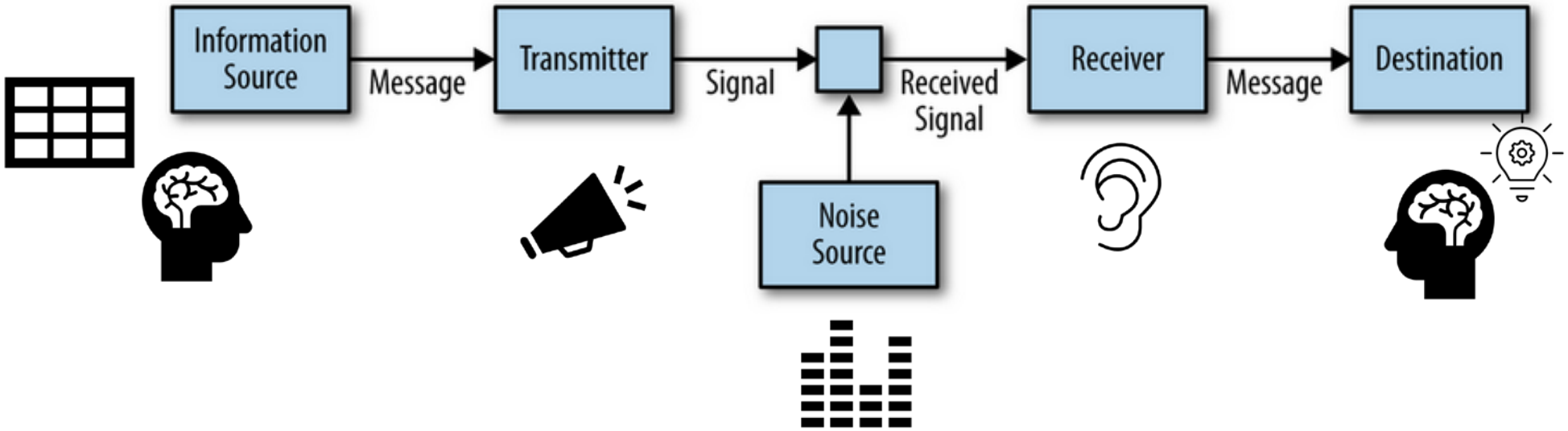
# Principles of Data Communication

**Model of a communication system**




Shannon, Claude E. and Weaver, Warren. 1940. *The Mathematical Theory of Communication*. Urbana: University of Illinois Press.

Source: Jones, Ben. 2014. *Communicating Data with Tableau: Designing, Developing, and Delivering Data Visualizations.* Sebastopol, CA: O'Reilly Media, Inc.

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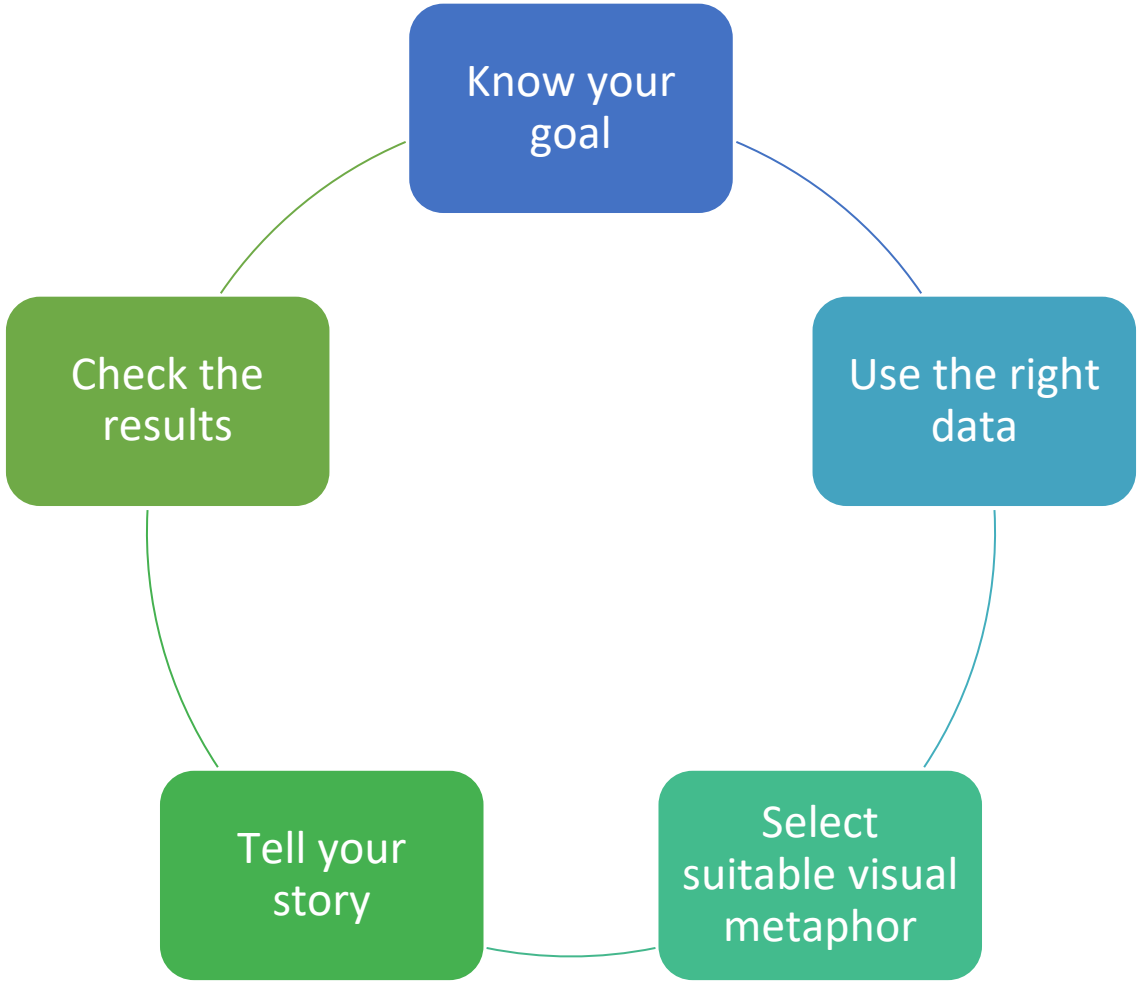
# Principles of Data Communication

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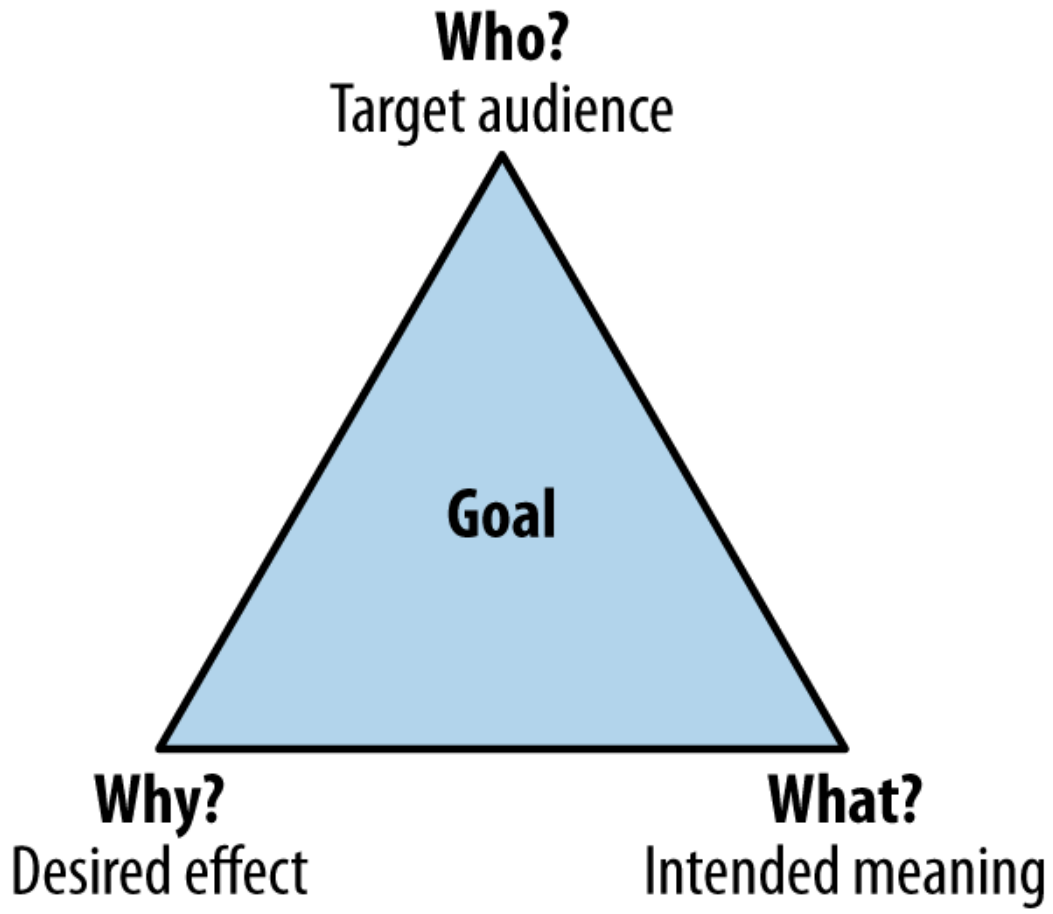
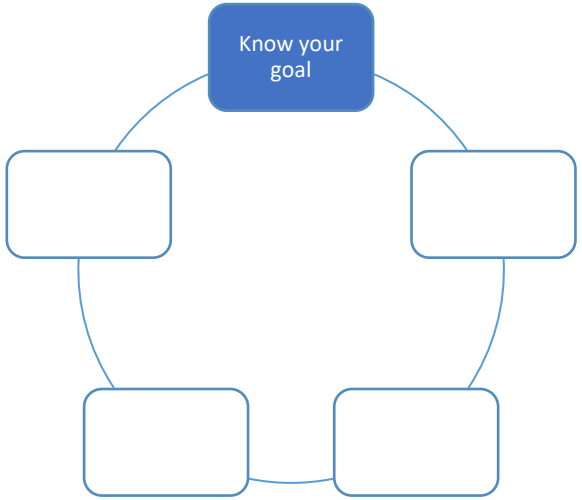
# Know your Goal




Source: Jones, Ben. 2014. *Communicating Data with Tableau: Designing, Developing, and Delivering Data Visualizations.* Sebastopol, CA: O'Reilly Media, Inc.

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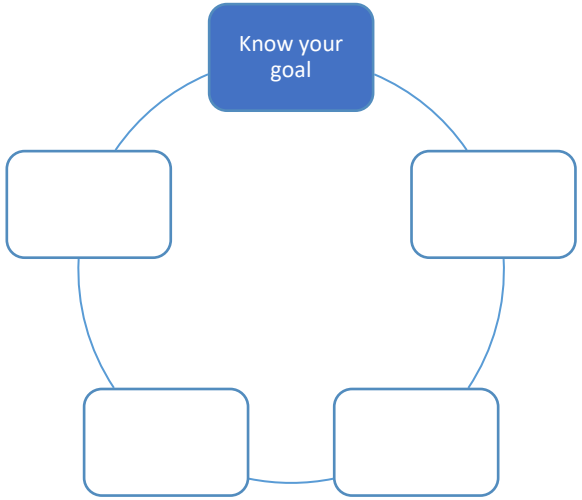
# Know your Goal Example




If your goal is to inform **governments** on differences in <u>educational attainment</u> across regions.

Who is your target audience?

What should the intended meaning of the product be?

What is the desired effect you would like to see?

# Know your Goal Example: Public Health Spending

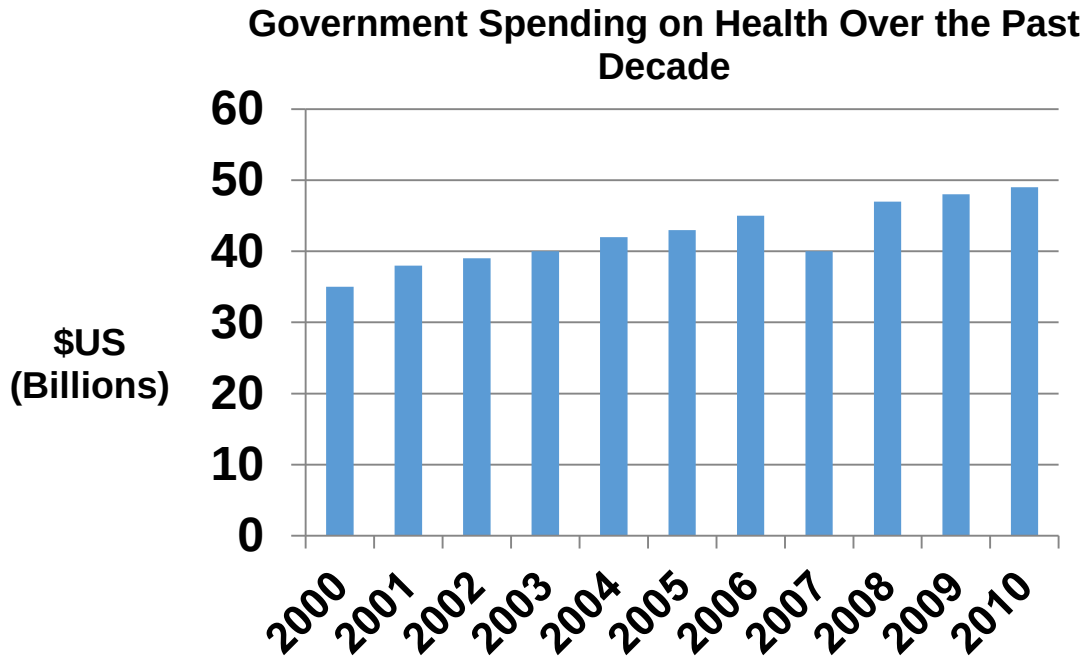
**Example 1**: Original tabular data release of government spending from the Public Health Department in May 2011

| Year | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $Bil. | 35 | 38 | 39 | 40 | 42 | 43 | 45 | 40 | 47 | 48 | 49 |

**Example 2**: Text in a local newspaper from June 2011

"According to data released last month by the Public Health Department, government spending on health rose from $35 billion in 2000 to $49 billion in 2010. The rise was relatively steady, year by year, except for a dip of $5 billion in 2007 due to a temporary cut in the national budget that affected all government agencies."

**Example 3**: Bar chart in a business magazine

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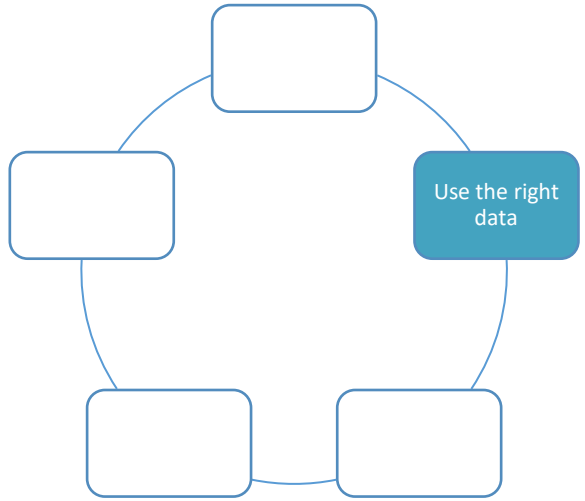
# Use the Right Data

Using the right data involves giving your **target audience enough** data that they understand your **intended meaning** and can act to create your **desired effect**.




This involves balancing many things, like:

- Levels of geography
- Length of time series
- Number of Rows/columns in a table
- Categories included on a graph
- Inclusion of technical language

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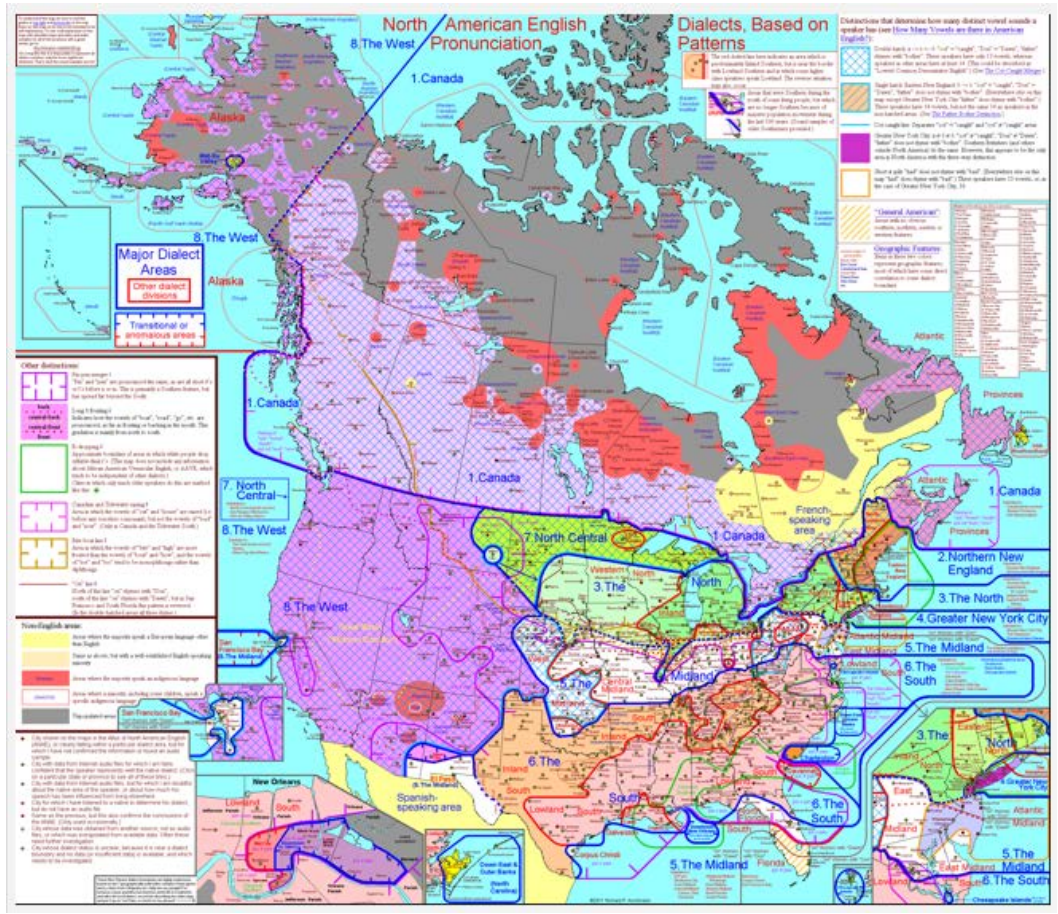
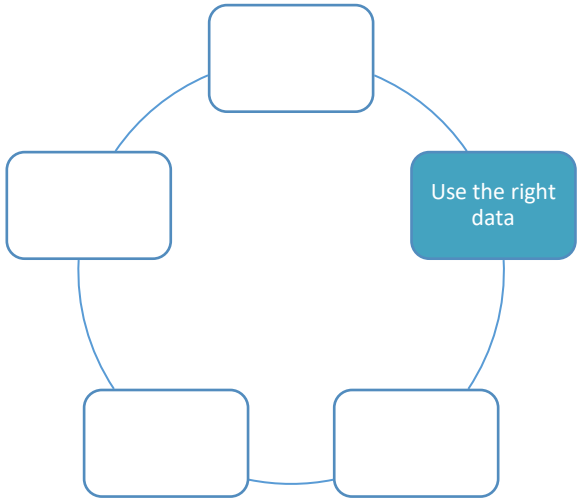
# Use the Right Data, Not all the Data




American English Dialects (aschmann.net)




It is easy to overwhelm users with complexity.

All the information you have is useful, but unorganized.

Produce products that allow your users to avoid organizing the data themselves.

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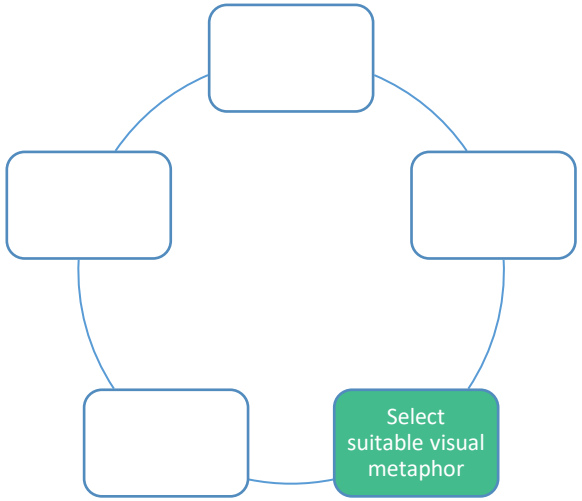
# Select Suitable Visual Metaphor

The are many different types of visualizations that you can set up for a given set of data. But we should choose graphical forms that assist thinking.

These forms should match the dimensionality of the data and should facilitate the intended analytic comparisons.

People naturally make comparisons when presented with information. It is important to account for this natural tendency and design accordingly.




"Good visual metaphors do more than merely encode data - they suggest to the reader how to understand the data…"

- Guidelines and Best Practices for Interactive Data Visualizations, US Census Bureau

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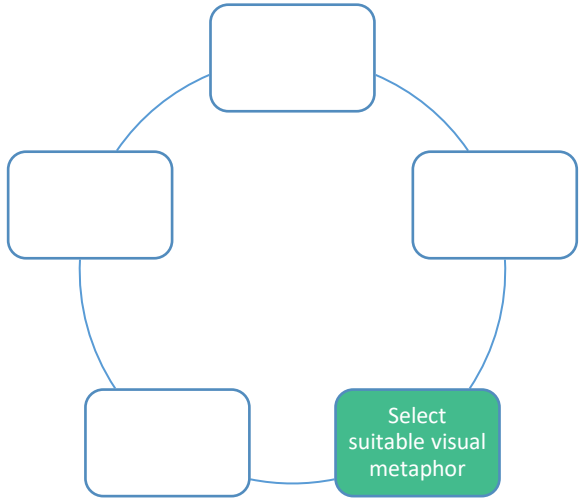
# Select Suitable Visual Metaphor




Visualizations need to:

- Be informative without biasing feelings.
- Combine to build a story that at least partially achieves your goal.
- Present a clear, honest representation of the data.

Considerations for good designs:

- Good design is subtle.
- Design for iconic memory.
- Design for short-term memory challenges.
- Salience and prominence
- Plain language
- Restraint

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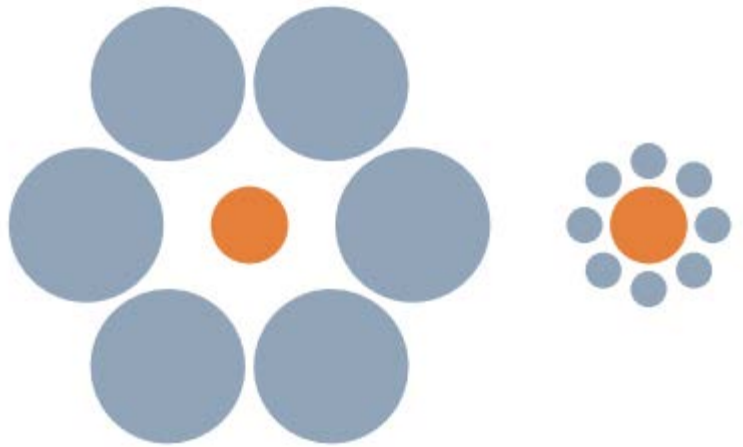
# Be Aware of Visual Perception

Humans perceive visual channels with different levels of accuracy.

**Visual Perception** is affected by:

- Proximity
- Similarity and discriminability
- Grouping
- Separability
- Interference



- Guidelines and Best Practices for Interactive Data Visualizations, US Census Bureau

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# Selecting Suitable Visual Metaphor

“Anyone can put some data into a graphing application and create a graph.”

- Cole N. Knaflic, Storytelling With Data


<u>The Core Five</u>

- Line Chart
- Bar Chart
- Area Chart
- Dots – Lollipop, Dot Plot
- Scatter Plot

<u>Other Visualizations</u>

- Sankey Diagram
- Slope Diagram
- Heat Map
- Timeline
- Trellis Diagram
- Butterfly Chart
- Network Diagram
- Tree Map
- Map

<u>Visuals to Avoid</u>

- Pie and Donut Chart
- Overlapping Charts
- Packet Bubble Chart
- Word Cloud
- Tile Maps
- Symbol Maps

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# The Core Five: Line Chart

**Uses**

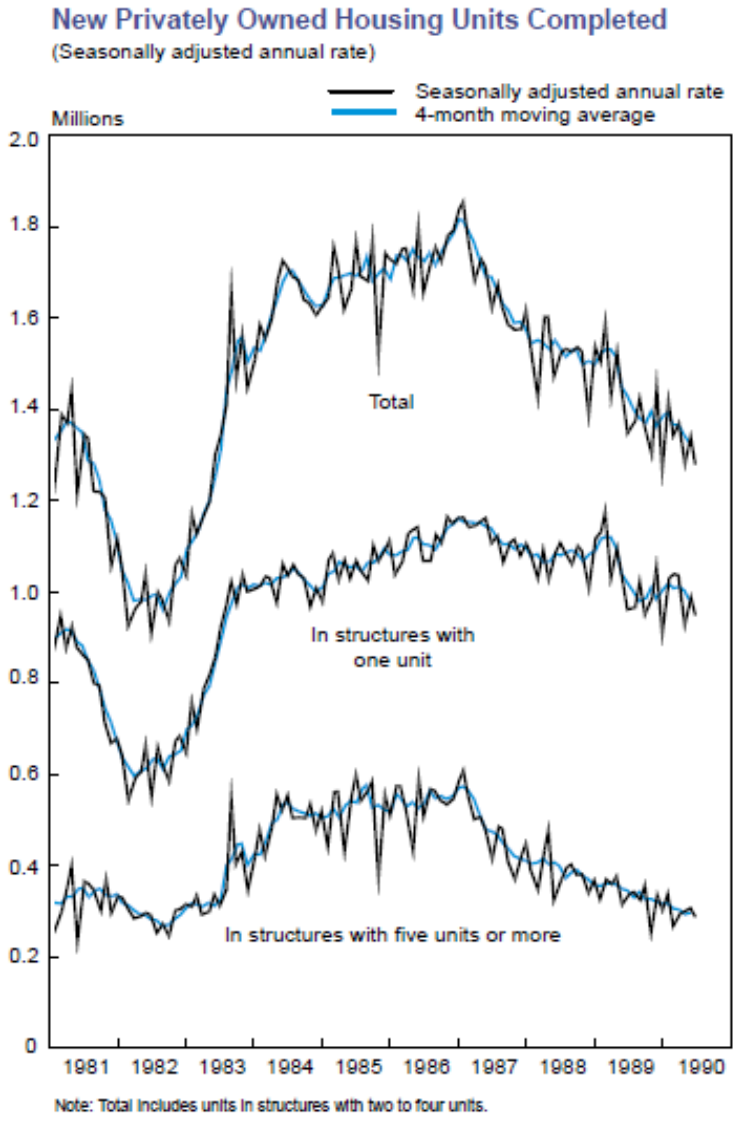
- For **continuous** variables, like time
- When the slope of the line has meaning.

**Visual Metaphor**

- Flight of an arrow or a traveler's path.
- Movement always in one direction.

**Advantages**

- Can present several variables at once.
- Important areas can be highlighted.
- Line type can be varied to indicate times where data might be missing.

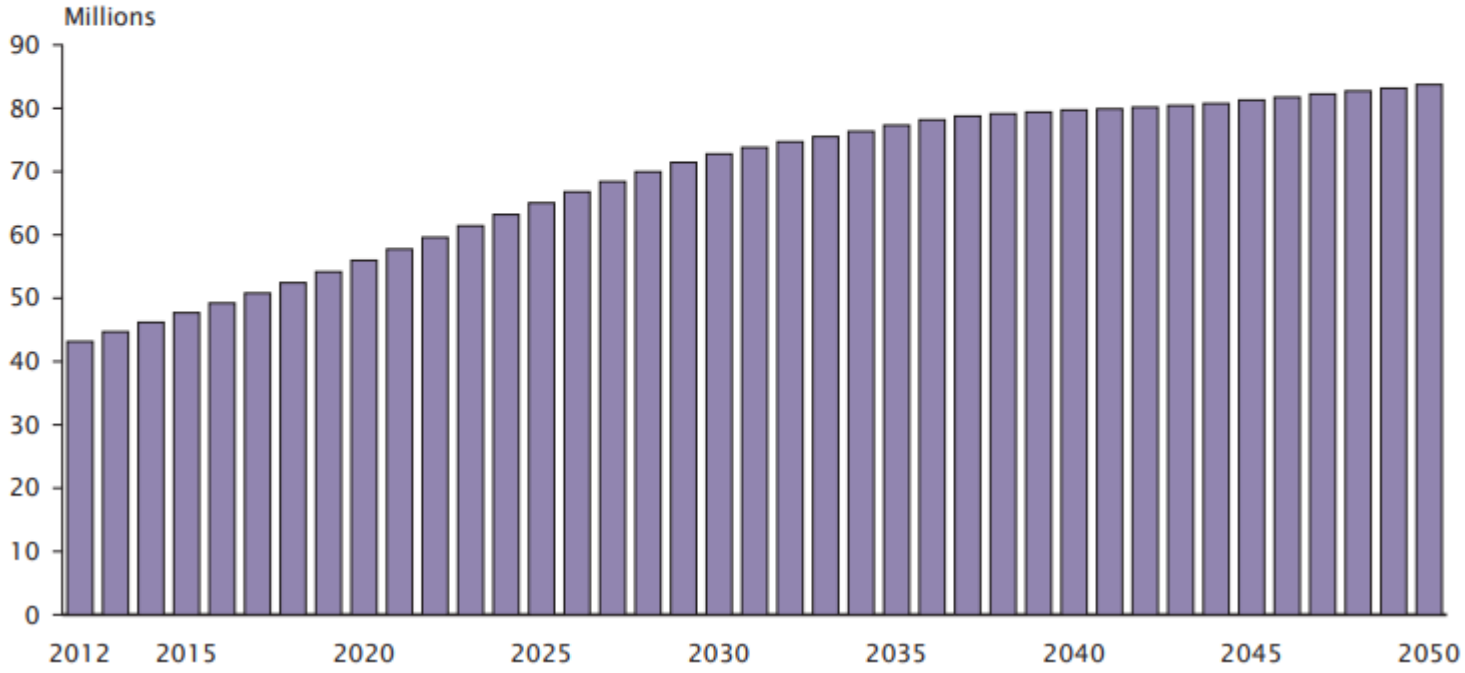


# The Core Five: Bar Chart

Figure 7.

**Bar Chart Example 1**

*The bar chart starts at zero, shows countable data, and gives emphasis to each individual data point.*




**Uses**

- For discrete variables
- Countable measurements
- Relative magnitude

**Visual Metaphor**

- A stack of stuff
- Gravity dictates that a taller stack is more stuff.

**Advantages**

- Simple format for category comparison.
- Emphasize individual points.
- Can easily show rank.
- Many additional dimensions are easily included.

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- Guidelines and Best Practices for Interactive Data Visualizations, US Census Bureau

# The Core Five: Bar Chart Continued

Figure 8.
**Bar Chart Example 2**
*This bar chart uses the vertical axis to show ordered, categorical data and a color change to indicate a second categorical dimension.*

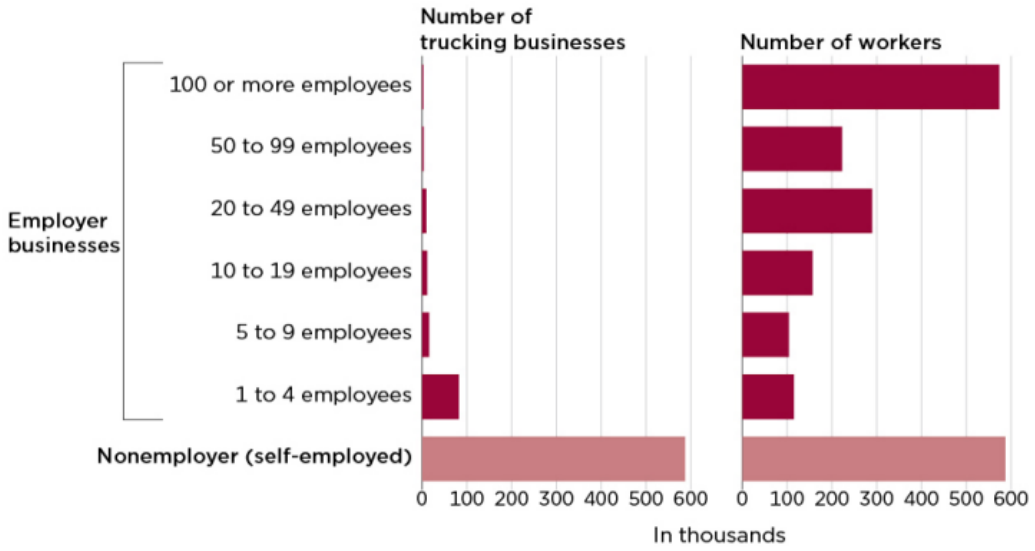
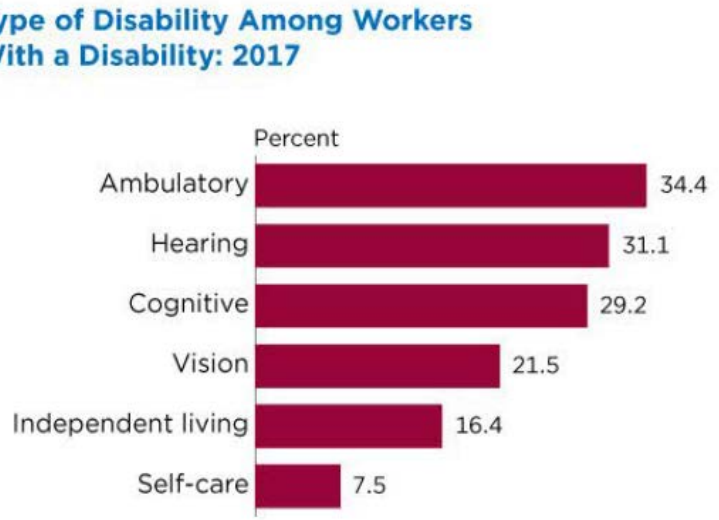



Figure 9.
**Bar Chart Example 3**
*This bar chart shows a list sorted by the quantity represented by the bars, so that the vertical axis can be read as a ranked list. Sorting facilitates comparisons.*

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# The Core Five: Area Chart

Figure 12.
**Stacked Bar Chart Example 1**
*This cumulative graphic facilitates comparisons between the bottom subgroups and the totals, and where the in-between subgroups differ enough that the eye can still perceive it.*

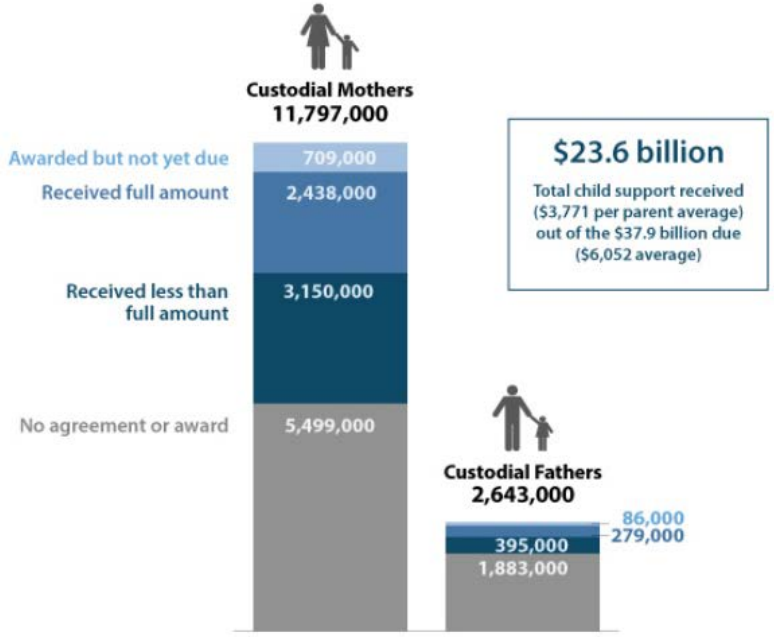
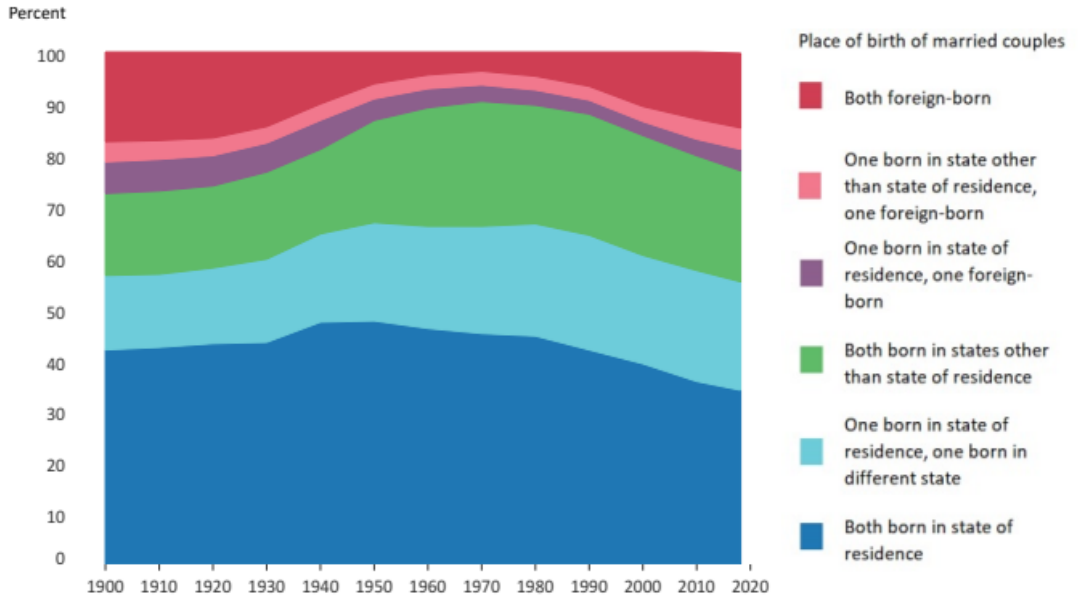



Figure 14.
**Stacked Line Chart Example**
*Area diagrams give a sense of flow, suggesting continuous change. Here, hue (blue, green, red) is used to signify group, order, and relationship among groups.*

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# The Core Five: Dot Charts

Figure 15.
**Lollipop Chart Example**
*Here, the lollipop chart signals a different measure than that in the bars.*

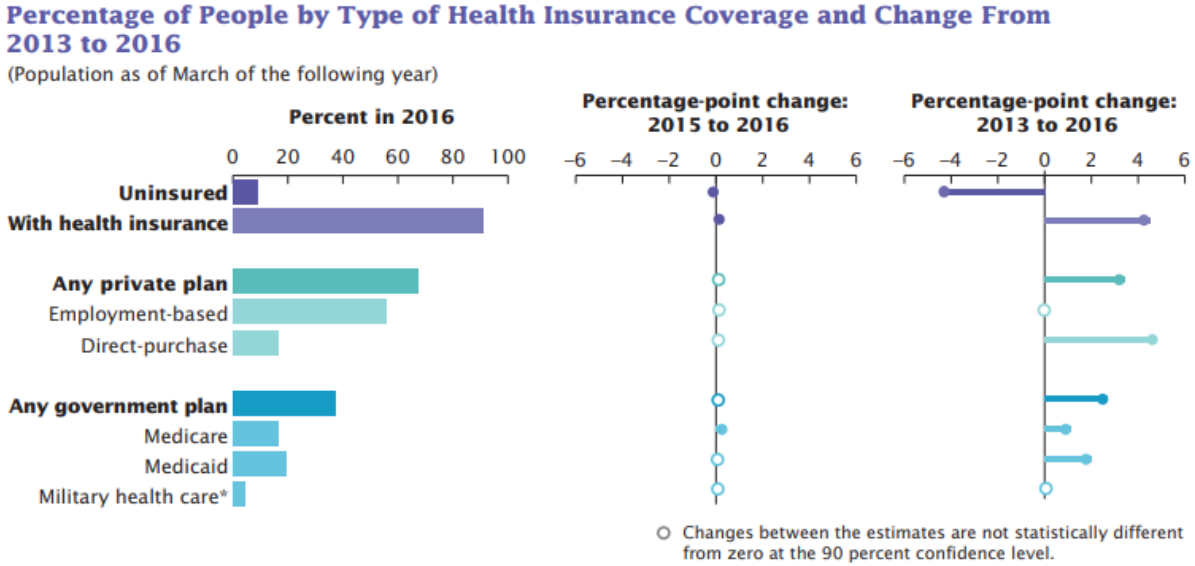
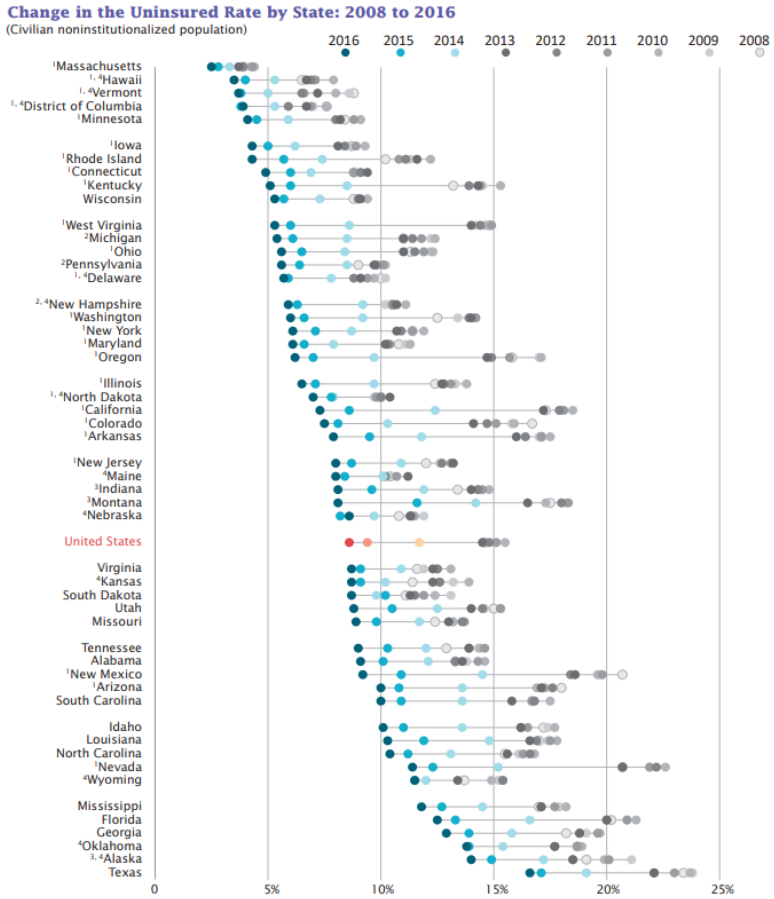



Figure 16.
**Stacked Line Chart Example**
*The state list is sorted by the most current year estimate. The line extends from highest point to lowest point to emphasize the range. White space is used to break up the long list that otherwise creates a dense block of text.*



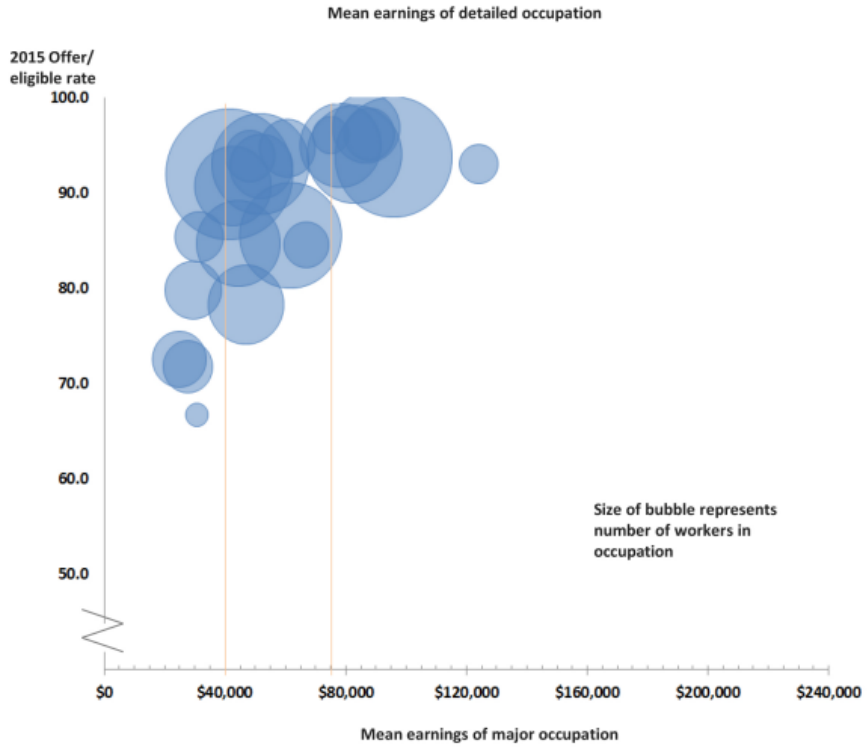

**Uses**
- Alternative to bar chart
- Expressing ratios

**Visual Metaphors**
- Runners in a race
- Beads on a string

- Guidelines and Best Practices for Interactive Data Visualizations, US Census Bureau

# The Core Five: Scatter Plot

Figure 18.
**Scatter Plot Chart Example 1**
*The size of each bubble shows population counts. Transparency helps users see all bubbles. Vertical lines denote analytically relevant areas for the reader.*

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**Uses**
- Show relationships between two continuous variables

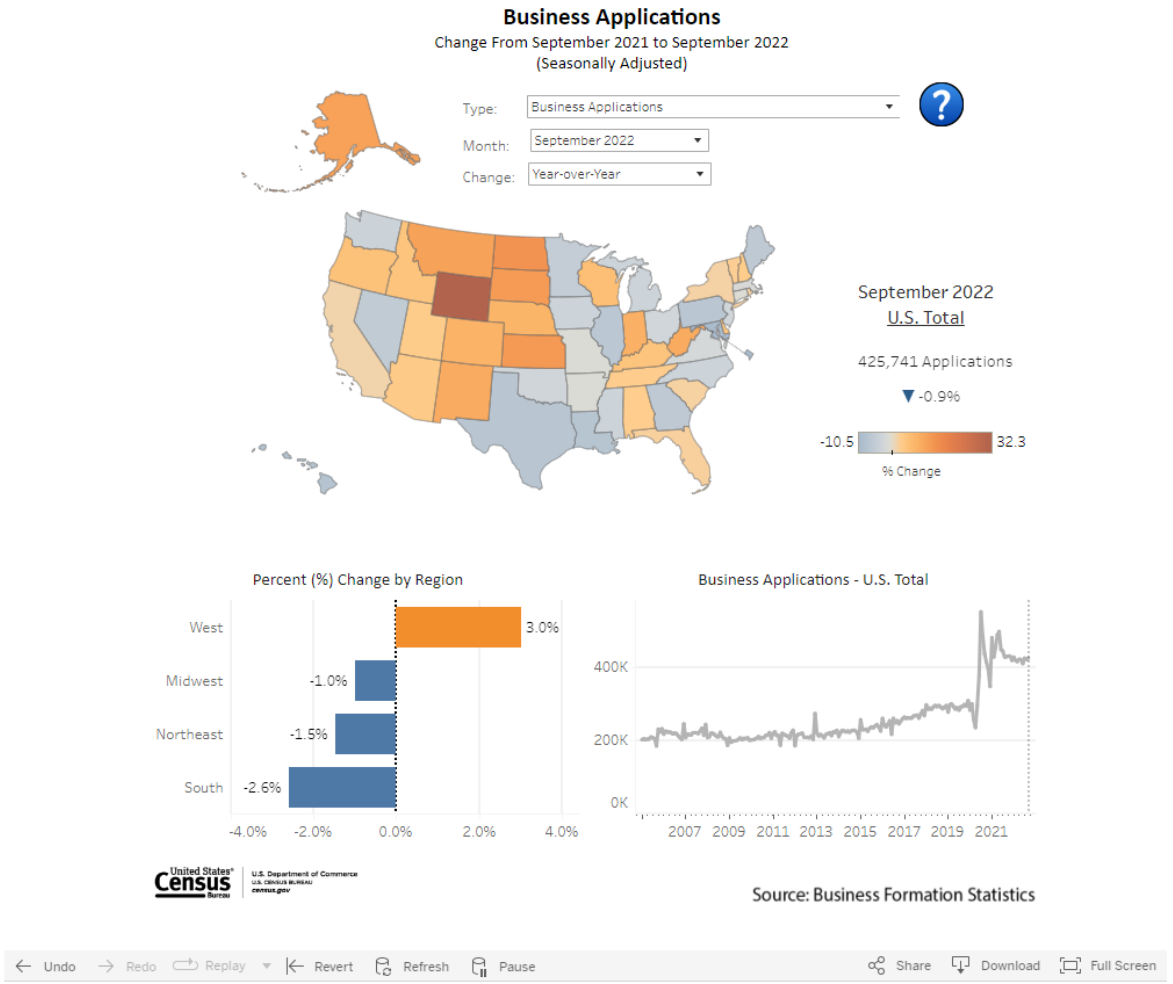
**Visual Metaphor**
- No physical metaphor.
- A map without reference to geography.

**Advantages**
- Additional variables are easy to add.
- Analytically flexible.

# Interactive Visualizations

Good Interactive Visualizations:

- Find a good story.
- Design for the UX.
- Design for the Web.
- Design for interactivity.




[Business Formation Statistics by State (census.gov)]

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# Telling Your Story

“No, no! The adventures first, explanations take such a dreadful time.”

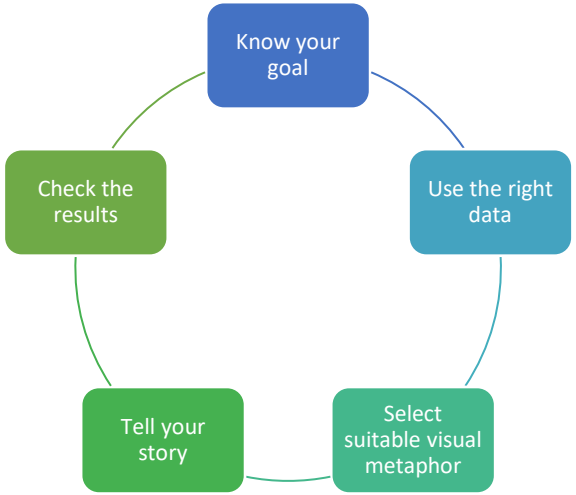
- Lewis Carroll, Adventures in Wonderland

“The purpose of a storyteller is not to tell you how to think, but to give you questions to think upon.”

- Brandon Sanderson, The Way of Kings

Begin at the beginning and go on till you come to the end: then stop.”

- Lewis Carroll, Adventures in Wonderland

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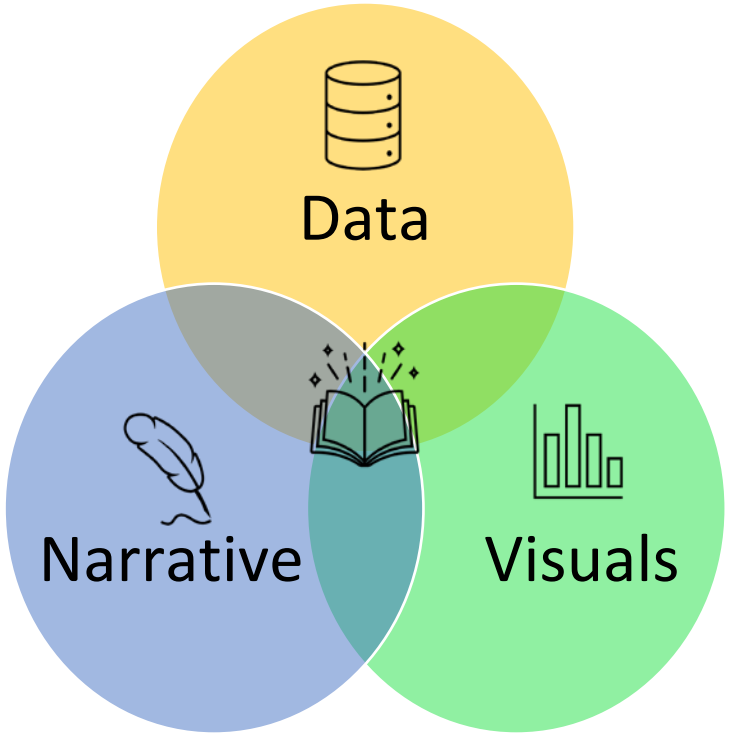
# Creating a Message

When creating your story:

- Give your story a logical narrative flow.
  - Begin at the highest level of data and work down.
  - Start at one point in time and move to another.
- Keep it simple and brief
  - Only highlight noteworthy changes.
  - Prioritize the main takeaway.
- Use facts and numbers creatively, but accurately.
  - Ask: do you have enough data to do this?
  - Provide the complete story, don't cherry-pick.

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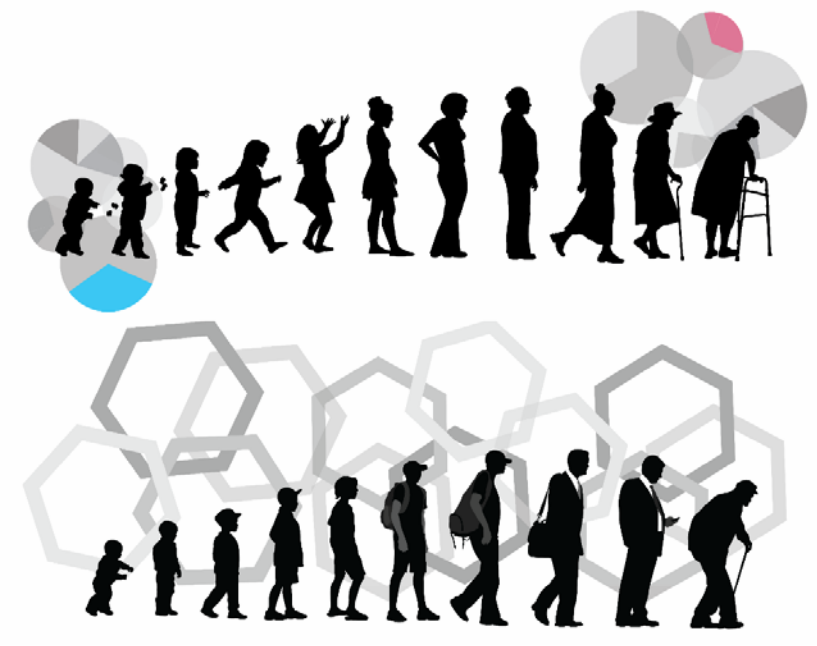
# How to Say It Example


[OECD Better Life Index]


[Cicadas 2021 | Cicadas (juiceboxdata.com)]



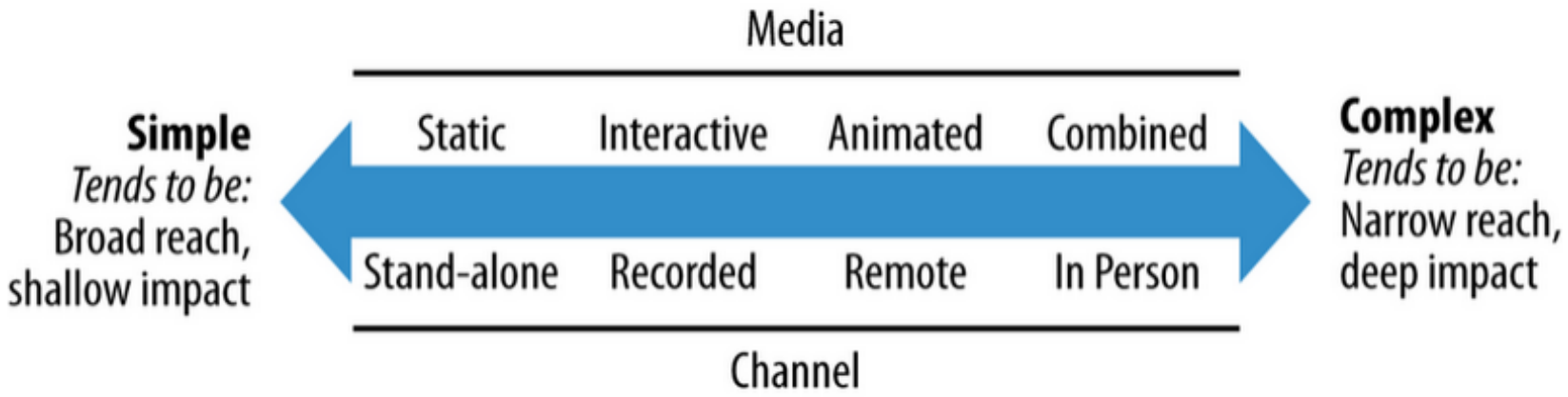
[An Aging World: 2020 (census.gov)]

# Where to Say It

**Medium**
**(Form of the message)**
Paper, electronic, internet
Static, interactive, animated, combined

**Channel**
**(Message delivery method)**
Stand-alone, recorded, remote, in person

## Reach vs. Impact




Source: Jones, Ben. 2014. *Communicating Data with Tableau: Designing, Developing, and Delivering Data Visualizations.* Sebastopol, CA: O'Reilly Media, Inc.

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# Feedback

**Reach**

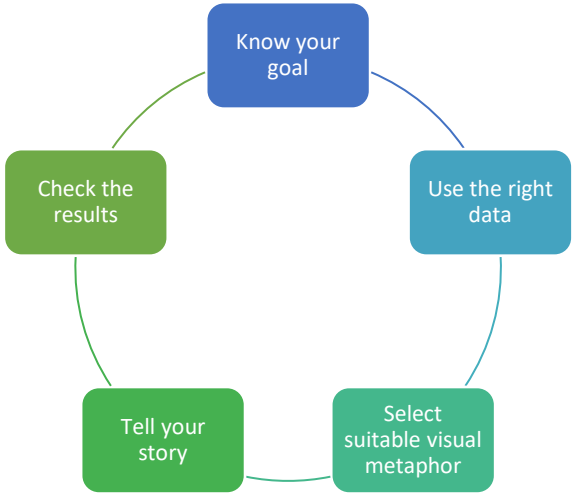
Did the audience even receive your message at all? Who did and who didn't?

**Understanding**

Did the audience interpret the data message in the way you intended?

**Impact**

Did the audience react in the way you wanted them to react?




**Ask people what they need, and they will tell you.**

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