

# Data Visualization (CSCI 627/490)

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## Introduction

Dr. David Koop

# What is Data Visualization?

How is it different from Computer Graphics?

The purpose of computing is about insight, not numbers

- R. W. Hamming

The purpose of **visualization** is about **insight**, not pictures

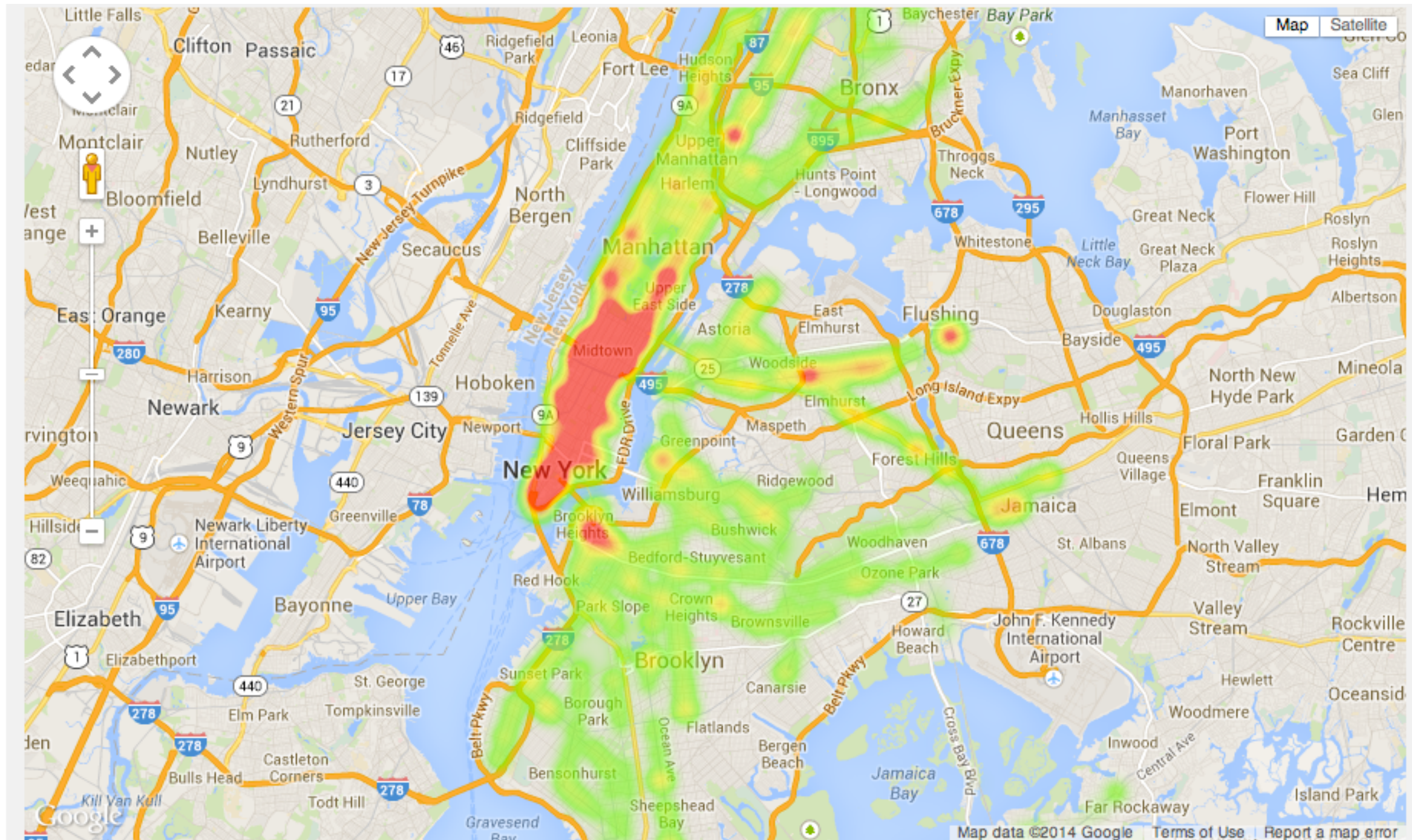
- Card, Mackinlay, Schneiderman

Why do we visualize data?  
(vs. looking at tables?)

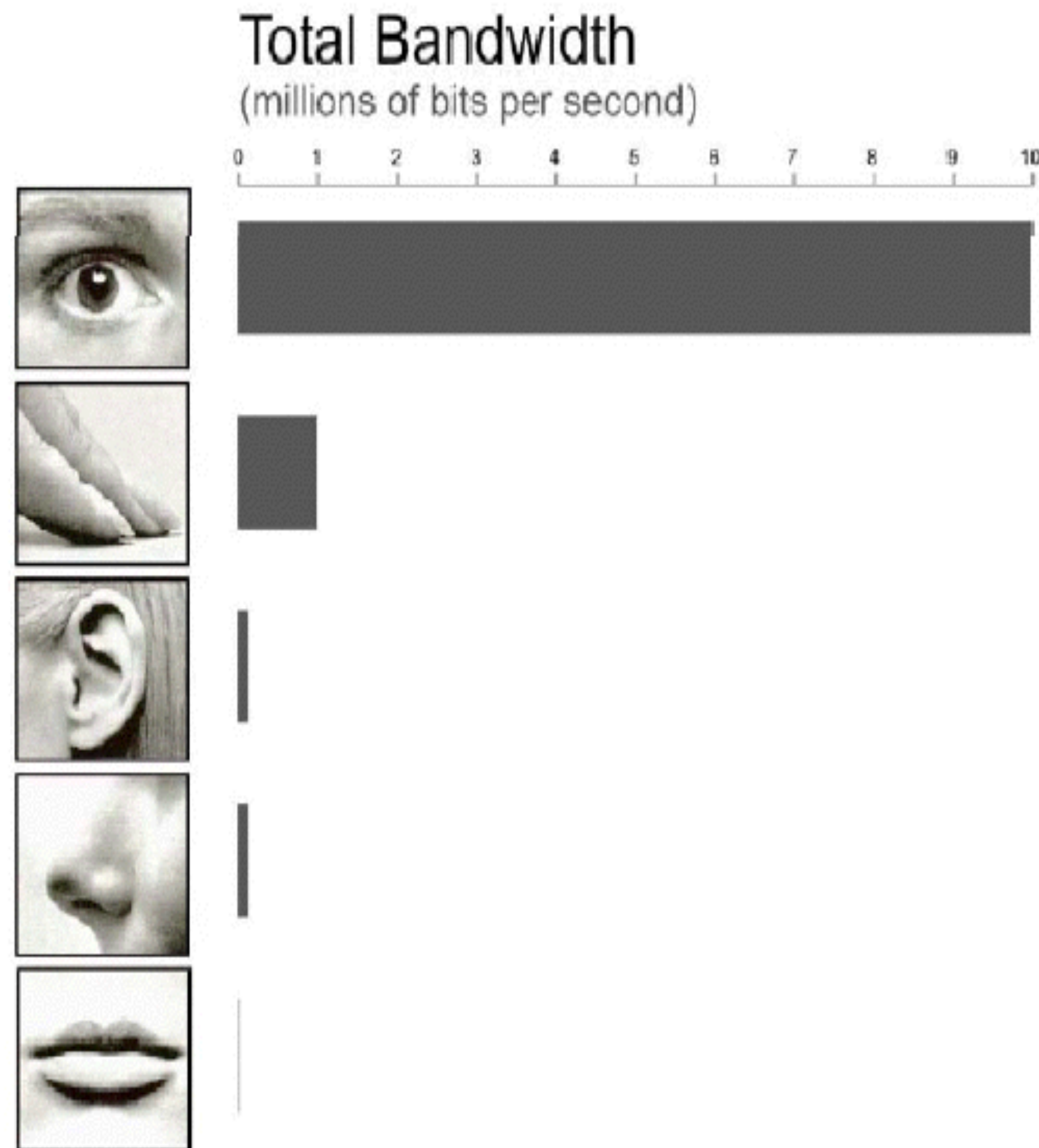
# MTA Fare Data Table

|    | REMOTE | STATION                     | FF ▼     | SEN/DIS  | 7-D AFAS UNL | D AFAS/RMF I | JOINT RR TKT | 7-D UNL  | 30-D UNL |
|----|--------|-----------------------------|----------|----------|--------------|--------------|--------------|----------|----------|
| 1  | R011   | 42ND STREET & 8TH AVENUE    | 00228985 | 00008471 | 00000441     | 00001455     | 00000134     | 00033341 | 00071255 |
| 2  | R170   | 14TH STREET-UNION SQUARE    | 00224603 | 00011051 | 00000827     | 00003026     | 00000660     | 00089367 | 00199841 |
| 3  | R046   | 42ND STREET & GRAND CENTRAL | 00207758 | 00007908 | 00000323     | 00001183     | 00003001     | 00040759 | 00096613 |
| 4  | R012   | 34TH STREET & 8TH AVENUE    | 00188311 | 00006490 | 00000498     | 00001279     | 00003622     | 00035527 | 00067483 |
| 5  | R293   | 34TH STREET - PENN STATION  | 00168768 | 00006155 | 00000523     | 00001065     | 00005031     | 00030645 | 00054376 |
| 6  | R033   | 42ND STREET/TIMES SQUARE    | 00159382 | 00005945 | 00000378     | 00001205     | 00000690     | 00058931 | 00078644 |
| 7  | R022   | 34TH STREET & 6TH AVENUE    | 00156008 | 00006276 | 00000487     | 00001543     | 00000712     | 00058910 | 00110466 |
| 8  | R084   | 59TH STREET/COLUMBUS CIRCLE | 00155262 | 00009484 | 00000589     | 00002071     | 00000542     | 00053397 | 00113966 |
| 9  | R020   | 47-50 STREETS/ROCKEFELLER   | 00143500 | 00006402 | 00000384     | 00001159     | 00000723     | 00037978 | 00090745 |
| 10 | R179   | 86TH STREET-LEXINGTON AVE   | 00142169 | 00010367 | 00000470     | 00001839     | 00000271     | 00050328 | 00125250 |
| 11 | R023   | 34TH STREET & 6TH AVENUE    | 00134052 | 00005005 | 00000348     | 00001112     | 00000649     | 00031531 | 00075040 |
| 12 | R029   | PARK PLACE                  | 00121614 | 00004311 | 00000287     | 00000931     | 00000792     | 00025404 | 00065362 |
| 13 | R047   | 42ND STREET & GRAND CENTRAL | 00100742 | 00004273 | 00000185     | 00000704     | 00001241     | 00022808 | 00068216 |
| 14 | R031   | 34TH STREET & 7TH AVENUE    | 00095076 | 00003990 | 00000232     | 00000727     | 00001459     | 00024284 | 00038671 |
| 15 | R017   | LEXINGTON AVENUE            | 00094655 | 00004688 | 00000190     | 00000833     | 00000754     | 00020018 | 00055066 |
| 16 | R175   | 8TH AVENUE-14TH STREET      | 00094313 | 00003907 | 00000286     | 00001144     | 00000256     | 00038272 | 00074661 |
| 17 | R057   | BARCLAYS CENTER             | 00093804 | 00004204 | 00000454     | 00001386     | 00001491     | 00039113 | 00068119 |
| 18 | R138   | WEST 4TH ST-WASHINGTON SO   | 00093562 | 00004677 | 00000251     | 00000965     | 00000127     | 00031628 | 00074458 |

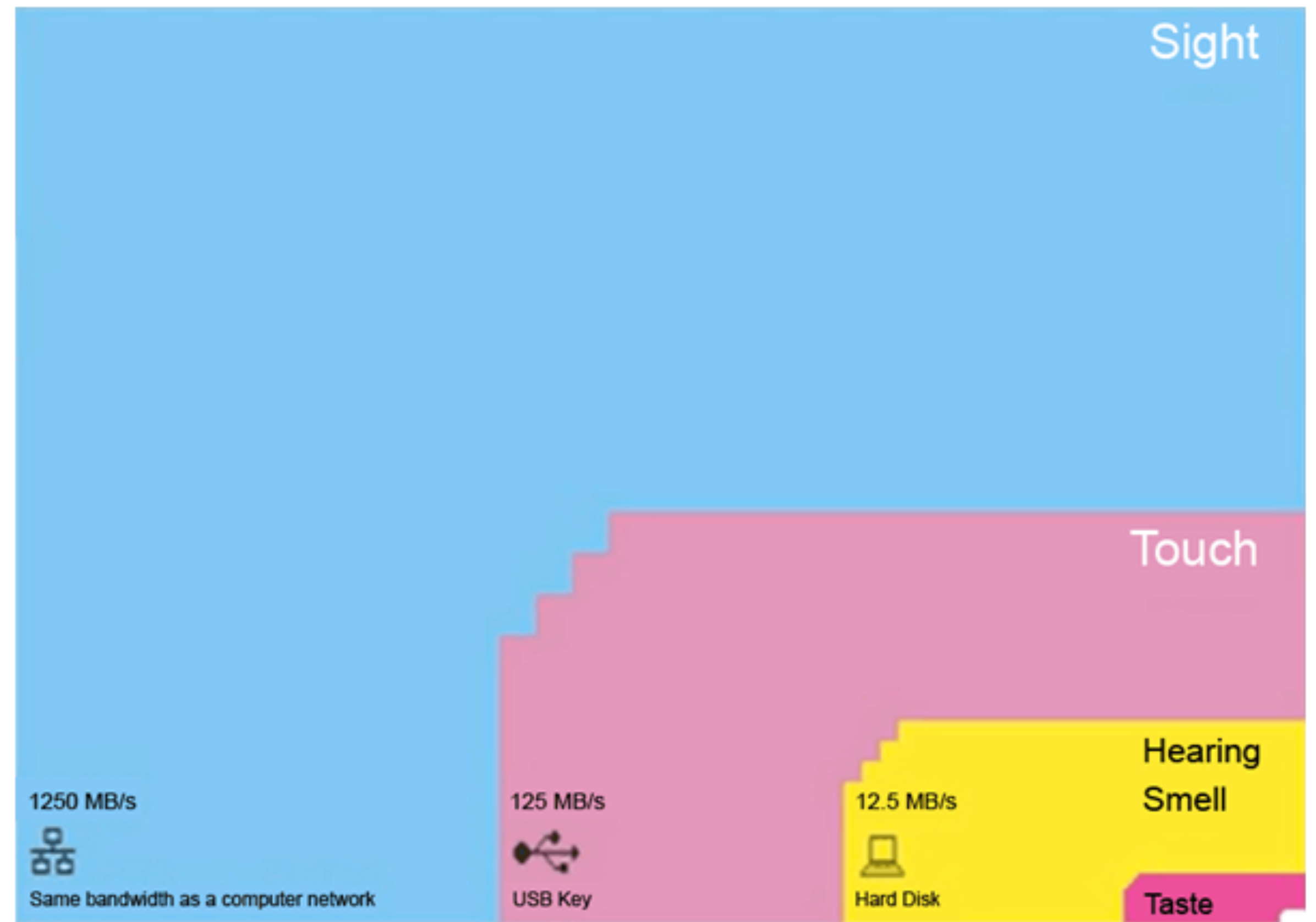
# MTA Fare Data Visualization



# Why do we visualize data?



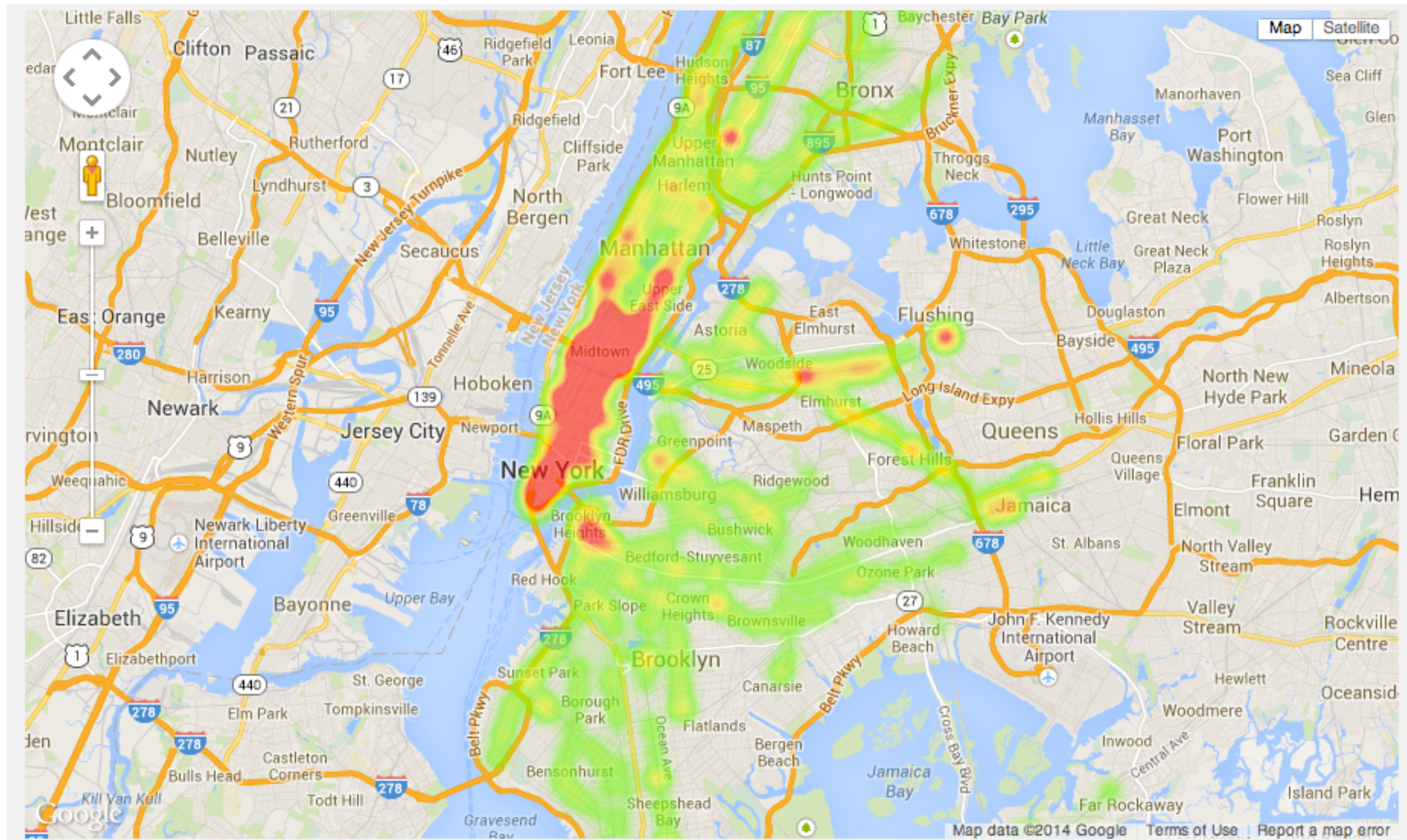
[via A. Lex]



[T. Nørretranders]

What are the purposes for visualization?

# Exploration: Subway Ridership Density

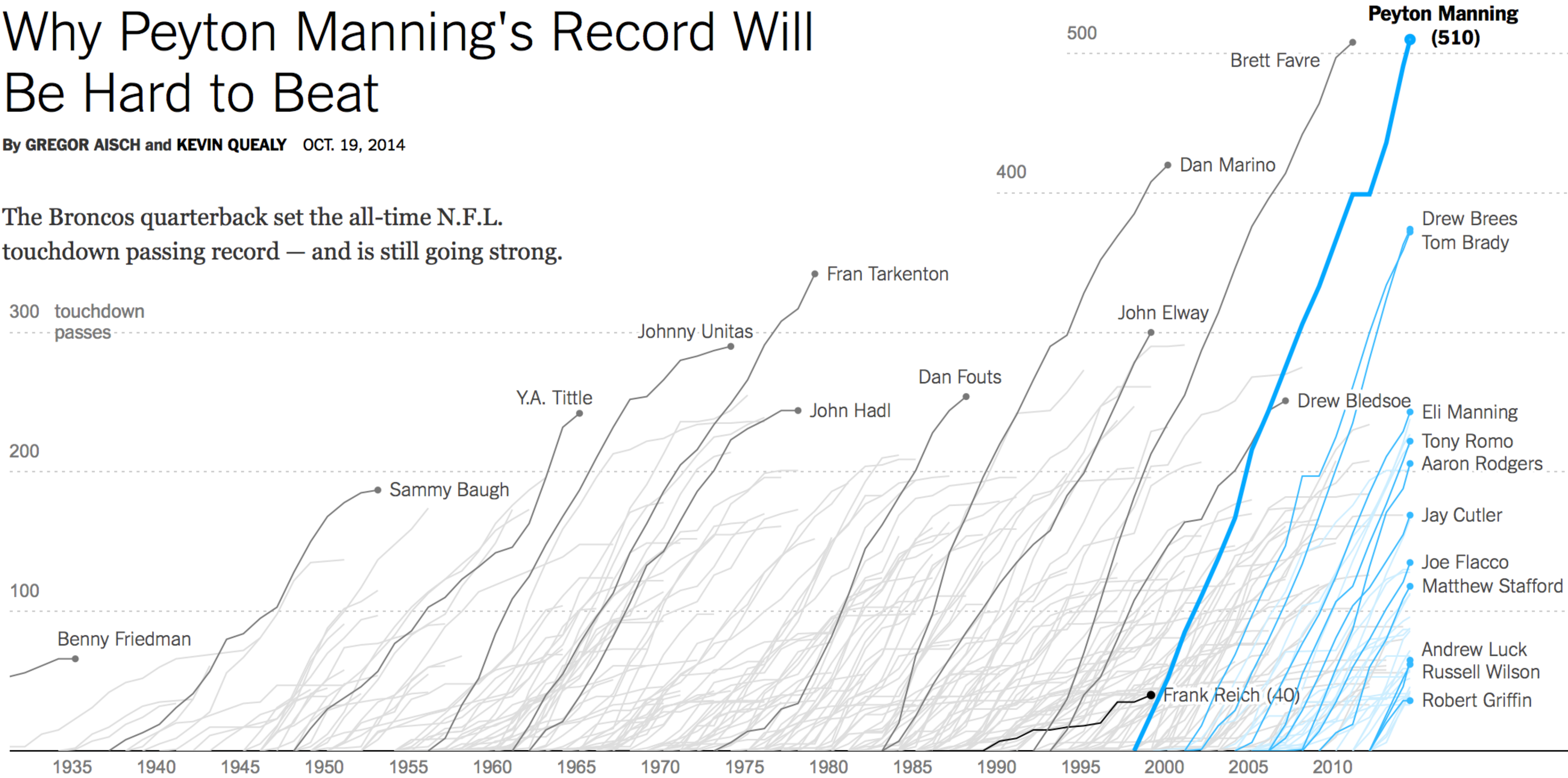


# Communication: Peyton's Records

## Why Peyton Manning's Record Will Be Hard to Beat

By GREGOR AISCH and KEVIN QUEALY OCT. 19, 2014

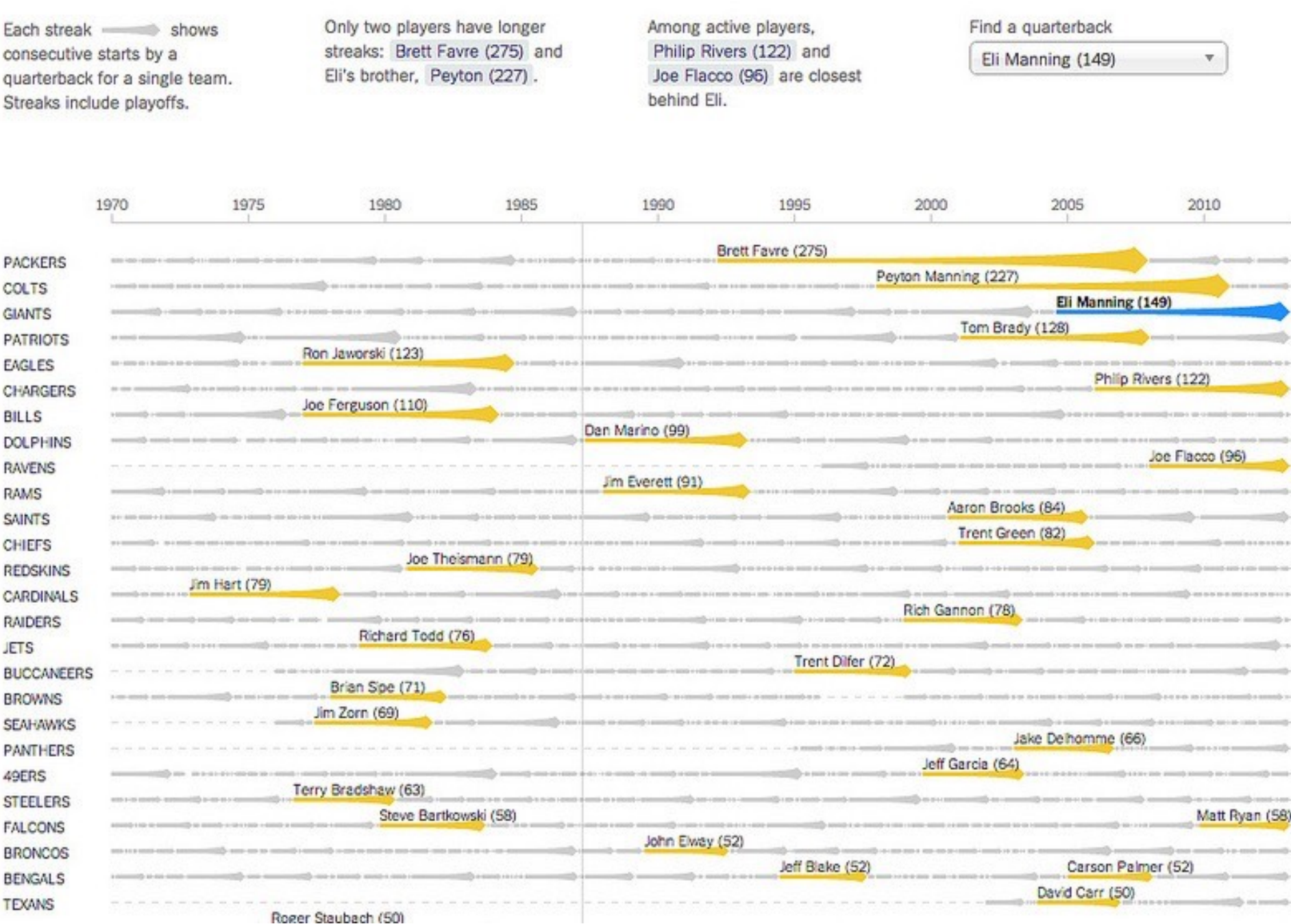
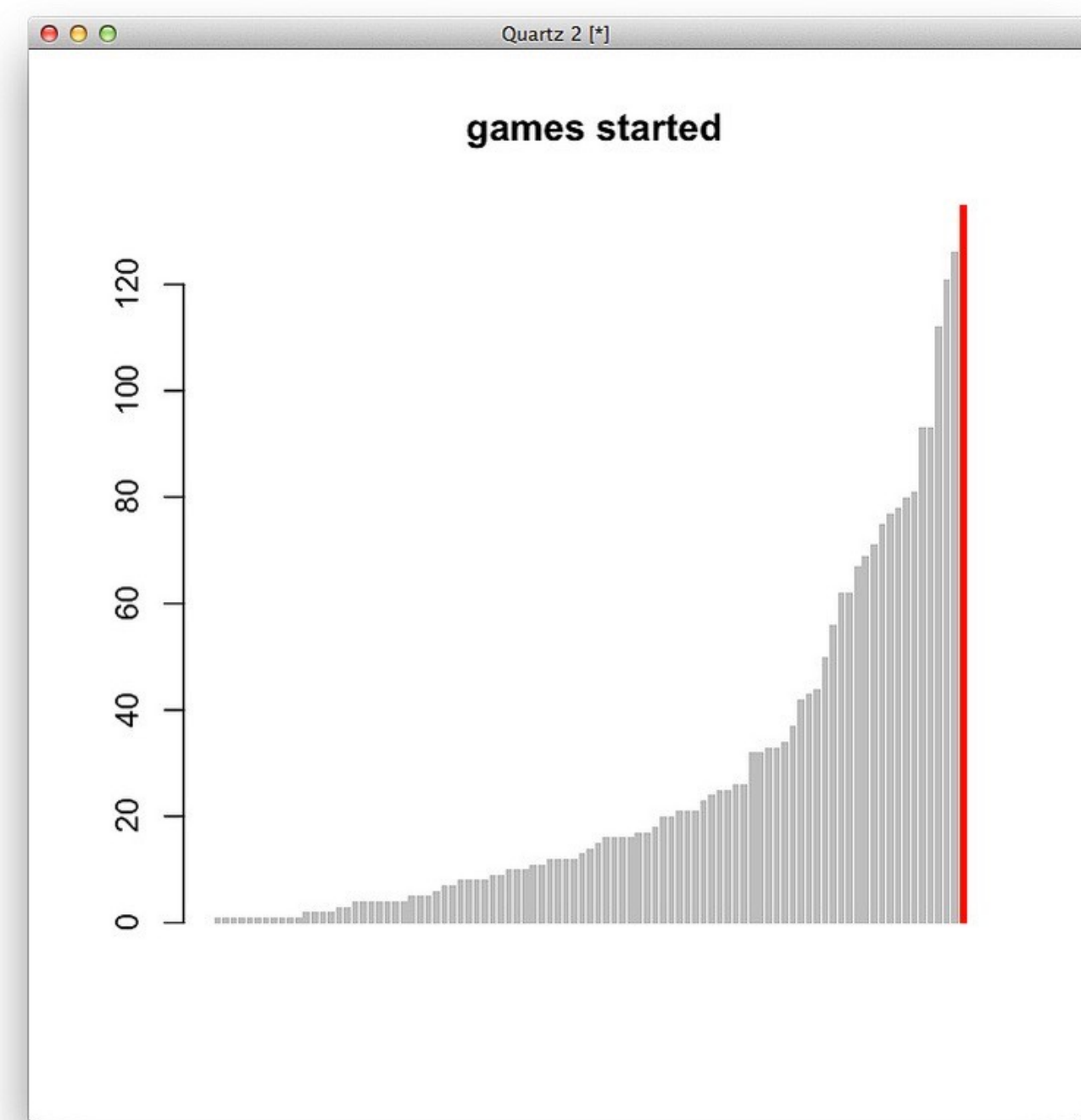
The Broncos quarterback set the all-time N.F.L. touchdown passing record — and is still going strong.



[G. Aisch and K. Quealy, [NYTimes](#)]

# Exploration <-> Communication Spectrum

## Consecutive Starts by a Quarterback for a Single Team



Exploration

Confirmation

Communication

Questions

Answers/Persuasion

[K. Quealy, 2013]

What types of data can we visualize?

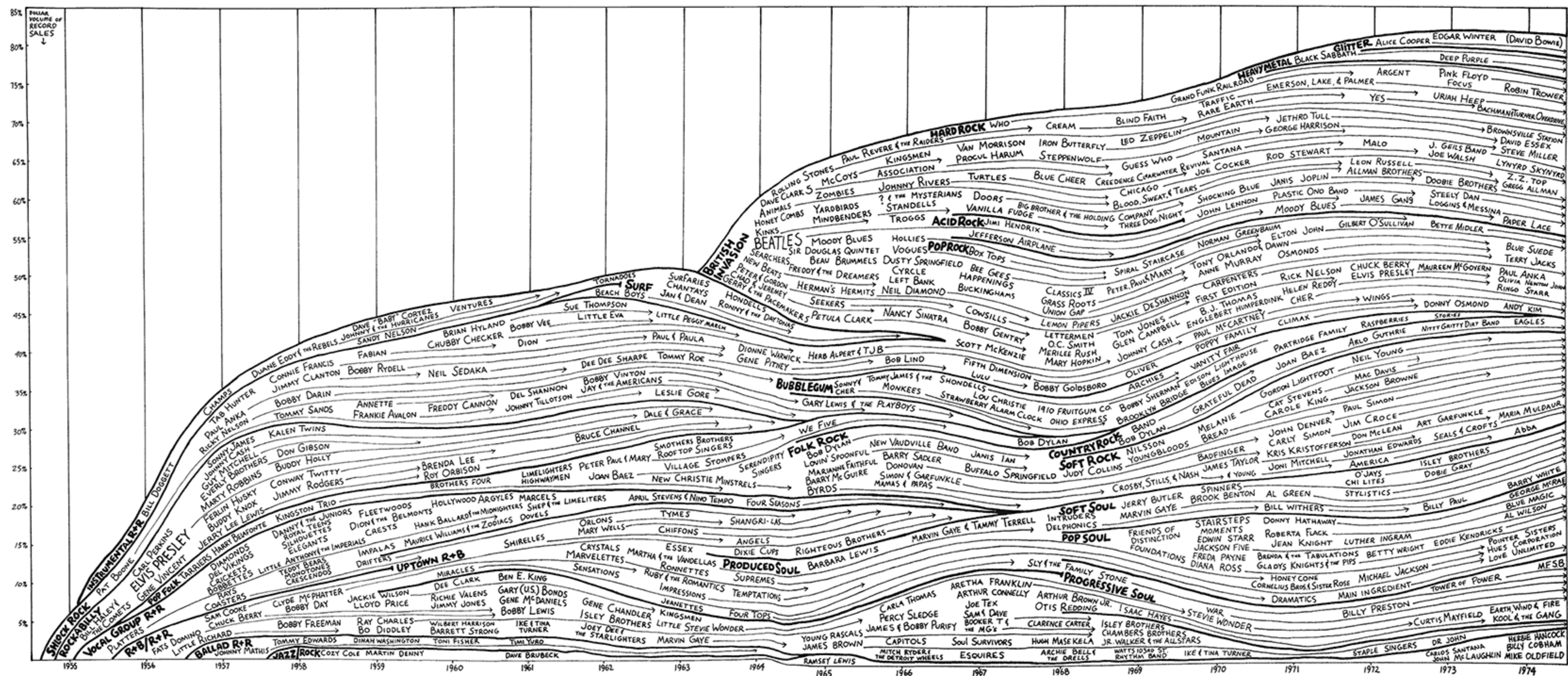
# Types of Data

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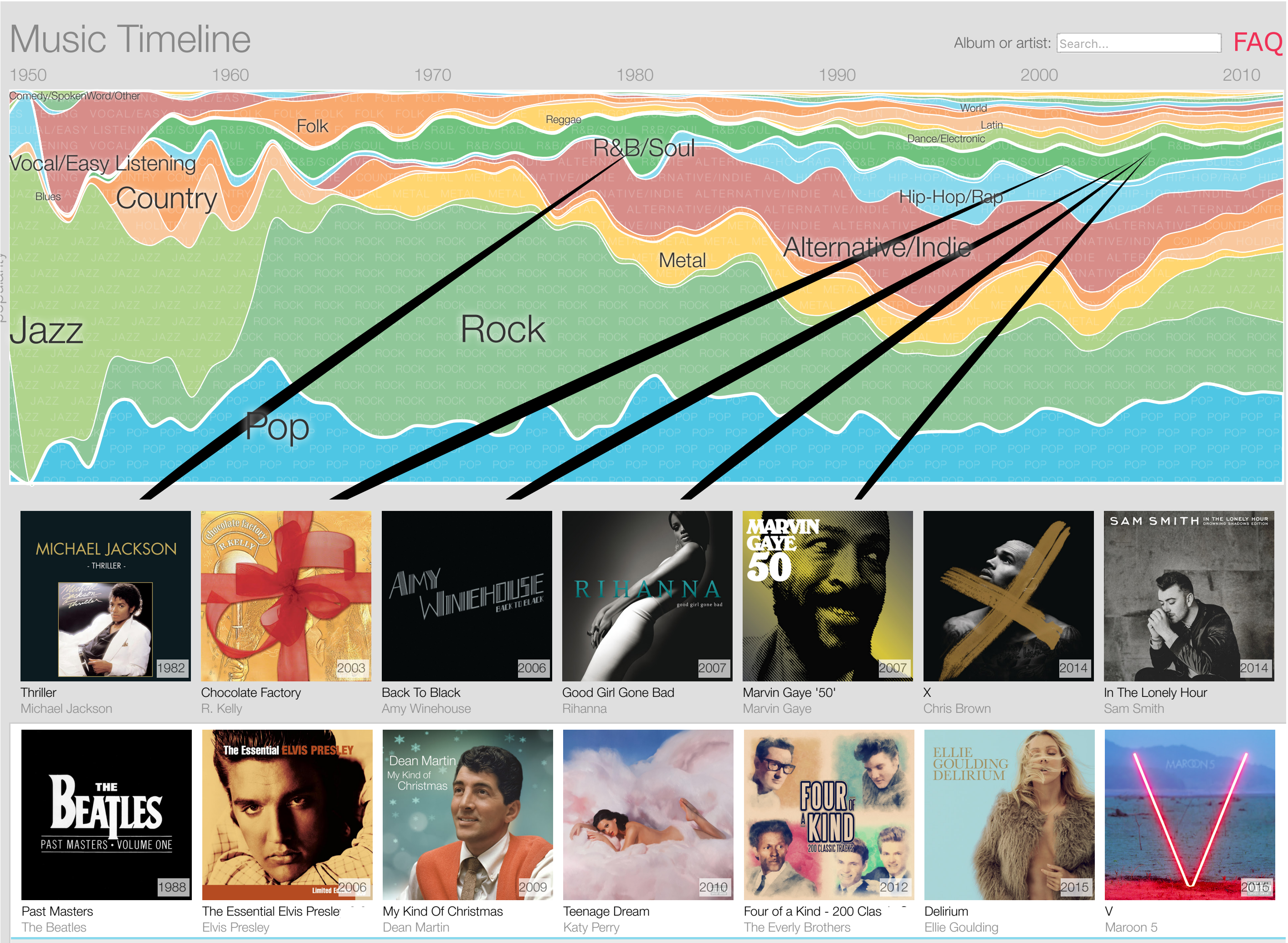
- Tables
- Networks (Graphs)
- Spatial Data
  - Geography
  - Physical (e.g. Scientific, Medical)
- Text
- Sets

Where have you seen visualizations?

# Books / Posters



[Rock 'N' Roll is Here to Pay, R. Garofalo, 1977 (via Tufte)]



[Music Timeline, Google Research]

What is the advantage of the second version?

# Interaction

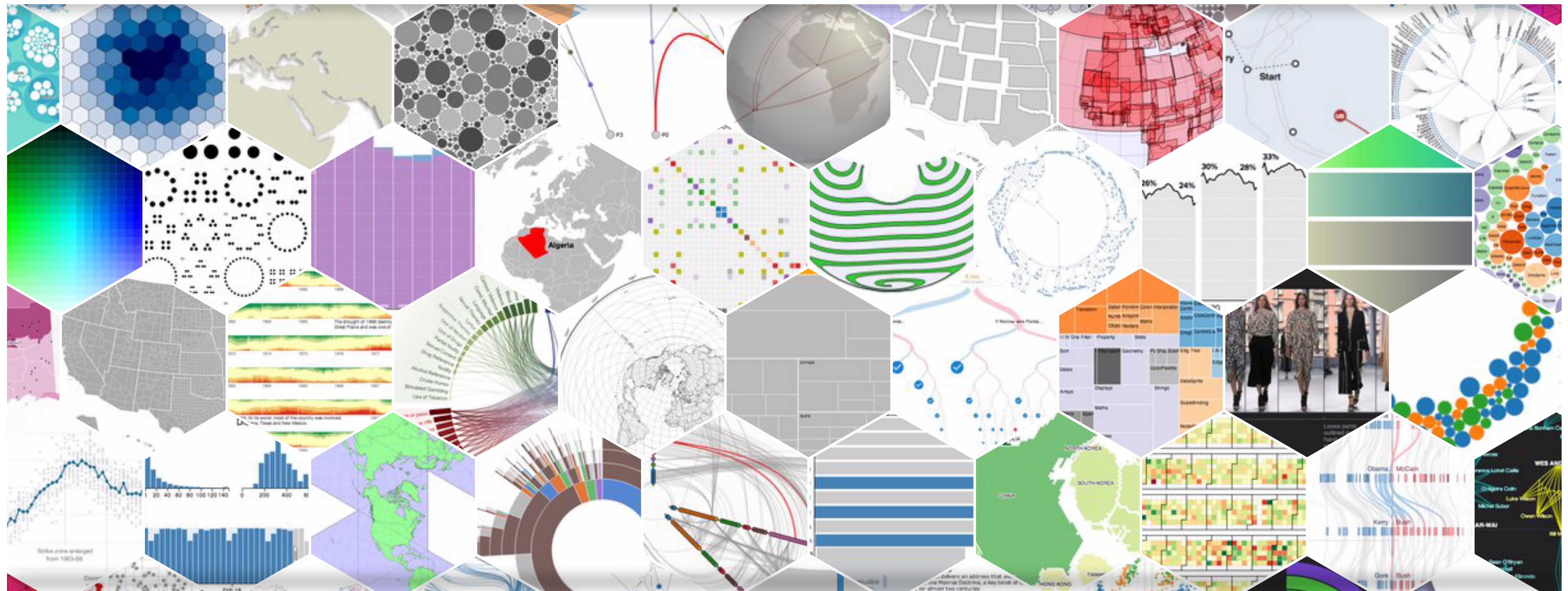
How do we create modern visualizations?

# Tools

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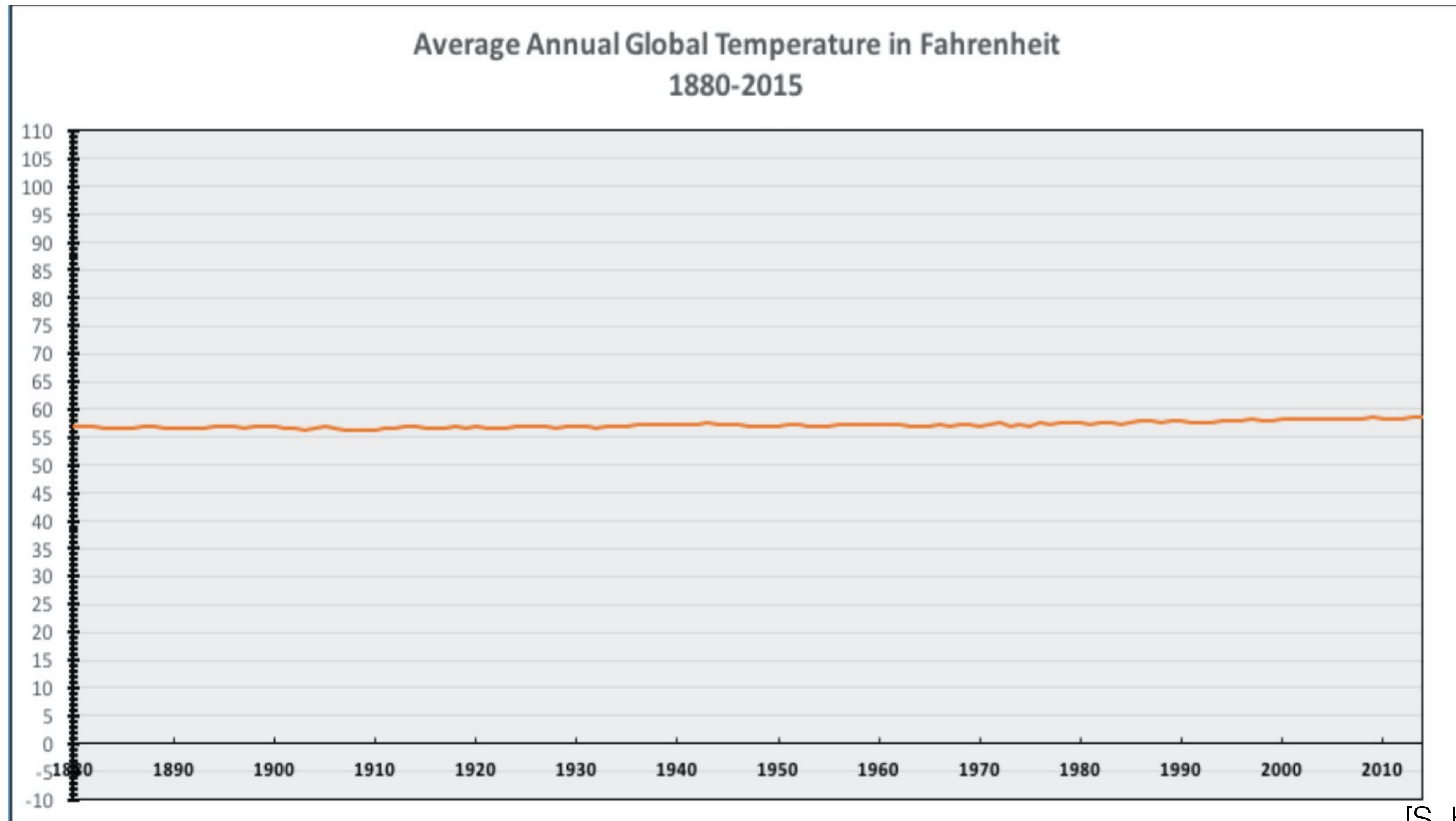
- Desktop Applications:
  - Excel (see [excelcharts.com](https://www.excelspider.com/excelcharts.com))
  - Tableau
  - ...
- Grammars:
  - Vega-Lite
- Programming Frameworks
  - d3.js
  - deck.gl, MapboxGL
  - ...
- Tradeoffs
  - Speed
  - Customization
  - Understanding
  - Dissemination

d3.js



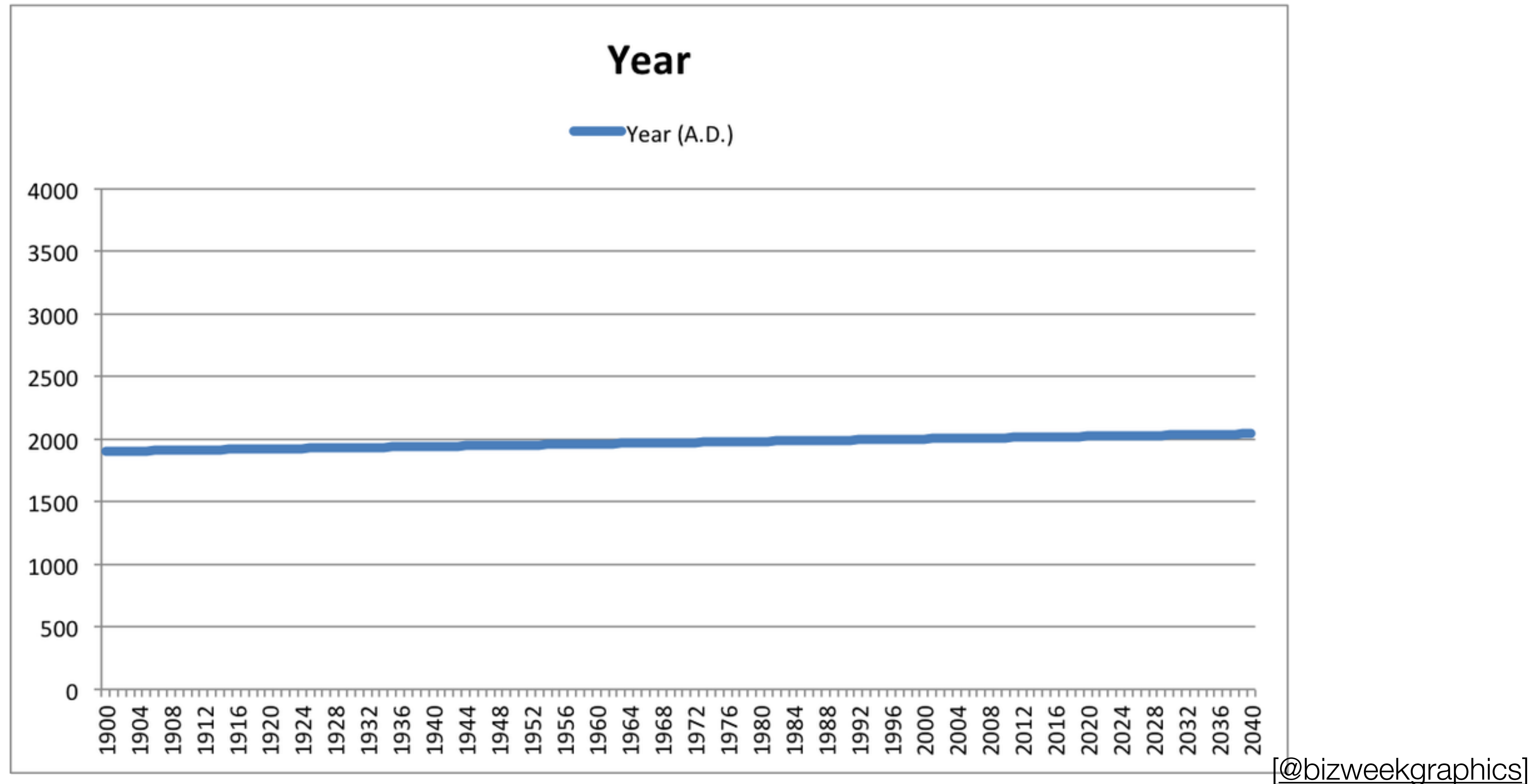
Why do we care about the design of visualizations?

# Design: Focus on only the y-axis

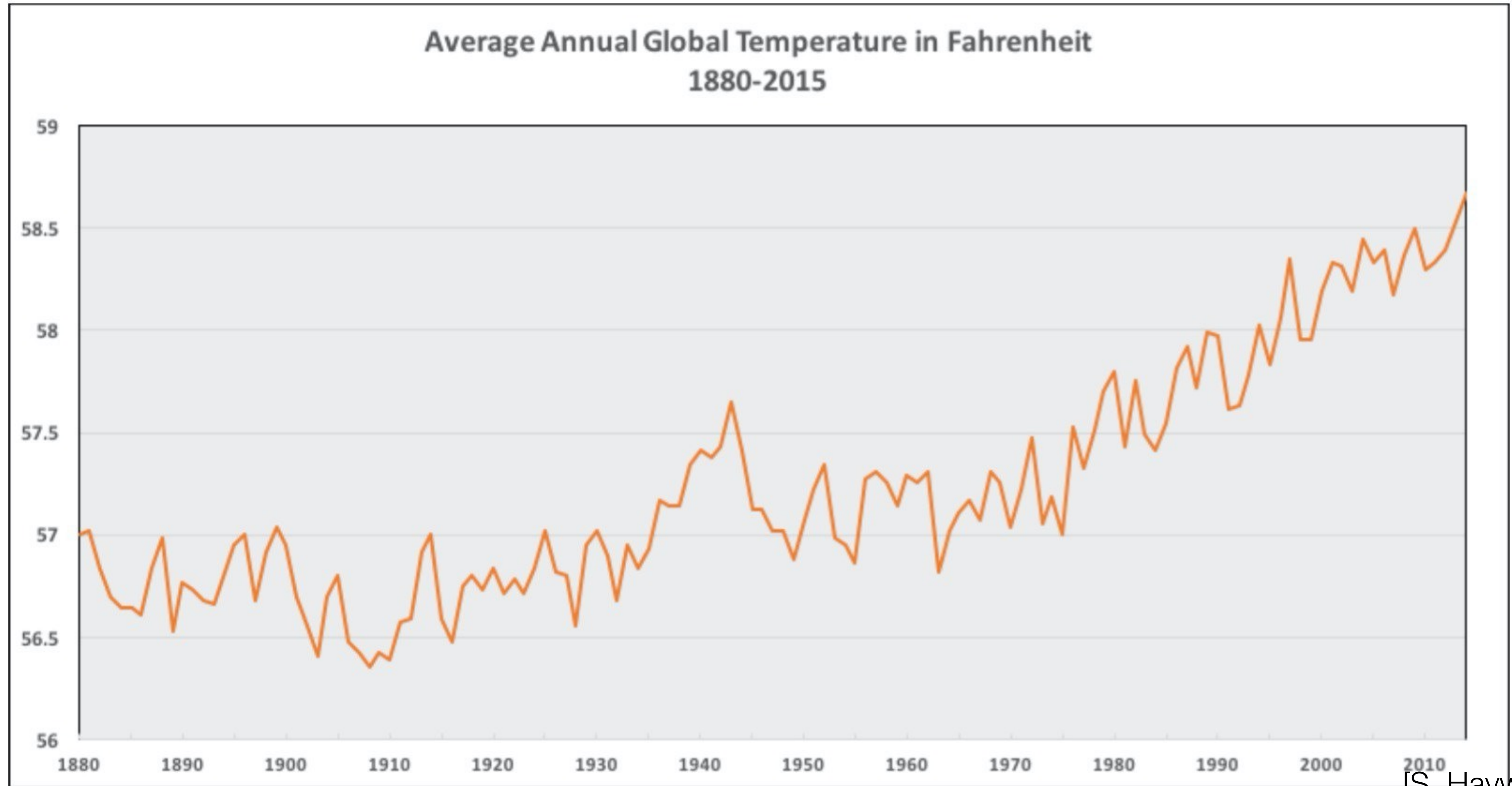


[S. Hayward, 2015]

# Design: Year on the y-axis



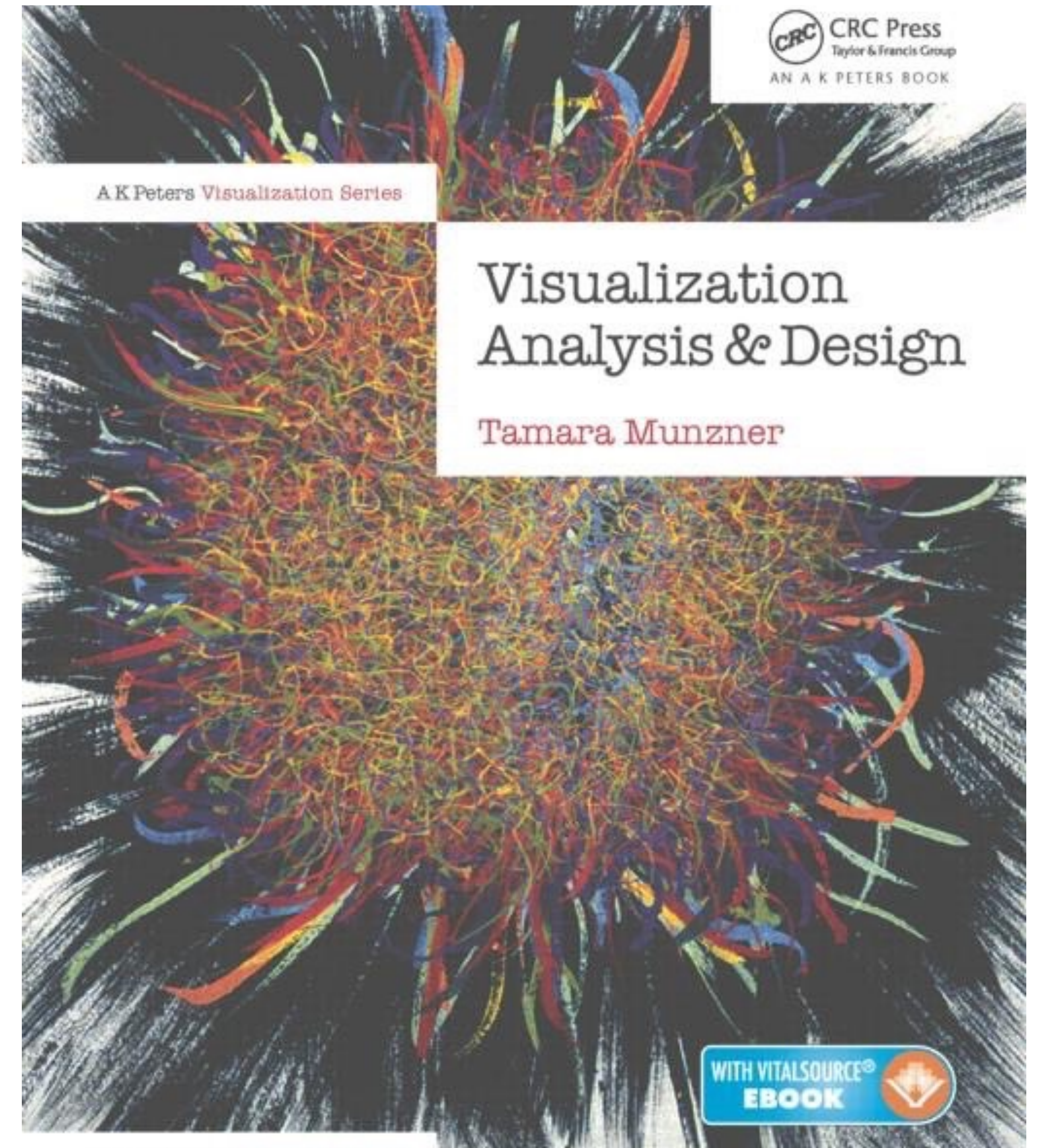
# Design: Different y-axis



[S. Hayward, 2015]

# Administrivia

- Course Web Site
- Syllabus
  - Plagiarism
  - Accommodations
- Textbook:
  - Required: Munzner (VAD)
  - Recommend: Murray, 2nd ed. (IDV)
- Assignments
- Exams: Midterm (Oct. 15) and Final (TBA)
- Registration



# Administrivia

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- Undergraduate (CSCI 490) and Graduate (CSCI 627)
  - Graduate: Extra reading, exam questions, project emphasis
- Research Topics:
  - Also investigate some topics in depth
  - Research papers as assigned reading (CSCI 627)
- Project: Create an interactive visualization (or vis research)
  - Design
  - Data analysis
  - Insight
  - **Presentations:** Last week of class

# Online Synchronous Course

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- Lectures will be given 9:30-10:45am TuTh
  - Better for learning if you are engaged
  - **Ask questions**
  - Please **mute** your microphone if you are not asking a question or discussing
  - Please advise me of any issues
- Slides will be posted to the course website
- Recordings will be made available on Blackboard

# Office Hours & Email

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- Office hours will be held via Blackboard Collaborate
- Scheduled office hours are open to all students
  - TTh: 11am-12pm, or by appointment
- You do not need an appointment to stop in during scheduled office hours
- If you need an appointment outside of those times, please email me with **details** about what you wish to discuss
- Many questions can be answered via email. **Please consider writing an email before scheduling a meeting.**