Cognitive and Visual Principles
Part 1: Gestalt Principles

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Theories of Cognition and Perception

- From the domain of Psychology

- Help us understand principles that can be used in design

- These are principles that you should be able to apply in creating visualizations
  - Also apply to a lot of User Interface design, as well

Gestalt Laws

- Gestalt: German word meaning "pattern"
  - An organized whole that is perceived as more than the sum of its parts
- German psychologists: 1912 founded the "Gestalt school of psychology"
  - Identified Gestalt laws of pattern perception
- While the neural basis for the laws did not hold up, the laws themselves have been widely recognized as having value

Which Laws?

- There are several Gestalt laws that are relevant

- Some more widely used than others

Proximity

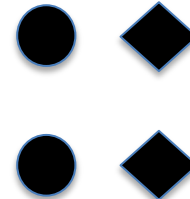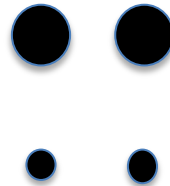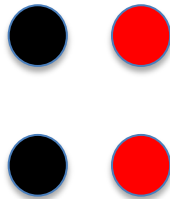- Things that are close together, or are of similar density, are grouped together.

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Similarity

- Common shape, color, texture, orientation, size, etc. tends to lead to grouping.
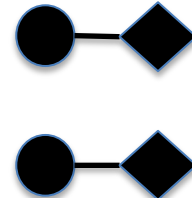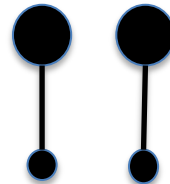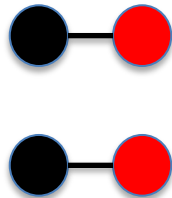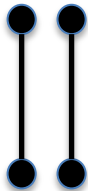
Connectedness

- Connections between elements (i.e. with lines) groups them together
  - More powerful than proximity, color, size, shape

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Continuity

- We are more likely to connect things that are smooth and continuous, than those that have sharp features
    - If things are aligned, we group them
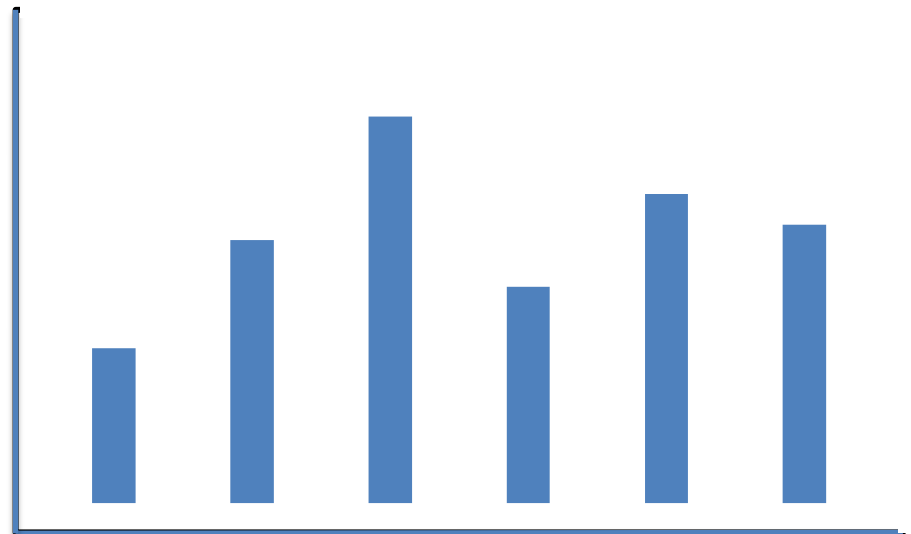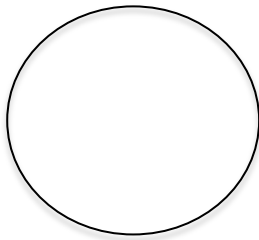   - Easier to follow patterns

Closure

- Perceptual tendency to close contours that have gaps in them
  - Leads to us filling in gaps that might be in data/display
  - Leads to us creating an enclosure around a perceived whole
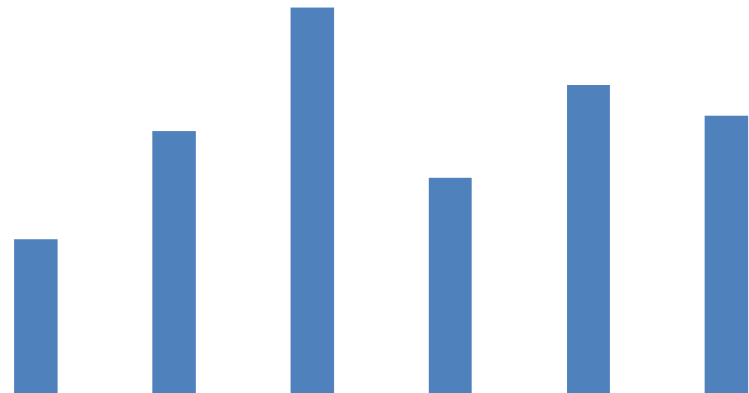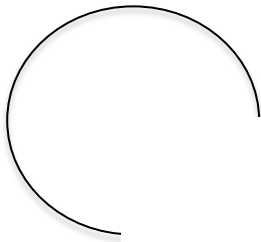
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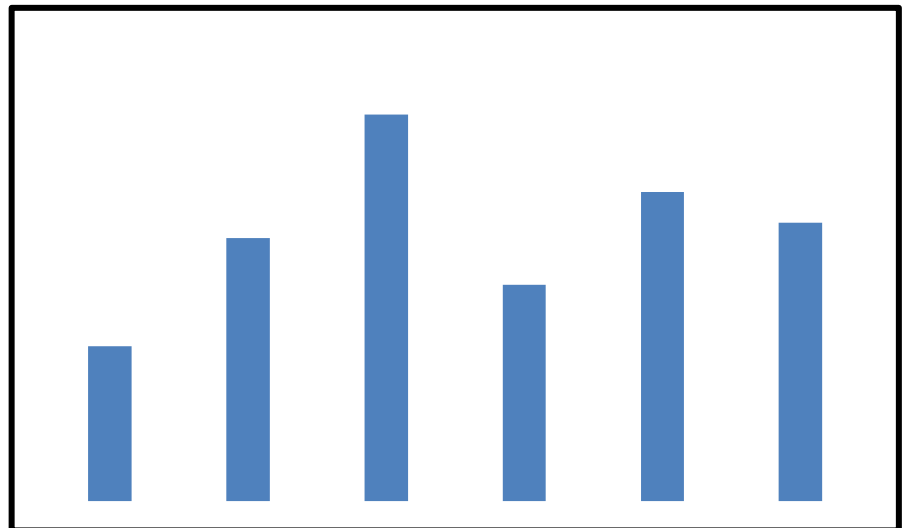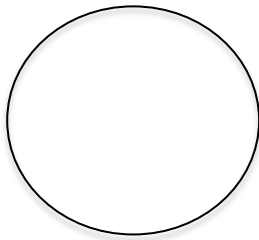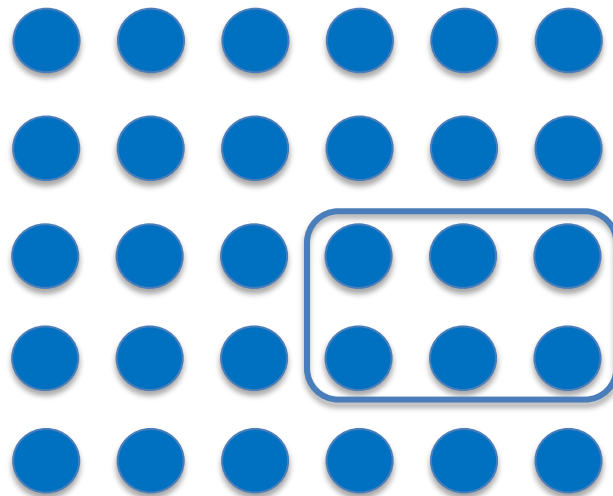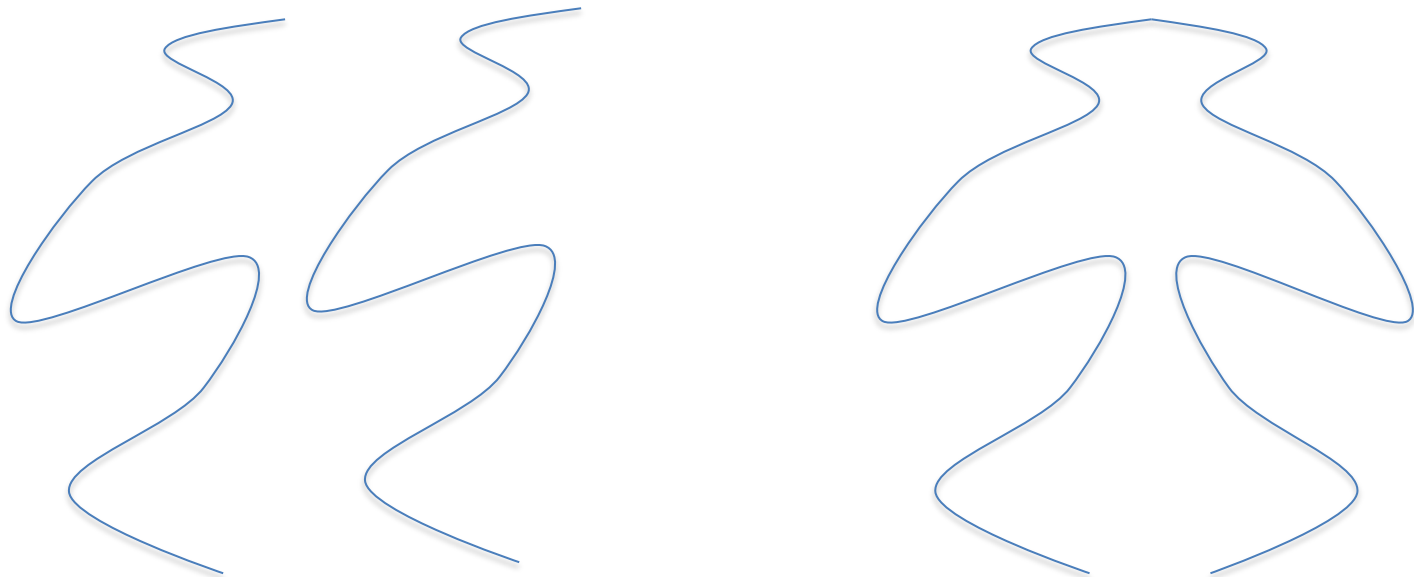 - Leads to us creating an enclosure around a perceived whole

Enclosure

- Closed contours tend to divide inside from outside (group things enclosed)
  - Most powerful way to indicate grouping (more than color/shape/etc.)

Symmetry

- Symmetry (reflectional symmetry) better allows things to be perceived as a whole

Symmetry

- Symmetry is better observed on vertical (best) or horizontal (OK, not as good) axis (vs. oblique)

- Most sensitive to small symmetry
  - 1 degree width, 2 degrees height, centered at fovea
  - Means small variations aren't noticed well if symmetric pattern is too large

- Can use if comparing two data sets
  - Symmetric views better than parallel views

Common Fate

- Lines moving in the same direction are perceived as being in the same group
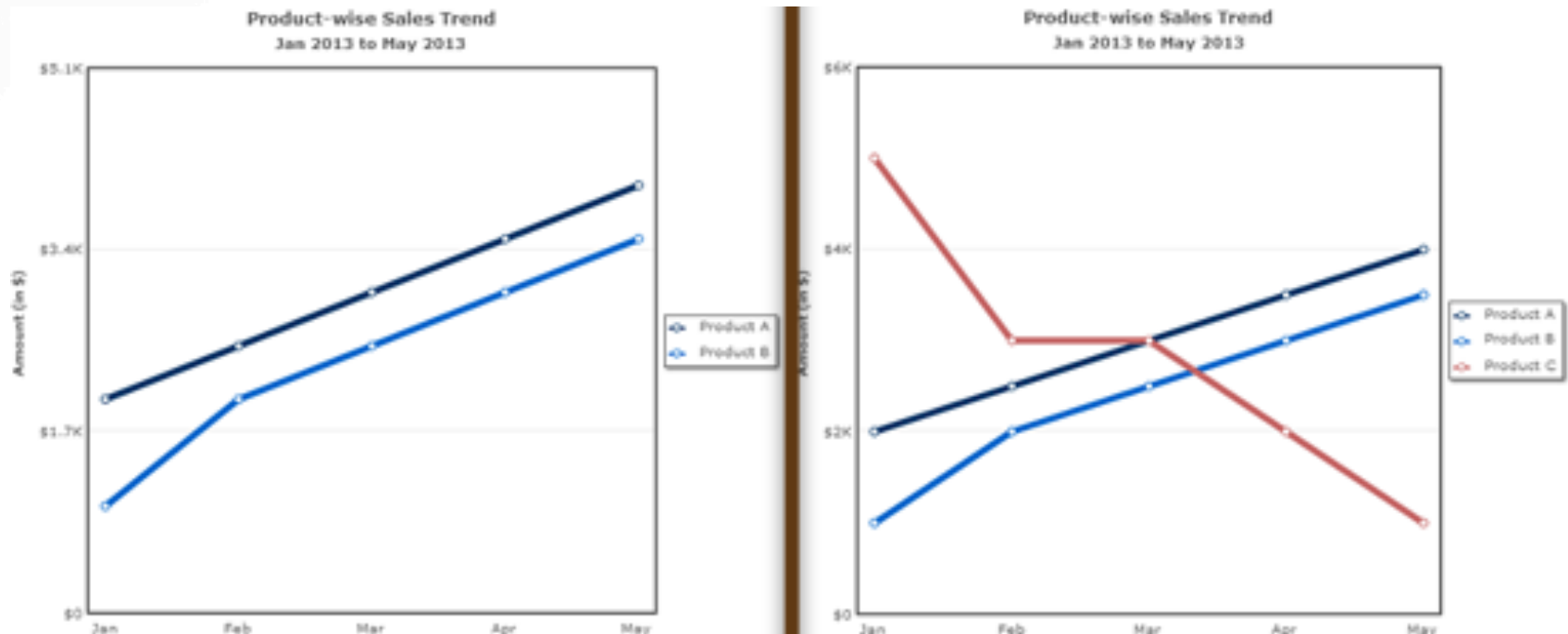
A Note on Contours
(not a Gestalt principle)

- Perceptual studies provide evidence for low-level processing leading to contour detection

  – Groups of collinear receptors fire in synchrony

- People will identify contours if possible even in random fields

- Will be key to some visualizations, including vector fields

Simplicity (Pragnanz = Pithiness)

- We most easily perceive when things are in the simplest form possible.
  - – Reduce cognitive load

https://www.webfx.com/blog/web-design/data-visualization-gestalt-laws/
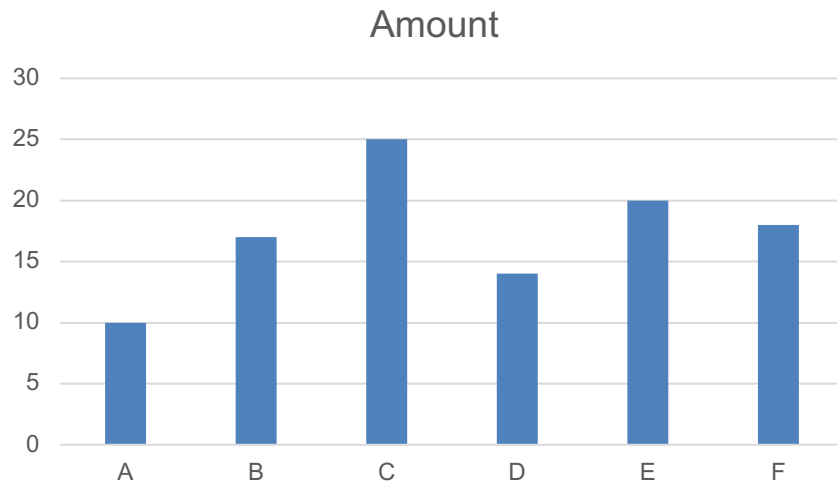
Figure-Ground

- We perceive elements as either the figure (foreground, in focus) or ground (background)
  - Need to emphasize which is which – i.e. high contrast is better

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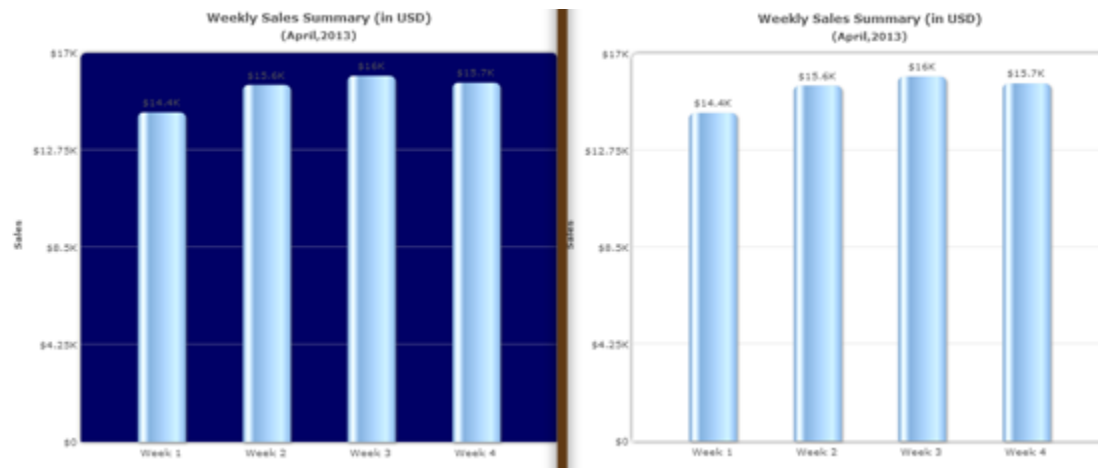
Focal Point

- ## Attention is grabbed by a point of emphasis, difference, or interest
  - ### Distinct color, size, shape
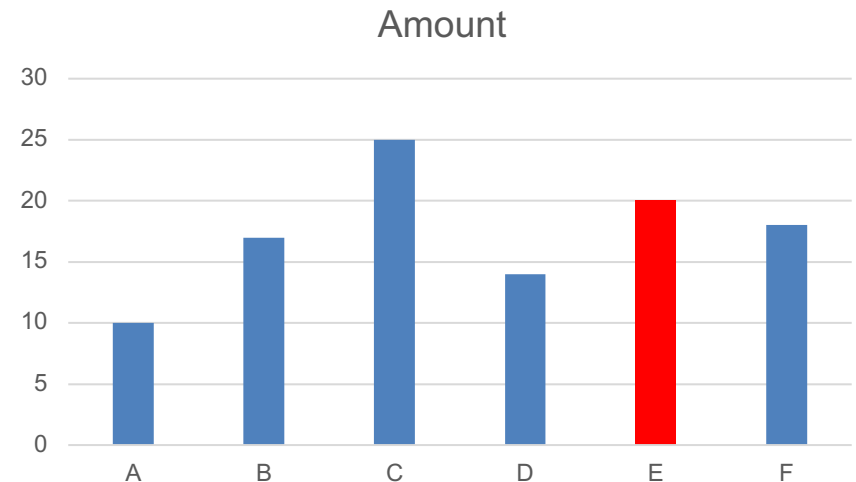
Isomorphic Correspondence

- People interpret and respond to images based on past experience

- Honor standard conventions (e.g. red = bad, green = good)

Total Revenue (in USD)
(Jan,2012 to Jun,2012)

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