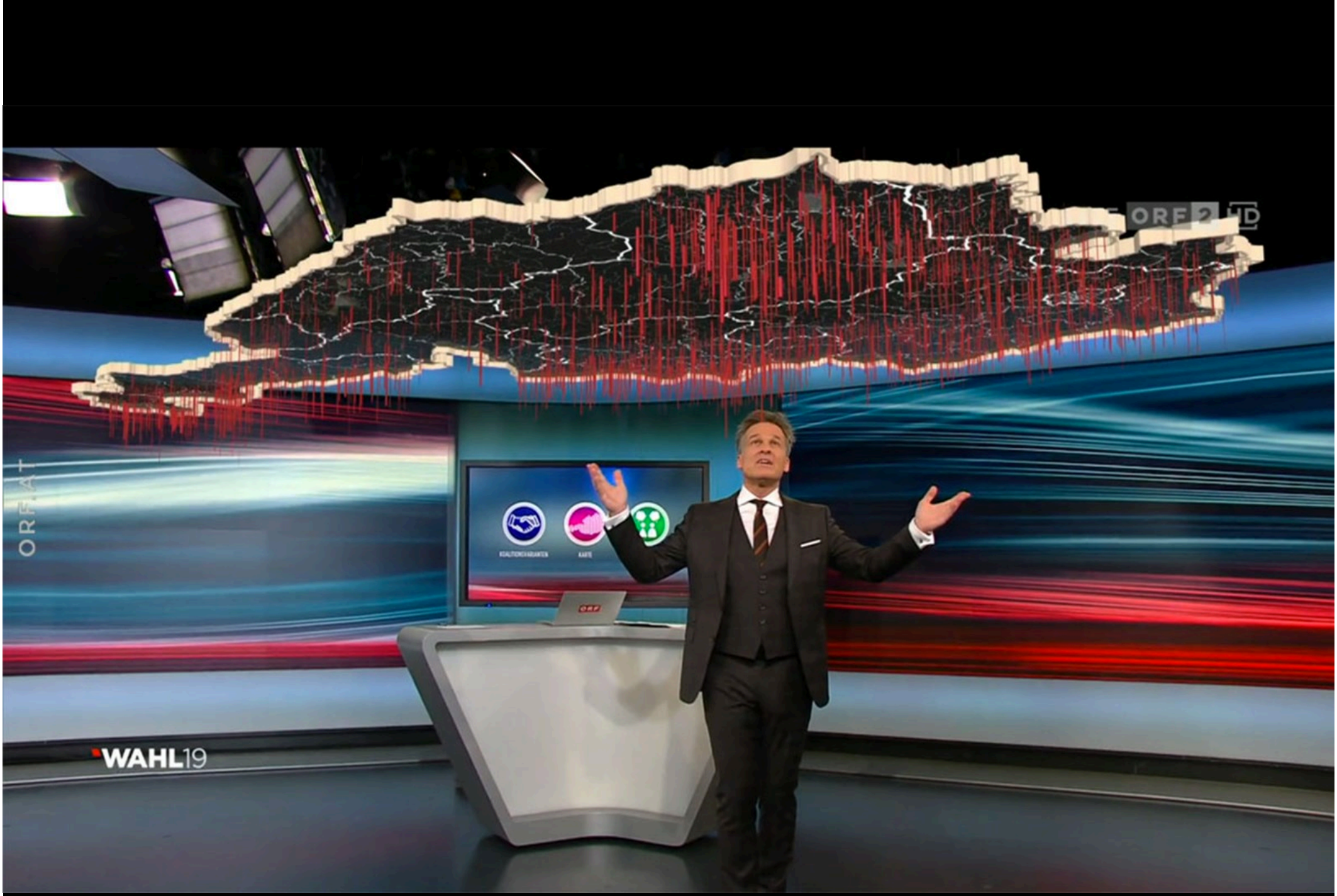
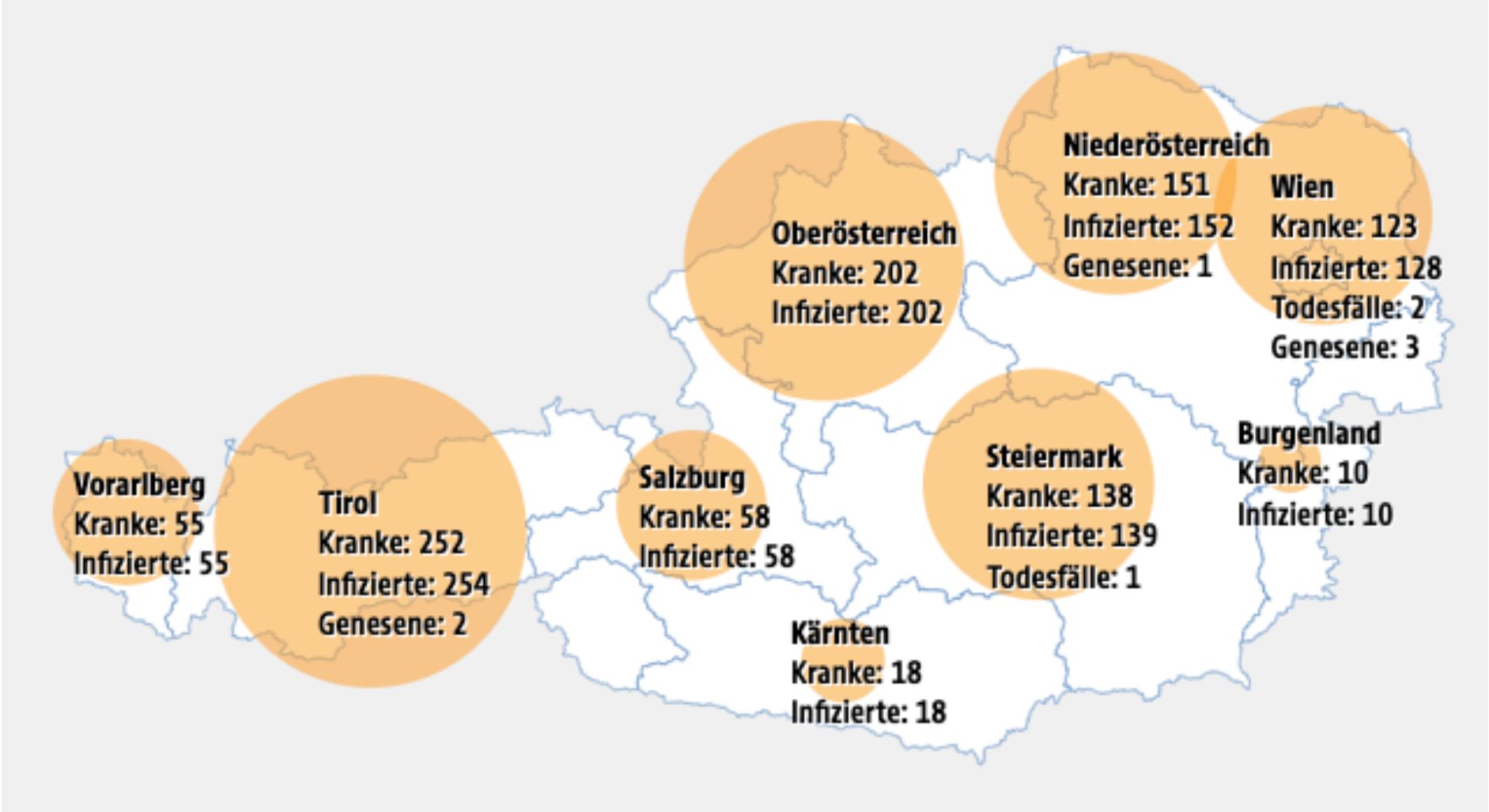
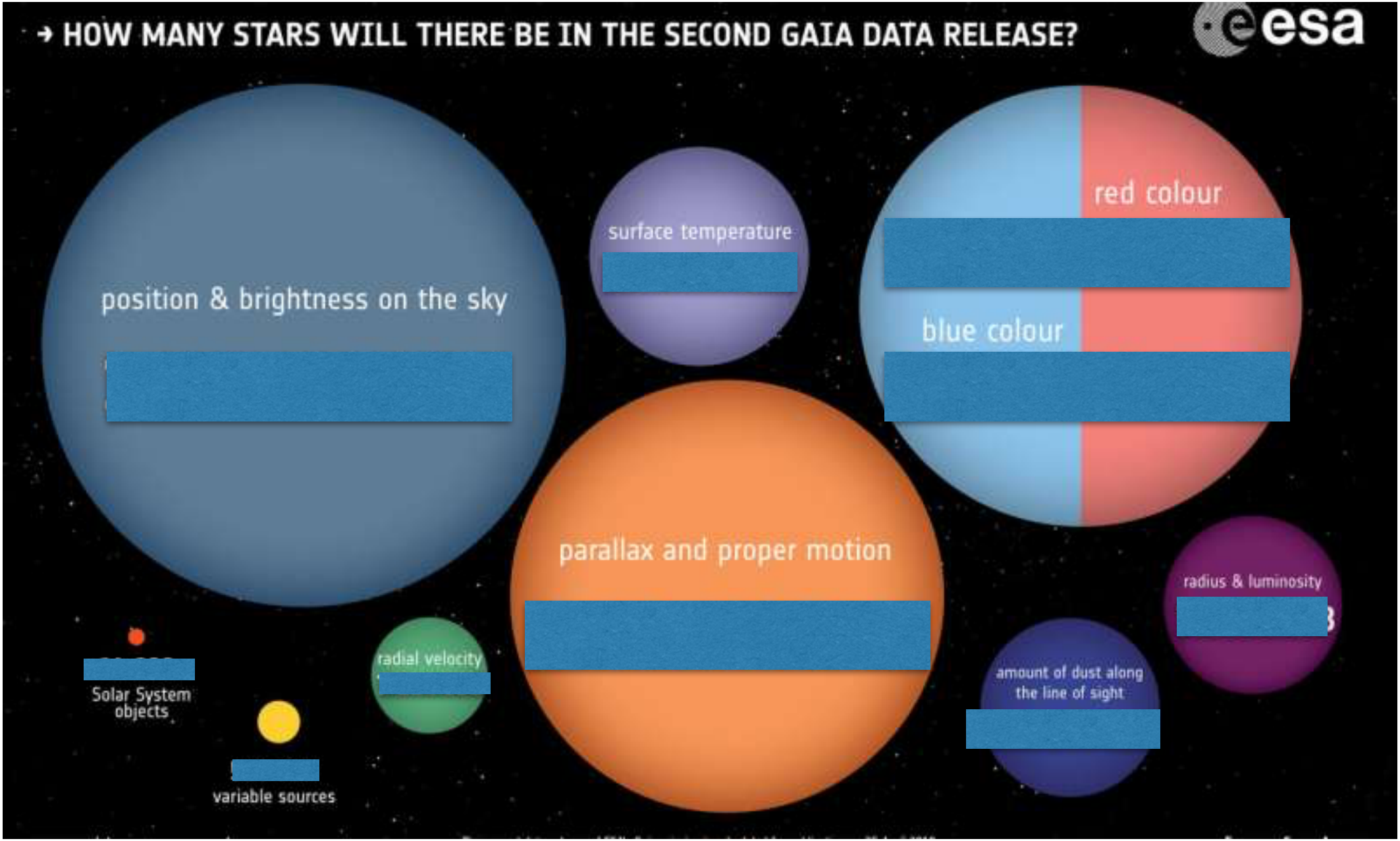
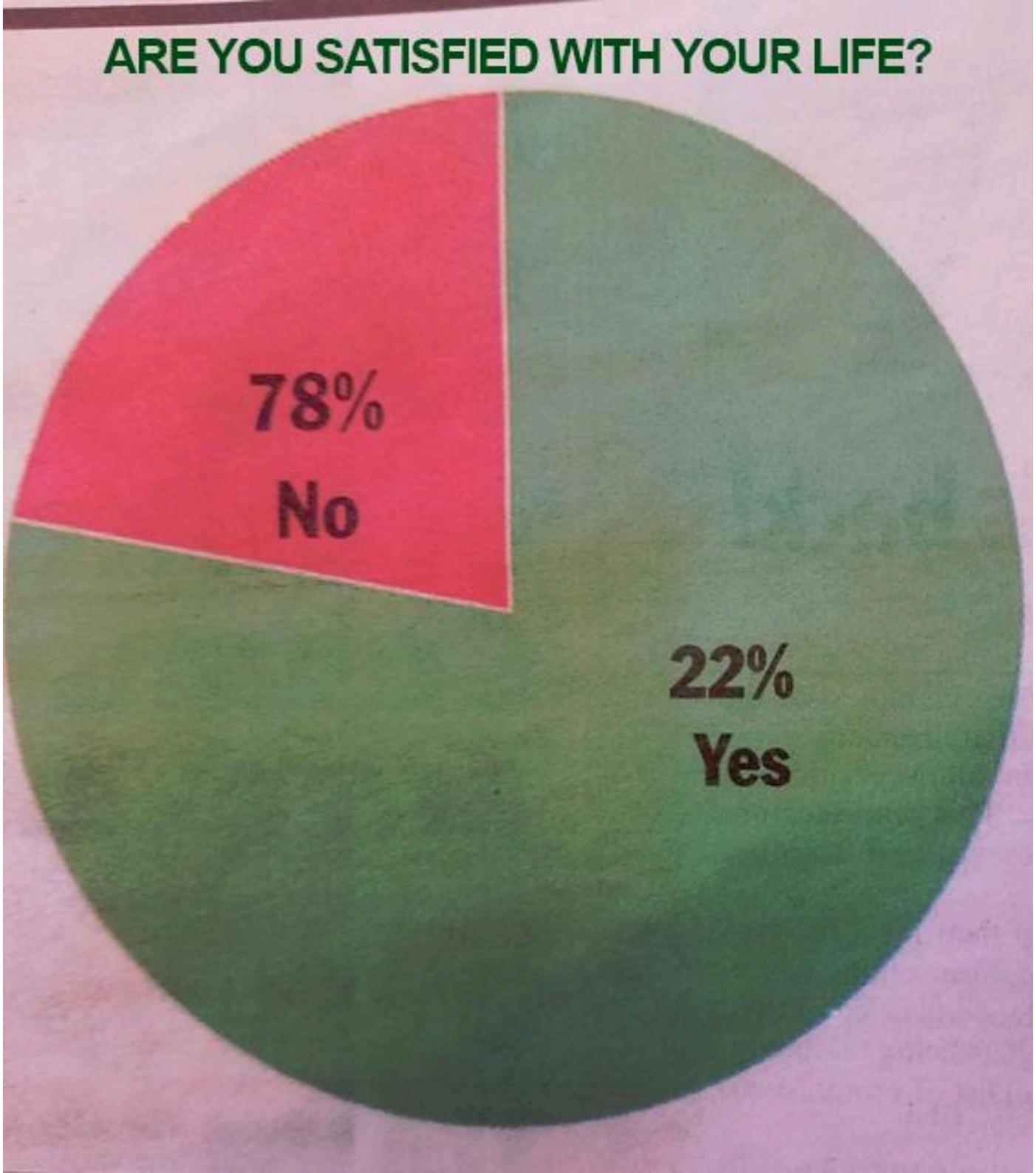

ORF 2
ORF.AT
WAHL19



As of Mar 16, 2020, 3pm

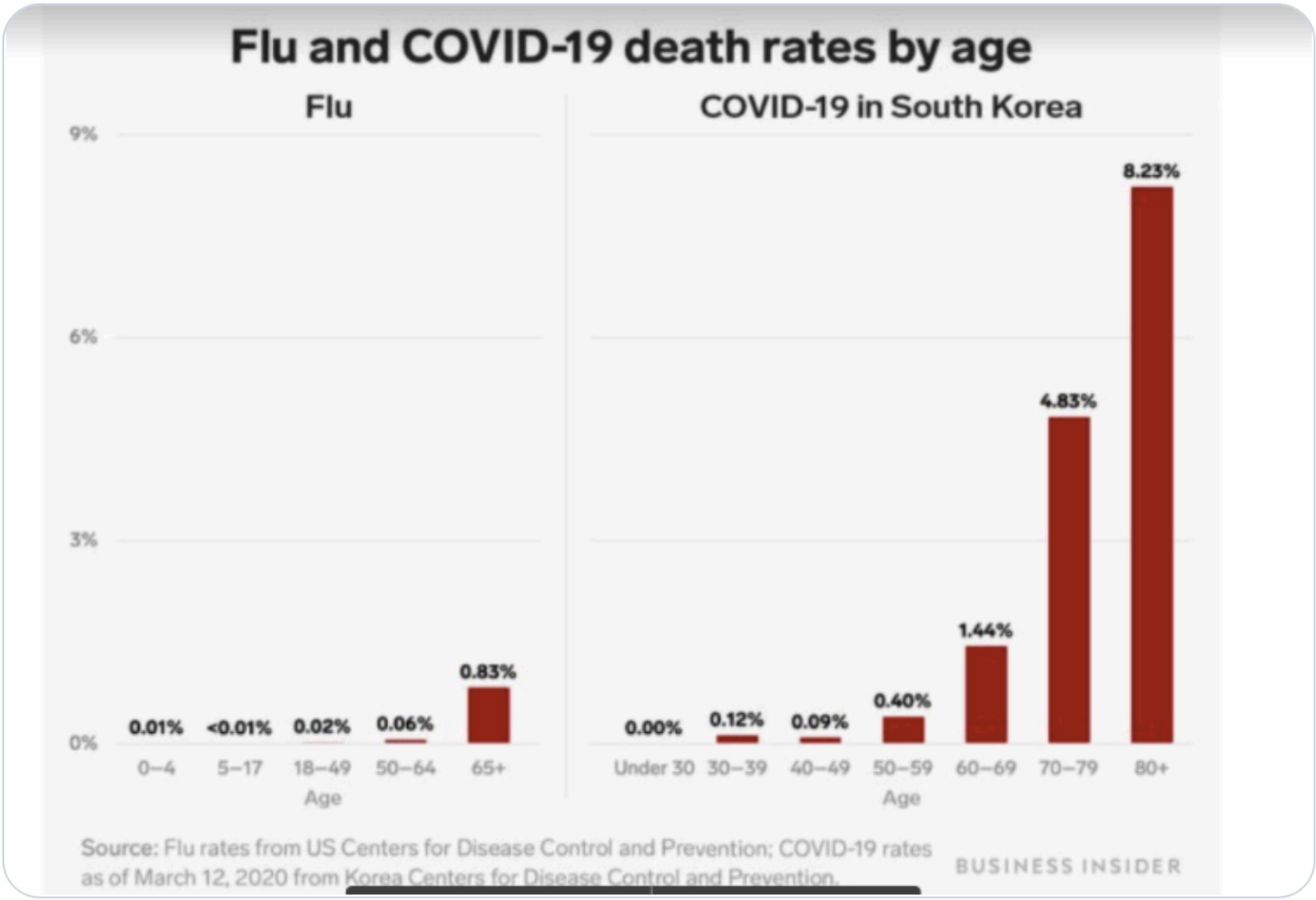

→ HOW MANY STARS WILL THERE BE IN THE SECOND GAIA DATA RELEASE?
esa
position & brightness on the sky
surface temperature
red colour
blue colour
parallax and proper motion
radius & luminosity
radial velocity
amount of dust along the line of sight
Solar System objects
variable sources


→ HOW MANY STARS WILL THERE BE IN THE SECOND GAIA DATA RELEASE?
esa
position & brightness on the sky
1 692 919 135
surface temperature
161 497 595
red colour
1 383 551 713
blue colour
1 381 964 755
parallax and proper motion
1 331 909 727
radius & luminosity
76 956 778
amount of dust along the line of sight
87 733 672
radial velocity
7 224 631
14 099
Solar System objects
550 737
variable sources


ARE YOU SATISFIED WITH YOUR LIFE?
78%
No
22%
Yes

Ann Coulter
@AnnCoulter

For people under 60, coronavirus is LESS dangerous than the seasonal flu:



1:11 PM · Mar 24, 2020

053622 Visual and Exploratory Data Analysis (VU) & 136013 Visualization of humanities data (UE)

Acil Cetin + Christian Knoll + Laura Koesten + Torsten Möller + Timothée Schmude + Florian Windhager

What is Visualization?

- What?
- Why?
- Who?
- How?

Sources

- Selective contributions from
  - Raghu Machiraju
  - Tamara Munzner
  - Hanspeter Pfister
  - Melanie Tory
  - Daniel Weiskopf

What is Visualization?

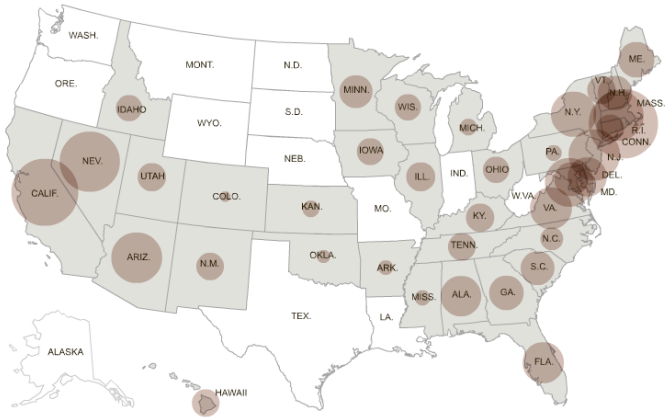
- What?
- Why?
- Who?
- How?

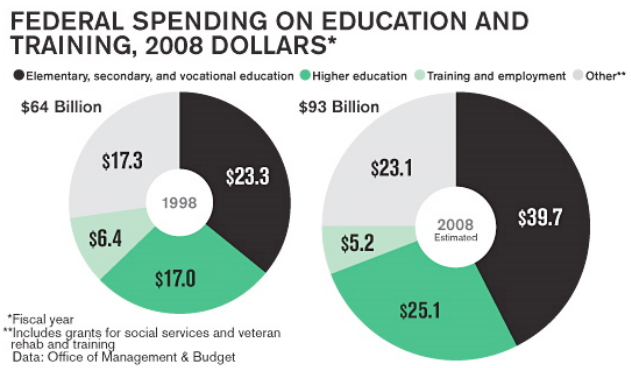
vi·su·al·ize

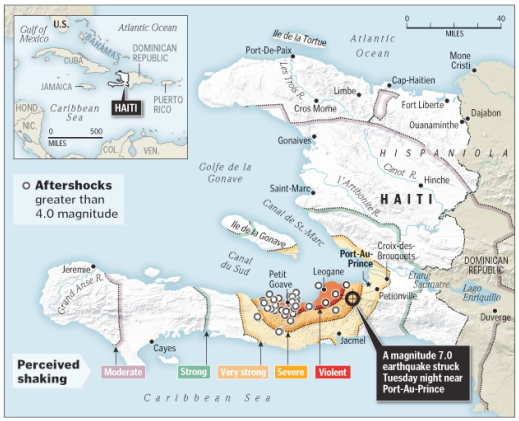
1. To form a mental image of
2. To make visible

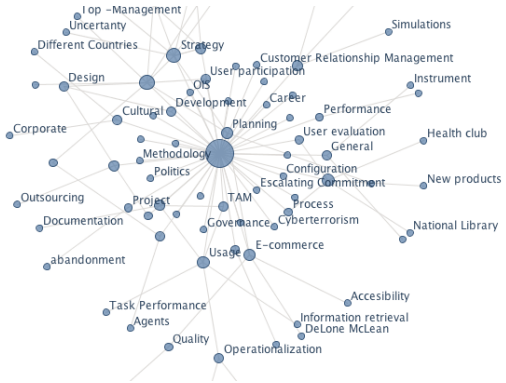
Visualization

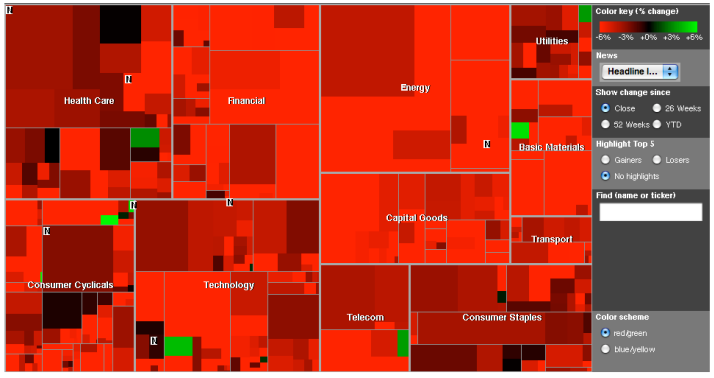
To convey information through visual representations

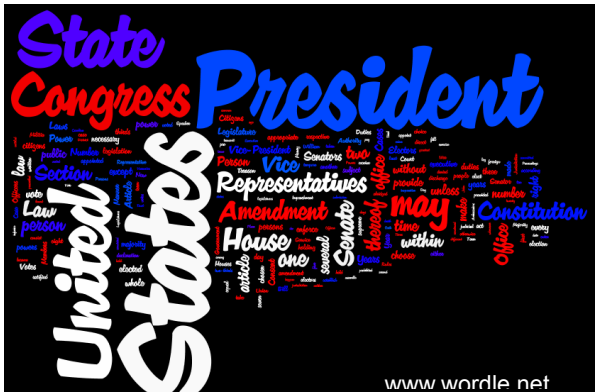












Definitions

- B. McCormick, T. DeFanti, and M. Brown:

  Visualization is a method of computing. It transforms the symbolic into the geometric, enabling researchers to observe their simulations and computations. Visualization offers a method for seeing the unseen. It enriches the process of scientific discovery and fosters profound and unexpected insights. In many fields it is already revolutionizing the way scientists do science.

McCormick, B.H., T.A. DeFanti, M.D. Brown, **Visualization in Scientific Computing**, Computer Graphics 21(6), November 1987

Definitions

- Tamara Munzner, 2012:

  Computer-based visualization systems provide visual representations of datasets intended to help people carry out some task more effectively.

T. Munzner: **Visualization Design and Analysis: Abstractions, Principles, and Methods**, AK Peters, 2014

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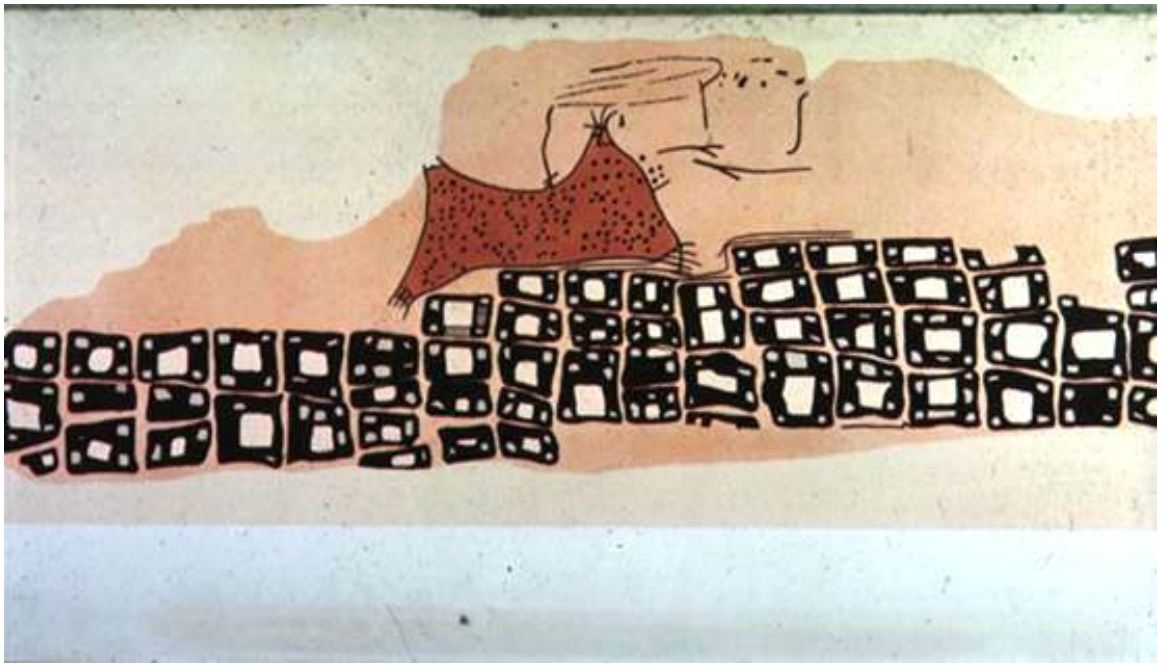
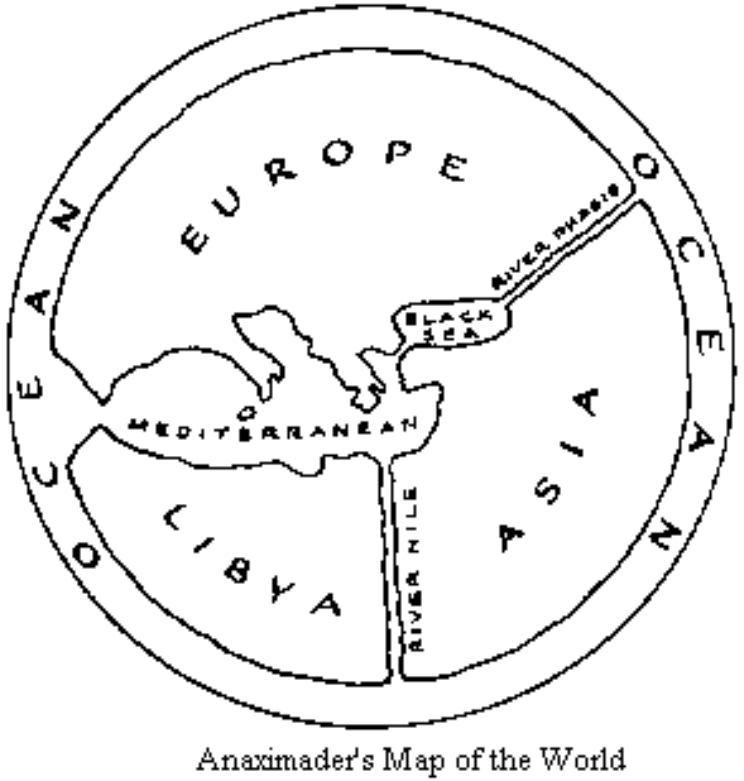
T. Munzner: **Visualization Design and Analysis: Abstractions, Principles, and Methods**, AK Peters, 2014

Visualization Goals

Map



Konya town map, Turkey, c. 6200 BC

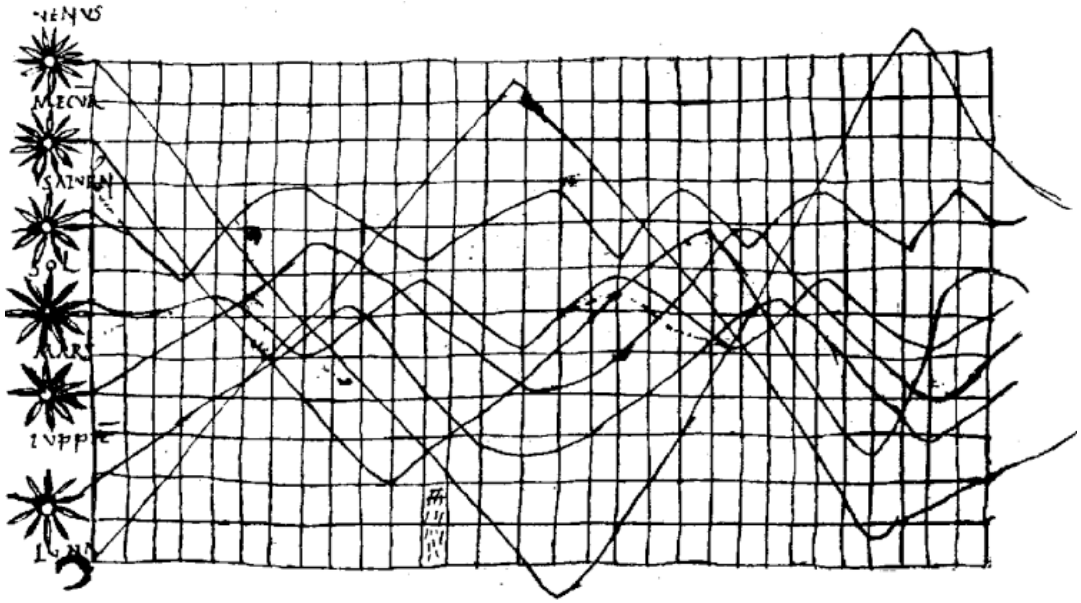


Anaximander's Map of the World

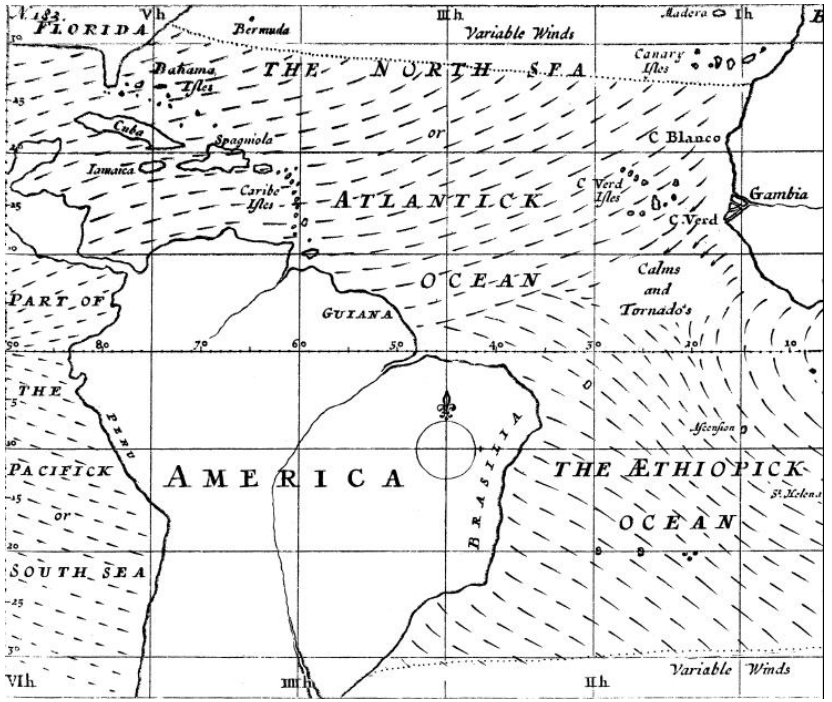
Anaximander of Miletus, c. 550 BC

Milestones Project
http://www.math.yorku.ca/SCS/Gallery/milestone/

Map

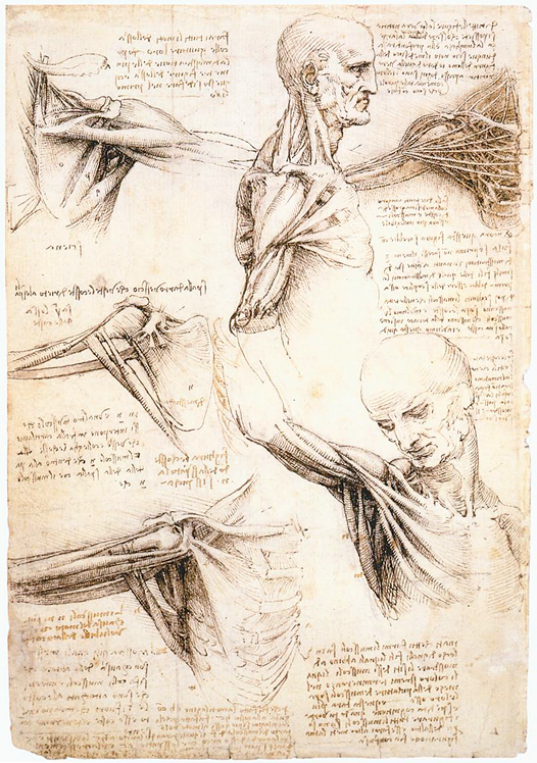


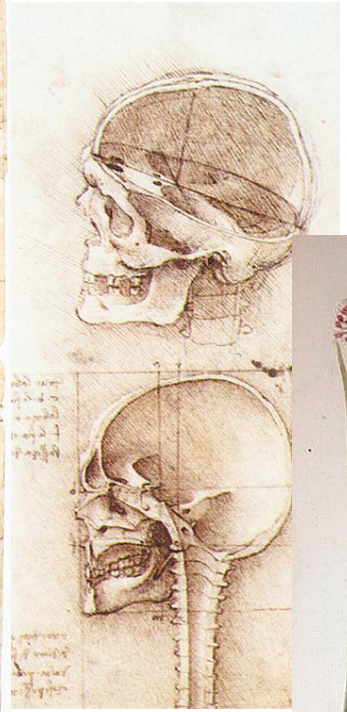
Planetary Movement Diagram, c. 950



Halley's Wind Map, 1686

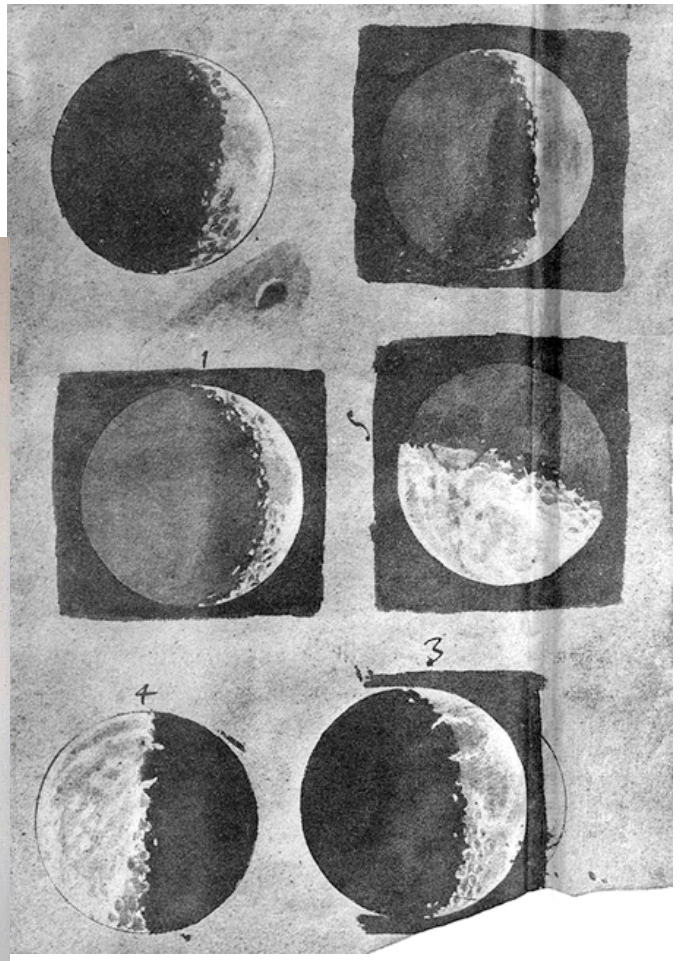
Record





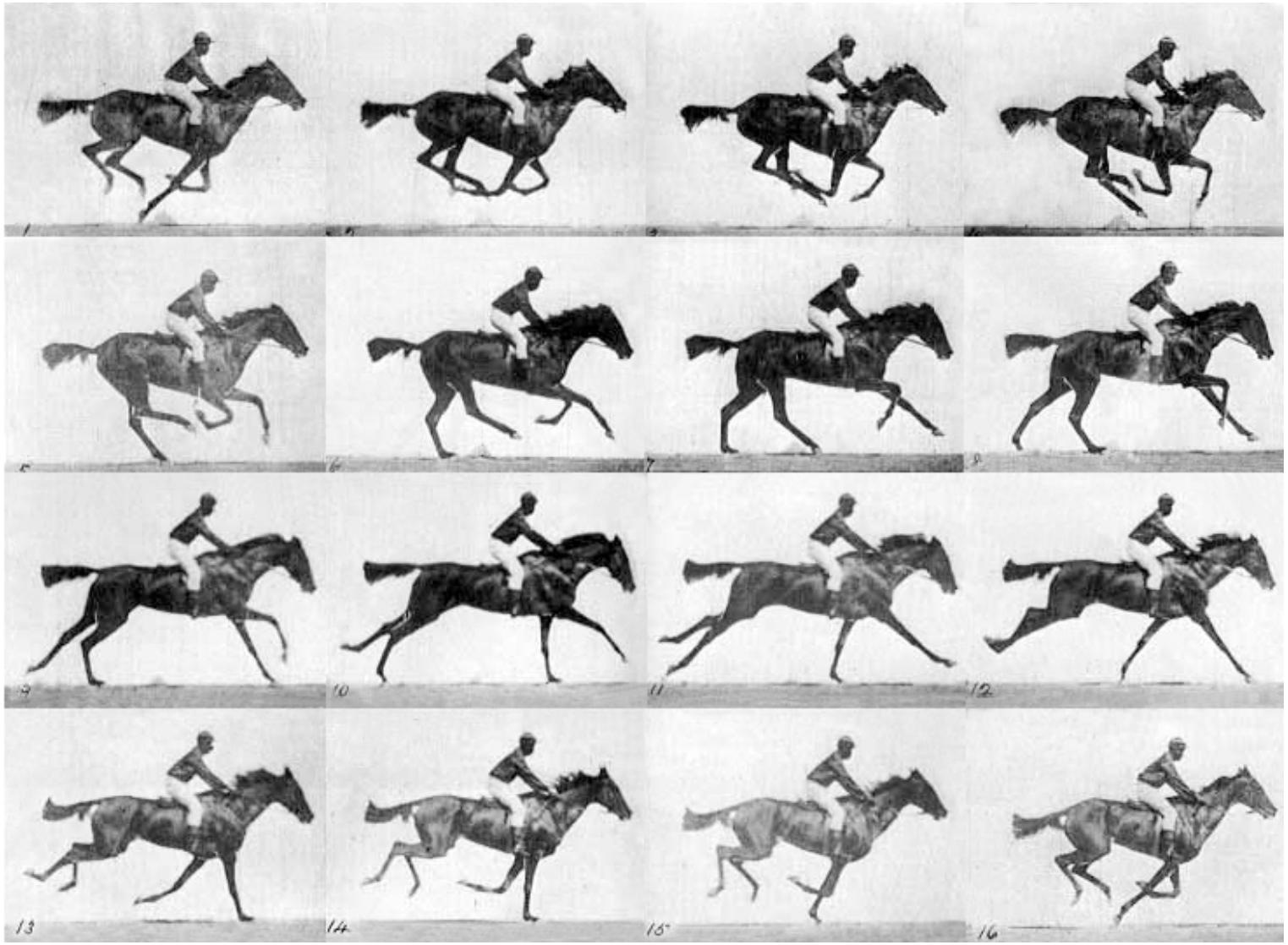
Leonardo Da Vinci, ca. 1500

William Curtis (1746-1799)



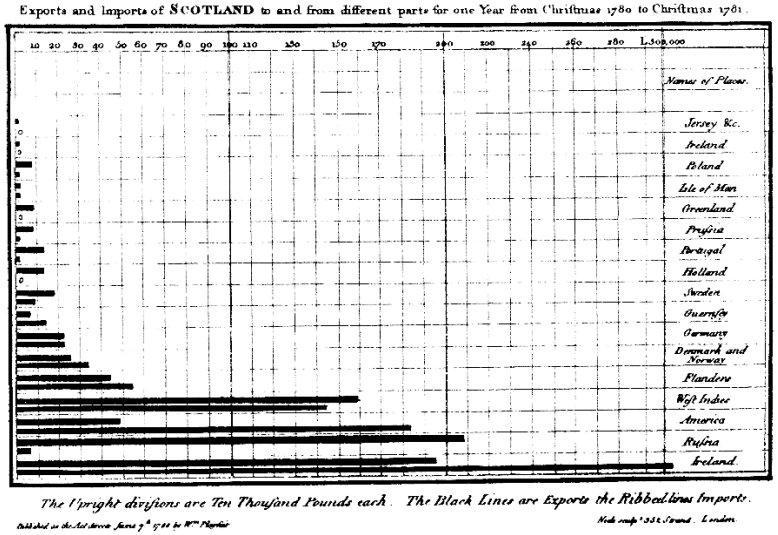
Galileo Galilei, 1616

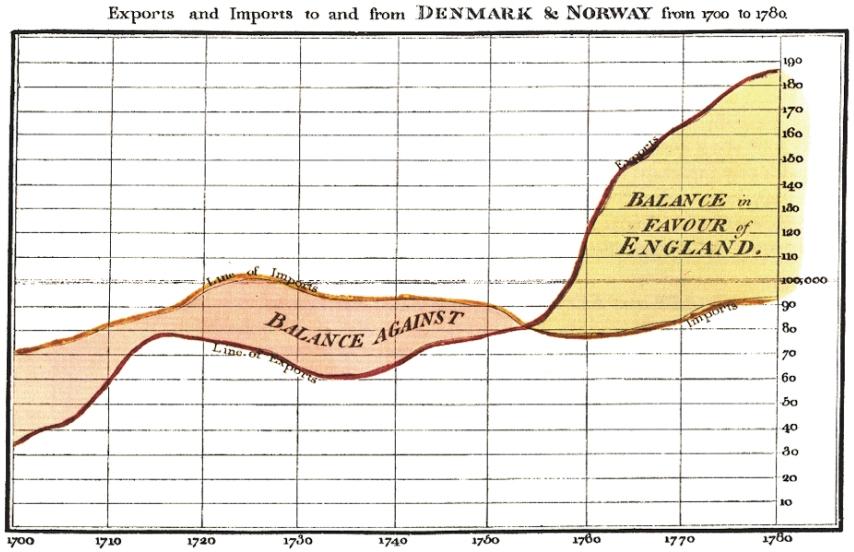
Record



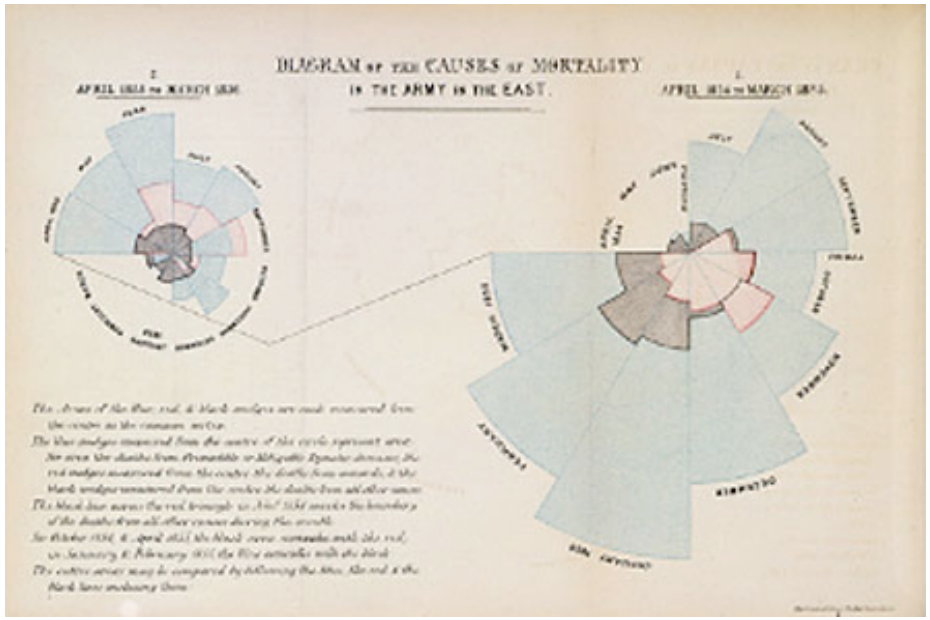
E. J. Muybridge, 1878

Abstract





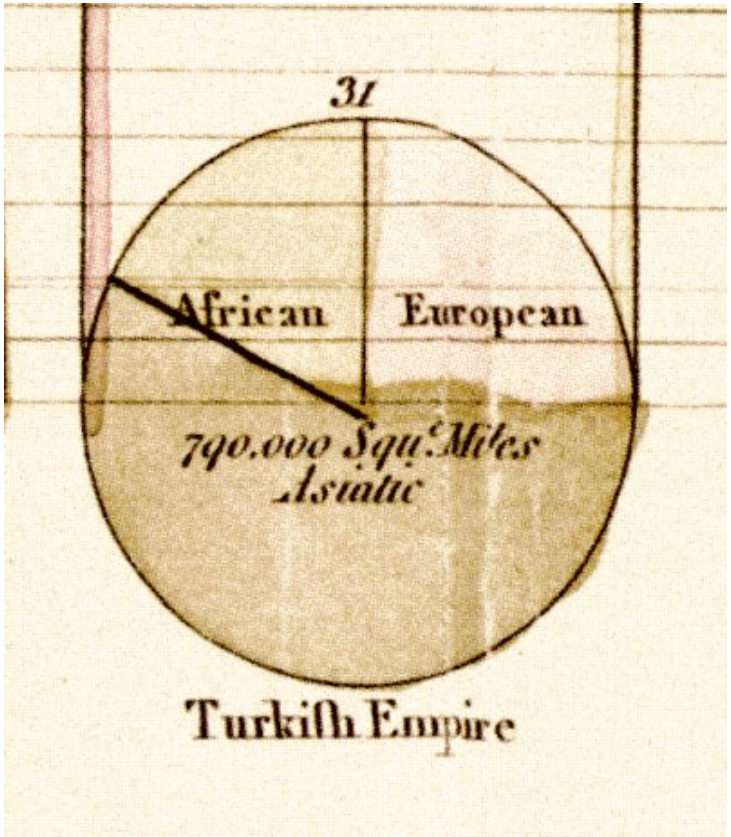
W. Playfair, 1786



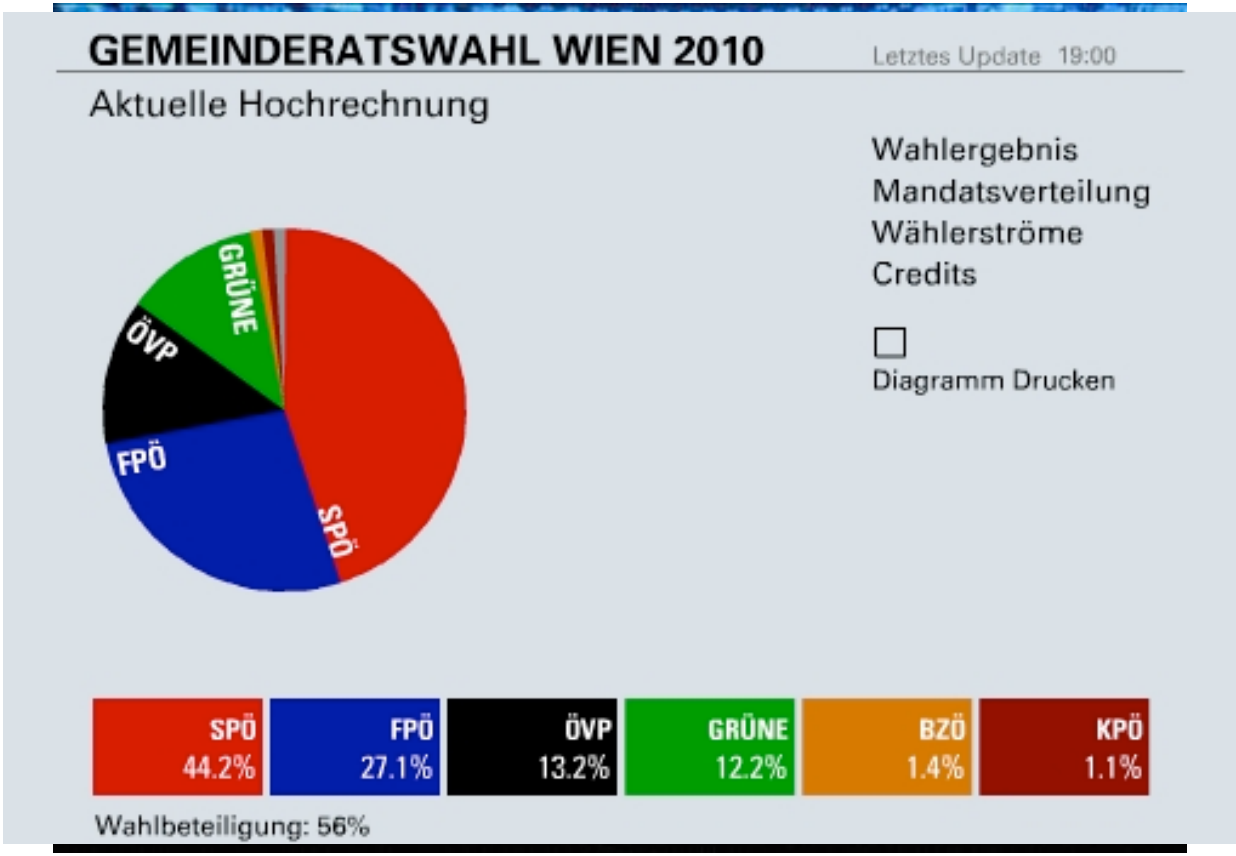
F. Nightingale, 1856

wikipedia.org

Abstract



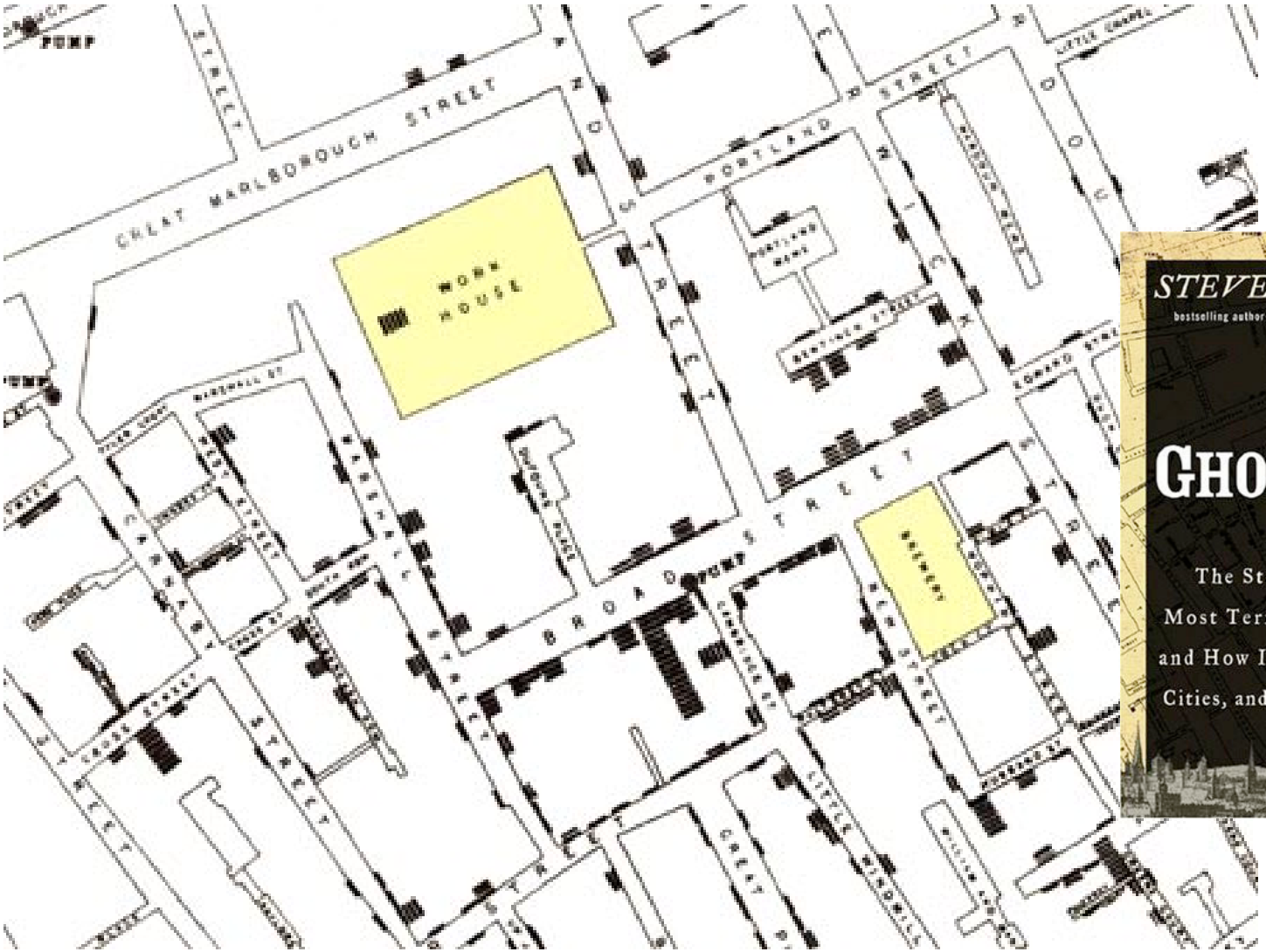
W. Playfair, 1801

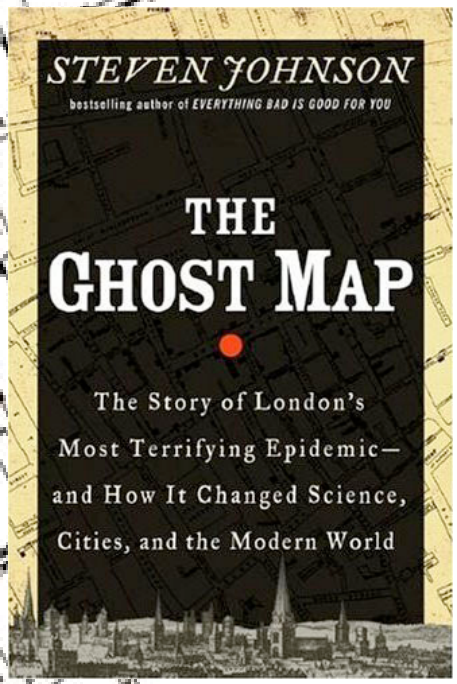


derStandard.at, 2010

wikipedia.org

Discover

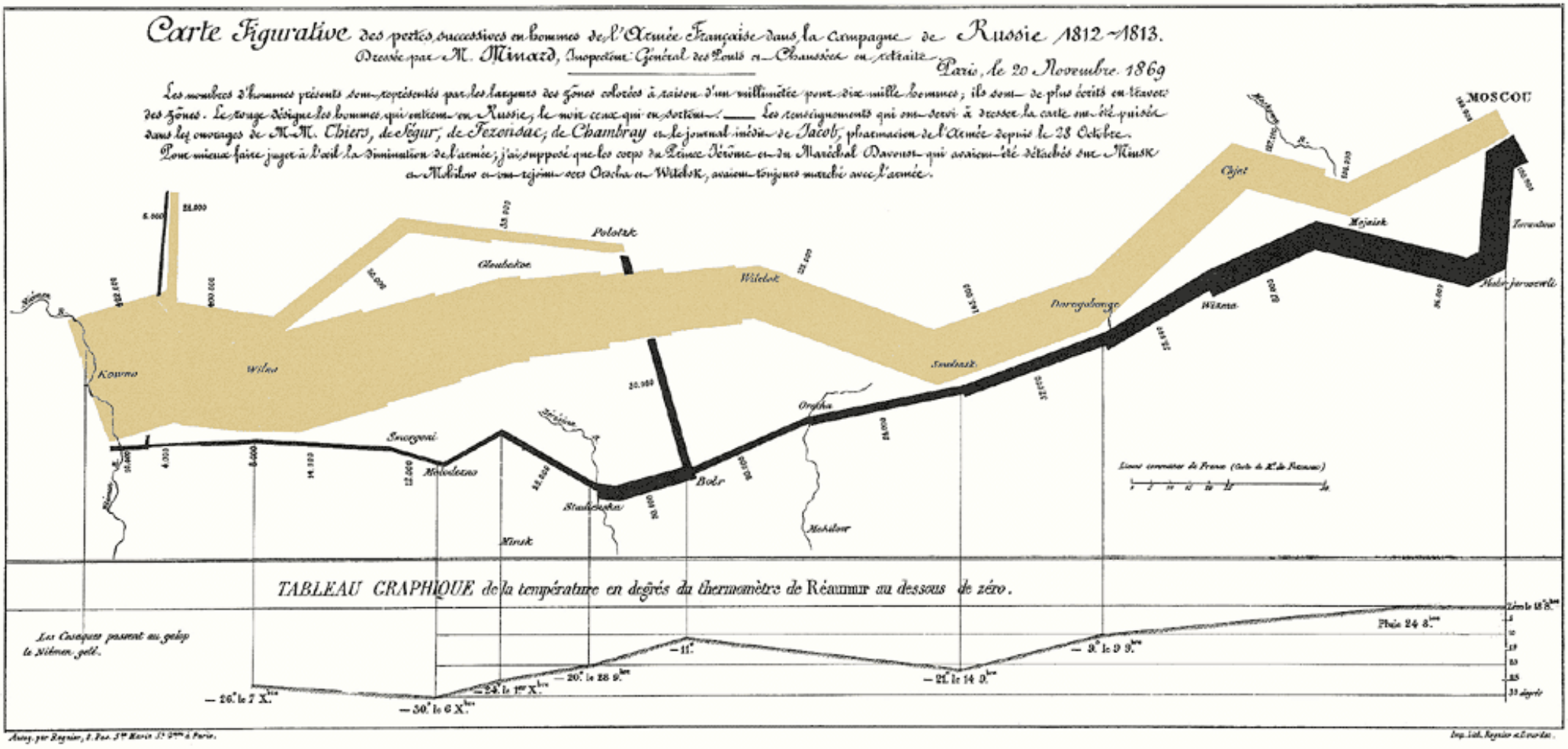




John Snow, 1854

E. Tufte, Visual Explanations, 1997

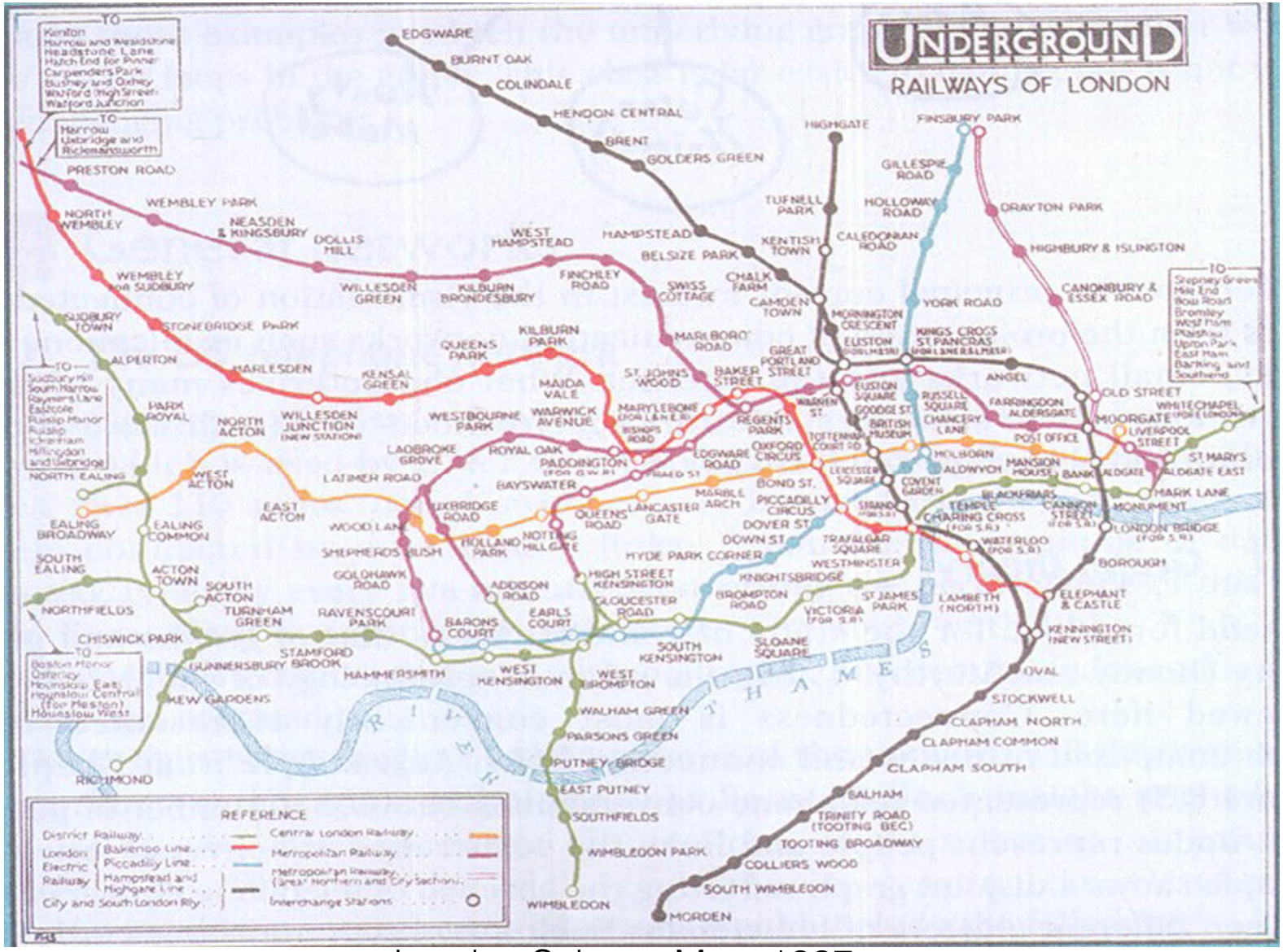
Discover



C.J. Minard, 1869

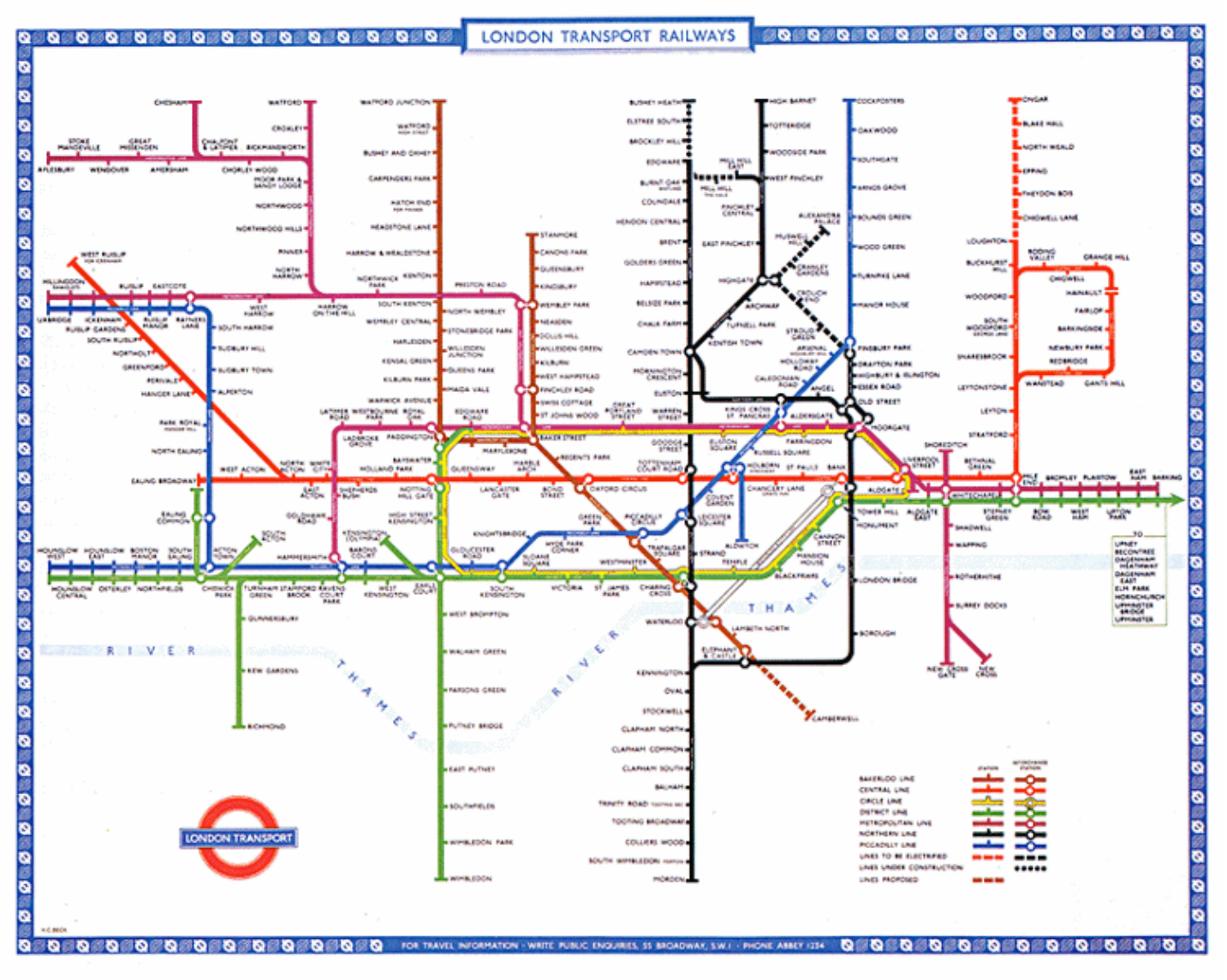
E. Tufte, Writings, Artworks, News

Clarify



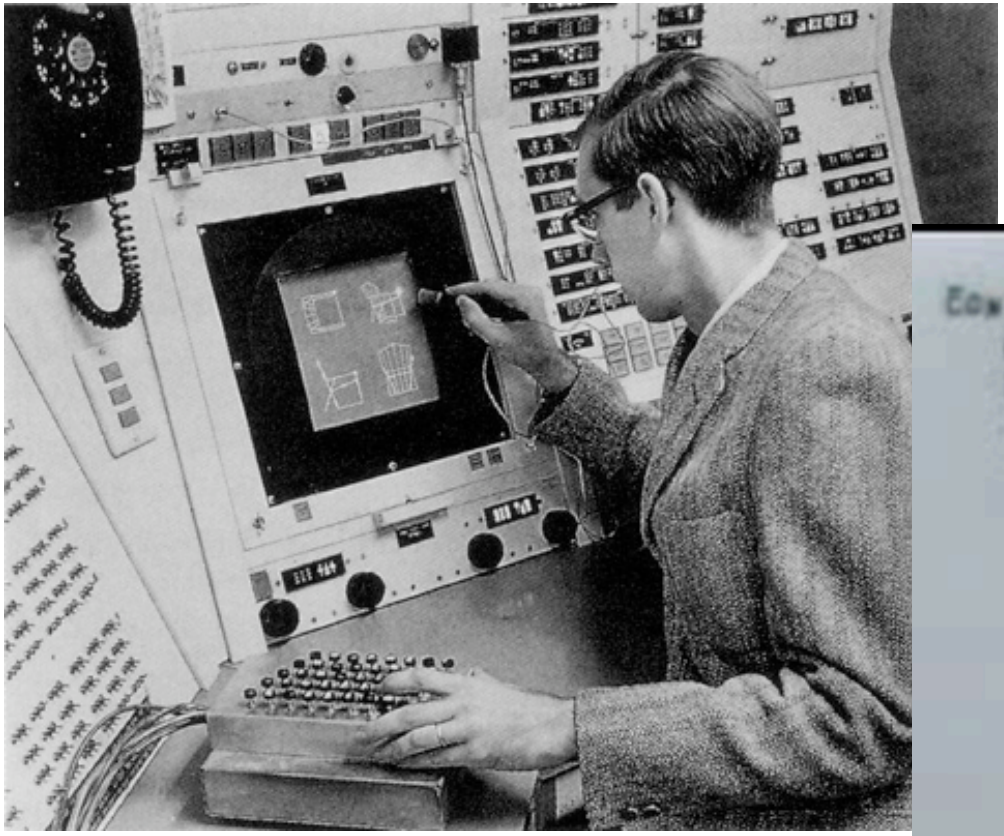
London Subway Map, 1927

Clarify

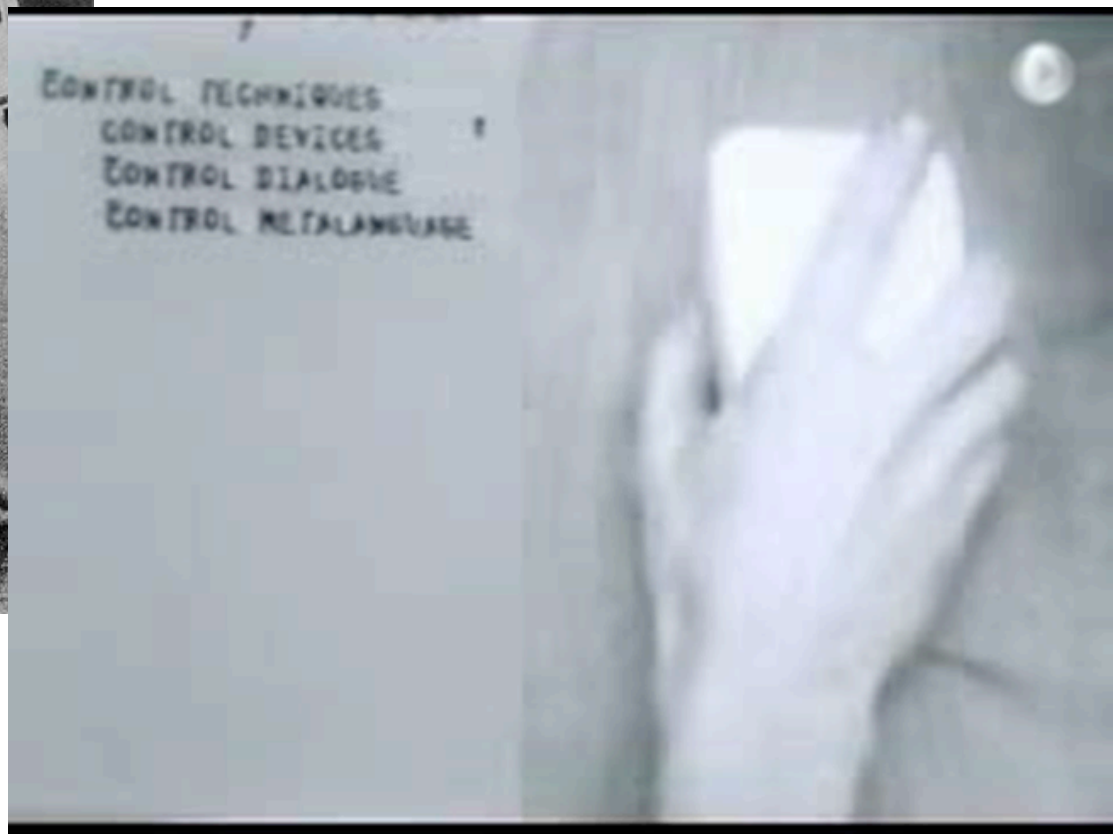


Harry Beck, 1933

Interact



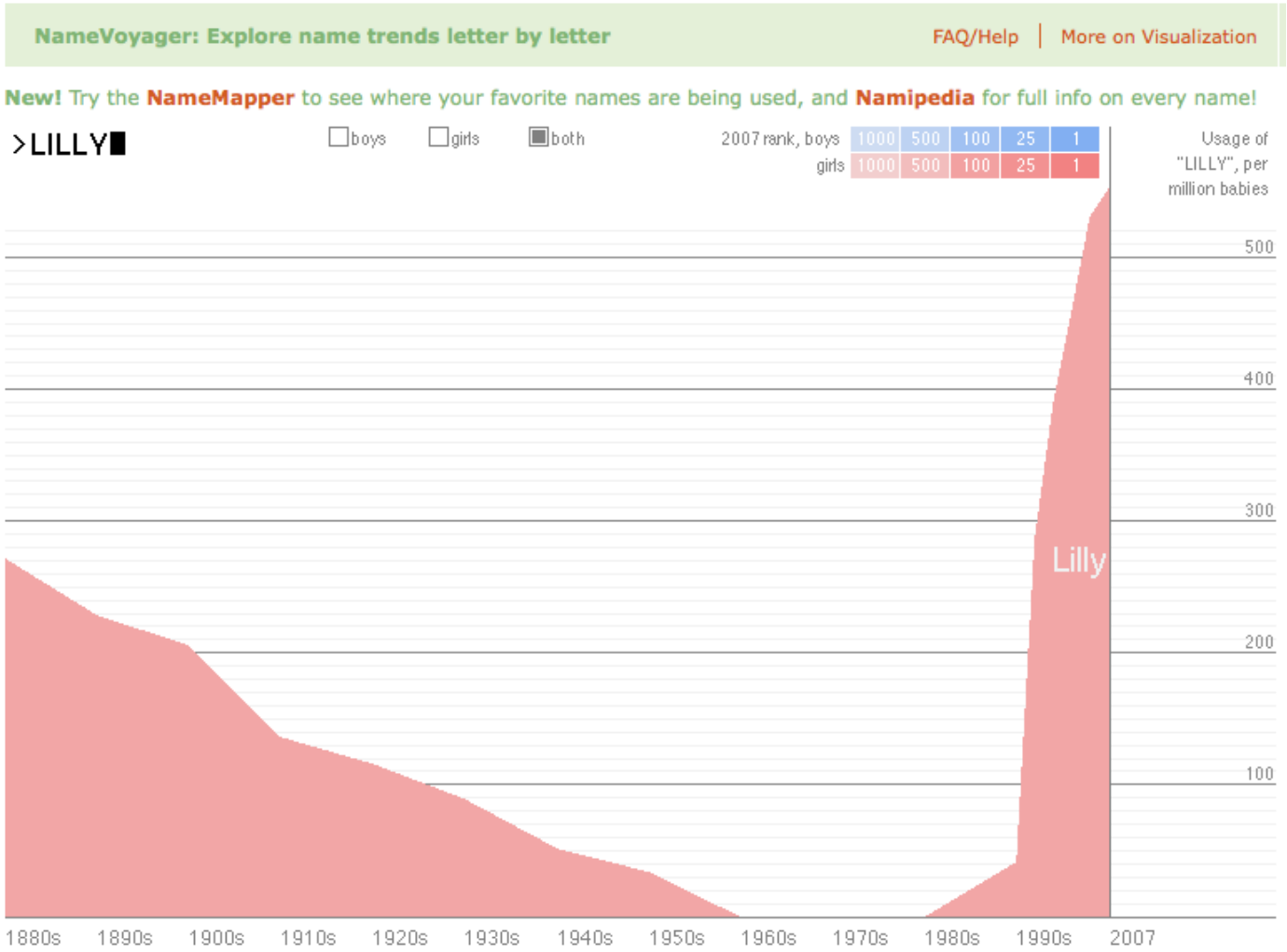
Ivan Sutherland, Sketchpad, 1963



Doug Engelbart, 1968

T. Takeda, 4D2U Project

Interact



M. Wattenberg, 2005

Interact

A Peek Into Netflix Queues

Examine Netflix rental patterns, neighborhood by neighborhood, in a dozen cities. Some titles with distinct patterns are Mad Men, Obsessed and Last Chance Harvey. Comments (131)

100 titles that were frequently rented from Netflix in 2009

◄ Previous | Next ►

Most rented — Least rented

Change how movies are sorted

Most rented | Alphabetical | By metascore

Paul Blart: Mall Cop

Fat people are funny. Fat people who fall over are funnier. Fat people who fall over and have humiliating working-class jobs? Stop, you're killing me!

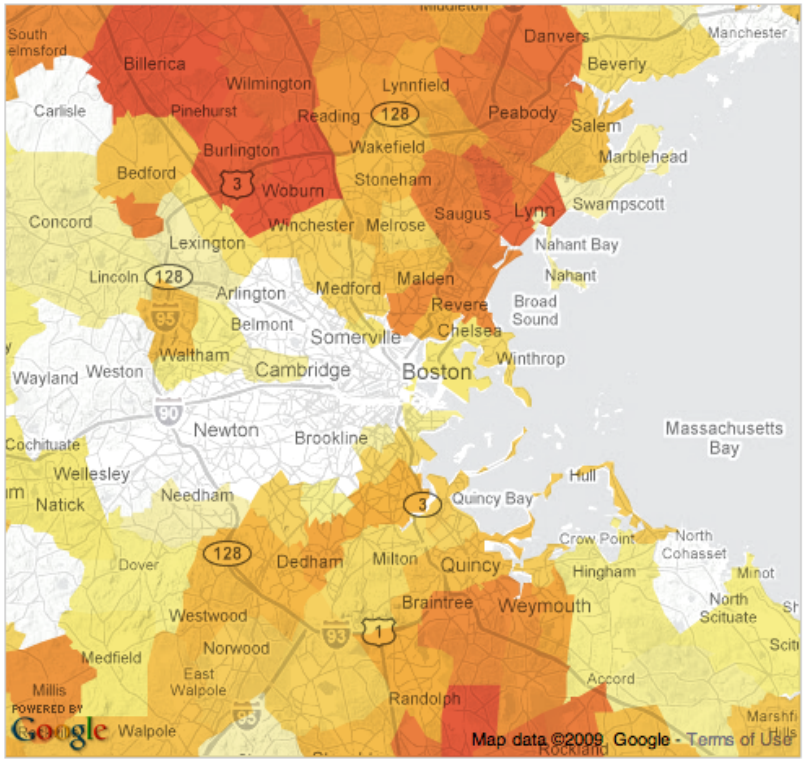
Read Rest of NYT Review »

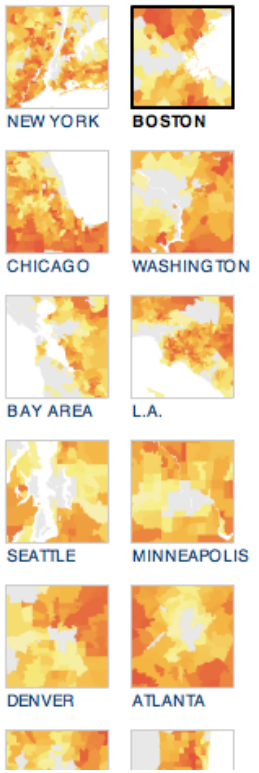
39

Metacritic score

100=loved by critics, 0=hated

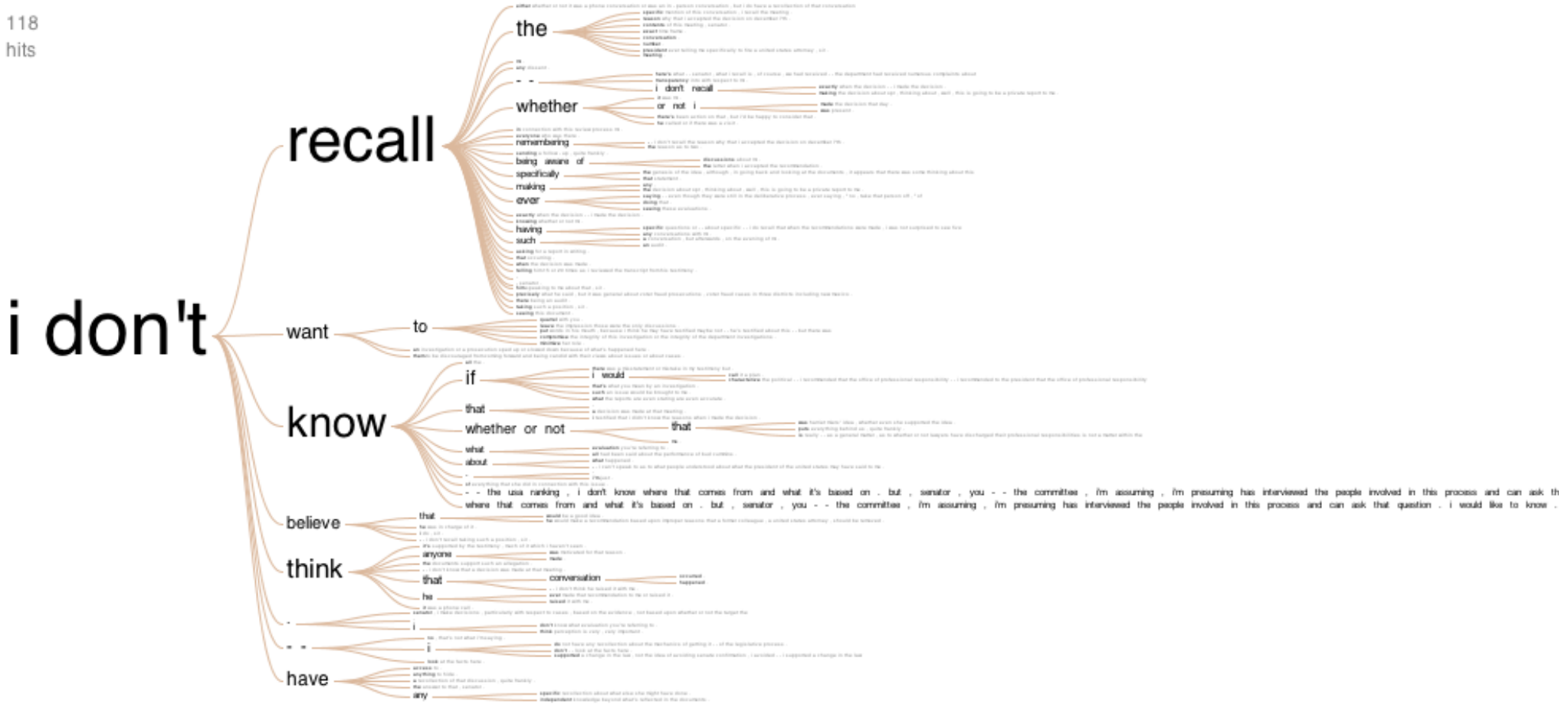
The ZIP codes are shaded according to each movie's rank. Ranked No. 1 — No. 50





NY Times

Communicate



Many Eyes, 2007

Communicate

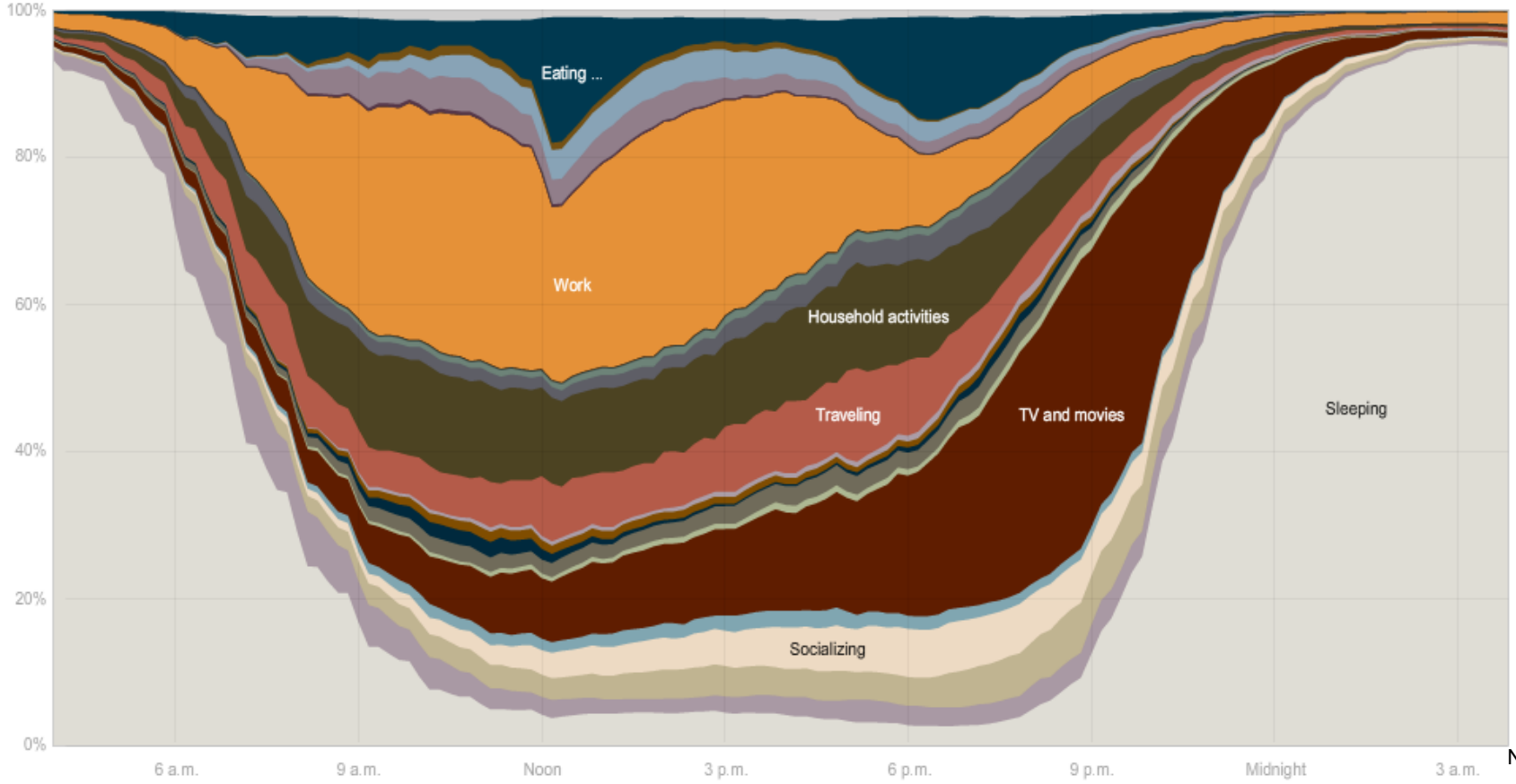
How Different Groups Spend Their Day

The American Time Use Survey asks thousands of American residents to recall every minute of a day. Here is how people over age 15 spent their time in 2008. Related article

Everyone

Sleeping, eating, working and watching television take up about two-thirds of the average day.

Everyone	Employed	White	Age 15-24	H.S. grads	No children
Men	Unemployed	Black	Age 25-64	Bachelor's	One child
Women	Not in lab...	Hispanic	Age 65+	Advanced	Two+ children



NY Times

Inspire / Tell a Story

Hans Rosling, TED 2006

Visualization

- To convey information through visual representations

Map	Clarify
Record	Interact
Abstract	Communicate
Discover	Inspire

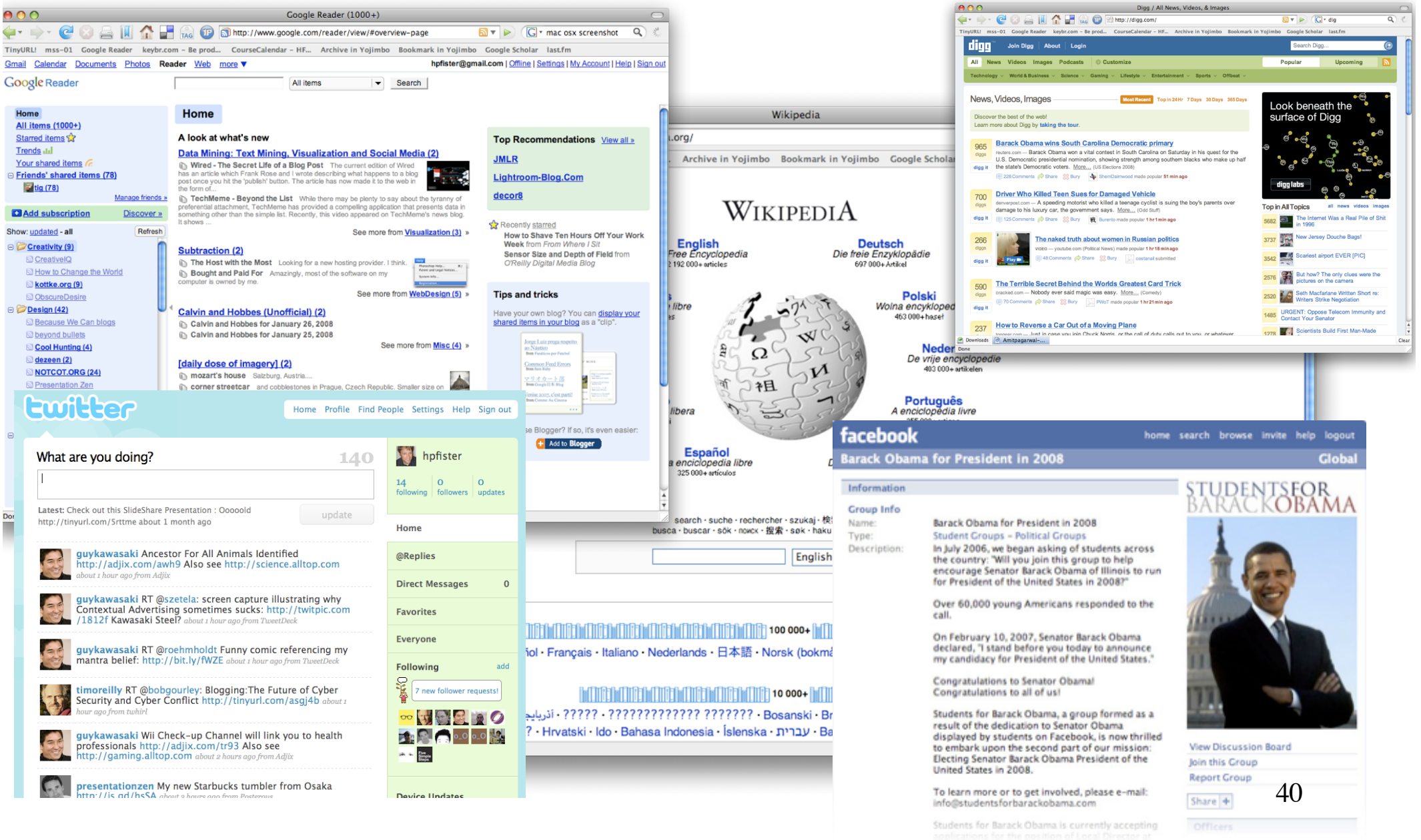
Goals

- Insight and analysis
  - Extract the information content
  - Make things/coherences visible that are not apparent
  - Analyze the data by means of the visual representation
- Communication
  - Allow the non–expert to understand
    - Present specific information in a way that all of us understand
  - Guide the expert into the right direction
- Exploration
  - Interactively control and drive your application
  - Use the visual representation to understand the phenomena as soon as possible
- “The purpose of computing is insight not numbers” (Hamming 1962)

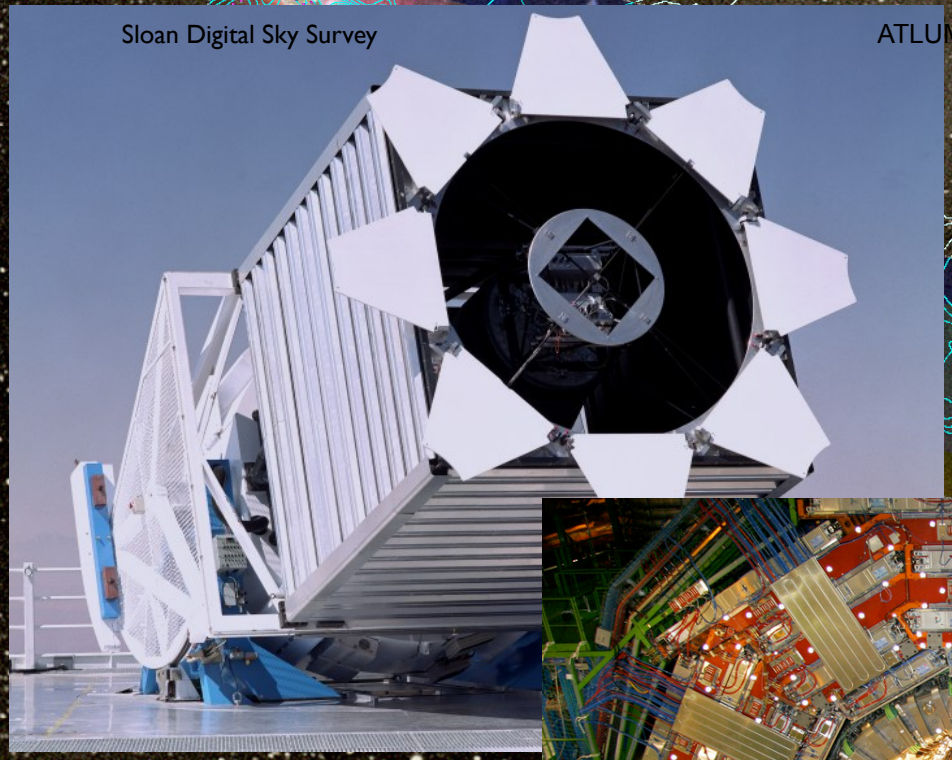
What is Visualization?

- What?
- Why?
- Who?
- How?

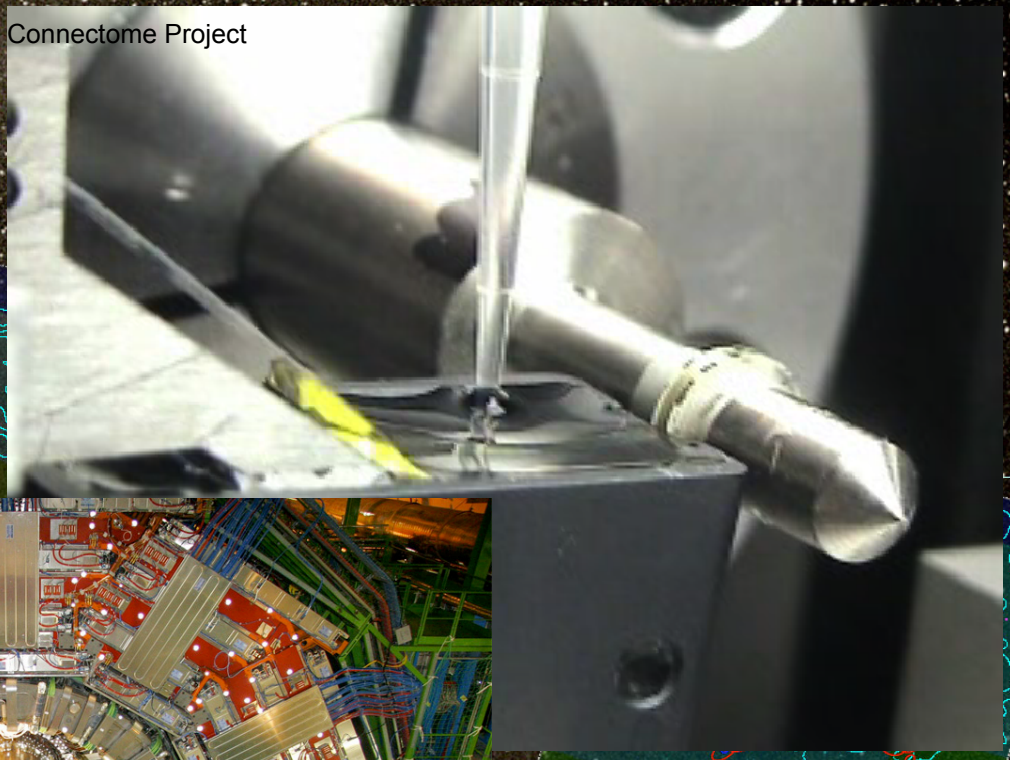
Information Explosion



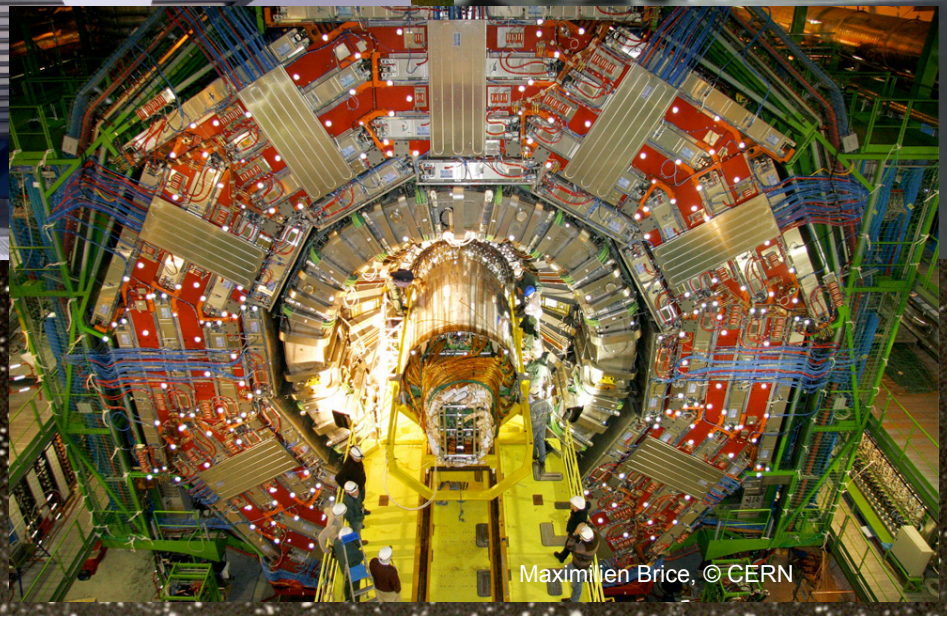
Instrument Data Explosion



Sloan Digital Sky Survey



ATLUM / Connectome Project



Maximilien Brice, © CERN

“The Industrial Revolution of Data”

Joe Hellerstein, UC Berkeley

Limits of Cognition

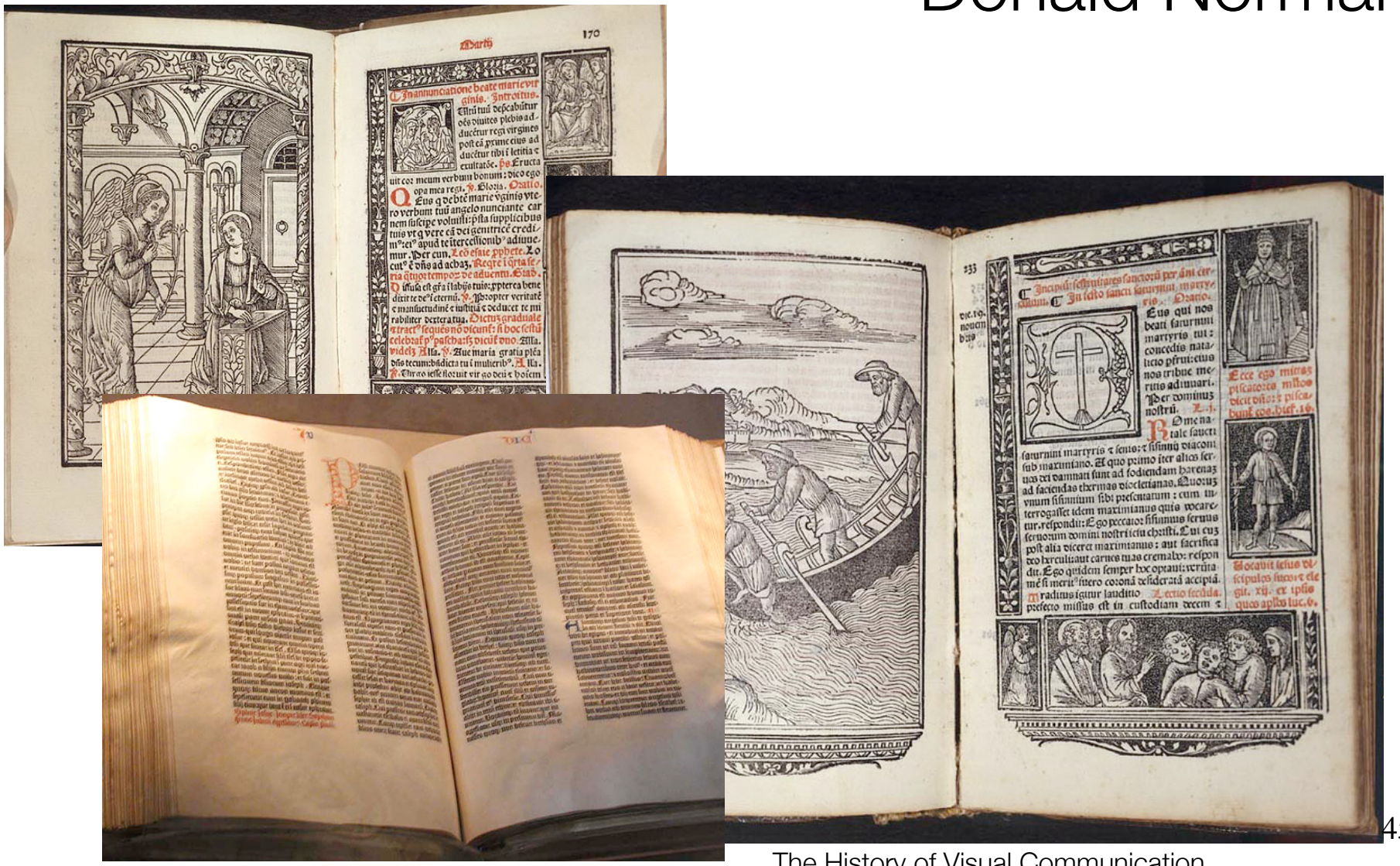
Daniel J. Simons and Daniel T. Levin, Failure to detect changes to people during a real world interaction, 1998

“It is things that make us smart.”

Donald Norman

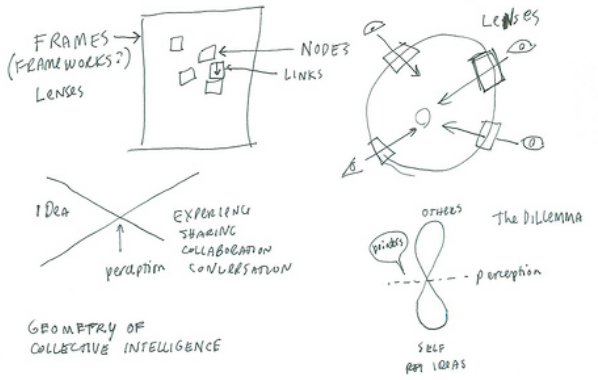
“It is things that make us smart.”

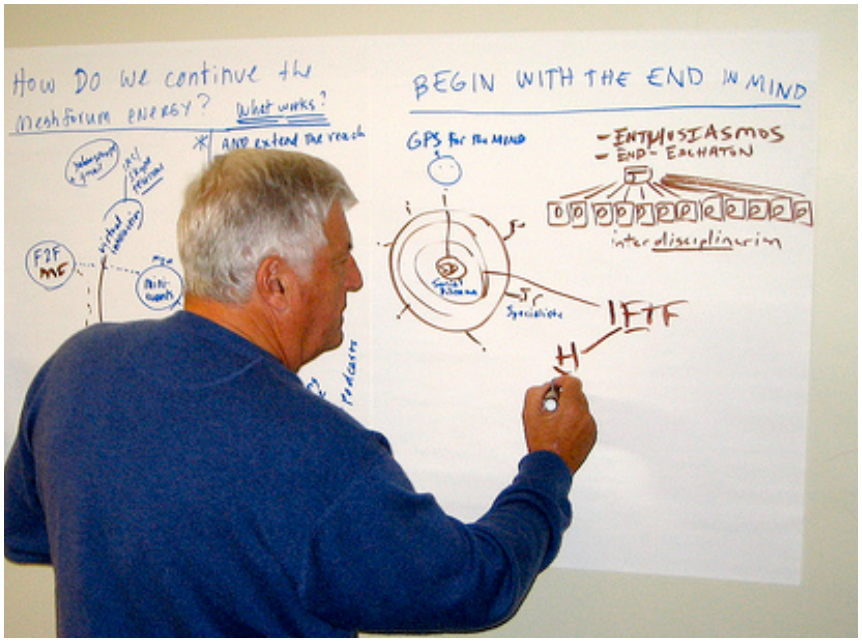
Donald Norman



“It is things that make us smart.”

Donald Norman





Visual Thinking Collection, Dave Grey

Idea Maps, by Jamie Nast

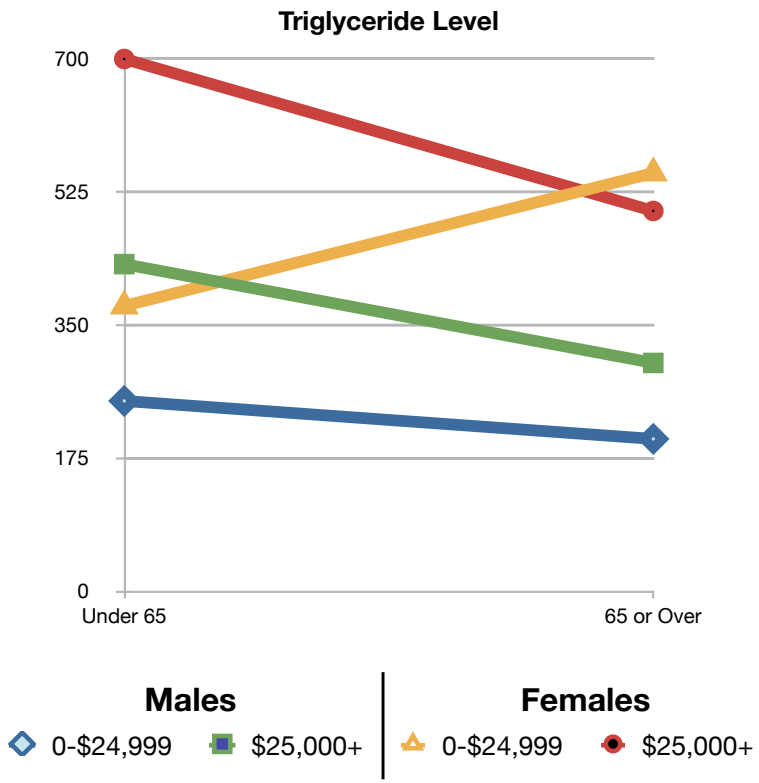
Mental Queries

Which gender or income level group shows different effects of age on triglyceride levels?

	Males		**Females**	
Income Group	Under 65	65 or Over	Under 65	65 or Over
0-$24,999	250	200	375	550
$25,000+	430	300	700	500

Slide after Stephen Kosslyn, Clear and to the Point

Visual Queries



Slide after Stephen Kosslyn, Clear and to the Point

Visualization

- Helps us think
- Reduces load on working memory
- Offloads cognition
- Uses the power of human perception

What is Visualization?

- What?
- Why?
- Who?
- How?

Our team

- Asil: asil.cetin@univie.ac.at
- Christian: christian.knoll@univie.ac.at
- Florian: Florian.Windhager@donau-uni.ac.at
- Laura: laura.koesten@univie.ac.at
- Tim: timothee.schmude@univie.ac.at
- Torsten: torsten.moeller@univie.ac.at
- Tutor Bernhard: bernhard.jordan@univie.ac.at
- Visualization and Data Analysis (VDA) Lab

About You

What is Visualization?

- What?
- Why?
- Who?
- How?

Goals of this course

- Learn basic design and perceptual principles
- Explore different visualization methods
- Implement an interactive visualization

Educational Goals

- Visualization specialist ... practitioner ... novice++
- Theory
  - Classification
  - Algorithms
  - Visual design
- Application
  - Methods
  - Visualization packages
- Experience
  - How to visualize something in the best way

Outline

- Fundamentals
  - What is vis?
  - Design principles
  - The visualization process
  - Data abstractions + Task abstractions
  - Design studies
- Visual Encodings + Algorithms
  - Basic visual encoding principles
  - Tables
  - Spatial data
  - Networks / trees
  - Time-varying data
  - 3D scalar fields (isosurfaces + volume rendering)
  - 3D vector and tensor field visualization
- Perception + Cognition
  - Color
  - Aggregation: Items + Attributes
  - Space / Order; Multiple views
  - Depth / Occlusion; Focus + Context
- Interaction
- Evaluation

Syllabus

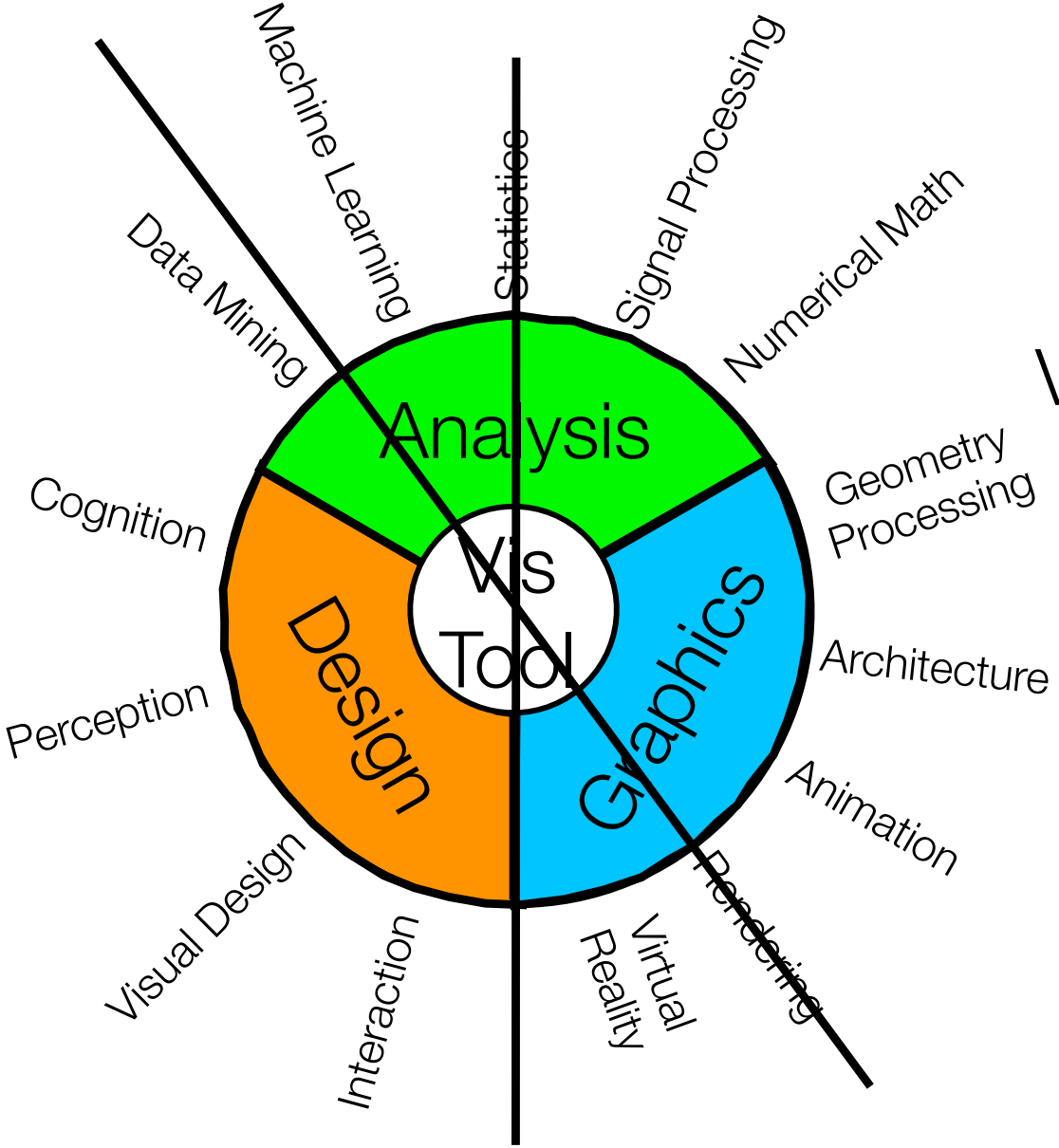
See Web Page

http://vda.cs.univie.ac.at/Teaching/Vis/23s/

Related Fields

“Visual Analytics”

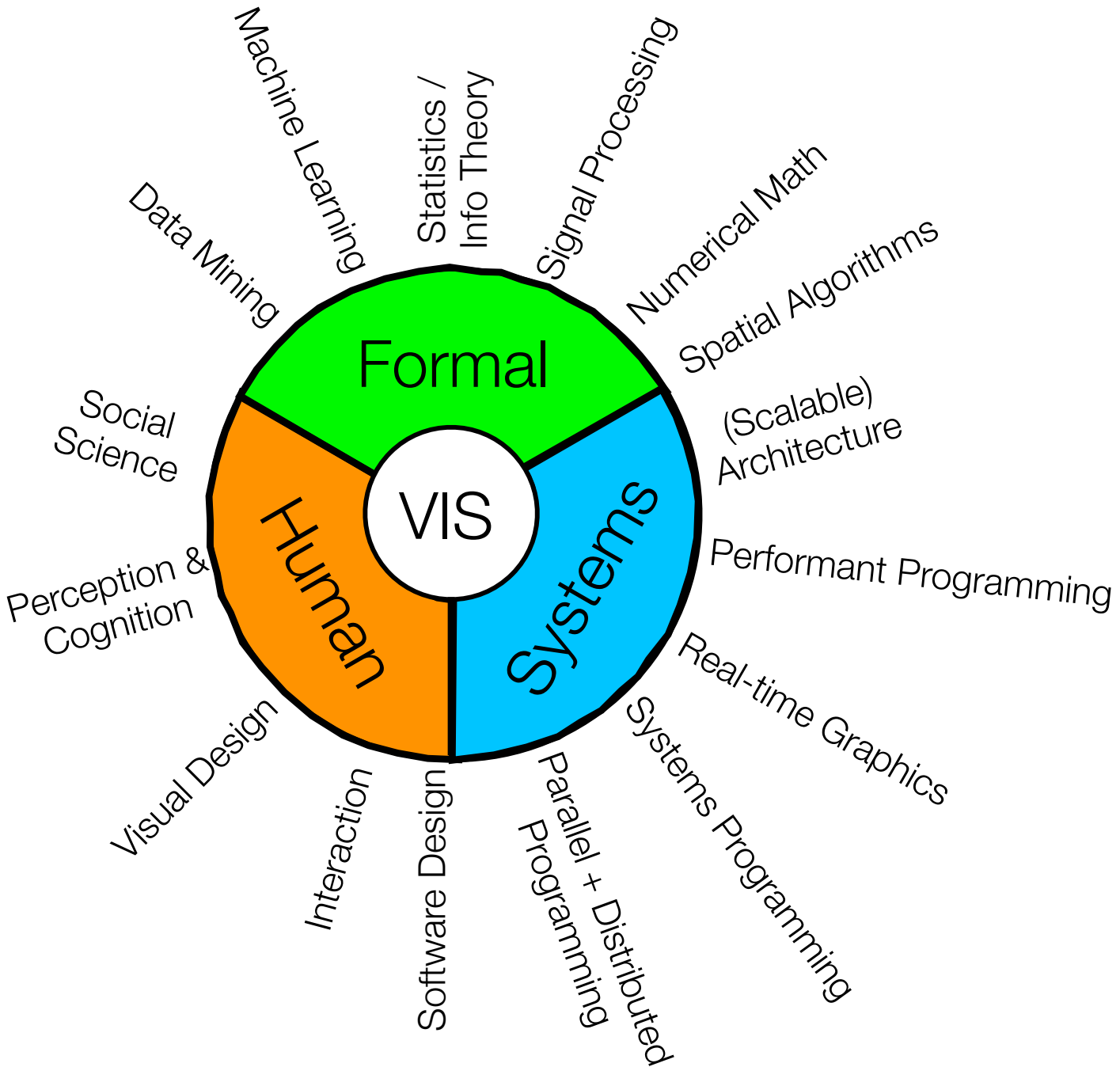
“Scientific Visualization”



“Information Visualization”

The Fabric of Visualization, G. Elisabeta Marai, Torsten Möller, 2019

Related Fields



Visualization Flavors

- Spatial Data Vis (aka: Scientific visualization)
  - User Interfaces
  - Data representation/processing
  - Algorithms
  - Visual representations
  - Mainly: *Continuous* models + Mathematical approach
- Non-Spatial Data Vis (aka: Information visualization)
  - Abstract data
  - WWW documents
  - File structures
  - Arbitrary relationships
  - …
  - Mainly: *Discrete* models + Human-Centered Design

Textbook

- Tamara Munzner, **Visualization Analysis & Design: Abstractions, Principles, and Methods**, CRC Press, 2014

Further Reading

- Primary book on perception and visual design:
  - C. Ware: **Information Visualization: Perception for Design**, Elsevier/Morgan Kaufmann, (1st ed. 2000, 2nd ed. 2004)
  - C. Ware: **Visual Thinking for Design**, Morgan Kaufmann, 2008
- Primary book(s) on Spatial Data / Volume Graphics
  - C.D. Hansen, C.R. Johnson (eds.): **The Visualization Handbook**, Elsevier, 2005
  - K. Engel, M. Hadwiger, J.M. Kniss, C. Rezk-Salama, D. Weiskopf, **Real-time volume graphics**, AK Peters, 2006
- Primary book(s) on Non-Spatial Data
  - Ch. Chen, **Information Visualization: Beyond the Horizon**, Springer Verlag, 2004
  - Card, Mackinlay, and Shneiderman, (eds.), **Readings in Information Visualization: Using Vision To Think**; Morgan Kaufmann 1999

Further Reading

- References:
  - G.M. Nielson, H.Hagen, H. Müller: **Scientific Visualization**, IEEE CS Press, Los Alamitos, 1997
  - W.J. Schroeder, K.W. Martin, B. Lorenson: **The Visualization Toolkit: An Object-Oriented Approach to 3D Graphics**, 4th ed., Kitware, Clifton Park, 2006
  - **The Visualization Toolkit User's Guide**, 11th ed, Kitware, 2010
  - E.R. Tufte, **The Visual Display of Quantitative Information**, Graphics Press 1983
  - E.R. Tufte, **Envisioning Information**, Graphics Press 1990
  - E.R. Tufte, **Visual Explanations**, Graphics Press 1997

(Spatial) Visualization Tools

- Great / free:
  - VTK (The Visualization Toolkit) **http://www.vtk.org**
- Commercial tools:
  - Amira **http://www.amiravis.com**
  - AVS/Express **http://www.avs.com**
  - IDL **http://www.exelisvis.com/IntelliEarthSolutions/GeospatialProducts/IDL.aspx**
  - IRIS Explorer **http://www.nag.co.uk/Welcome_IEC.asp**
  - OpenDX (now open software): **http://www.opendx.org**

(Non-Spatial) Vis. Tools

- Tamara's resources page!
  http://www.cs.ubc.ca/~tmm/courses/533-11/resources.html
- Free:
  - Processing **http://www.processing.org/**
  - Prefuse (java) **http://prefuse.sourceforge.net/**
  - D3 **http://alignedleft.com/work/d3-book**
  - Xgobi **http://www.research.att.com/areas/stat/xgobi/**
- Commercial tools:
  - Tableau **http://www.tableausoftware.com/**