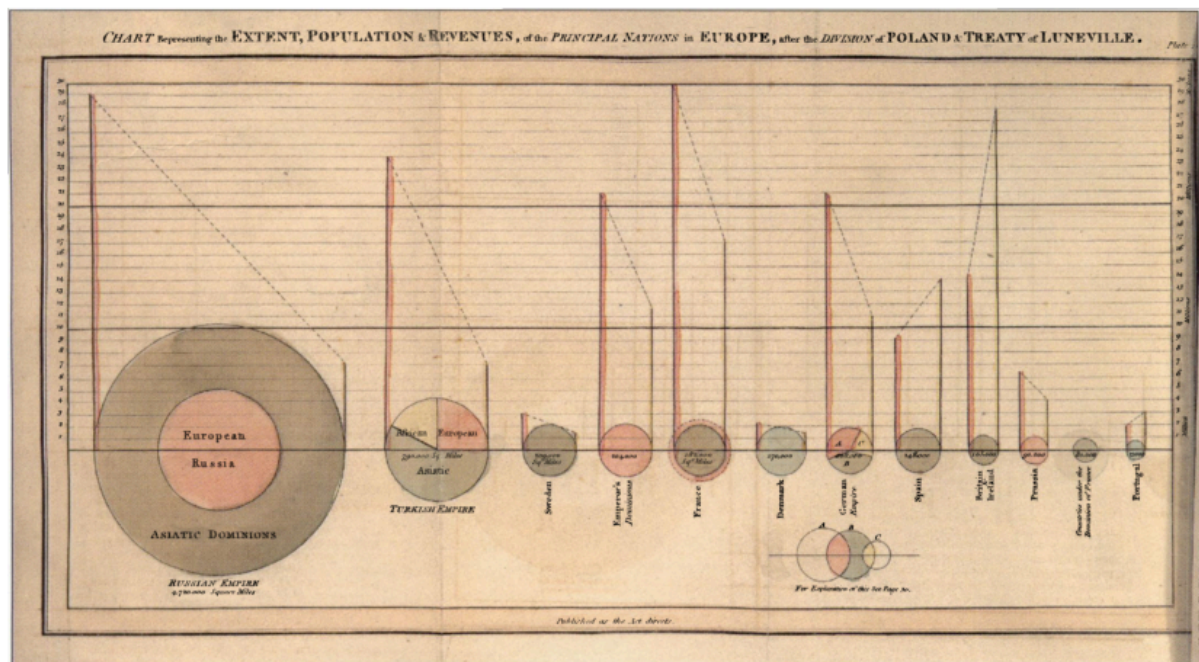


## Part 1: Critique

This first part is a critique of Playfair's data visualization.



- In a paragraph or two, summarize aspects of this graphic that work well to display quantitative information. You may want to refer back to the general principles and vocabulary we've discussed in the past few lectures.

- One aspect of Playfair's graphic that works well is that he used a hierarchy well and ordered the circles in descending order by their sizes. That makes the chart look organized. Additionally, the author used different colors (a bit faded, but contrasting) for the variables, allowing readers to distinguish between the measures of extent, population, and revenue. These design choices effectively apply basic principles of good data visualization, making the chart more interpretable at a glance.

- What aspects of this graph are perhaps not ideal? In other words, what visual elements don't display quantitative information as well as they could? Answer in another paragraph or two. I'd encourage you to think back to the talk on principles of good data visualization for ideas and vocabulary.

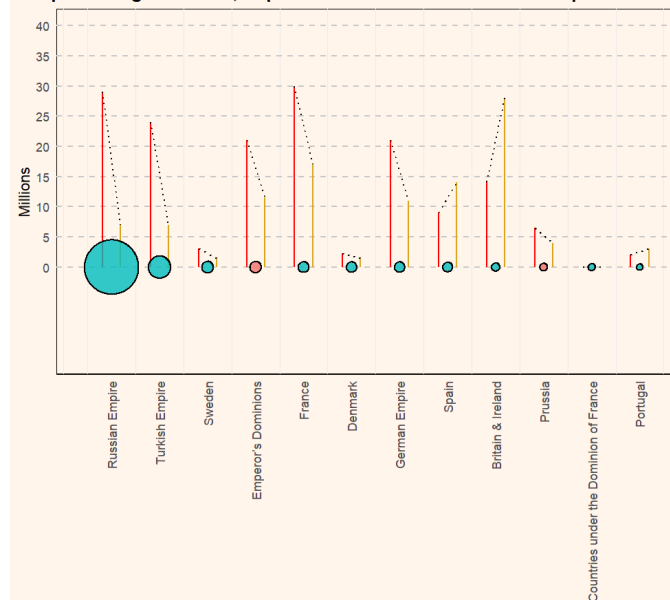
- We can also find some aspects where the visual elements didn't display quantitative information as well as they could. First of all, comparing the sizes of the circles is difficult, especially excluding the first two circles, which makes it challenging for the viewers to accurately find differences in the circles. This shows the limitation of using area to represent quantity as a circle graph, as human perception is less precise in comparing different sizes than with numeric values. Additionally, the gaps between the circles are inconsistent, reducing readability. Adjusting these design choices would make a better chart, which can also improve the readability of the visualization.

- **All things considered, does the graph communicate what it sets out to communicate?**

- Overall, Playfair's graph does give viewers the general idea of how the distribution of extent, population, and revenues in Europe is made. The viewers can see the amount of population and revenues in each country by seeing the red and yellow lines located at the edge of each circle. They can also see the relationship between them by following the dotted lines connecting the red and yellow lines. Like this, the chart did a good job in showing the relationship between population and revenue in different countries. However, the chart didn't effectively display the visualization regarding the extents of different countries to the viewers. Because circle size was used to represent extent, it becomes difficult for viewers to accurately perceive differences, especially among countries of similar size. Therefore, while the graph displayed some of its information well, its clarity and precision in some parts can also be improved.

## Part 2: ggplot Re-creation

Chart Representing the Extent, Population and Revenues of the Principal Nations in Europe



```
library(tidyverse)
library(ggforce)
europe <- read.csv("playfair_european_nations.csv")

europe$Country <- fct_reorder(europe$Country, europe$Area, .desc = TRUE)

#Changing the ratio
#Citation: 7.3. Preprocessing Data. scikit. (n.d.).
https://scikit-learn.org/stable/modules/preprocessing.html#scaling-features-to-a-range
scaling_factor <- max(sqrt(europe$Area / pi))
europe <- europe %>%
  mutate(radius = (sqrt(Area / pi) / scaling_factor) * 4.5)
```

```

ggplot(europe) +

#Adding lines of Population, Taxation, and connecting line
  geom_segment(aes(x = as.numeric(Country) * 8 - 1.5,
                  xend = as.numeric(Country) * 8 - 1.5,
                  y = 0, yend = Population),
              color = "red") +
  geom_segment(aes(x = as.numeric(Country) * 8 + 1.5,
                  xend = as.numeric(Country) * 8 + 1.5,
                  y = 0, yend = Taxation),
              color = "goldenrod") +
  geom_segment(aes(x = as.numeric(Country) * 8 - 1.5,
                  xend = as.numeric(Country) * 8 + 1.5,
                  y = Population, yend = Taxation),
              color = "black", linetype = "dotted") +

  #Citation: GeeksforGeeks. (2021, October 17). How to annotate a plot
  with circle in R.
  https://www.geeksforgeeks.org/r-language/how-to-annotate-a-plot-with-circle-in-r/
  geom_circle(aes(x0 = as.numeric(Country) * 8, y0 = 0, r = radius, fill
= as.factor(Power))), color = "black", alpha = 0.8) +

  labs(title = "Chart Representing the Extent, Population and Revenues
of the Principal Nations in Europe",
       x = NULL, y = "Millions") + guides(fill = "none") +
  scale_y_continuous(limits = c(-15, 40), breaks = seq(0, 40, by = 5)) +

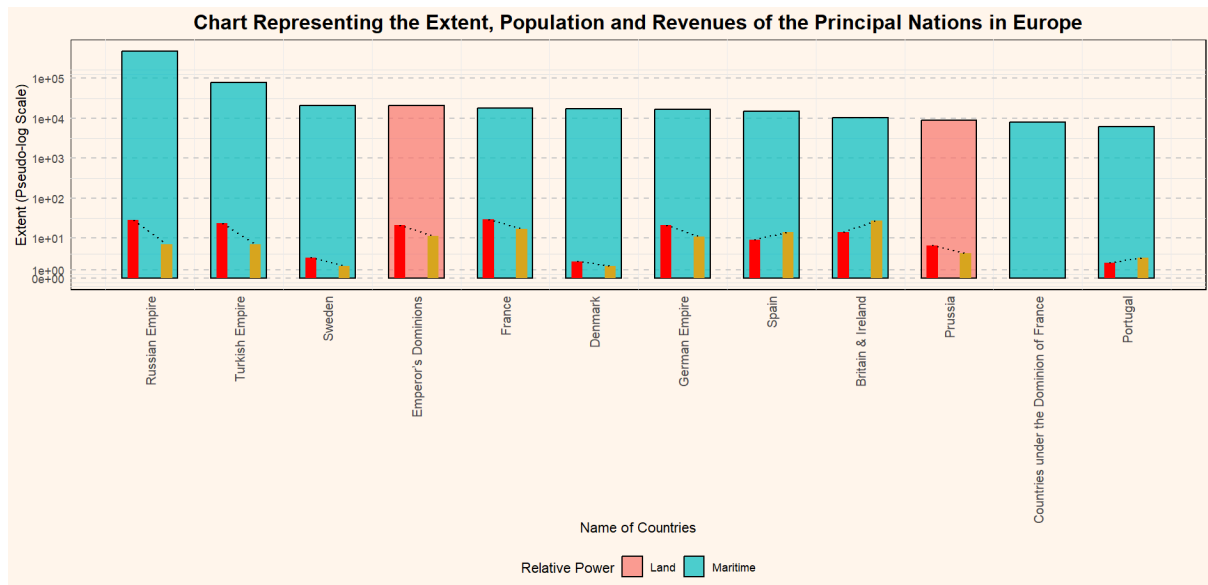
  scale_x_continuous(breaks = (1:12) * 8, labels = europe$Country) +
#citation: Hadley Wickham, D. N. (n.d.). 15 coordinate systems.
ggplot2. https://ggplot2-book.org/coord.html
  coord_fixed(ratio = 1) +

#citation: Hadley Wickham, D. N. (n.d.). 17 coordinate systems.
ggplot2. https://ggplot2-book.org/themes.html
  theme_minimal() +
  theme(
    plot.title = element_text(hjust = 0.5, face = "bold"),
    axis.text.x = element_text(angle = 90, vjust = 0.5, hjust = 1, size
= 9),
    panel.grid.major.y = element_line(color = "grey80", linetype =
"dashed"),
    panel.grid.minor.y = element_blank(),
    panel.grid.major.x = element_blank(), plot.background =

```

```
element_rect(fill = "seashell"),
  panel.background = element_rect(fill = "seashell")
)
```

### Part 3: New Data Visualization



```
library(tidyverse)
library(ggforce)
library(scales)
#Scale functions for visualization. Scale Functions for Visualization •.
(n.d.). https://scales.r-lib.org/
europe <- read.csv("playfair_european_nations.csv")

europe$Country <- fct_reorder(europe$Country, europe$Area, .desc = TRUE)

europe <- europe %>%
  mutate(Area_scaled = Area / 10)

ggplot(europe) +
  #Citation: Hadley Wickham, D. N. (n.d.-a). 3 individual geoms. ggplot2.
  https://ggplot2-book.org/individual-geoms.html#sec-basics
  geom_rect(aes(xmin = as.numeric(Country) * 8 - 2.5,
                xmax = as.numeric(Country) * 8 + 2.5,
                ymin = 0,
                ymax = Area_scaled,
                fill = as.factor(Power)),
            color = "black", alpha = 0.7) +
```

```

geom_rect(aes(xmin = as.numeric(Country) * 8 - 2.0,
              xmax = as.numeric(Country) * 8 - 1.0,
              ymin = 0,
              ymax = Population),
          fill = "red") +

geom_rect(aes(xmin = as.numeric(Country) * 8 + 1.0,
              xmax = as.numeric(Country) * 8 + 2.0,
              ymin = 0,
              ymax = Taxation),
          fill = "goldenrod") +

geom_segment(aes(x = as.numeric(Country) * 8 - 1.5,
                 xend = as.numeric(Country) * 8 + 1.5,
                 y = Population, yend = Taxation),
             color = "black", linetype = "dotted") +

labs(title = "Chart Representing the Extent, Population and Revenues
of the Principal Nations in Europe",
     x = "Name of Countries",
     y = "Extent (Pseudo-log Scale)",
     fill = "Relative Power") +

#Citation: Log transformations - transform_log. - transform_log •
scales. (n.d.). https://scales.r-lib.org/reference/transform\_log.html

scale_y_continuous(
  trans = pseudo_log_trans(sigma = 1),
  labels = label_scientific(),
  breaks = c(0, 1, 10, 100, 1000, 10000, 100000)
) +

scale_x_continuous(breaks = (1:12) * 8, labels = europe$Country) +

theme_minimal() +
theme(
  plot.title = element_text(hjust = 0.5, face = "bold", size = 16),
  plot.subtitle = element_text(hjust = 0.5, size = 12),
  axis.text.x = element_text(angle = 90, vjust = 0.5, hjust = 1, size
= 10),
  panel.grid.major.y = element_line(color = "grey80", linetype =
"dashed"),
  panel.grid.minor.y = element_line(color = "grey90"),
  panel.grid.major.x = element_blank(),
  plot.background = element_rect(fill = "seashell"),
  panel.background = element_rect(fill = "seashell"),
  legend.position = "bottom")

```

#### **Part 4:**

- **Why did you choose the particular aesthetic elements that variables were mapped to? Why were they appropriate?**

- I chose to use bar graphs instead of circles to represent the extent of each country because bar lengths are easier for viewers to compare than circle areas. Human perception is more accurate in comparing lengths side by side than areas, so this decision improves readability and precision. I also kept population and taxation as smaller bars on either side to preserve the comparative relationship Playfair emphasized. With this design, viewers can easily compare not only the extents of different countries but also their populations and revenues within a single chart. Using consistent bar shapes across all variables adds visual balance and allows readers to see overall trends at a glance.

- **Did you make any other decisions that lead to clear communication? You might review the elements from our lectures on good design principles—for example, did you make decisions about colors, spatial organization, etc.?**

- First, I used consistent spacing between countries along the x-axis to improve clarity, which addresses the uneven gaps in Playfair's original chart. I also applied more vivid colors—red for population and goldenrod for revenues—so that viewers can distinguish the bars more easily than in the original. In addition, I transformed the y-values with a pseudo-log scale, which made the extent data more interpretable across countries of varying sizes. Finally, the light background color (seashell) reduces visual strain and helps the colored bars stand out more clearly.

- **Are there any ways in which the graph could be improved, or any ways in which the graph doesn't communicate as clearly as it could? Briefly explain.**

Including three different bar graphs in a single chart may overwhelm viewers, as they need more time to process and understand the relationships among the variables. Using faceting or an alternative design could communicate the information more clearly. In addition, applying a pseudo-log scale is not necessarily the most effective choice for displaying the extent values. Exploring alternative transformations or scaling methods could make the chart easier for viewers to interpret.

- **Finally, does it appear that the data, as presented, supports Playfair's point about taxes?**

Playfair's main point was to show that "England was taxed more heavily than other European nations." My graph also successfully conveys the relationship between population and revenues for each country. One strength of Playfair's graph is that it visually emphasized the large gap between population and revenue, making the contrast more striking than in mine. However, readers can still clearly see in my graph that England paid more tax compared to other nations. Therefore, I believe my graph still supports Playfair's point effectively.