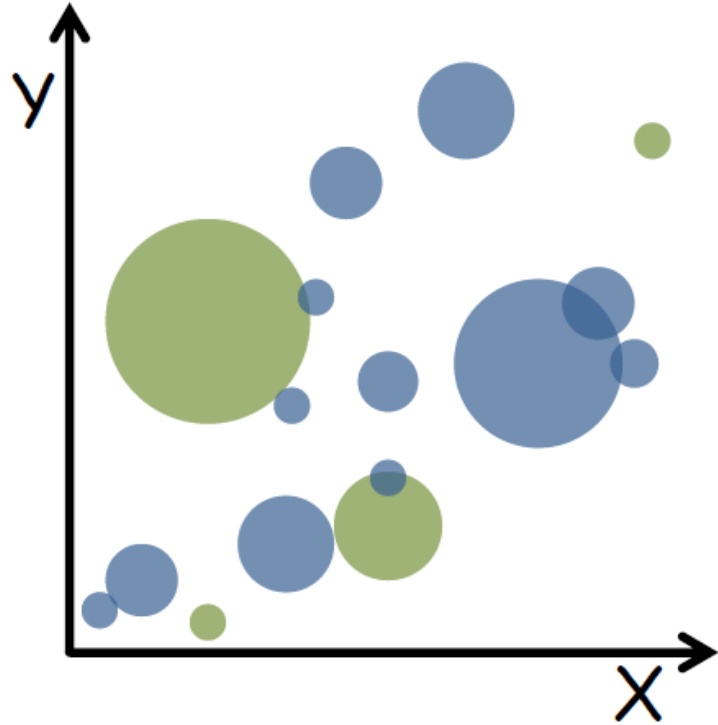
What kinds of channels are used?



How many attributes are encoded?

What kinds of marks are used?

What kinds of channels are used?



How many attributes are encoded?

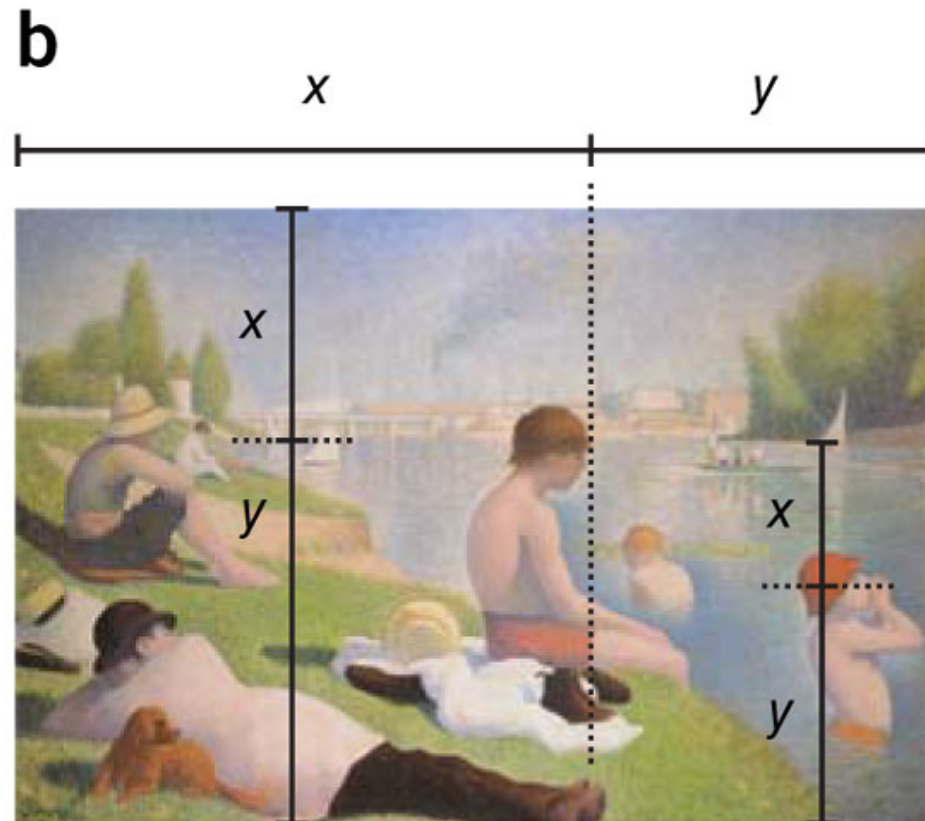
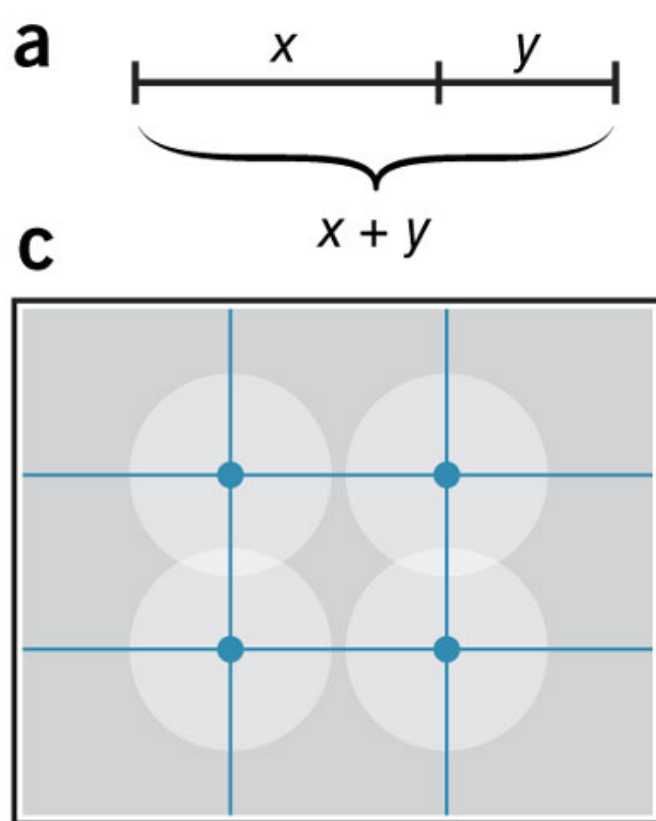
What kinds of marks are used?

What kinds of channels are used?

# Layout and Hierarchical Organization

Principles of effective layout  
have their origins in art and design theory,  
not just visualization

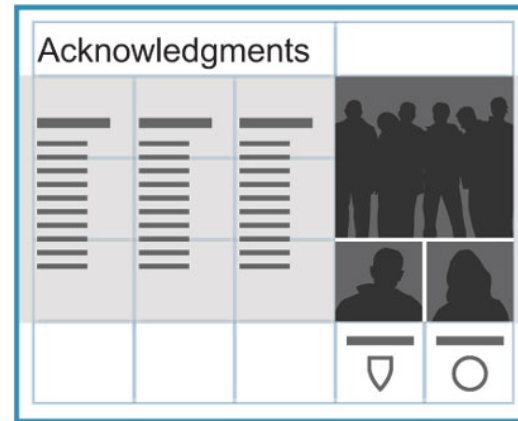
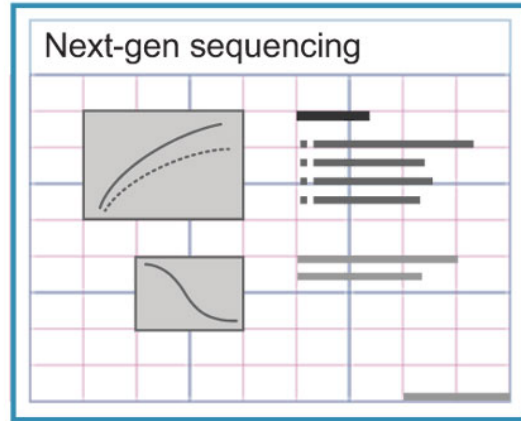
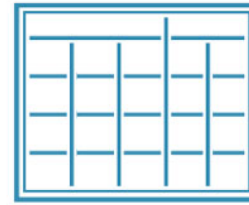
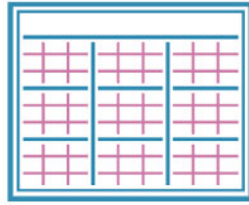
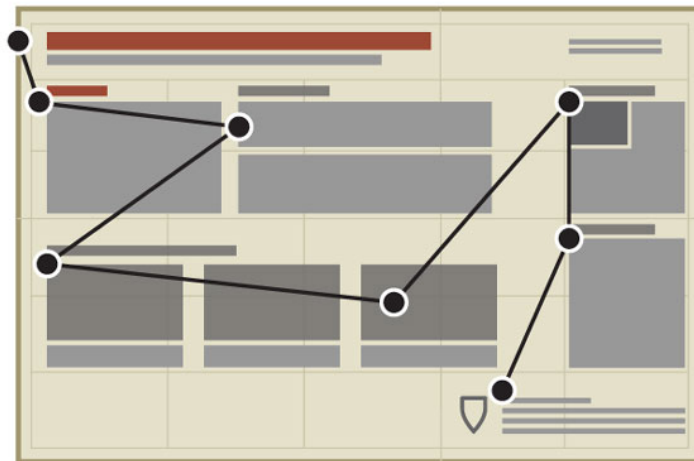
golden section  
Fibonacci sequence  
rule of thirds  
grids





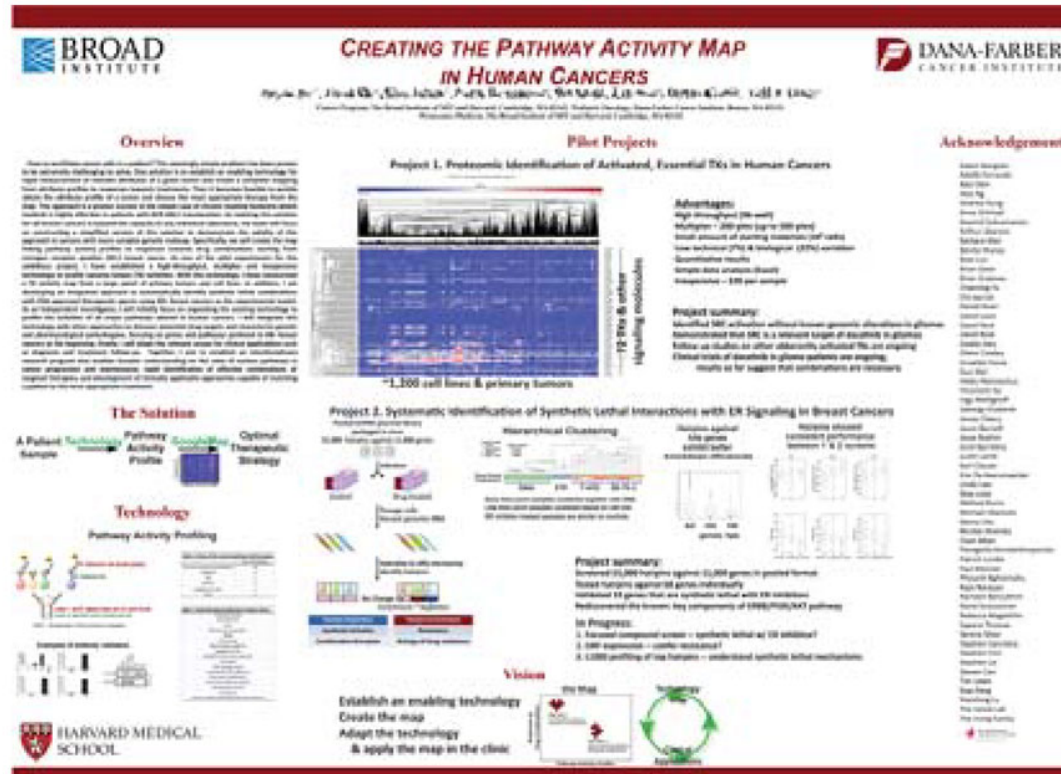
Effective layout helps determine  
**hierarchical organization**, which  
guides the eyes of the viewer

Complex information can be more easily  
understood when laid out effectively

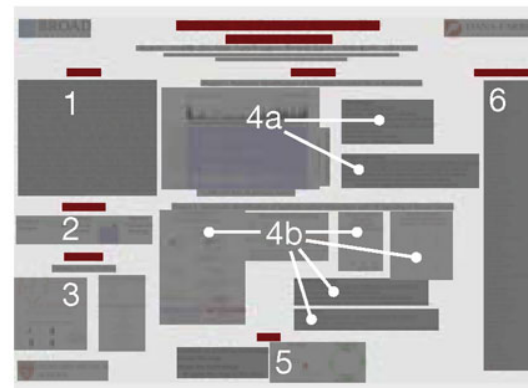
**a****b****c**

**BOLD LETTERING  
IN ALL CAPS, THE  
KIND SOMETIMES  
USED TO DEMAND  
OUR ATTENTION  
IN SIGNS  
AROUND  
THE LAB**      Read  
first.

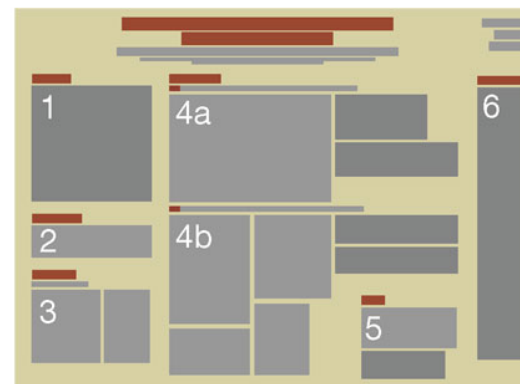
a



b



c



# Gestalt Principles

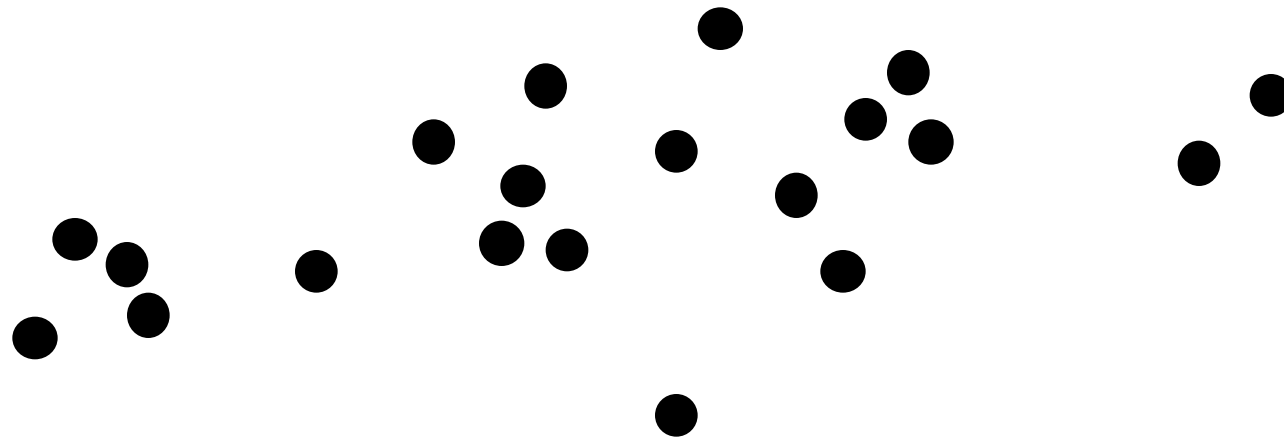
**Gestalt laws** of perceptual organization  
dominate in fast visual cognition

There are many ways to visually encode  
information, and Gestalt laws provide a way  
to leverage them effectively

## **LAW OF SIMILARITY**

Visually similar objects form a group

COLOR

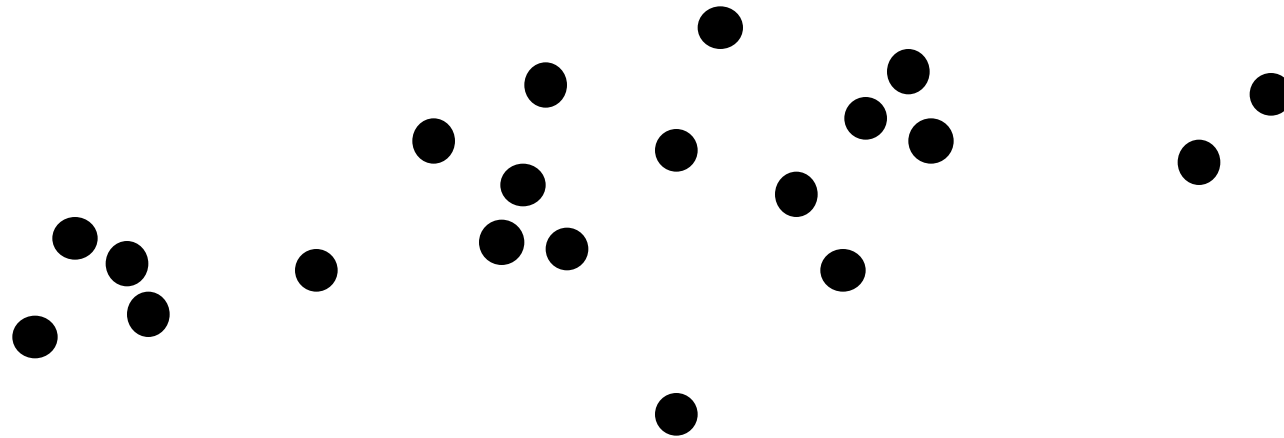


COLOR

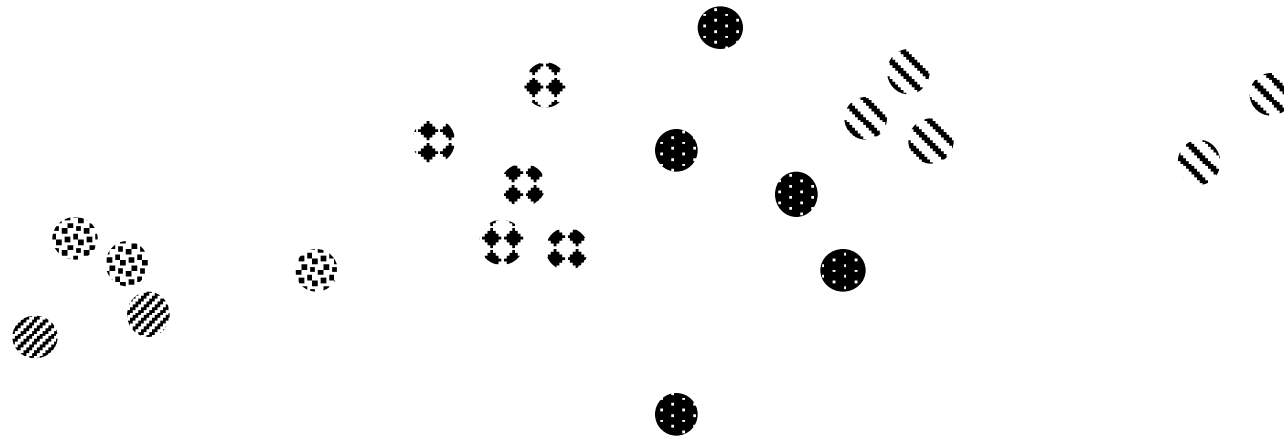




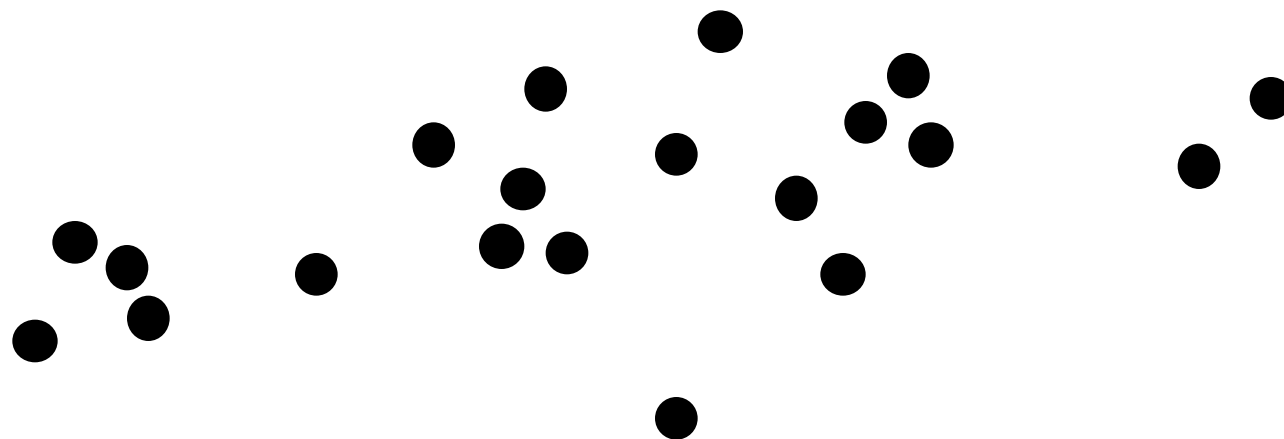
TEXTURE



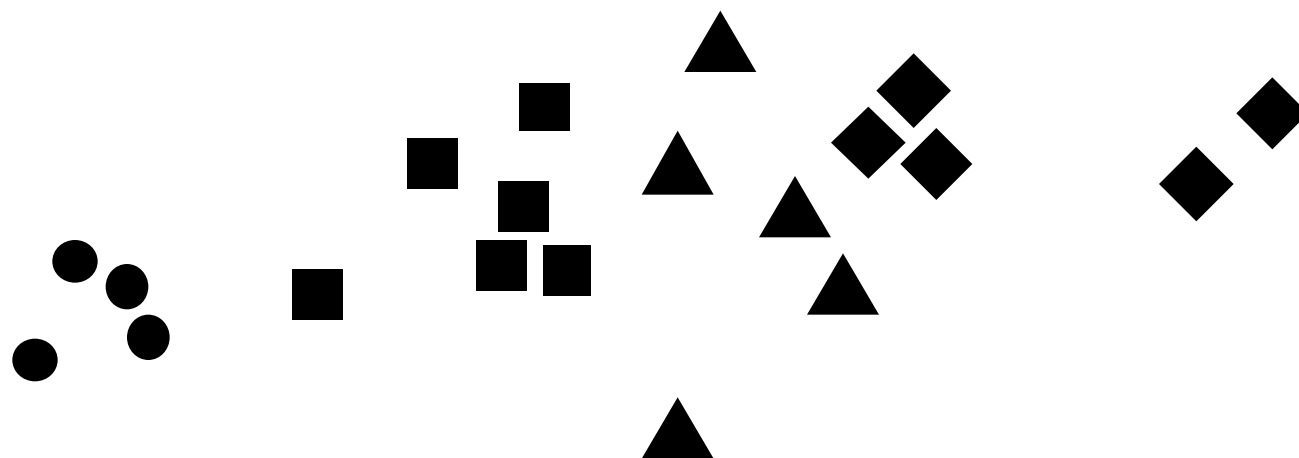
# TEXTURE



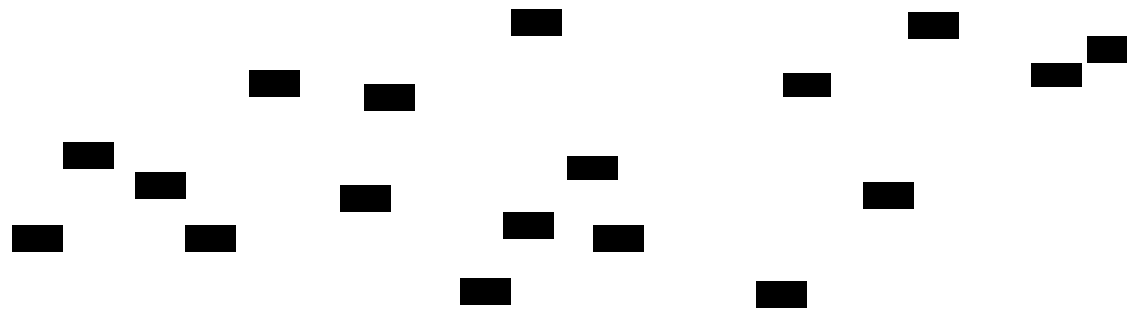
SHAPE



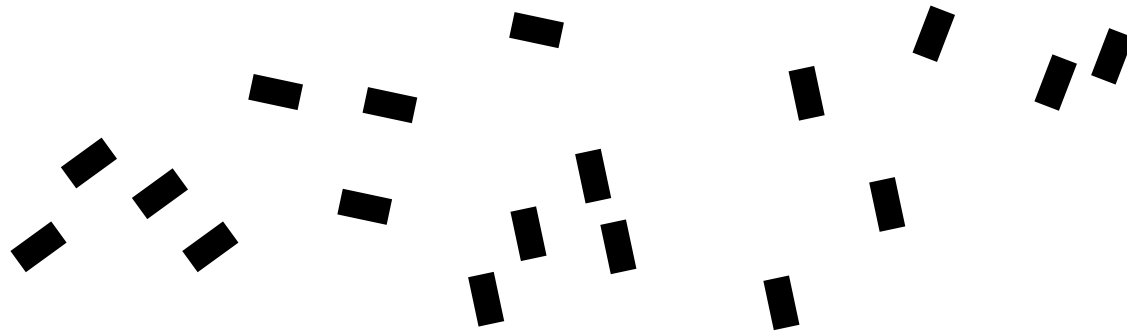
SHAPE



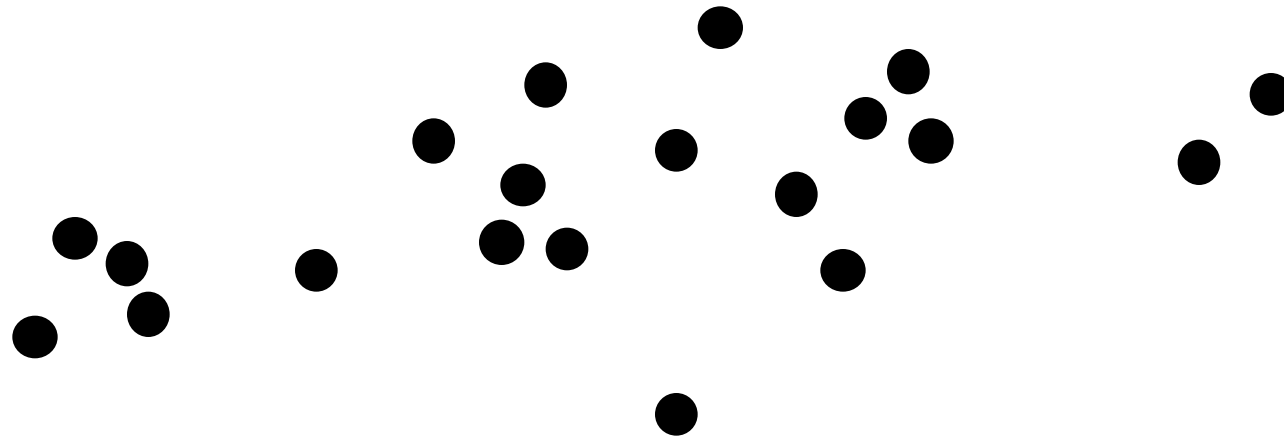
# ORIENTATION



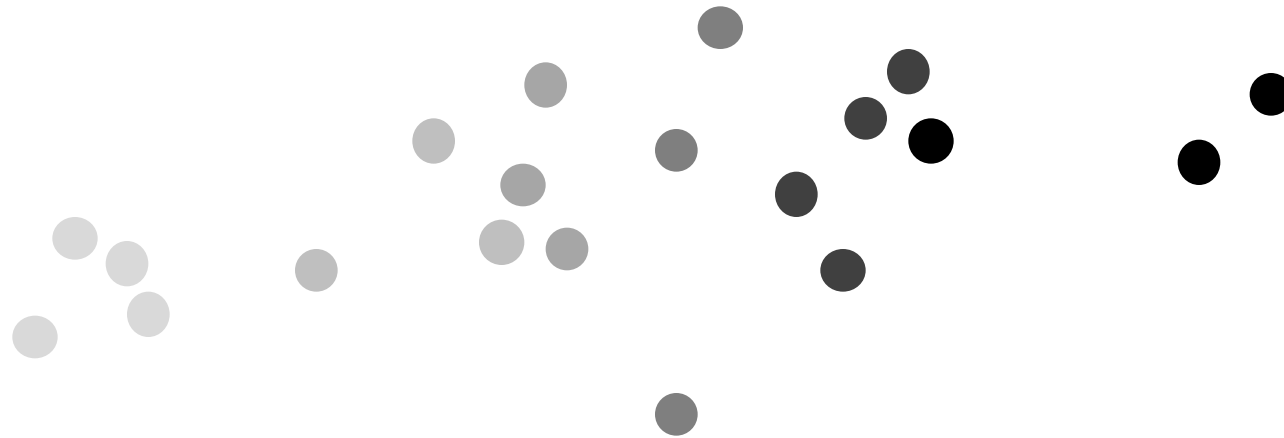
# ORIENTATION



VALUE

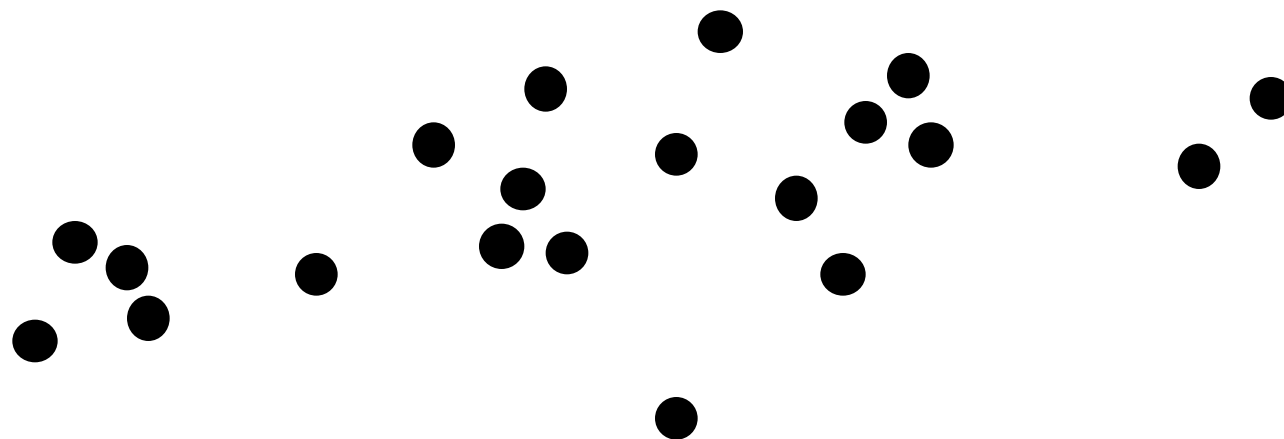


VALUE

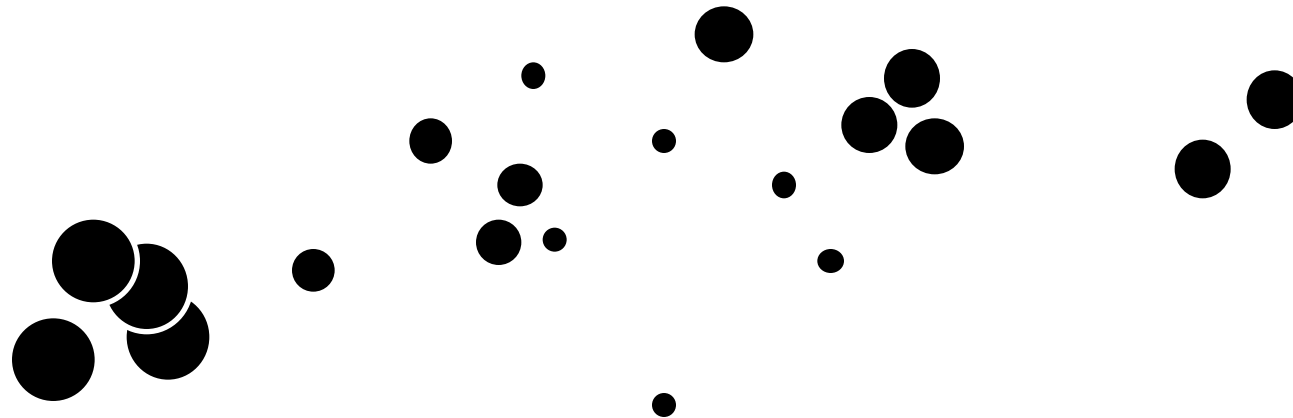




## SIZE AND SCALE



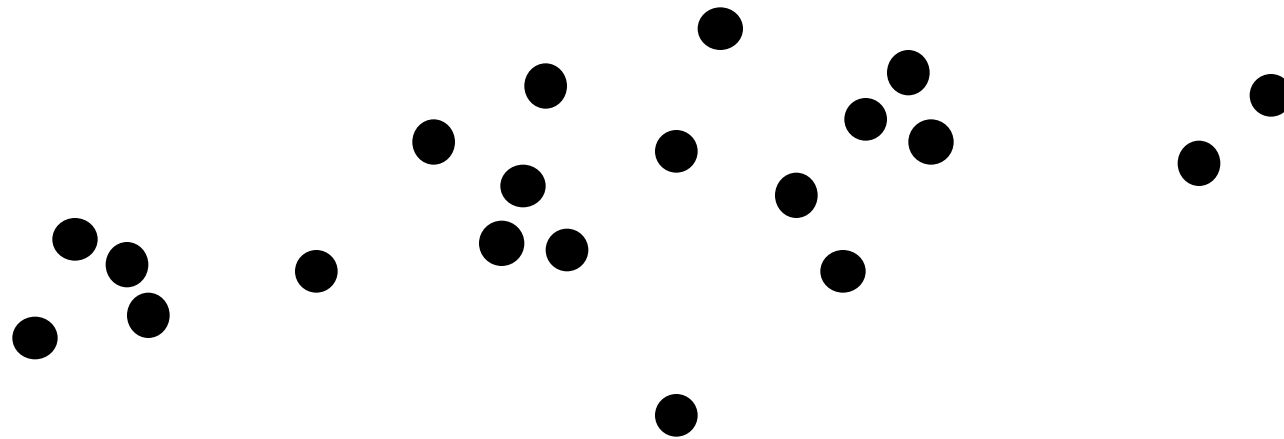
## SIZE AND SCALE



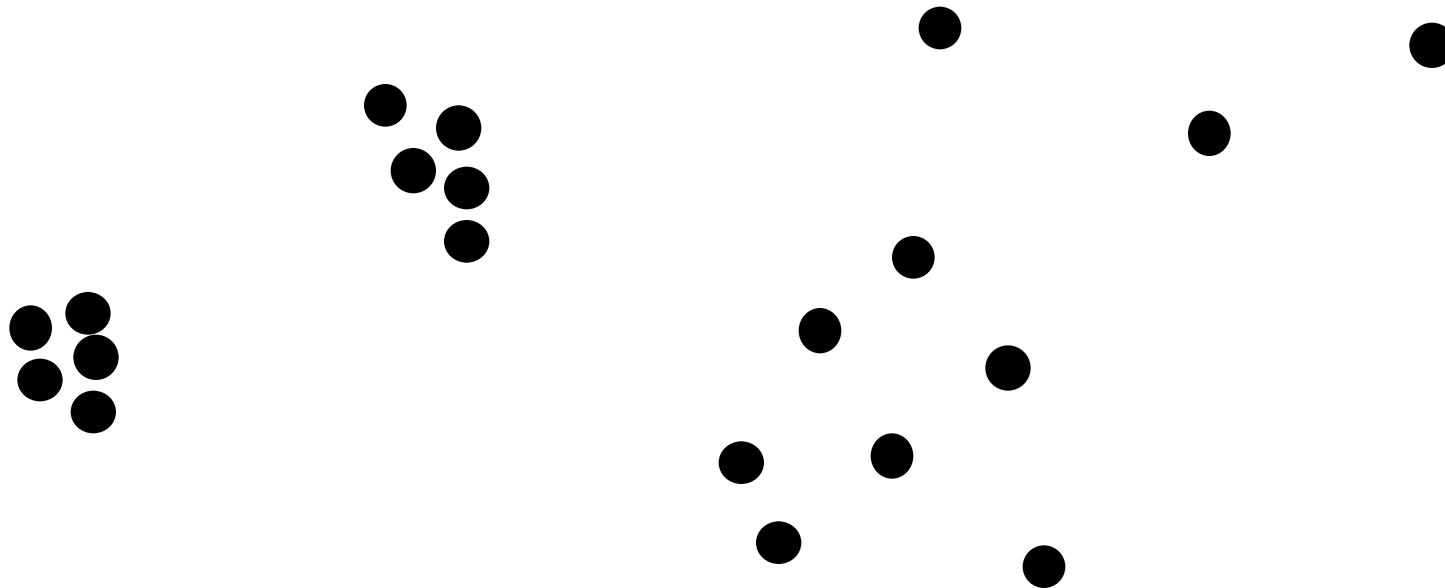
## **LAW OF PROXIMITY**

Objects close in space form a group

## PROXIMITY/DENSITY



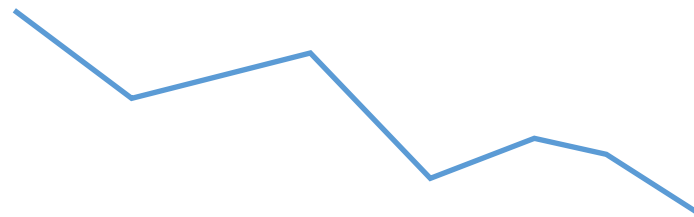
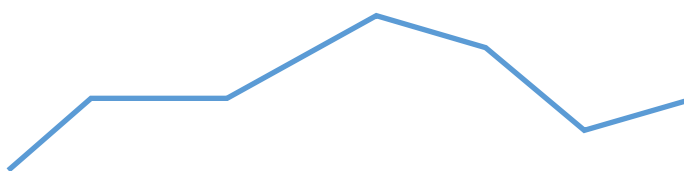
## PROXIMITY/DENSITY



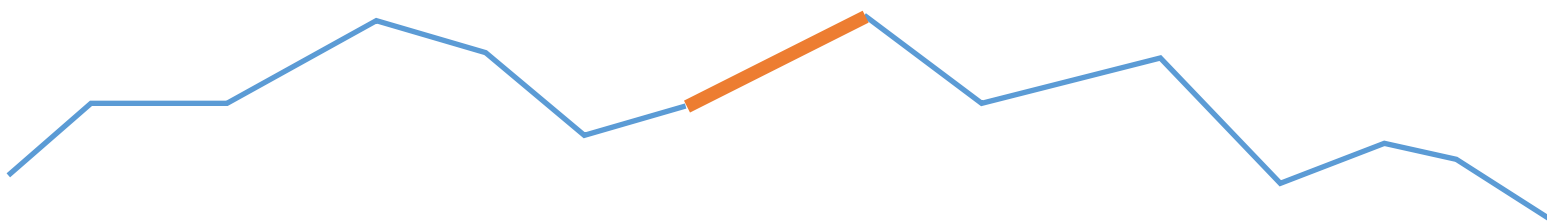
## **LAW OF CLOSURE**

Objects separated in space are  
connected in our mind

# CLOSURE



**CLOSURE**

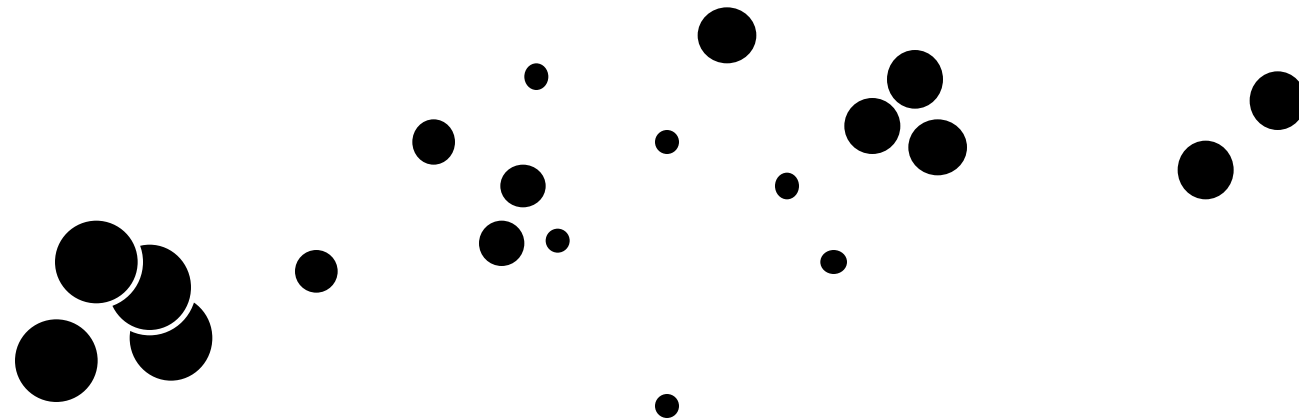




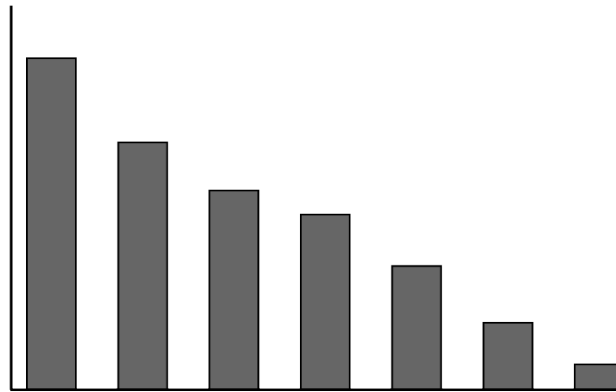
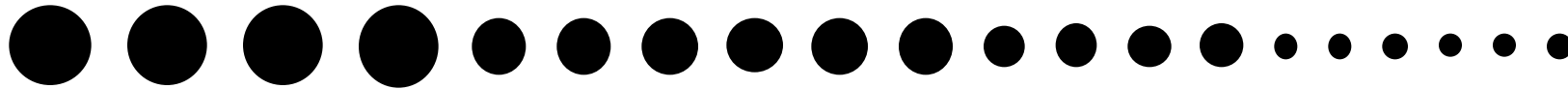
## LAW OF PRÄGNANZ

Cognitive load is optimized by  
reduction to the simplest form

# PRÄGNANZ



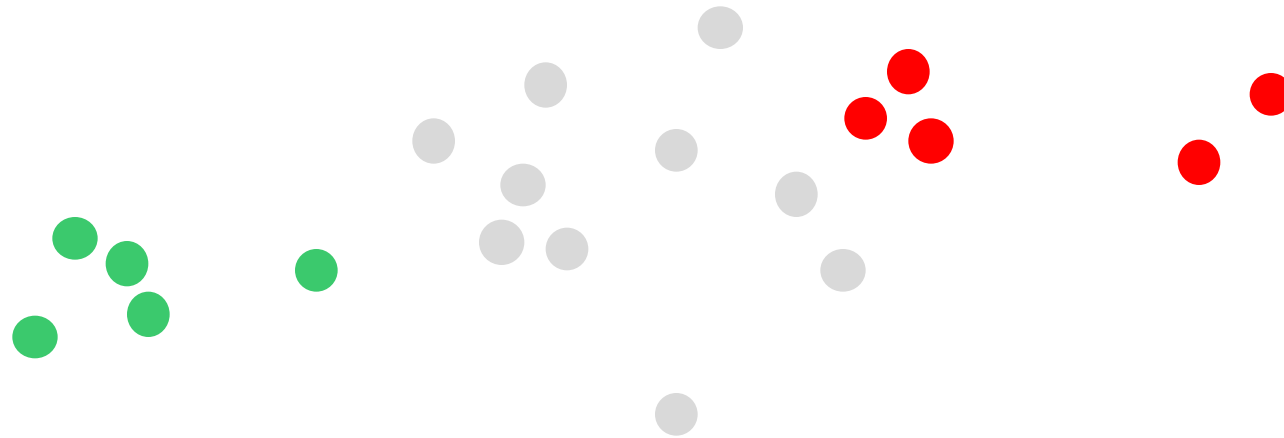
# PRÄGNANZ



## **LAW OF ISOMORPHIC CORRESPONDENCE**

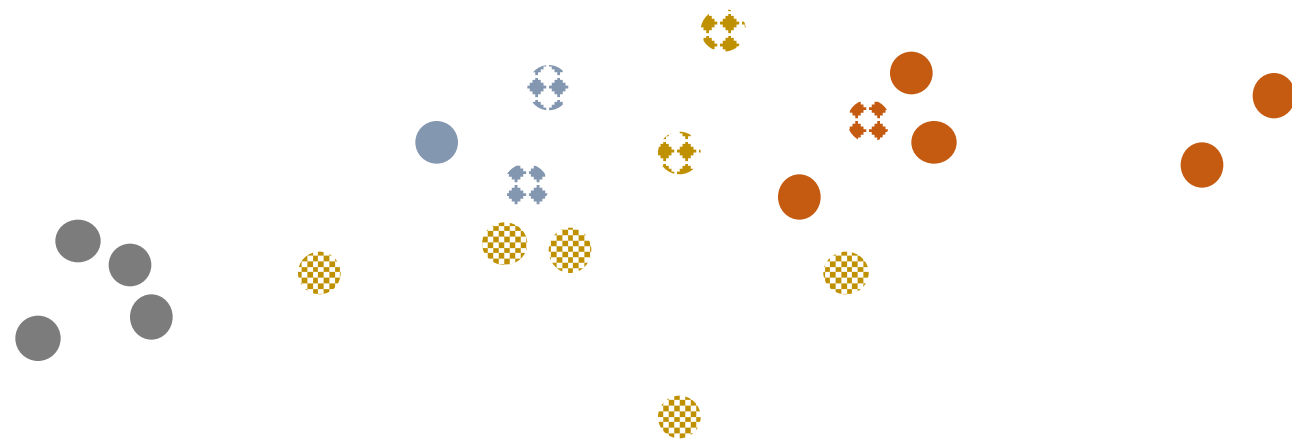
A viewer's interpretation of a  
visualization is informed by  
past experience

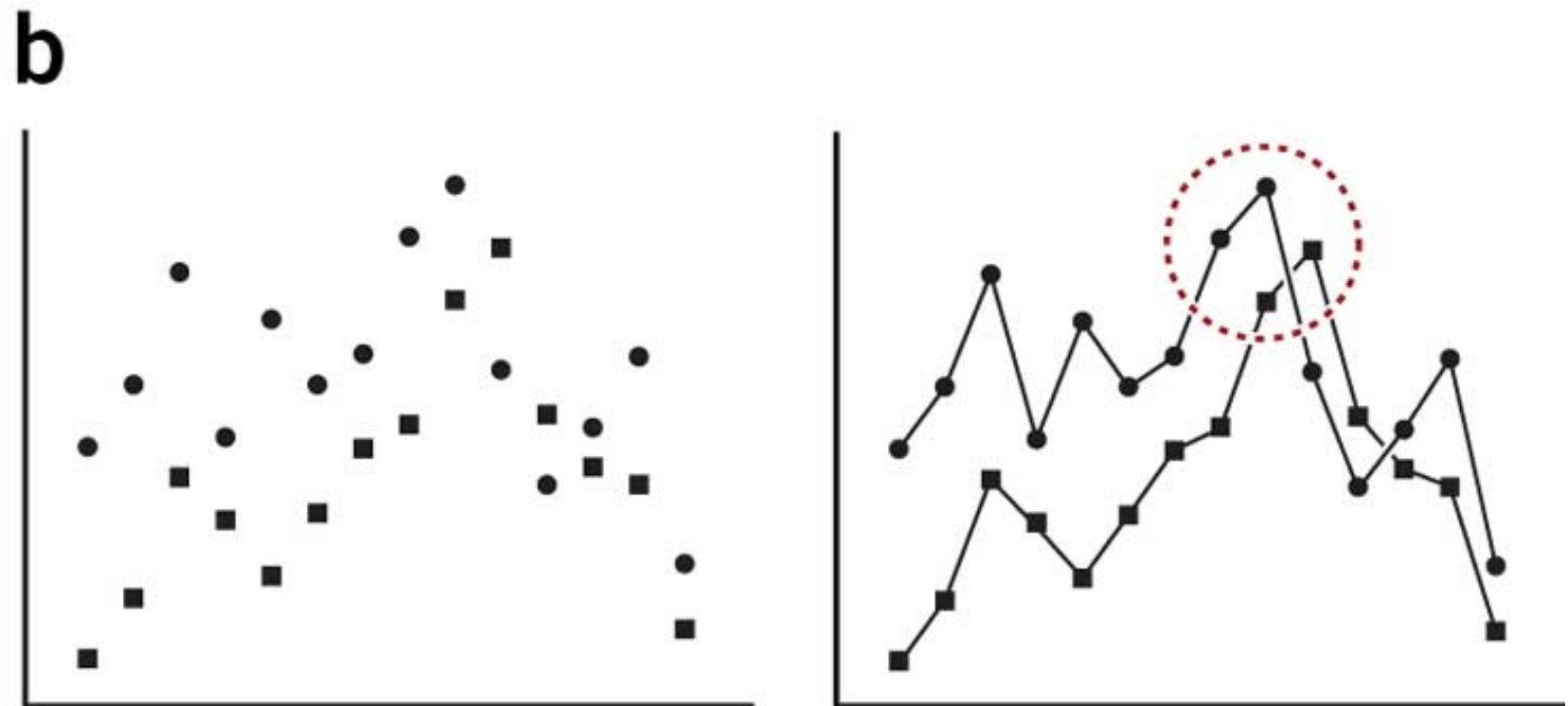
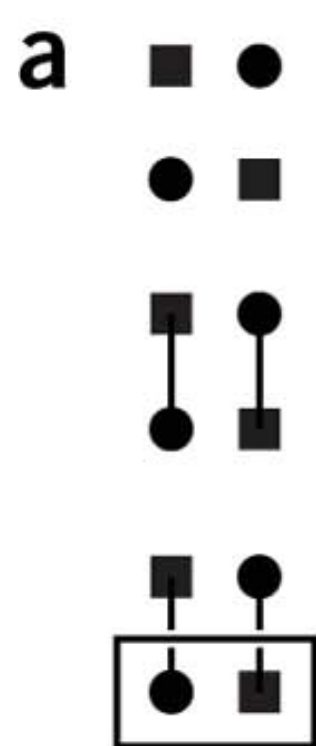
# ISOMORPHIC CORRESPONDENCE



We can leverage these principles in tandem  
to create an effective visualization,

but sometimes they operate in tension with  
one another

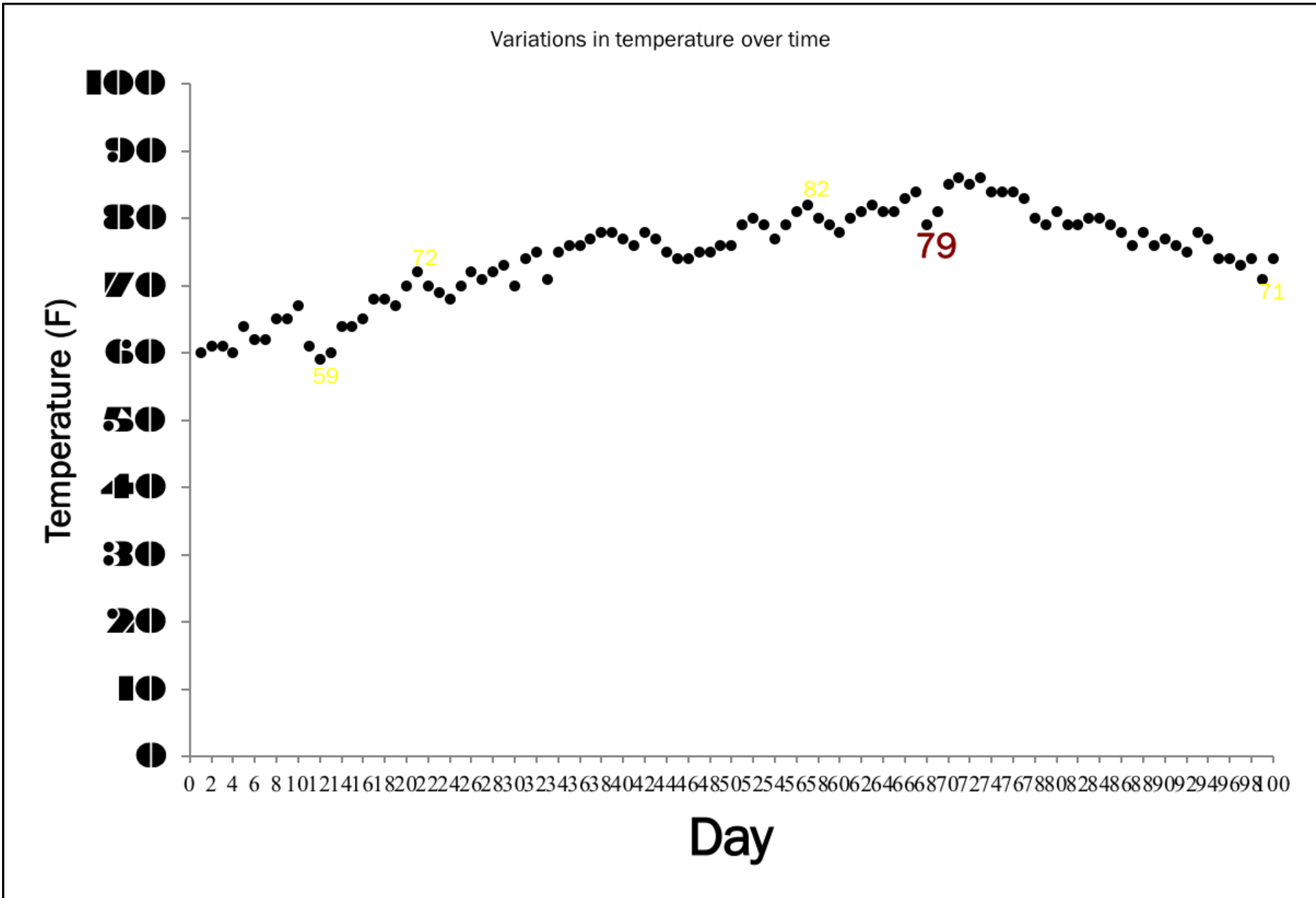






Typography can also be used to create  
hierarchical organization  
in visualizations

Size  
Typeface  
Weight  
Color  
Orientation  
Space  
Texture



# Outcome of treatment per condition

