

Data Visualization Foundations: Composition and Layout

Steven Braun

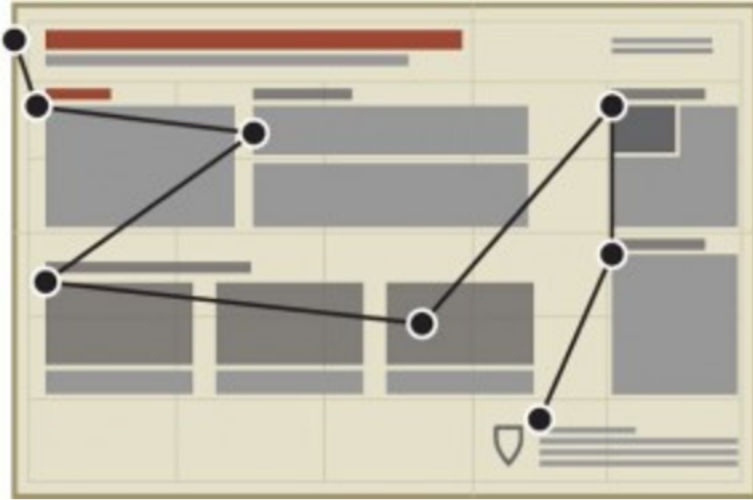
Data Analytics and Visualization Specialist

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

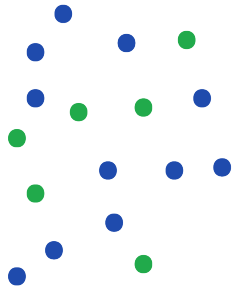
[Elements of visual style](#) – May 2013

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>

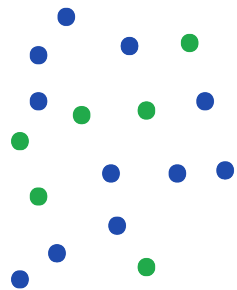


Data Collection

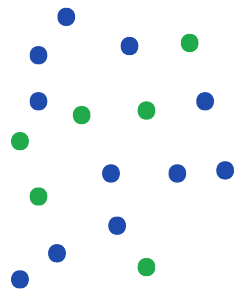
A lot can happen in the space between

A → **B**

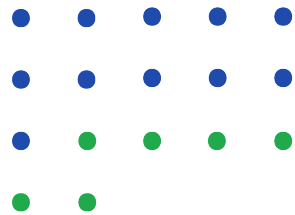
Interpretation



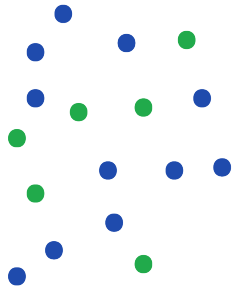
Data Collection



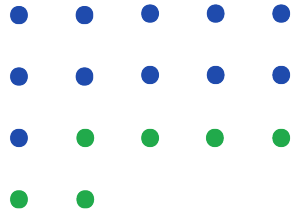
Data Collection



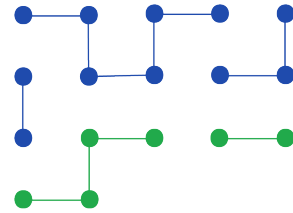
Structuring and Cleanup



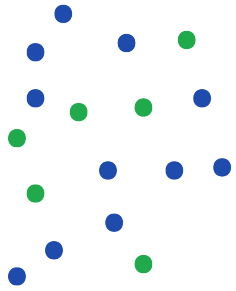
Data Collection



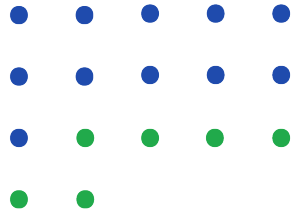
Structuring and Cleanup



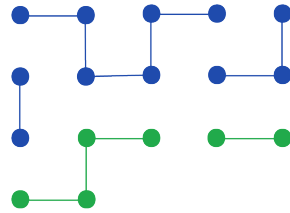
Analysis



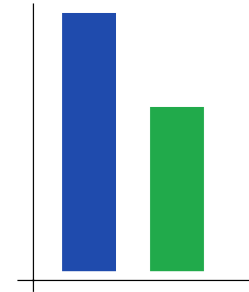
Data Collection



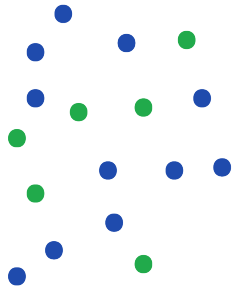
Structuring and Cleanup



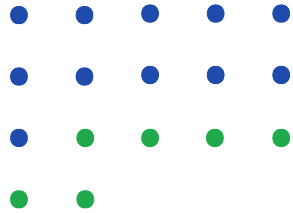
Analysis



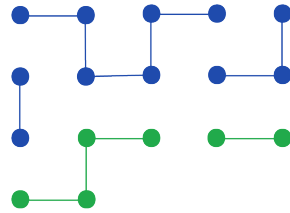
Visualization



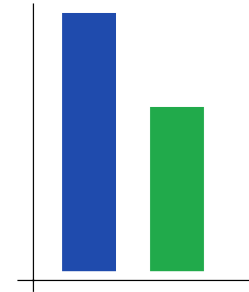
Data Collection



Structuring and Cleanup



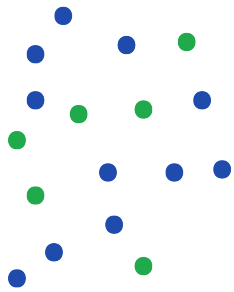
Analysis



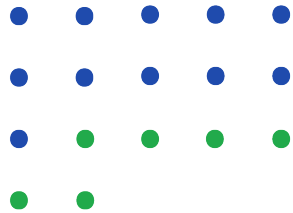
Visualization

A → **B**

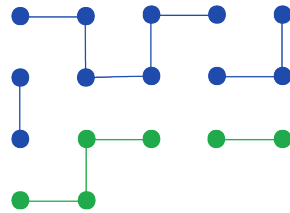
Interpretation



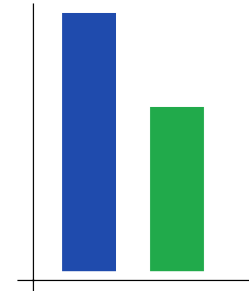
Data Collection



Structuring and Cleanup



Analysis



Visualization

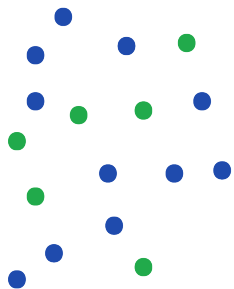
A → **B**

Interpretation

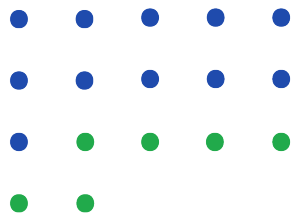
well-defined



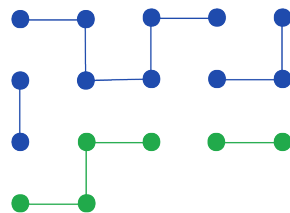
ill-defined



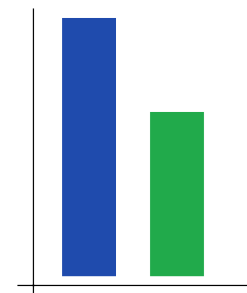
Data Collection



Structuring and Cleanup



Analysis



Visualization

A → **B**

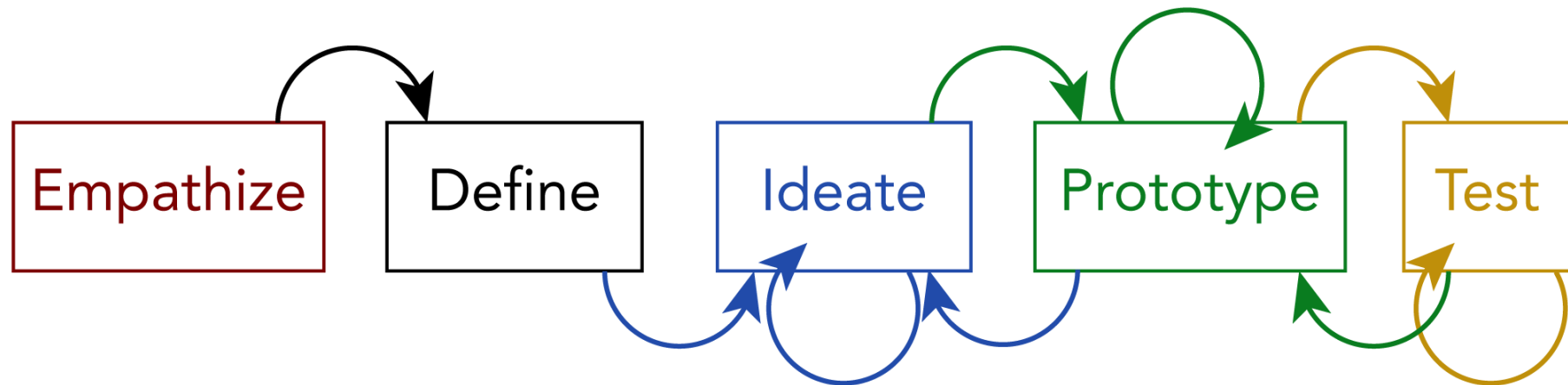
Interpretation

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

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EFFECTIVE DESIGN

ELEMENTS OF EFFECTIVE VISUALIZATION

Composition and Layout

Plot Types

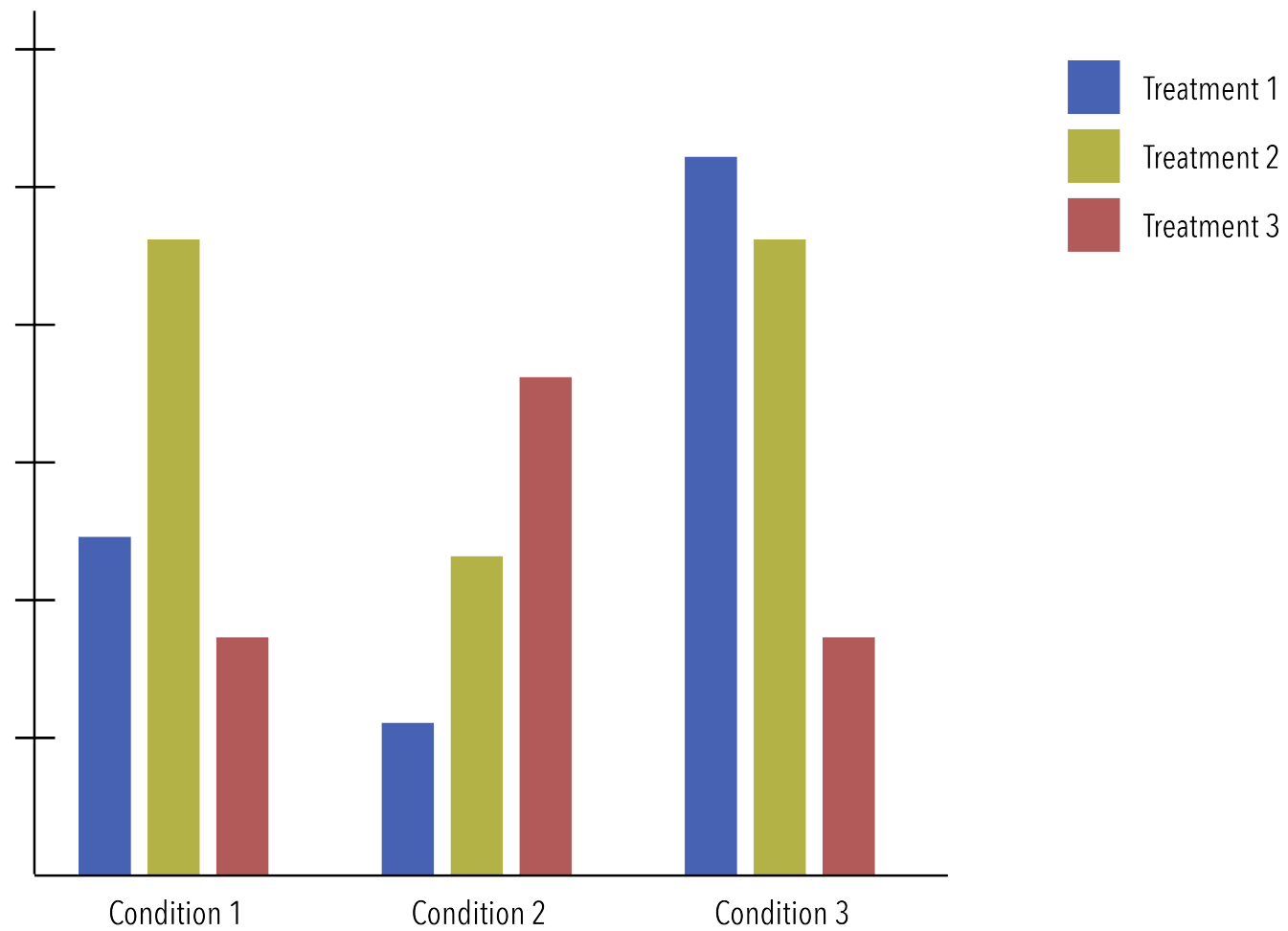
Color

Improving Figure Clarity

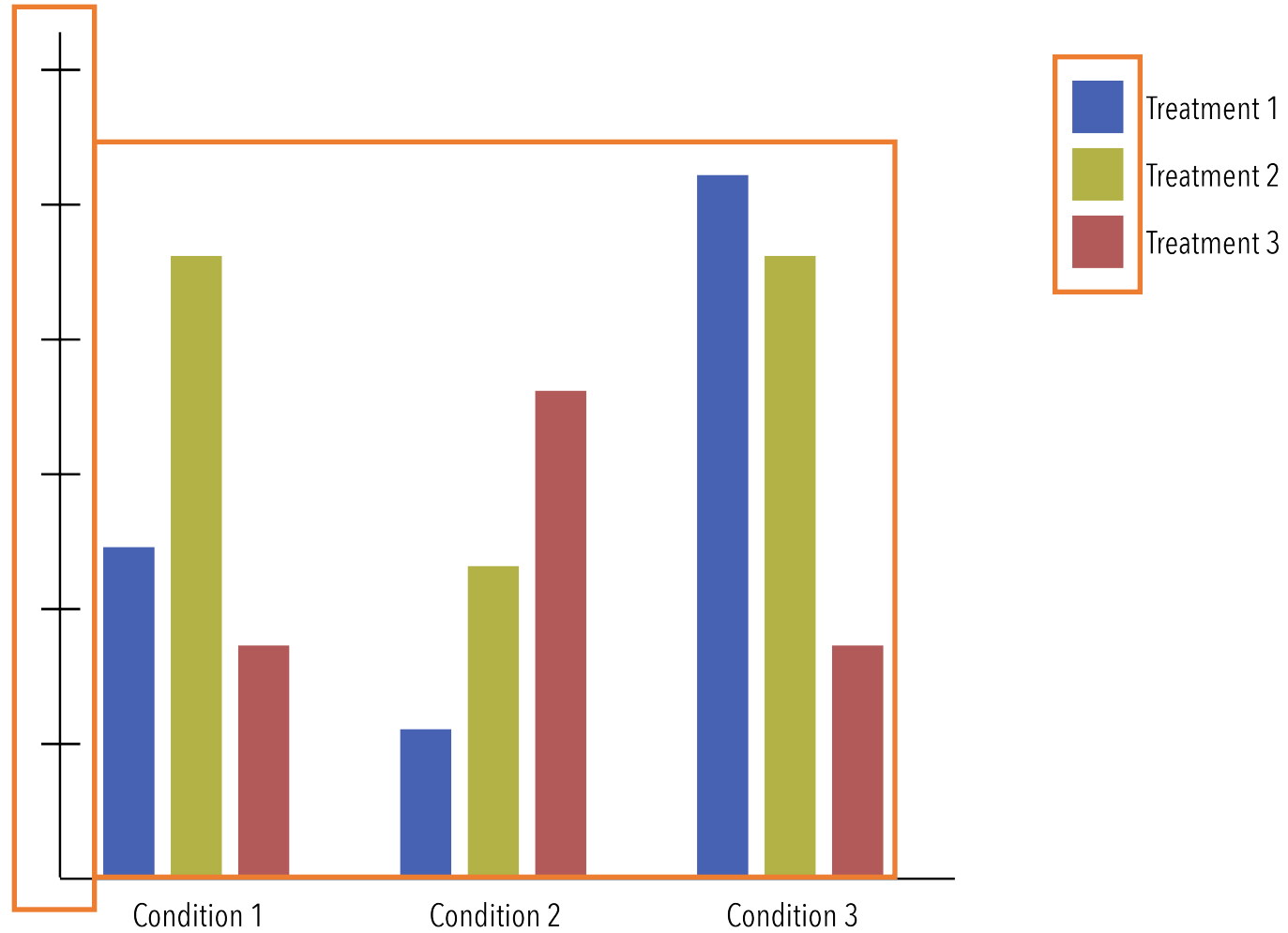
Multidimensional Data

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

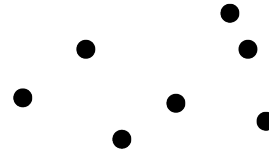
Channels

Ways to control mark appearance

Attributes

Dimensions of data

Points



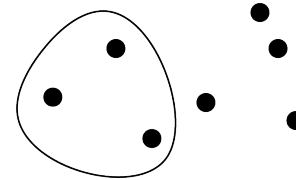
Lines



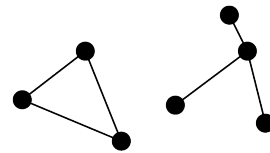
Areas



Containment



Links



CHANNELS

Color



Value/Gradation



Texture



Symbol



Sequence



Size + Scale



Orientation



Proximity/Density



Length



Area

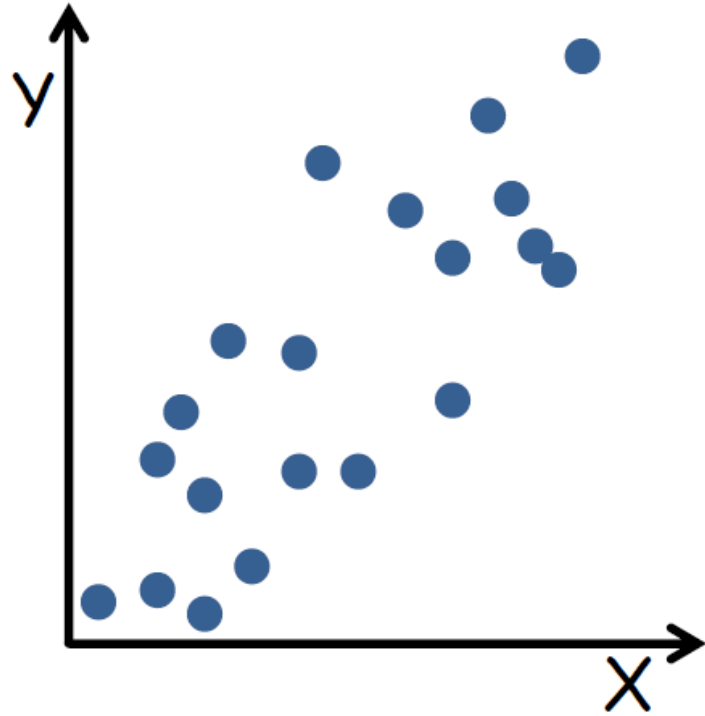


Proportion



Count

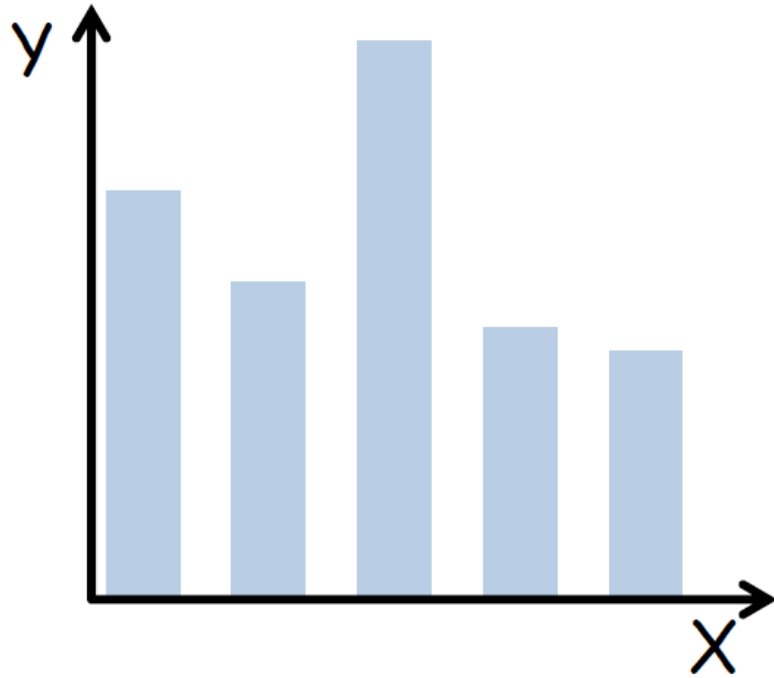




How many attributes are encoded?

What kinds of marks are used?

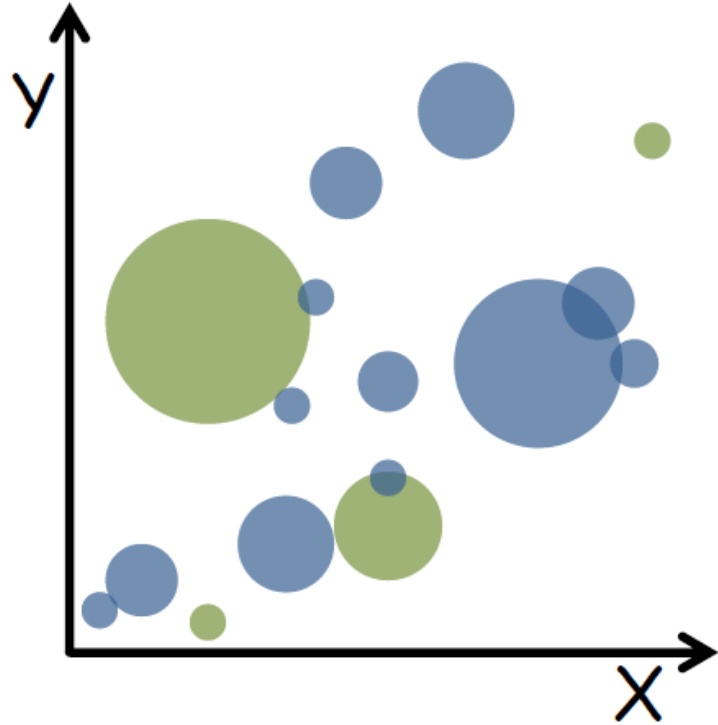
What kinds of channels are used?



How many attributes are encoded?

What kinds of marks are used?

What kinds of channels are used?



How many attributes are encoded?

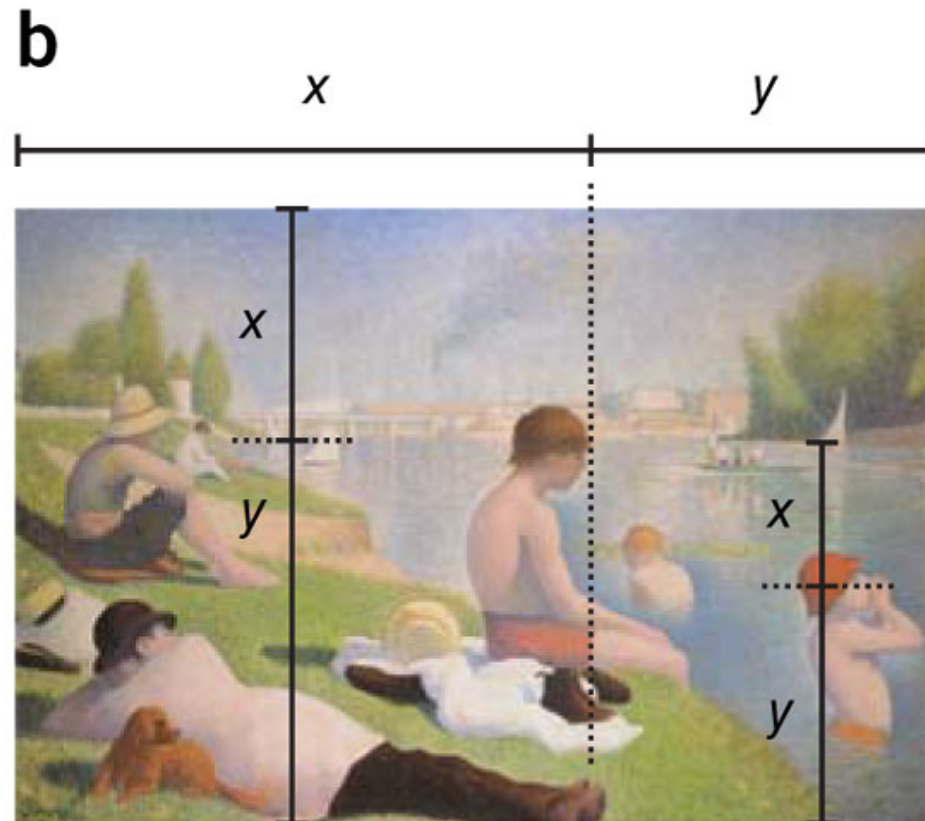
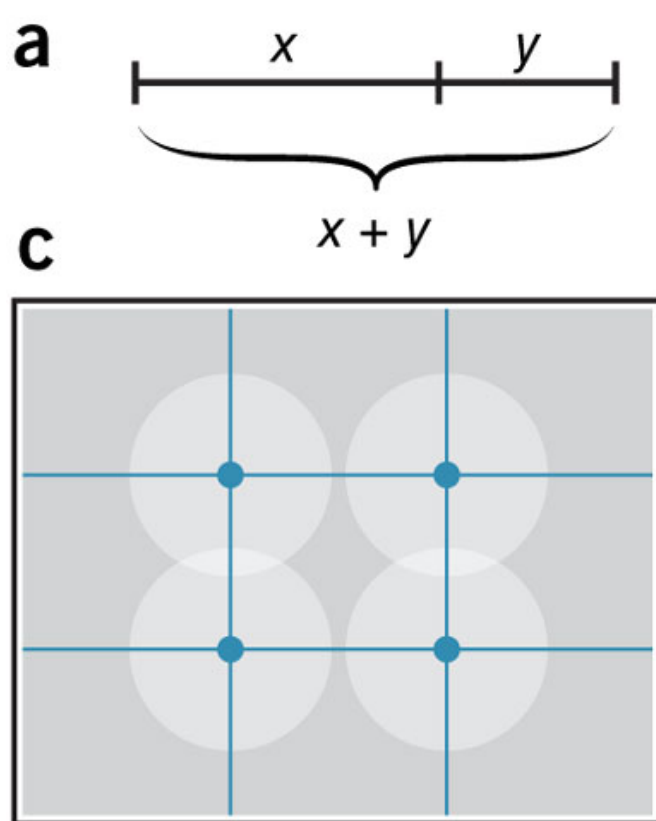
What kinds of marks are used?

What kinds of channels are used?

Layout and Hierarchical Organization

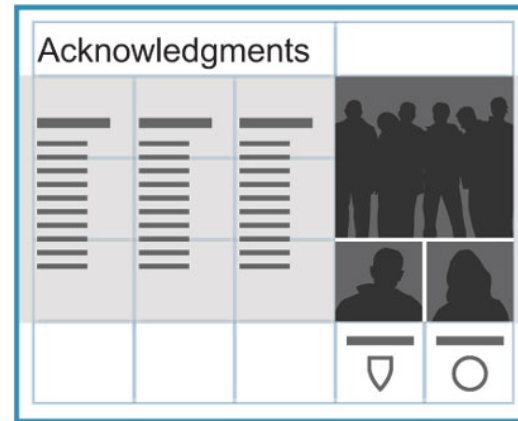
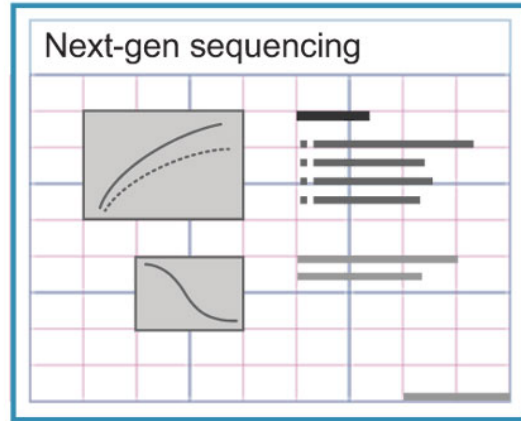
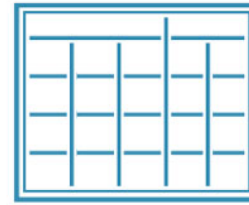
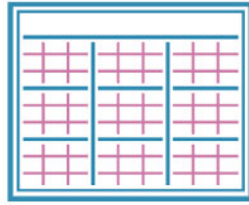
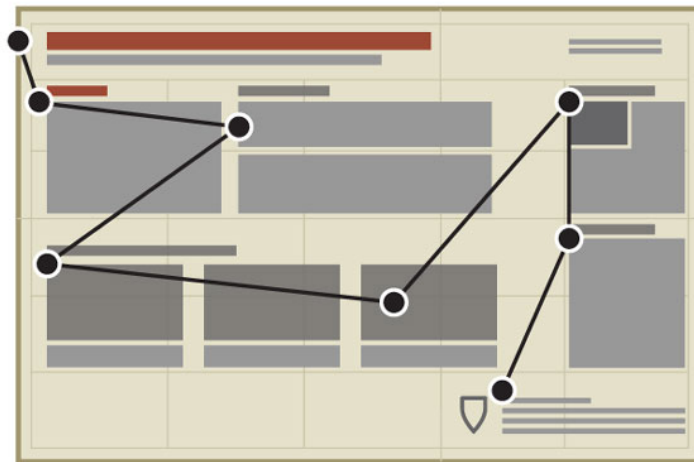
Principles of effective layout
have their origins in art and design theory,
not just visualization

golden section
Fibonacci sequence
rule of thirds
grids

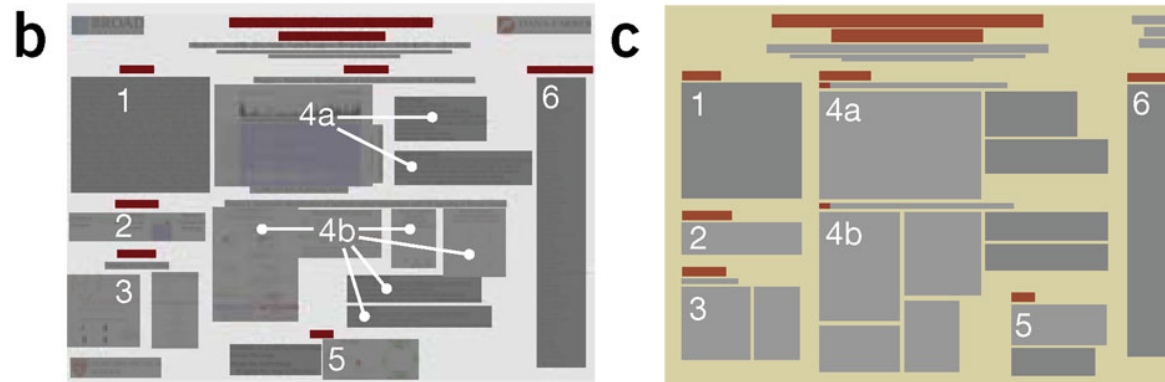


Effective layout helps determine
hierarchical organization, which
guides the eyes of the viewer

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.

[illegible]

Gestalt Principles

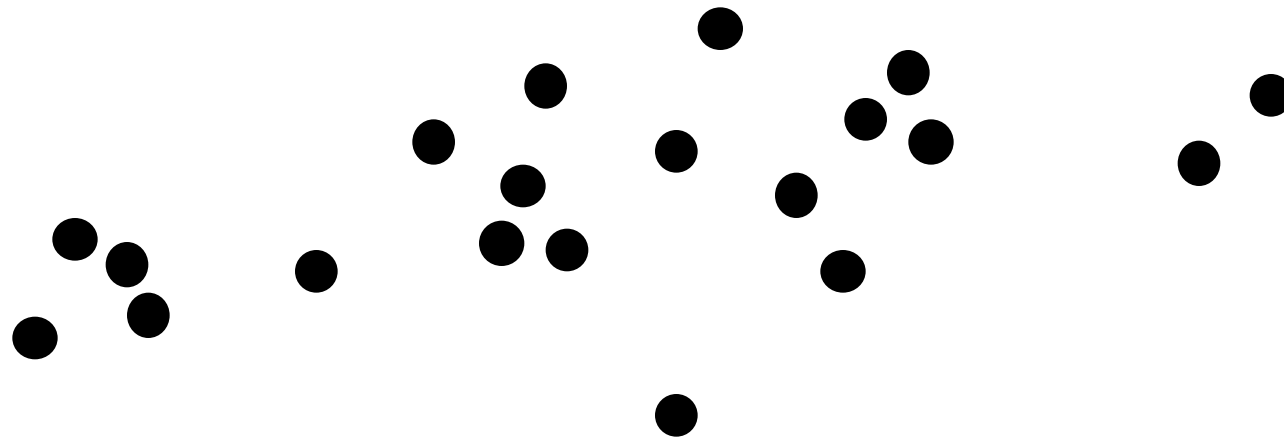
Gestalt laws of perceptual organization
dominate in fast visual cognition

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

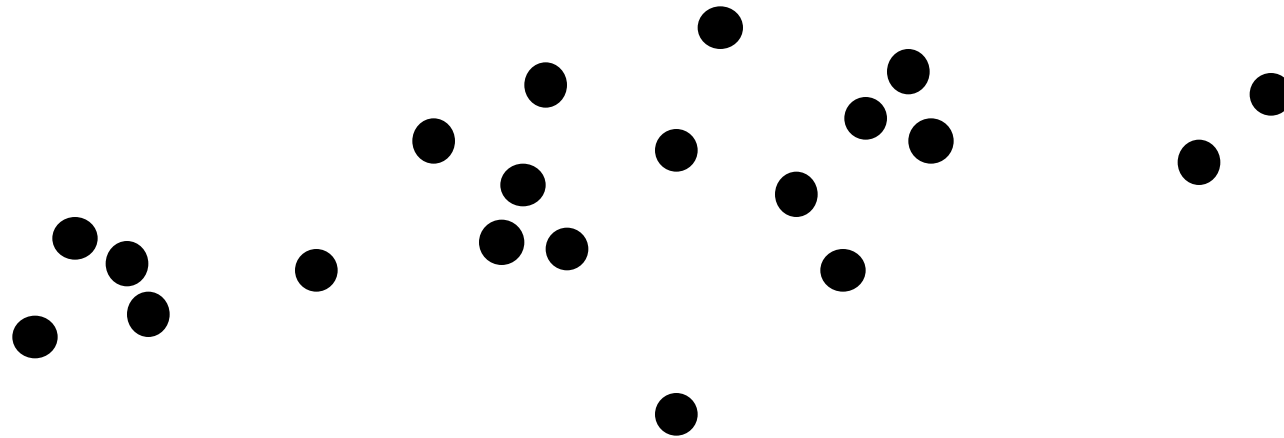
COLOR



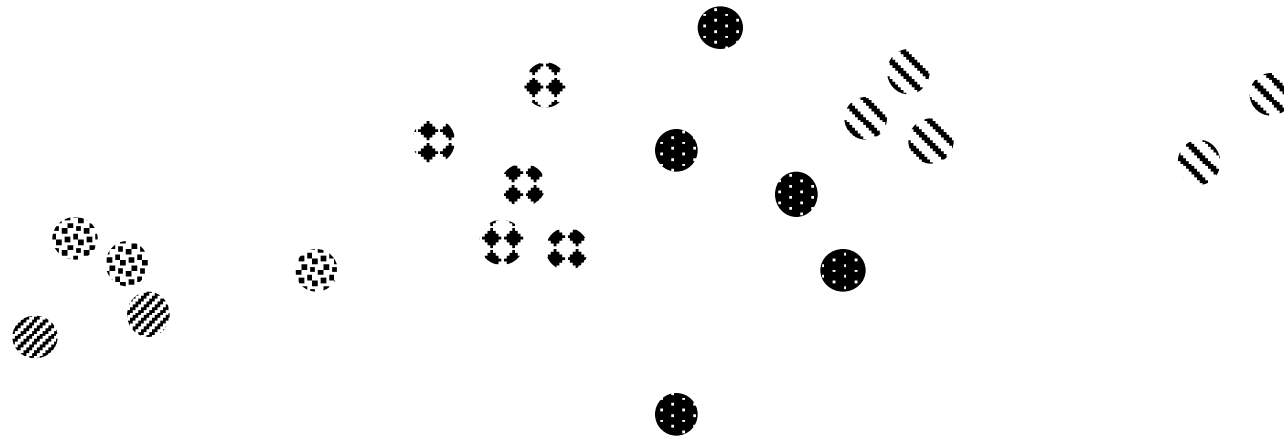
COLOR



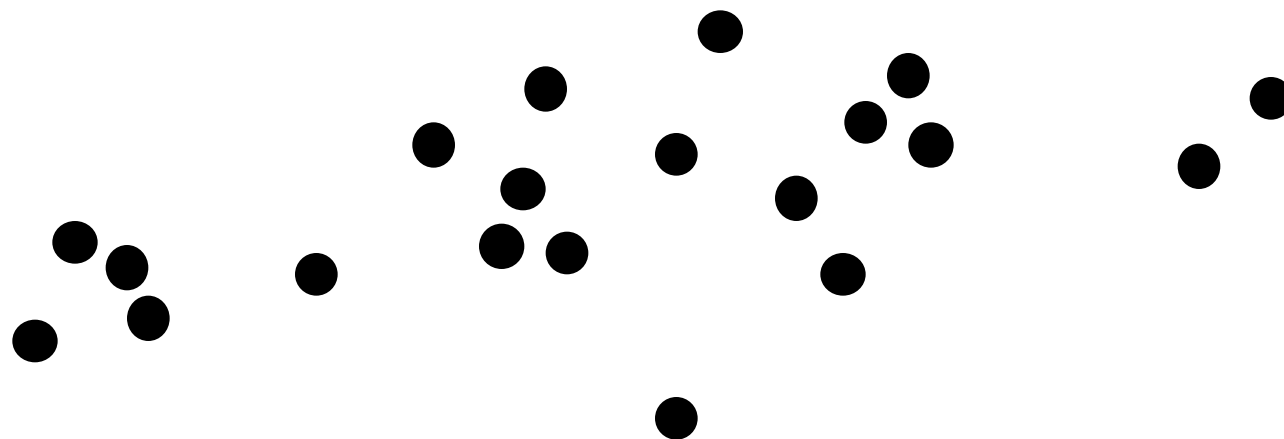
TEXTURE



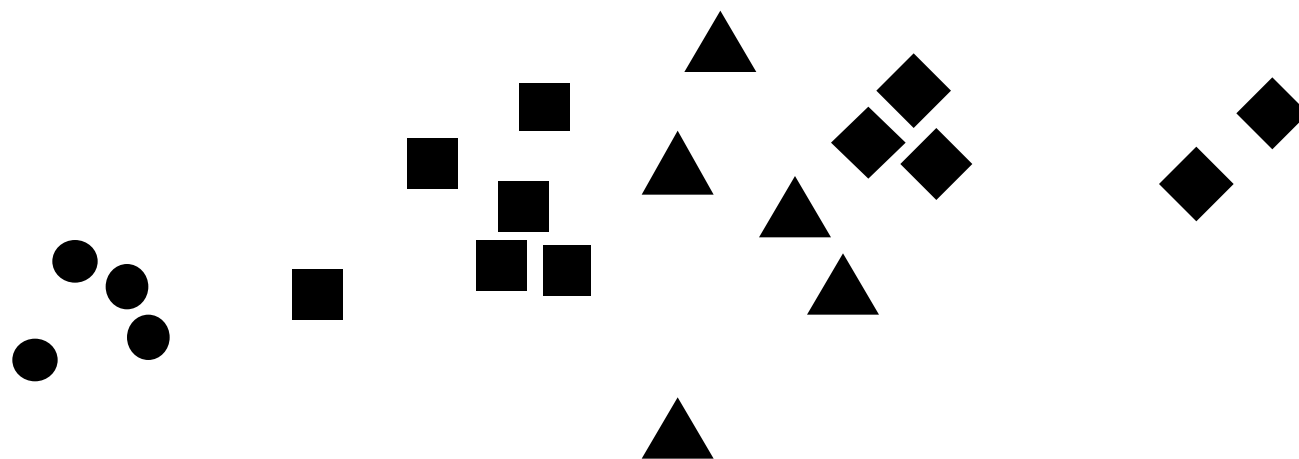
TEXTURE



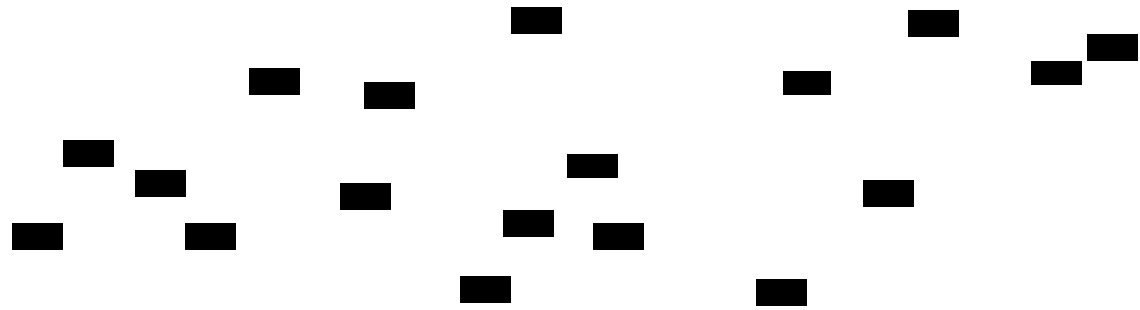
SHAPE



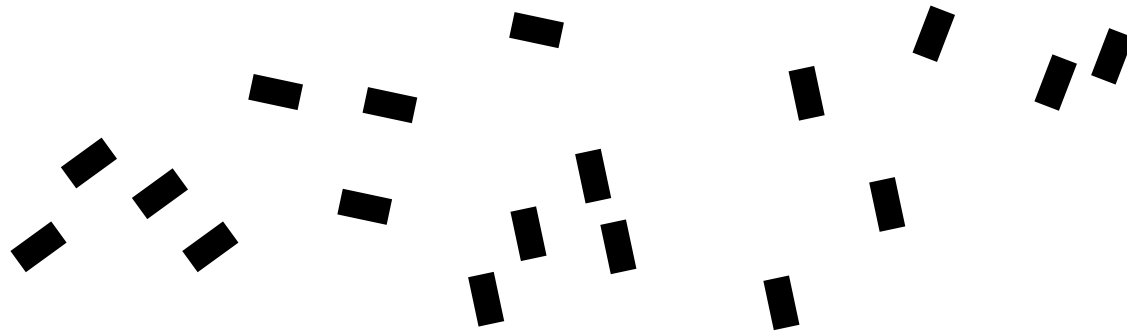
SHAPE



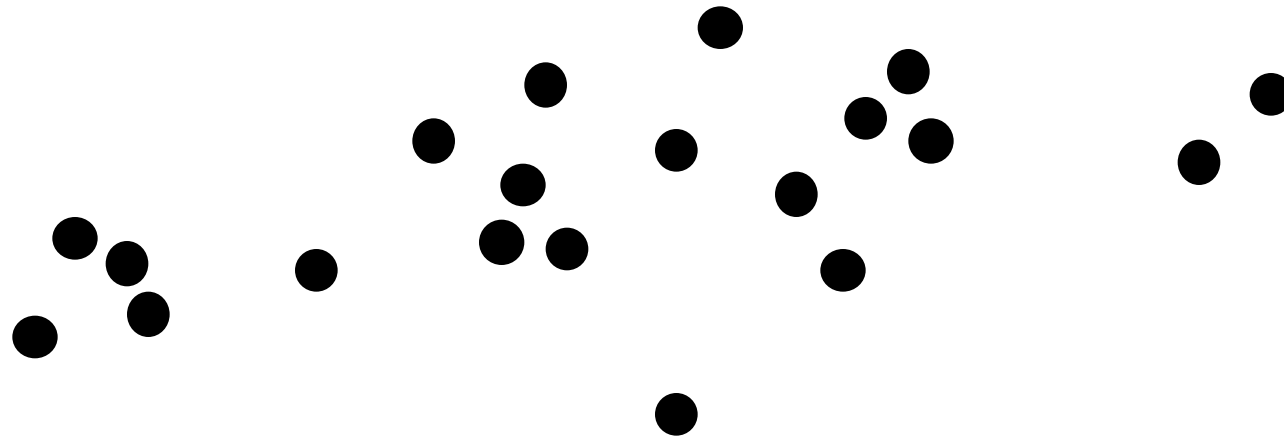
ORIENTATION



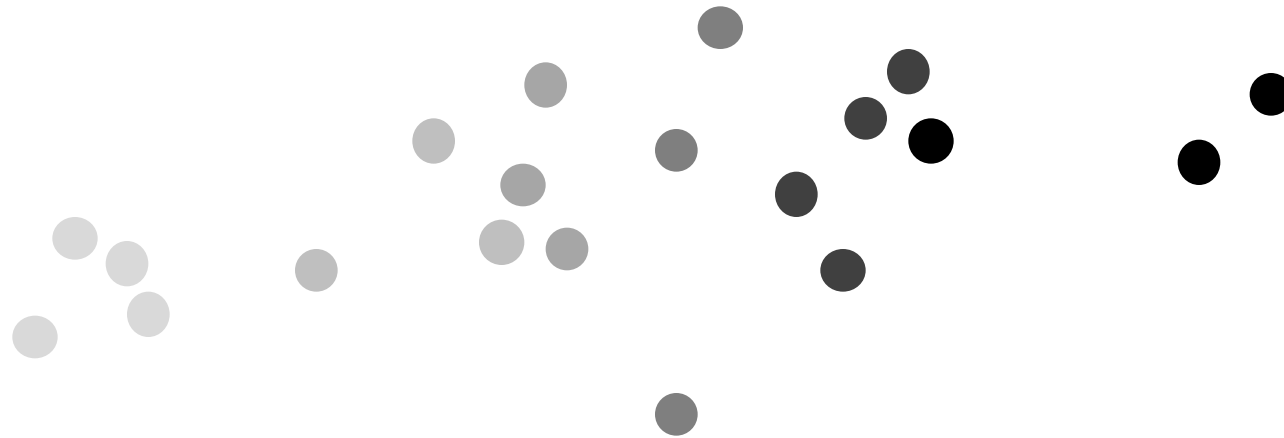
ORIENTATION



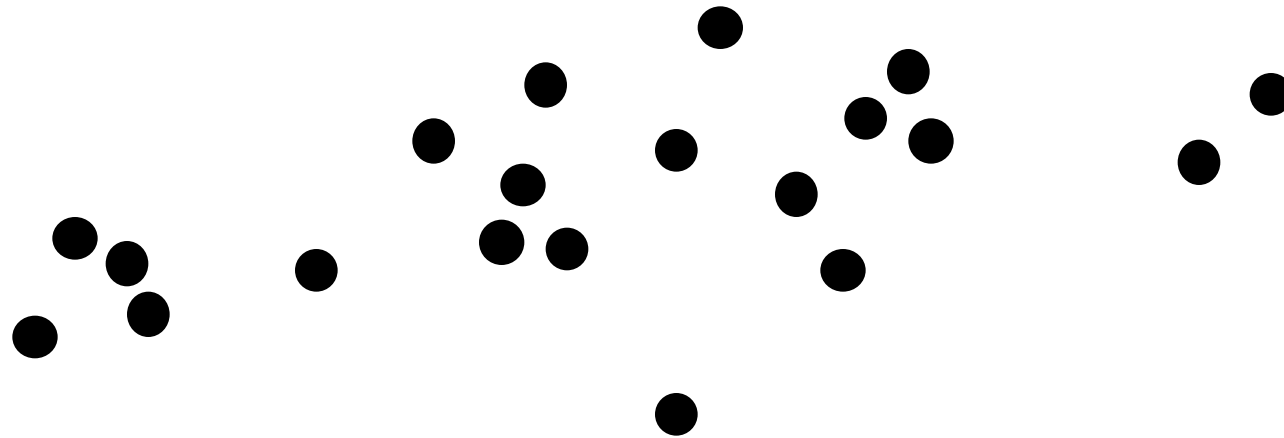
VALUE



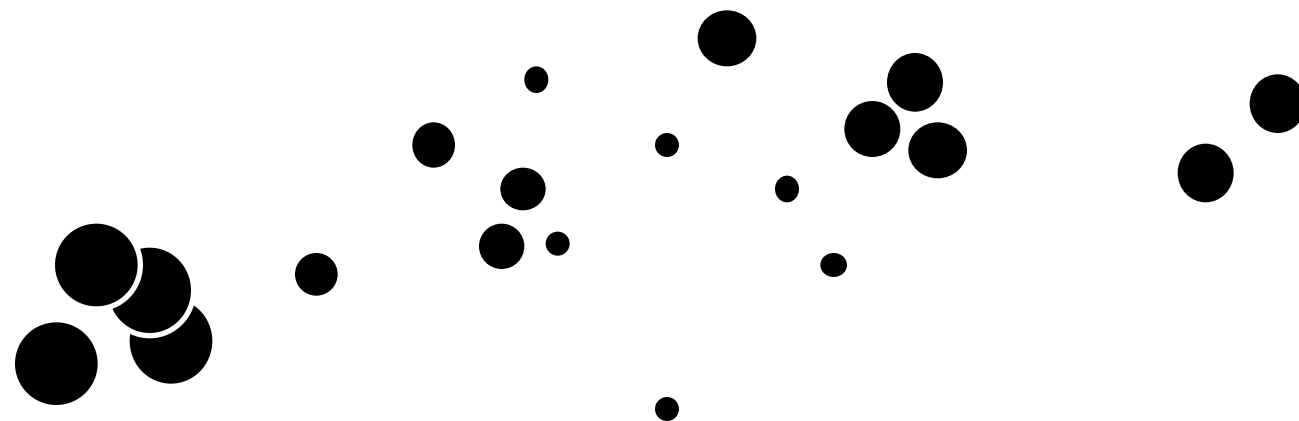
VALUE



SIZE AND SCALE



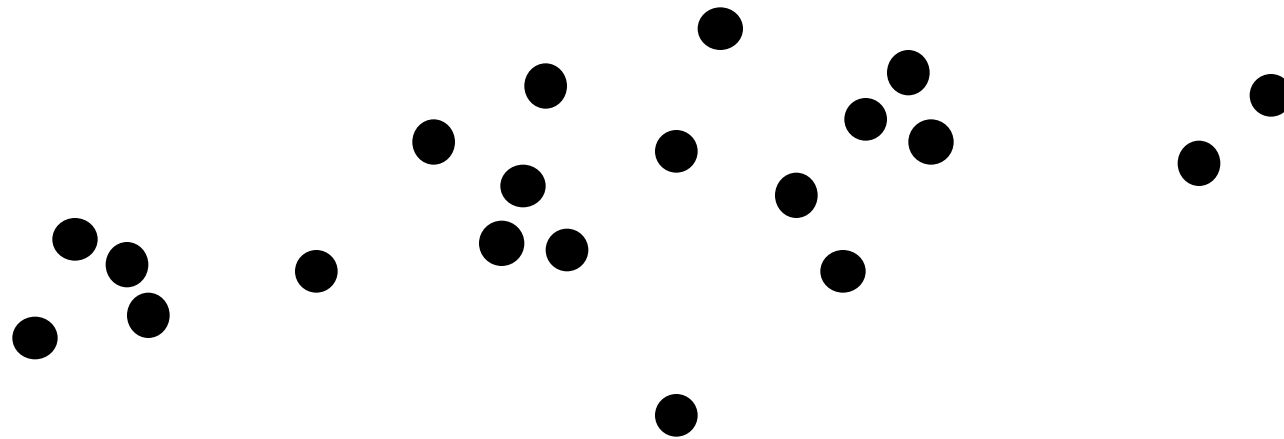
SIZE AND SCALE



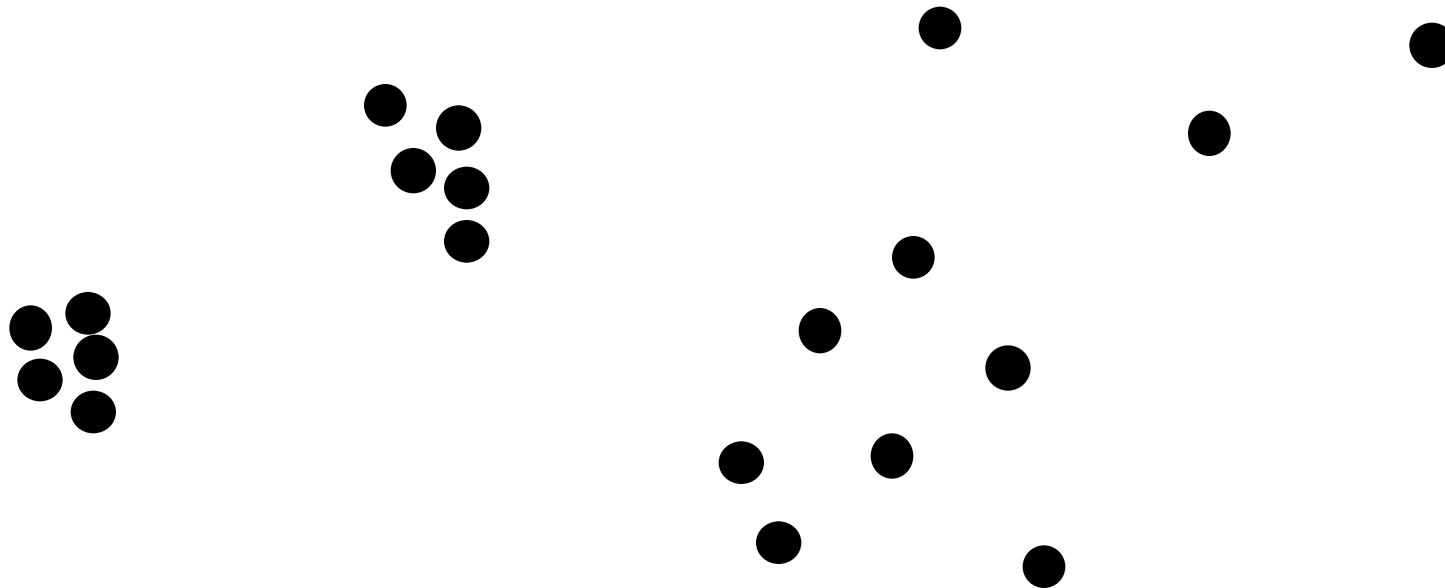
LAW OF PROXIMITY

Objects close in space form a group

PROXIMITY/DENSITY



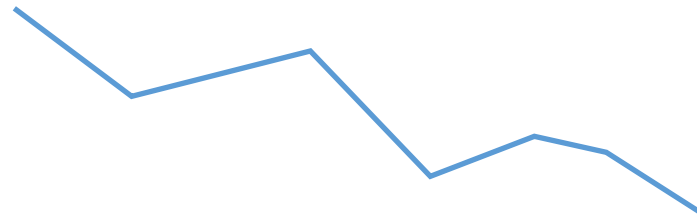
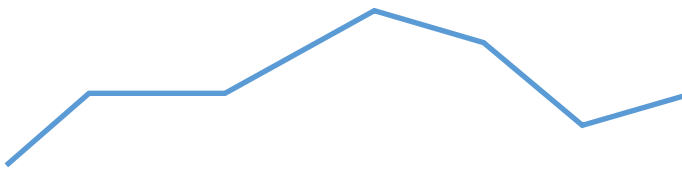
PROXIMITY/DENSITY



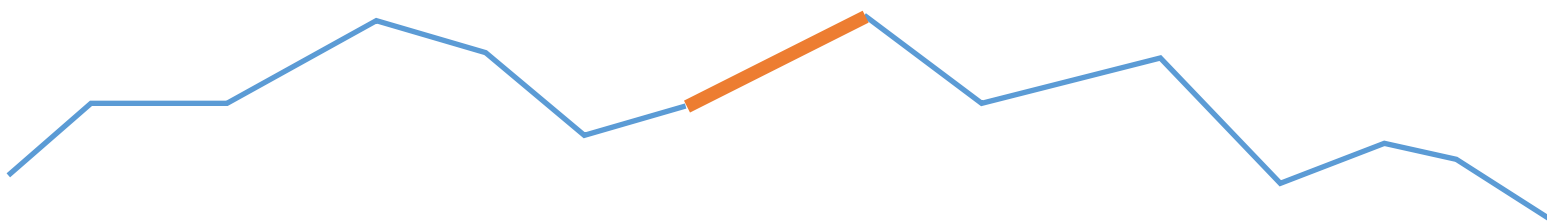
LAW OF CLOSURE

Objects separated in space are
connected in our mind

CLOSURE



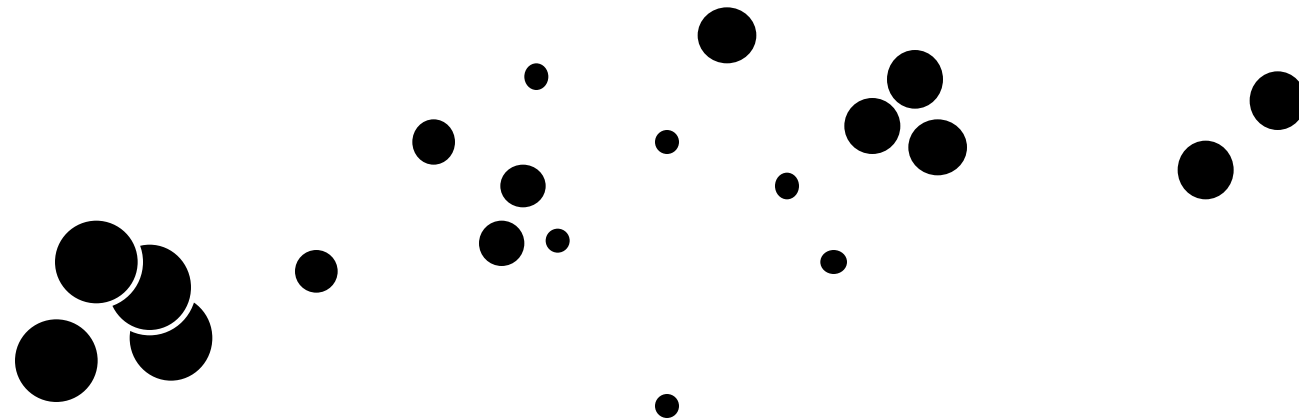
CLOSURE



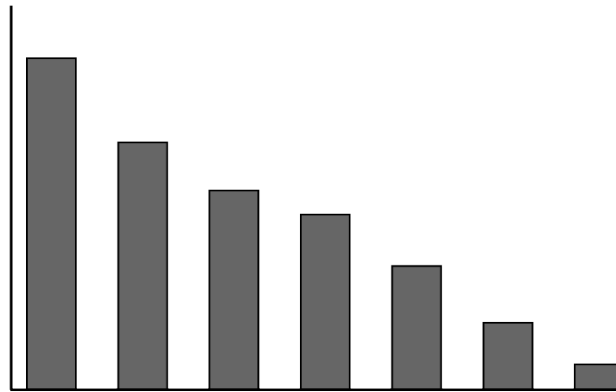
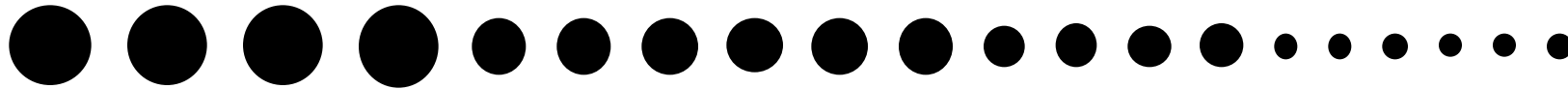
LAW OF PRÄGNANZ

Cognitive load is optimized by
reduction to the simplest form

PRÄGNANZ



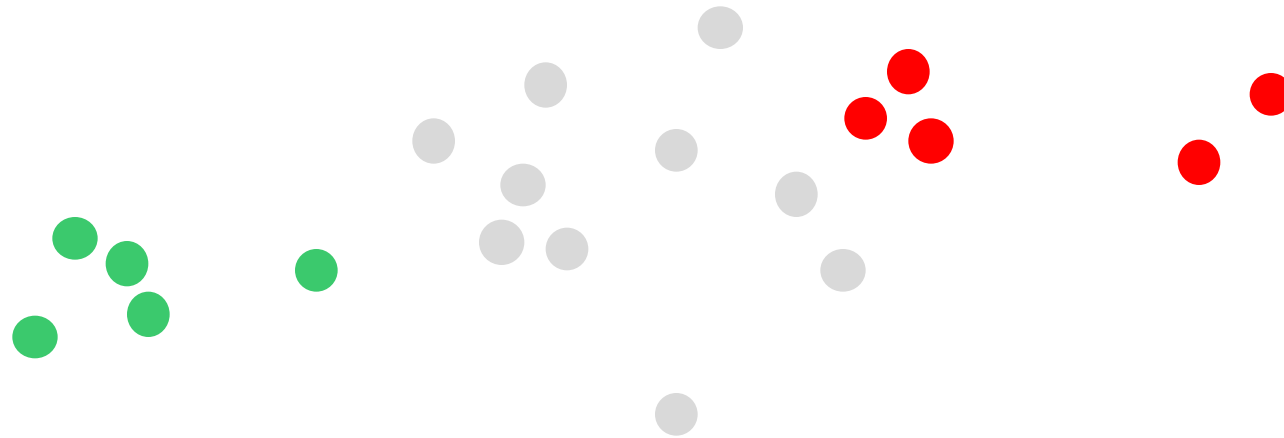
PRÄGNANZ



LAW OF ISOMORPHIC CORRESPONDENCE

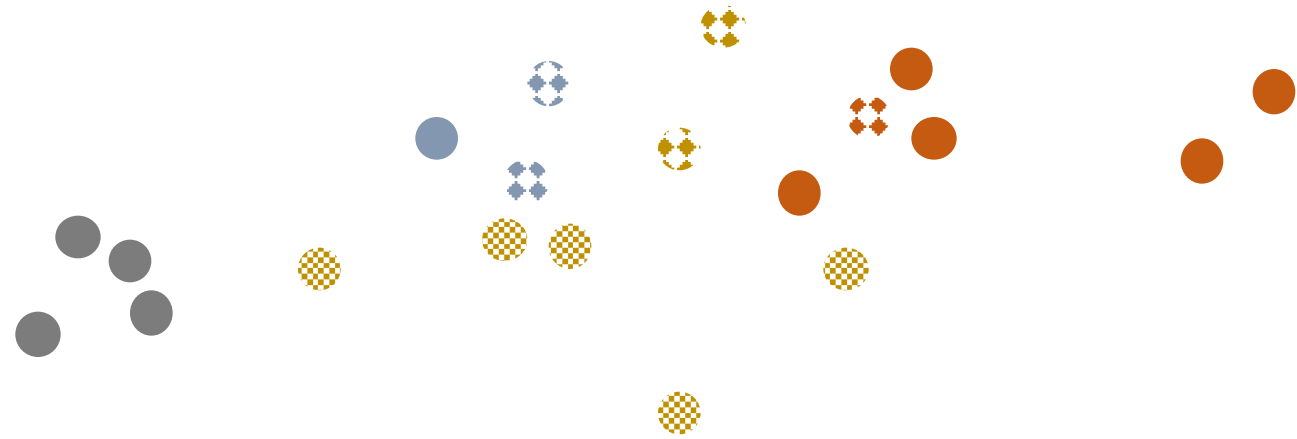
A viewer's interpretation of a
visualization is informed by
past experience

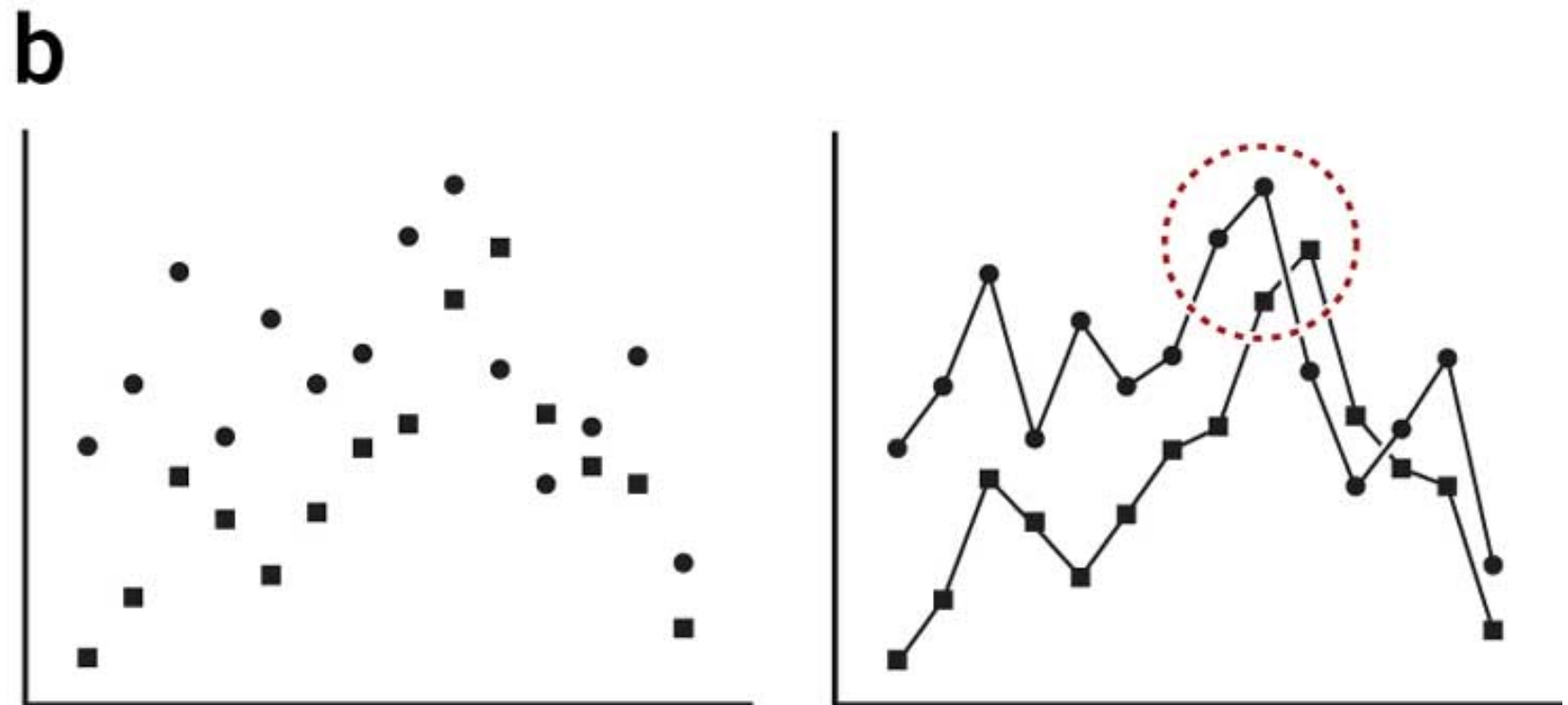
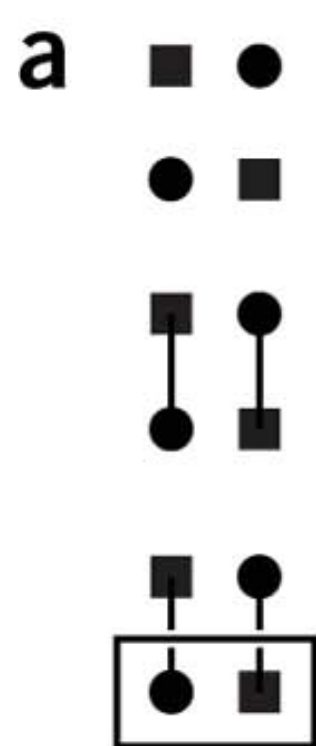
ISOMORPHIC CORRESPONDENCE



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

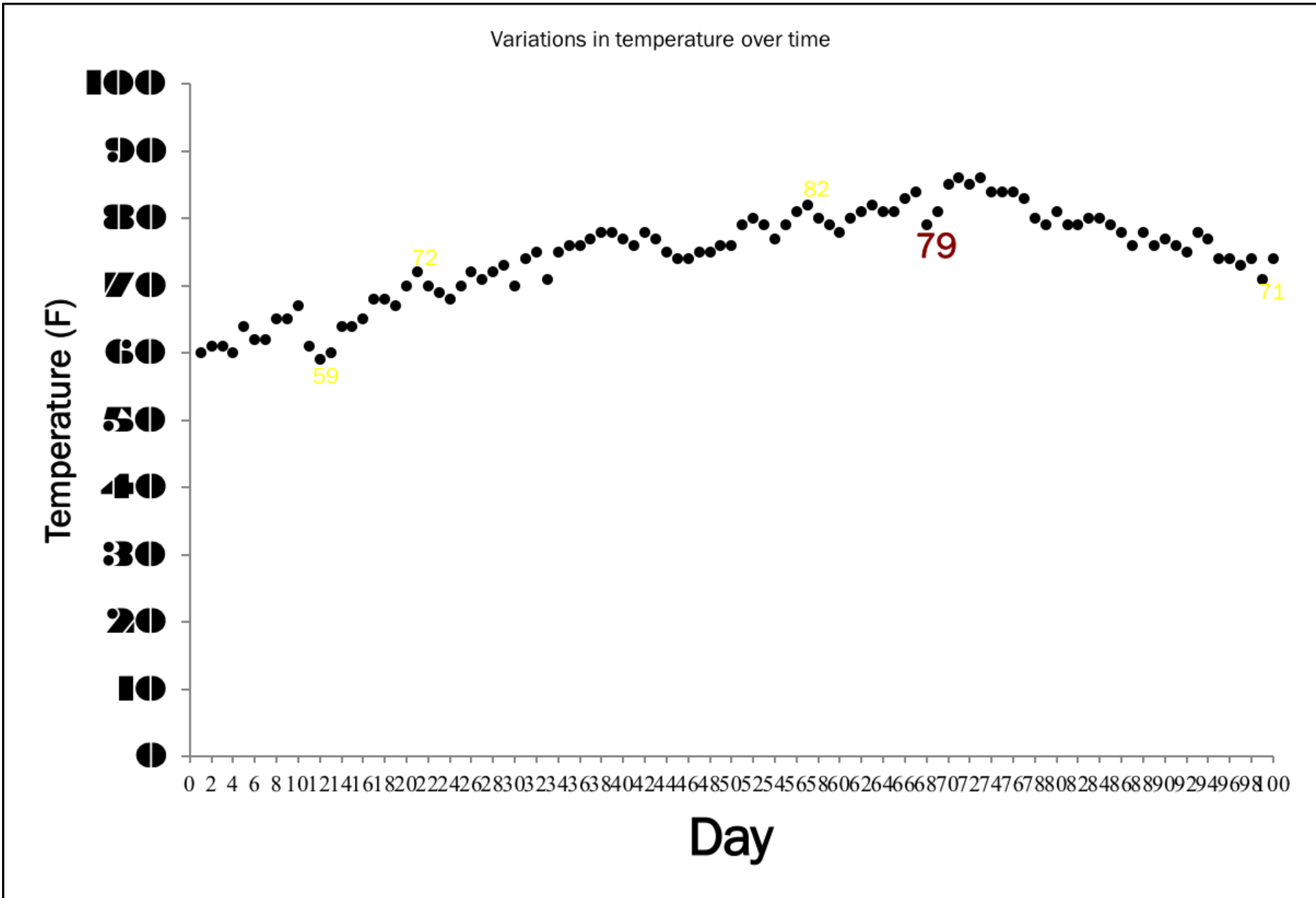
but sometimes they operate in tension with
one another





Typography can also be used to create
hierarchical organization
in visualizations

Size
Typeface
Weight
Color
Orientation
Space
Texture



Outcome of treatment per condition

