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Visualization for Data Science

DS-4630 / CS-5630 / CS-6630

Introduction to Visualization

Why Study Visualization?



data



INDUSTRIAL REVOLUTION OF DATA

Joe Hellerstein, UC Berkley, 2008



The ability to take data—to be able to **understand** it, to **process** it, to **extract value** from it, to **visualize** it, to **communicate** it—that's going to be a hugely important skill in the next decades...

Because now we really do have essentially free and ubiquitous data. So the complimentary scarce factor is the ability to understand that data and extract value from it.

Google's Chief Economist, Hal Varian, 2009

Data Science Top 3 Job since 2017 according to Glassdoor.com

50 **Best Jobs** in America

Awards

- Best Places to Work
- Highest Rated CEOs
- Best Places to Interview

Lists





- Best Jobs**
- Best Cities for Jobs
- Highest Paying Jobs
- Oddball Interview Questions

Trends


This report ranks jobs according to each job's Glassdoor Job Score, determined by combining three factors: number of job openings, salary, and overall job satisfaction rating.

Employers: Want to recruit better in 2017? [Find out how.](#)

United States | 2017

11k Shares |    

1 Data Scientist

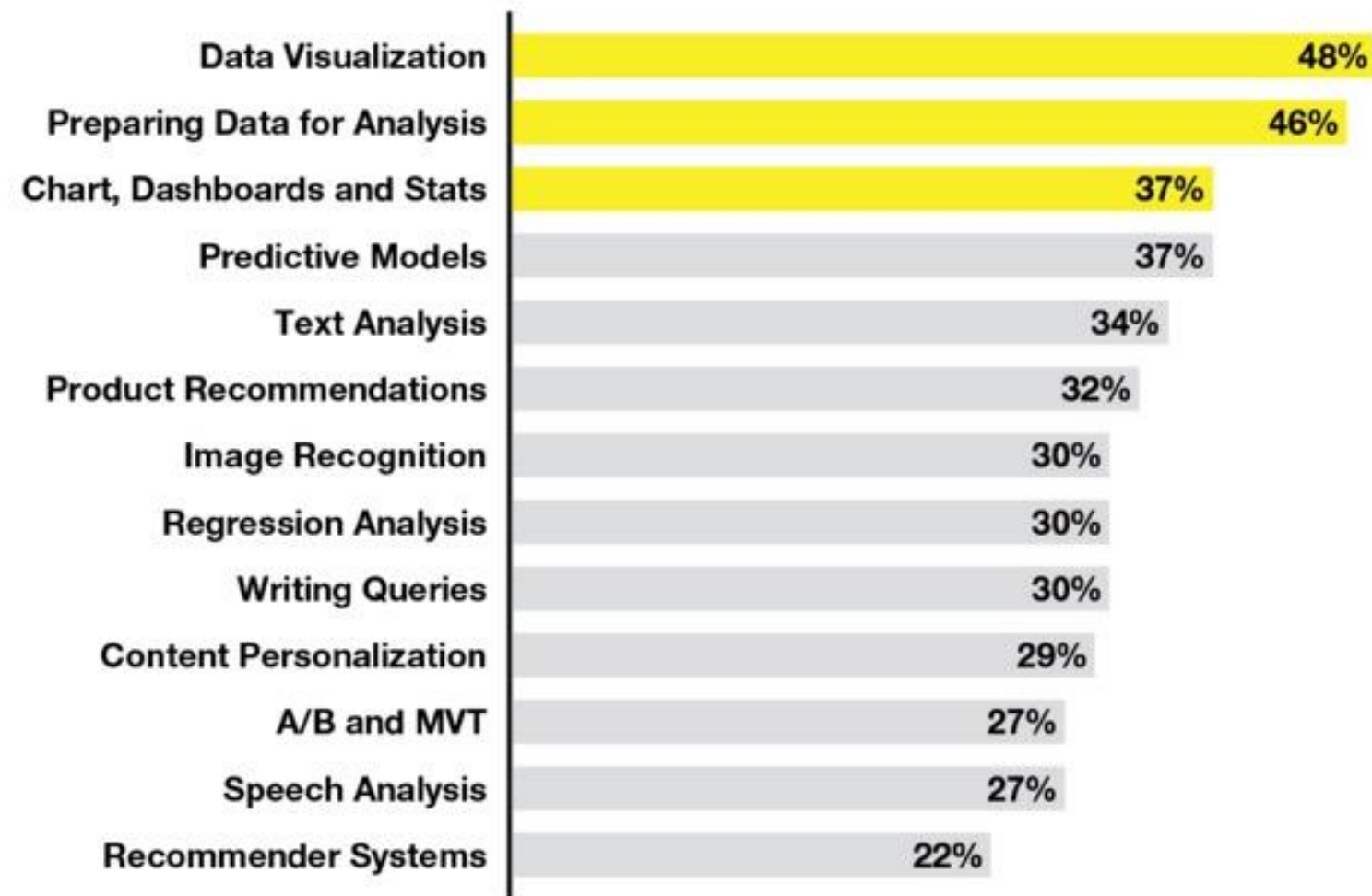


4.8 / 5 Job Score	4.4 / 5 Job Satisfaction
\$110,000 Median Base Salary	4,184 Job Openings

[View Jobs](#)

Expensive, talented resources are **misaligned.**

Which of the following activities does your company's data scientist (or advanced analytics resource) perform for your marketing analytics team?



Percentage of respondents. Multiple responses allowed.
Base: All respondents, n=503

gartner.com/SmarterWithGartner

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Gartner



VISUALIZATION GOALS

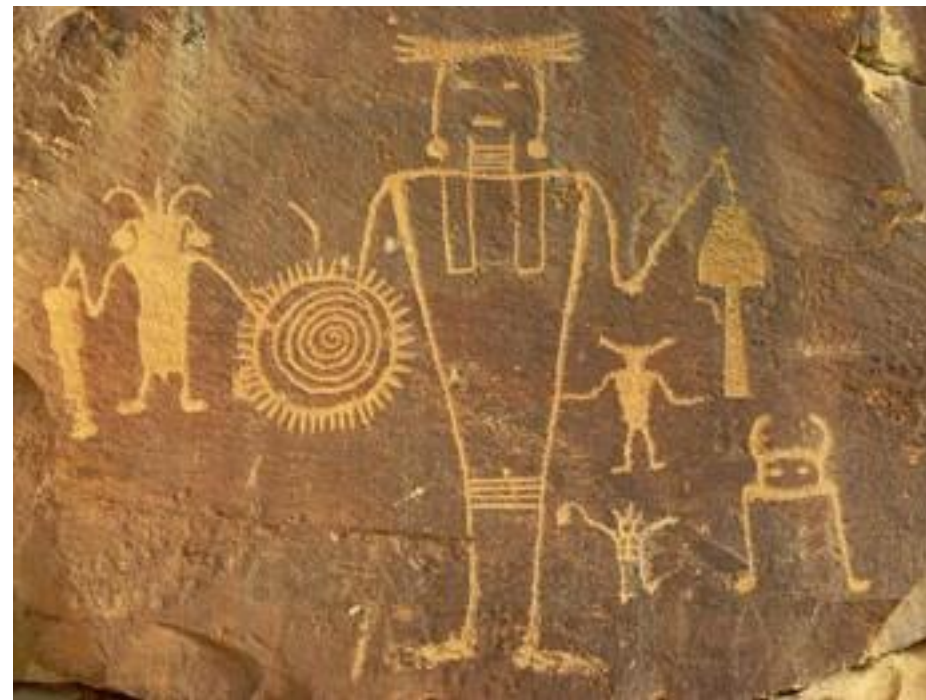
record information

analyze data to support reasoning

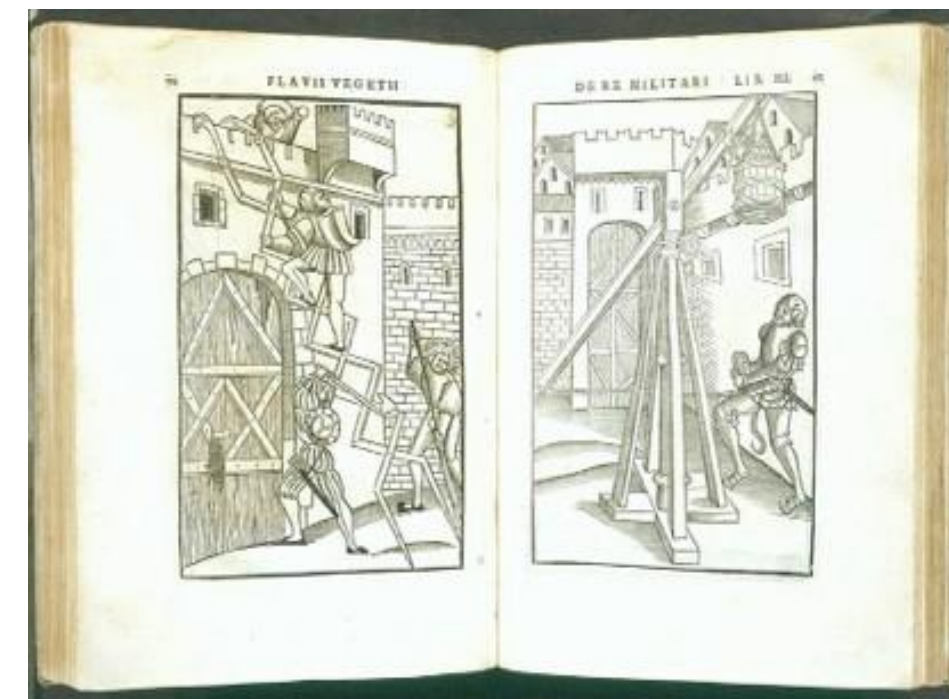
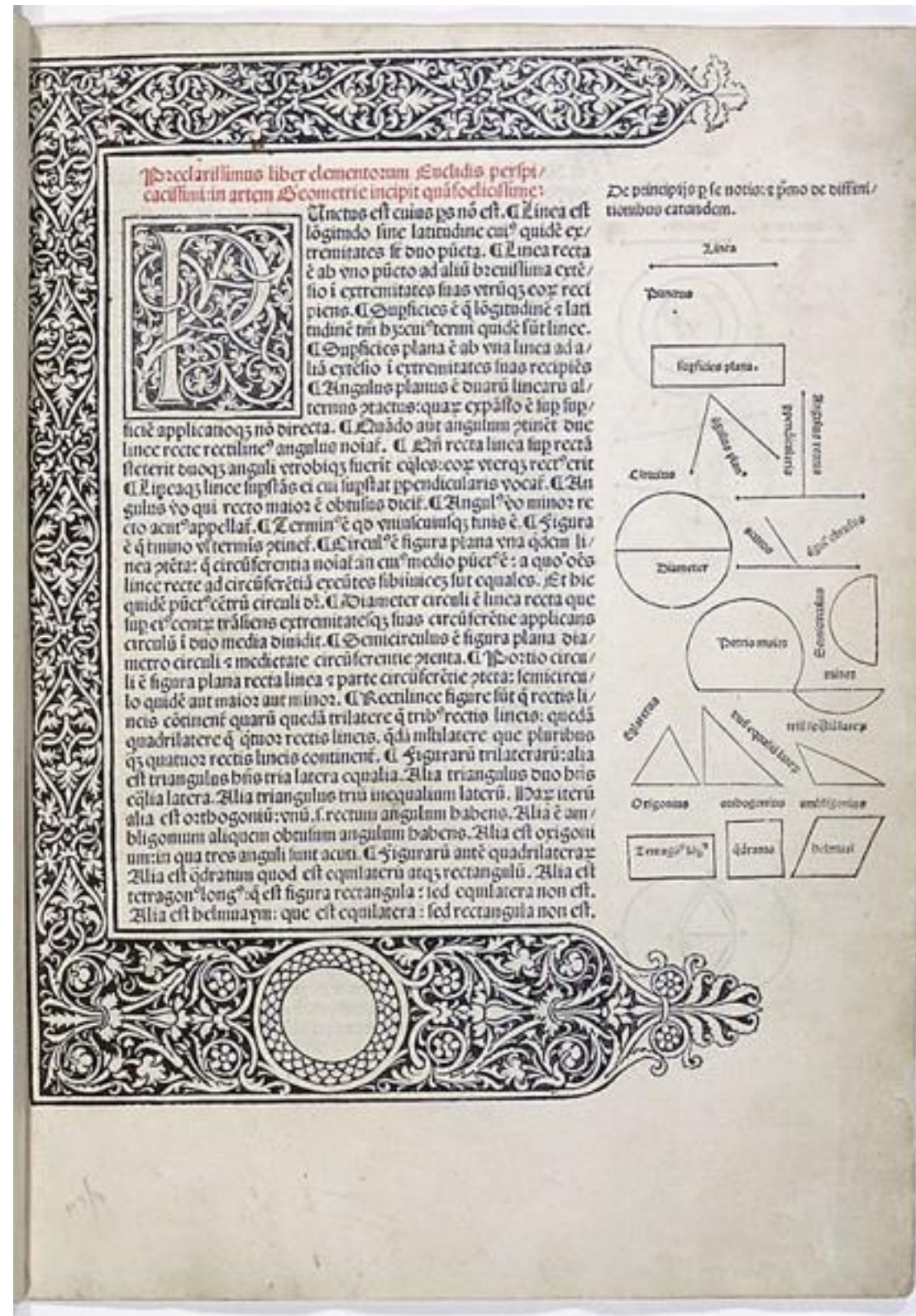
confirm hypotheses

communicate ideas to others

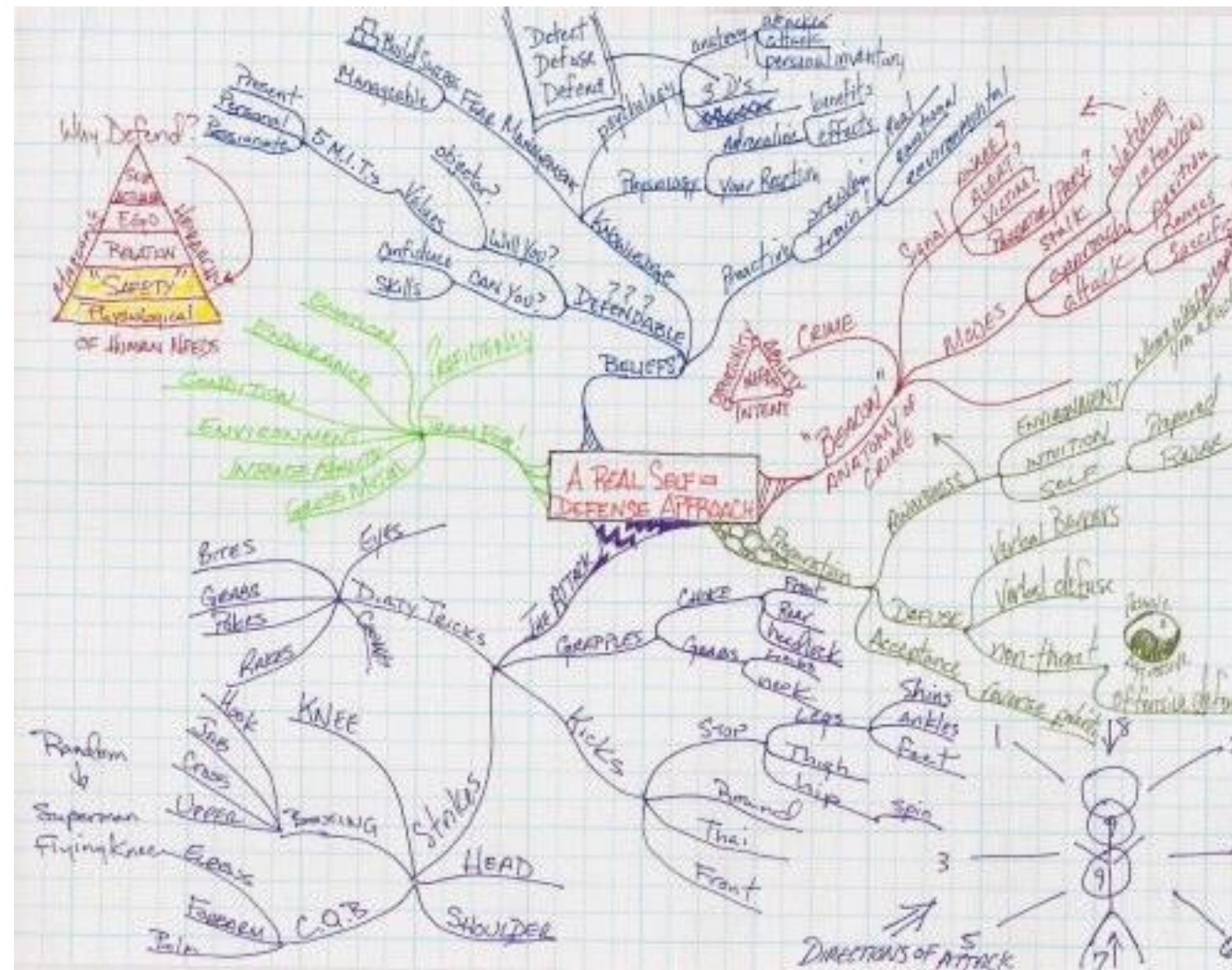
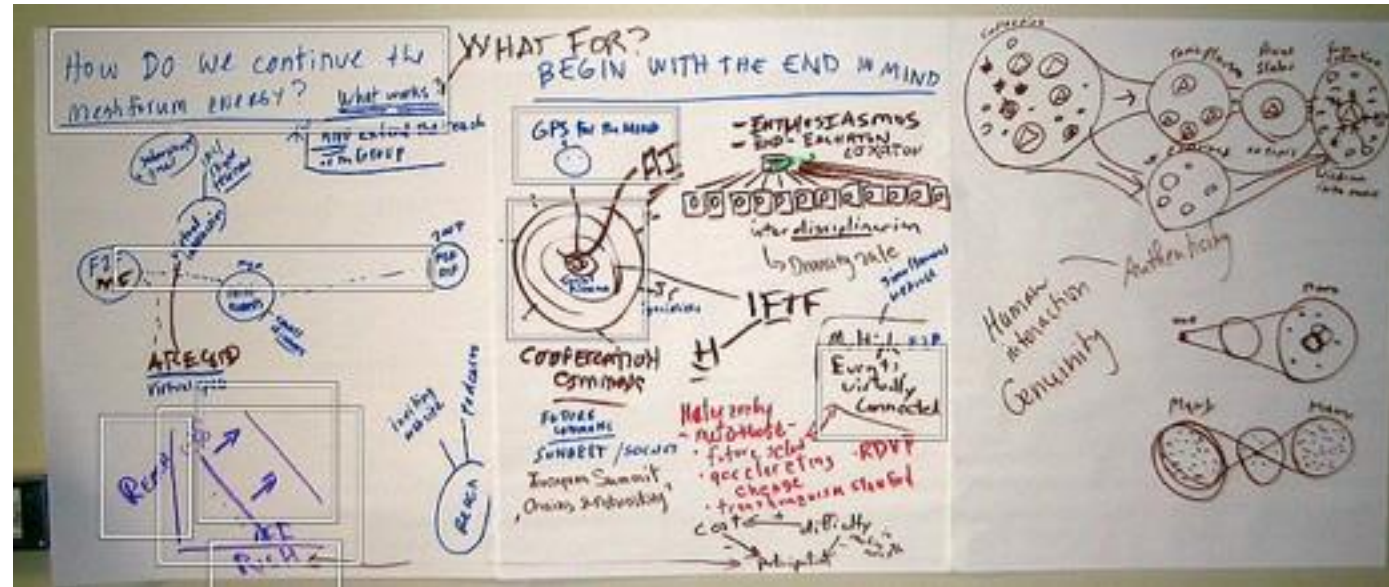
Record Information



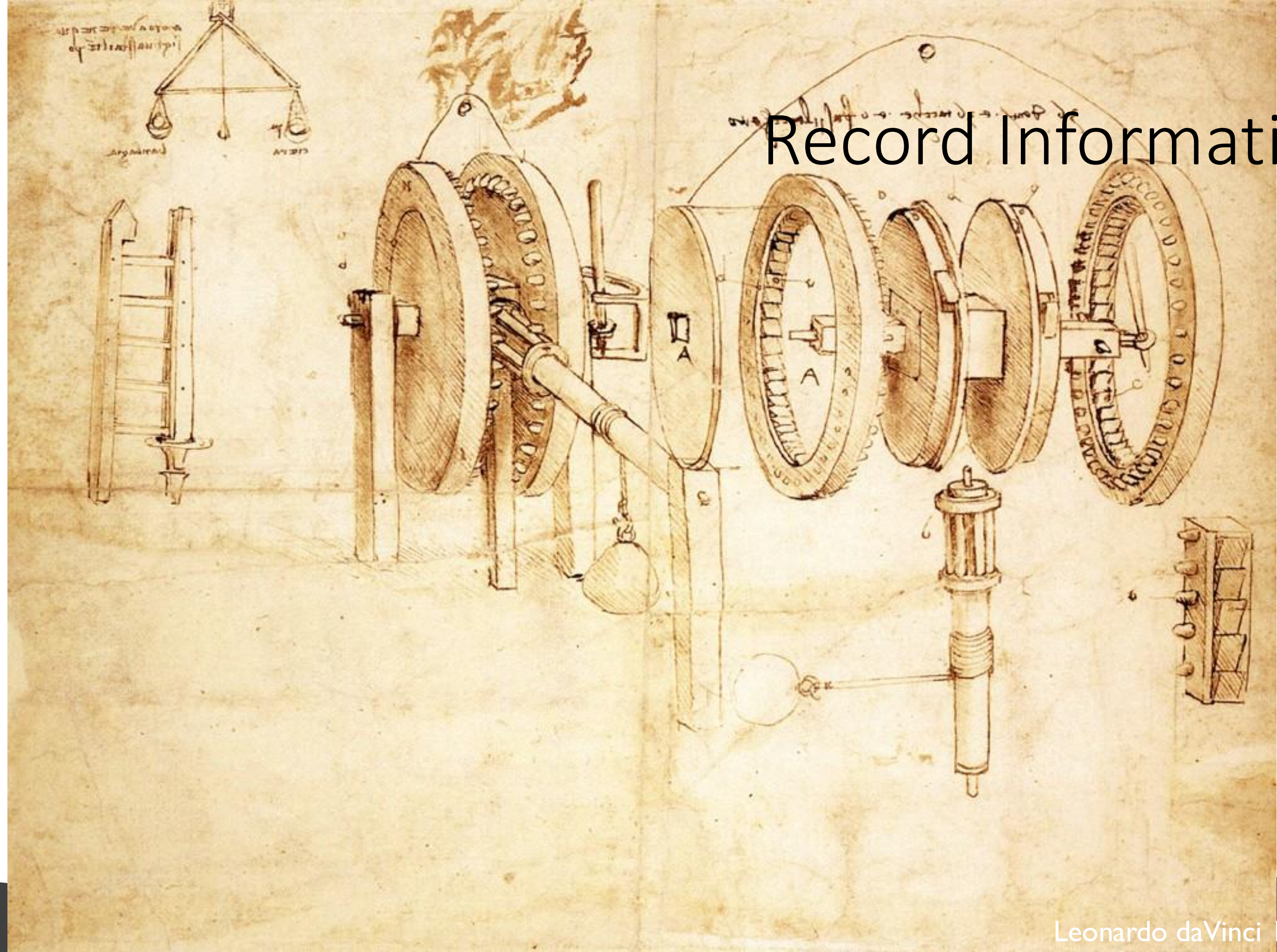
Record Information



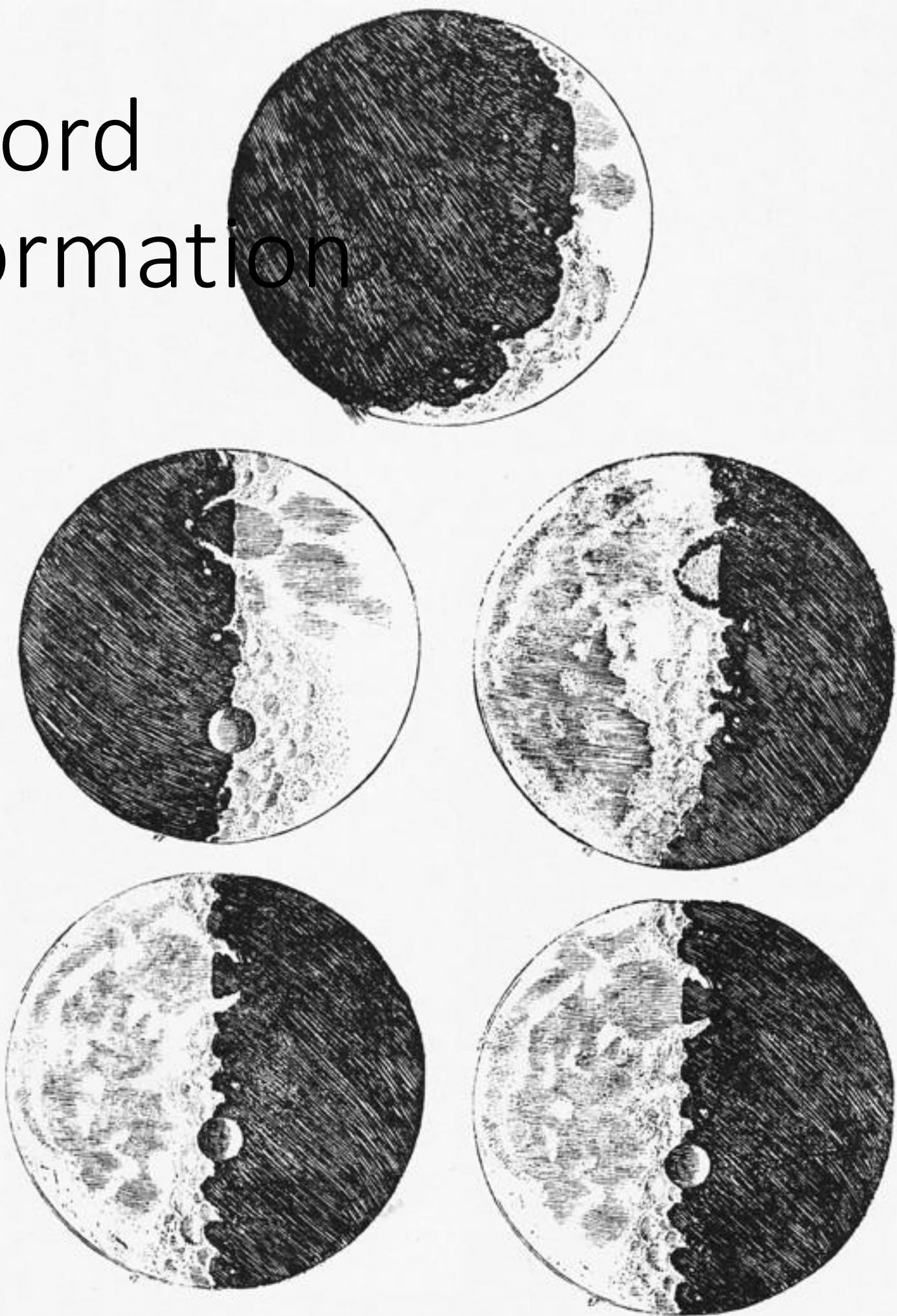
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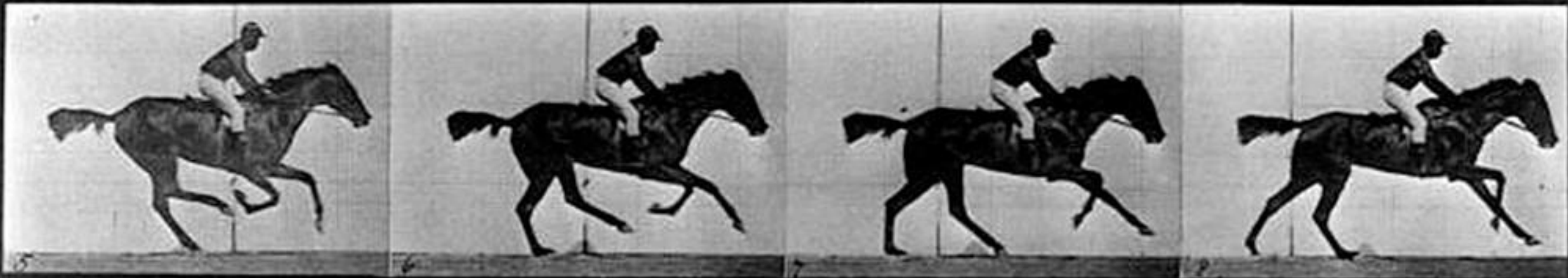


Record Information



Record Information





13

14

15

16

E.J. Muybridge 1878



ANALYSIS TO SUPPORT REASONING



Mapping Migration in the United States

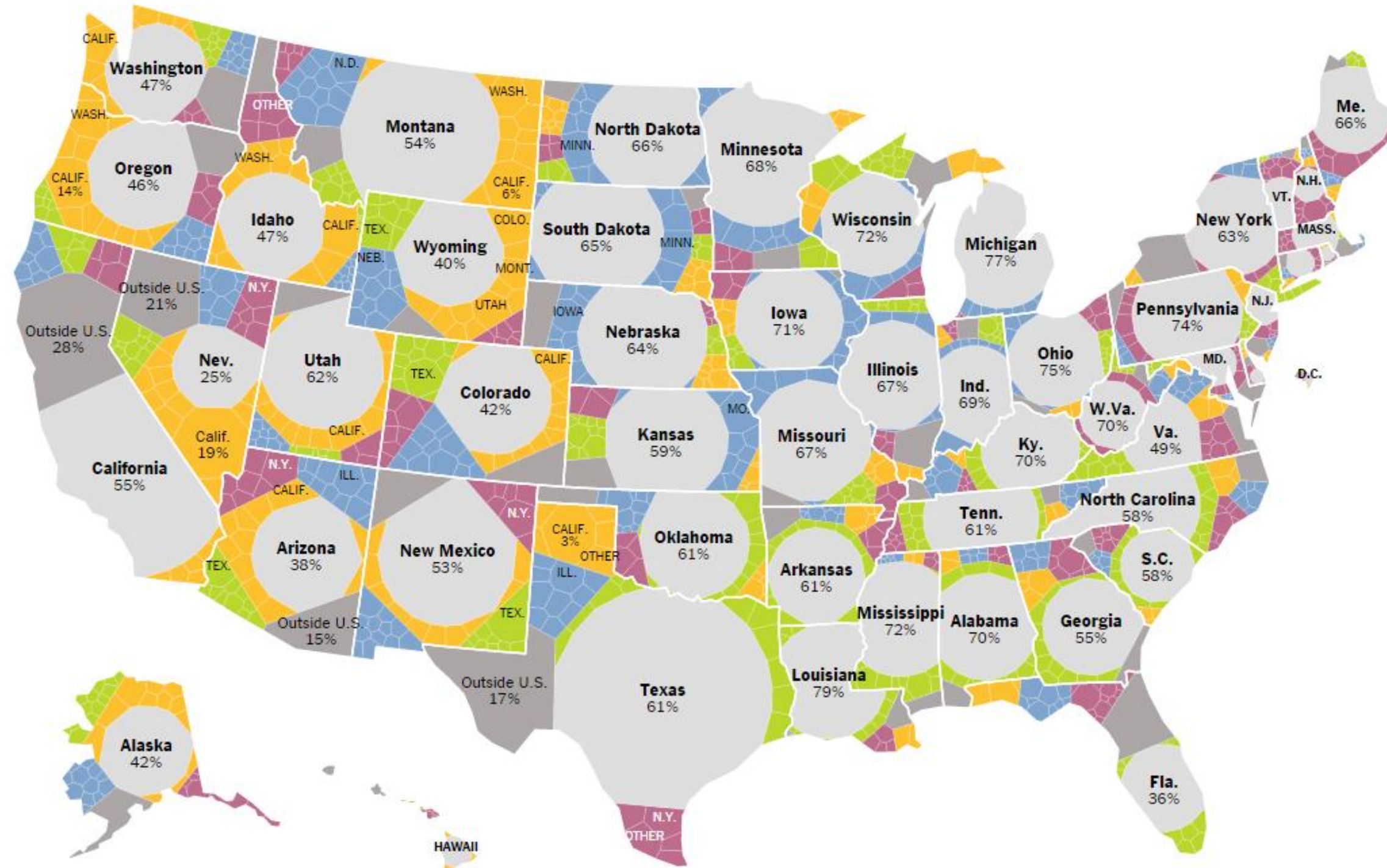
AUG. 15, 2014

Where people who lived in each state in 2012 were born

Each shape represents where the people living in a state were born. Within a state, larger shapes mean a group makes up a larger share of the population.

■ Northeast ■ South ■ Midwest ■ West ■ Outside the U.S.*

ANALYSIS TO SUPPORT REASONING



THE CHALLENGER DISASTER, 1986

Confirm Hypotheses





HISTORY OF O-RING DAMAGE ON SRM FIELD JOINTS

1161
OCT 20, 1985

	SRM No.	Cross Sectional View			Top View		Clocking Location (deg)	MOTOR	O-RING
		Erosion Depth (in.)	Perimeter Affected (deg)	Nominal Dia. (in.)	Length Of Max Erosion (in.)	Total Heat Affected Length (in.)			
61A LH Center Field**	22A	None	None	0.280	None	None	36° - 66°	DM-1	47
61A LH CENTER FIELD**	22A	NONE	NONE	0.280	NONE	NONE	338° - 18°	DM-2	52
51C LH Forward Field**	15A	0.010	154.0	0.280	4.25	5.25	163	QM-3	48
51C RH Center Field (prim)***	15B	0.038	130.0	0.280	12.50	58.75	354	QM-4	51
51C RH Center Field (sec)***	15B	None	45.0	0.280	None	29.50	354	SRM-15	53
41D RH Forward Field	13B	0.028	110.0	0.280	3.00	None	275	SRM-22	75
41C LH Aft Field*	11A	None	None	0.280	None	None	--	SRM-25	29
41B LH Forward Field	10A	0.040	217.0	0.280	3.00	14.50	351		27
STS-2 RH Aft Field	2B	0.053	116.0	0.280	--	--	90		

*Hot gas path detected in putty. Indication of heat on O-ring, but no damage.
 **Soot behind primary O-ring.
 ***Soot behind primary O-ring, heat affected secondary O-ring.

Clocking location of leak check port - 0 deg.

OTHER SRM-15 FIELD JOINTS HAD NO BLOWHOLES IN PUTTY AND NO SOOT NEAR OR BEYOND THE PRIMARY O-RING.

SRM-22 FORWARD FIELD JOINT HAD PUTTY PATH TO PRIMARY O-RING, BUT NO O-RING EROSION AND NO SOOT BLOWBY. OTHER SRM-22 FIELD JOINTS HAD NO BLOWHOLES IN PUTTY.

BLOW BY HISTORY

- SRM-15 WORST BLOW-BY
- o 2 CASE JOINTS (80°), (110°) ARC
 - o MUCH WORSE VISUALLY THAN SRM-22

SRM 22 BLOW-BY

- o 2 CASE JOINTS (30-40°)

SRM-13A, 15, 16A, 18, 23A 24A

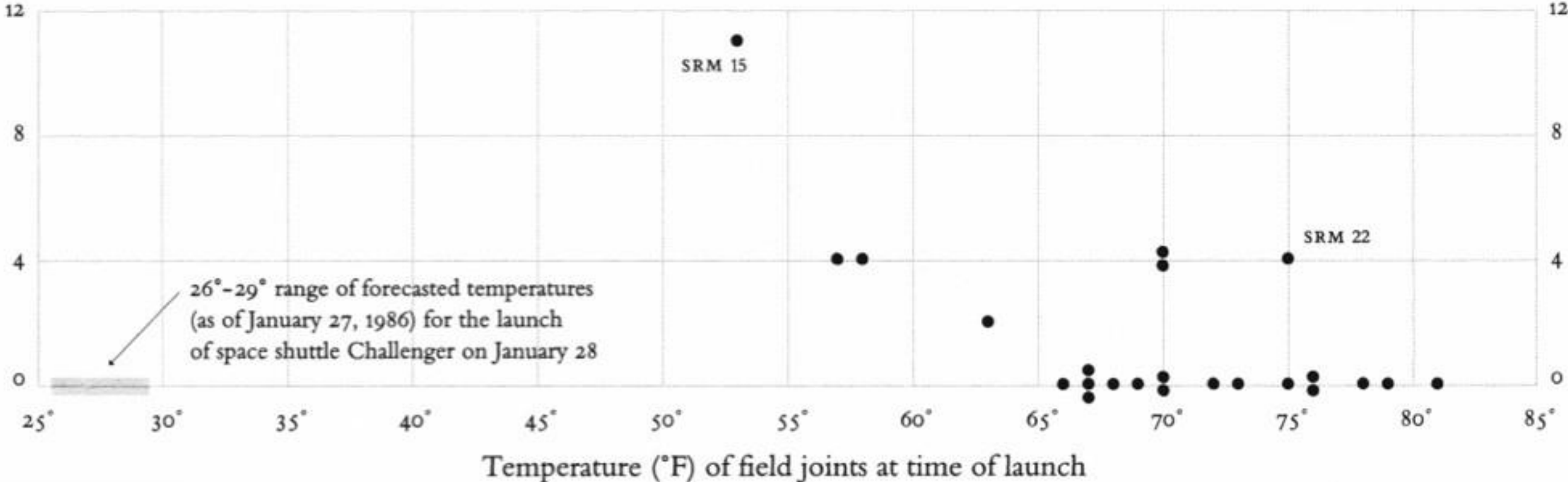
- o NOZZLE BLOW-BY

HISTORY OF O-RING TEMPERATURES (DEGREES - F)

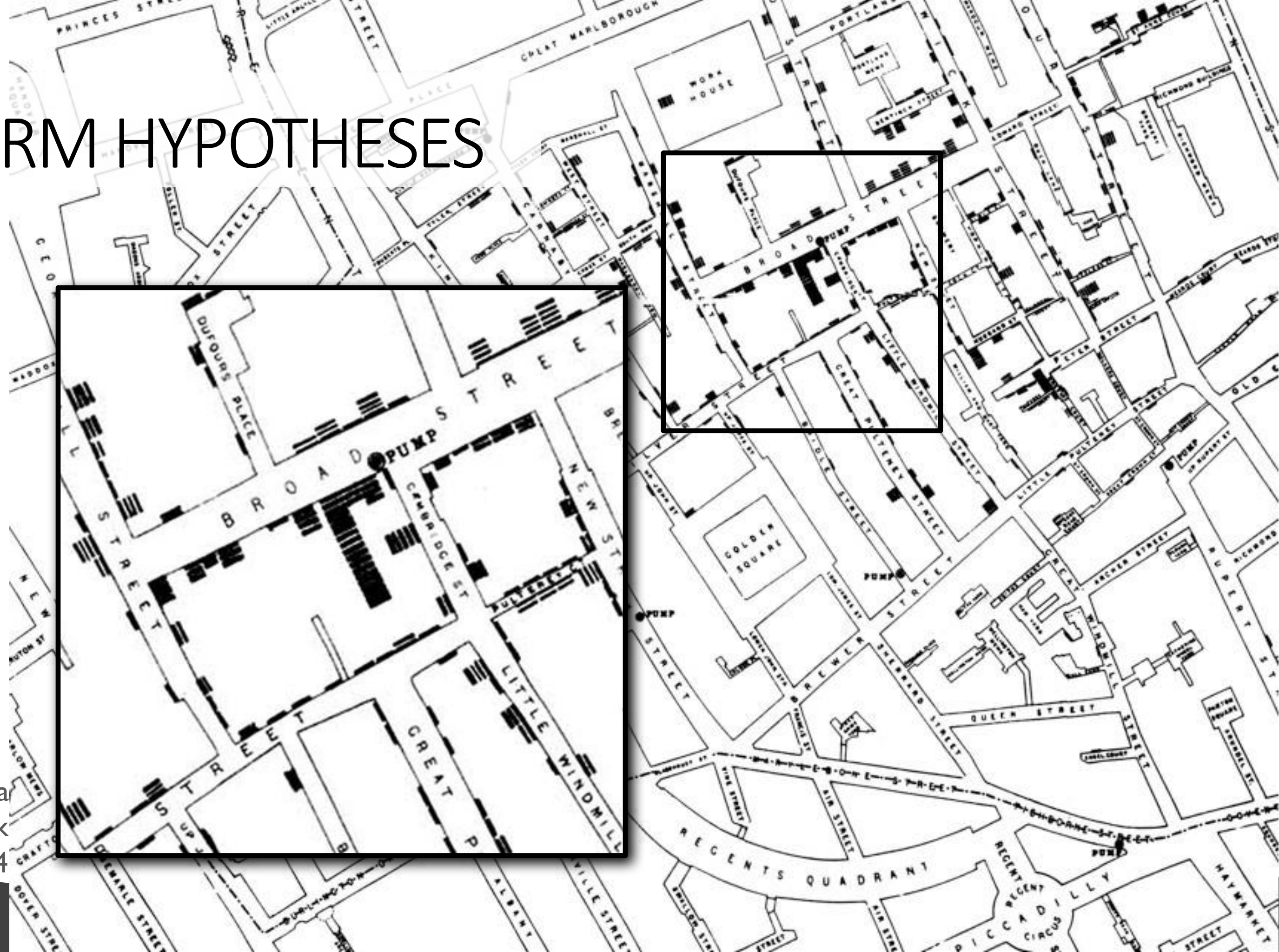
MOTOR	MBT	AMB	O-RING	WIND
DM-1	68	36	47	10 MPH
DM-2	76	45	52	10 MPH
QM-3	72.5	40	48	10 MPH
QM-4	76	48	51	10 MPH
SRM-15	52	64	53	10 MPH
SRM-22	77	78	75	10 MPH
SRM-25	55	26	29	10 MPH
			27	25 MPH



O-ring damage index, each launch



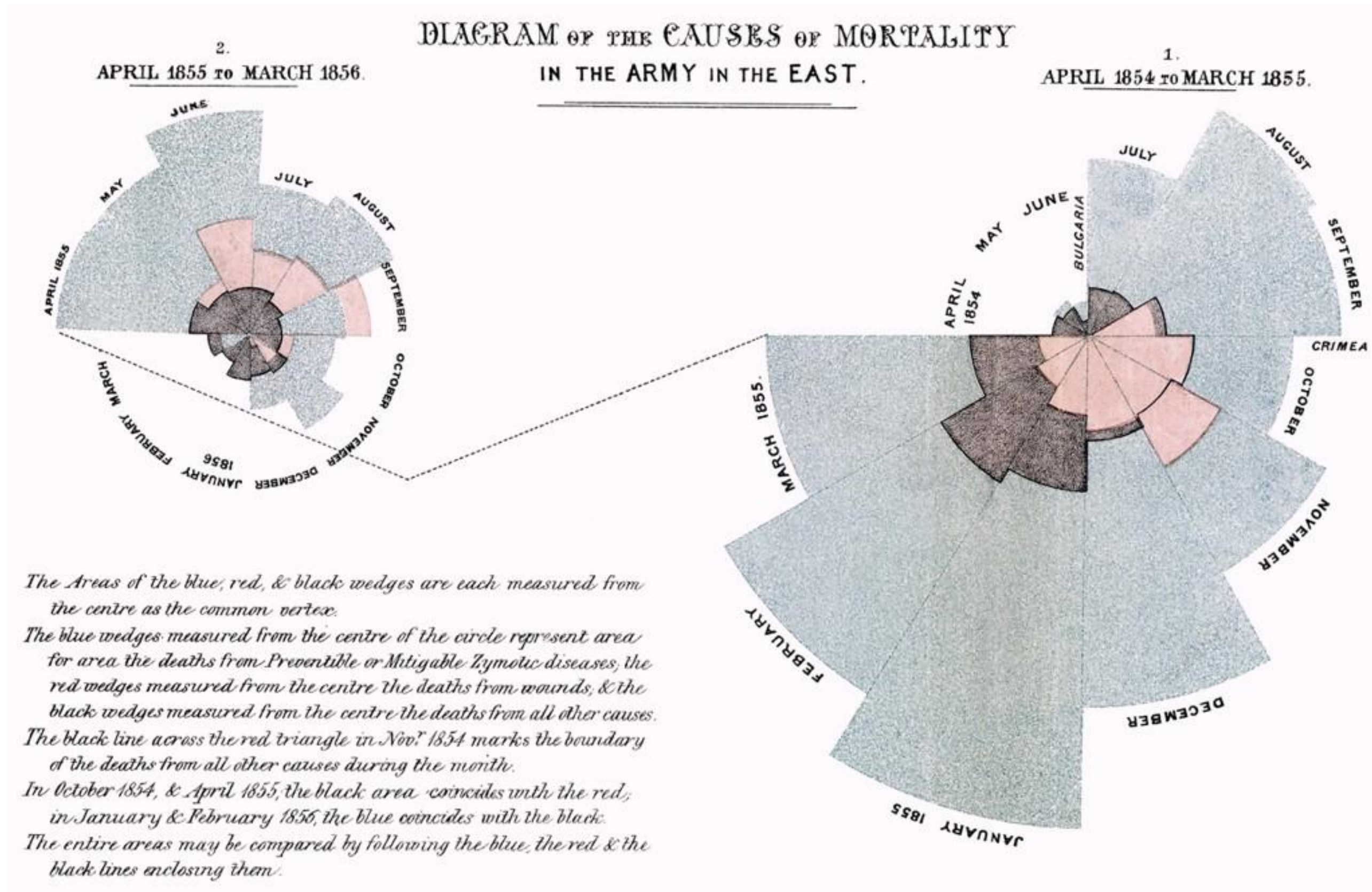
CONFIRM HYPOTHESES

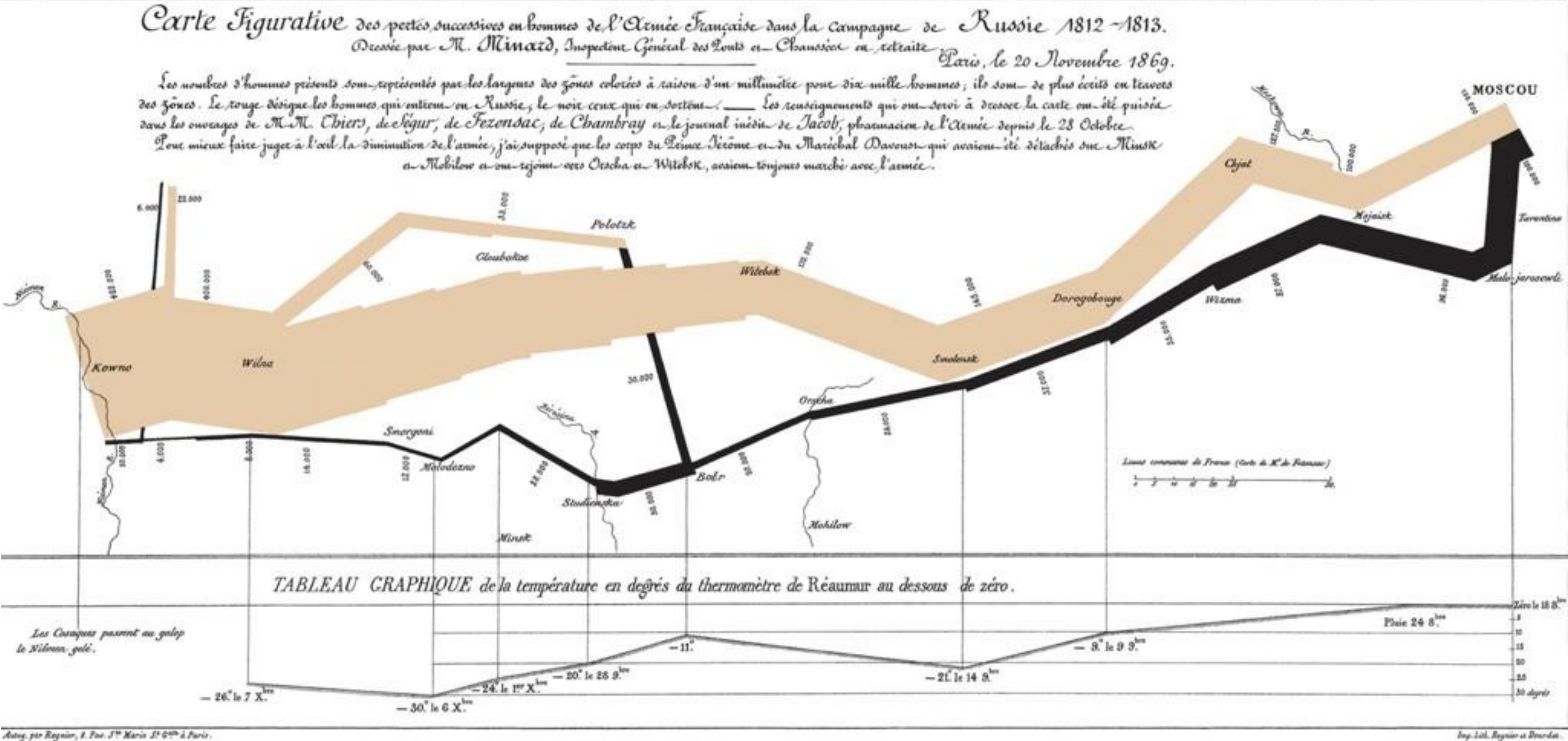


London Cholera
Outbreak
John Snow 1854



COMMUNICATE IDEAS





why does visualization work?

why does visualization
work?

cognition is limited

The screenshot shows a YouTube video player for "The 'Door' Study" by the channel "profsimons". The video is at the 0:20 mark of a 1:37 duration. The video content shows three people standing on a sidewalk. A copyright notice at the top of the video reads "Copyright (c) 1998 Simons & Levin. All rights reserved." Below the video player, the video has 260,166 views, 249 likes, and 5 dislikes. The description states: "This video shows footage from a 1998 study by Daniel Simons and Daniel Levin in which a participant fails to notice when the person he is talking to is replaced by someone else. The study was among the first to demonstrate that the phenomenon of 'change blindness' can occur outside the laboratory." The right sidebar features several recommended videos, including "Change Blindness 1" (36,759 views), "Gradual Change Test 1" (34,443 views), "Change Blindness" (25,498 views), "Test Your Awareness...." (43,847 views), "Perception of beauty" (92,589 views), "Amazing Fire & Gas Trick!" (1,078,932 views), "Try To Watch This Without Laughing Or" (2,042,315 views), "How much is: 75 + 26" (1:29), and "Sociopath Test" (213,997 views).

Visualization uses perception to point
out interesting things

MTHIVLWYADCEQGHKILKMTWYN
ARDCAIREQGHLVKMF PSTWYARN
GFPSVCEILQGKMFPSNVRCEQDI
PSGHLMFHKMVPSTWYACEQTWRN

MTHI**V**LWYADCEQGHKILKMTWYN
ARDCAIREQGH**L**VKMFPSSTWYARN
GFPS**V**CEILQGKMFPSNVRCEQDI
PSGHLMFHKM**V**PSTWYACEQTWRN

MTHI **V**LWYADCEQGHKILKMTWYN
ARDCAIREQGH **L**VKMF PSTWYARN
GFPS **V**CEILQ GKMFPSN **V**RCEQDI
PSGHLMFHKM **V**PSTWYACEQTWRN

(but can also deceive you)

why does visualization work?

memory is limited

calculation exercise . . . x 28 34

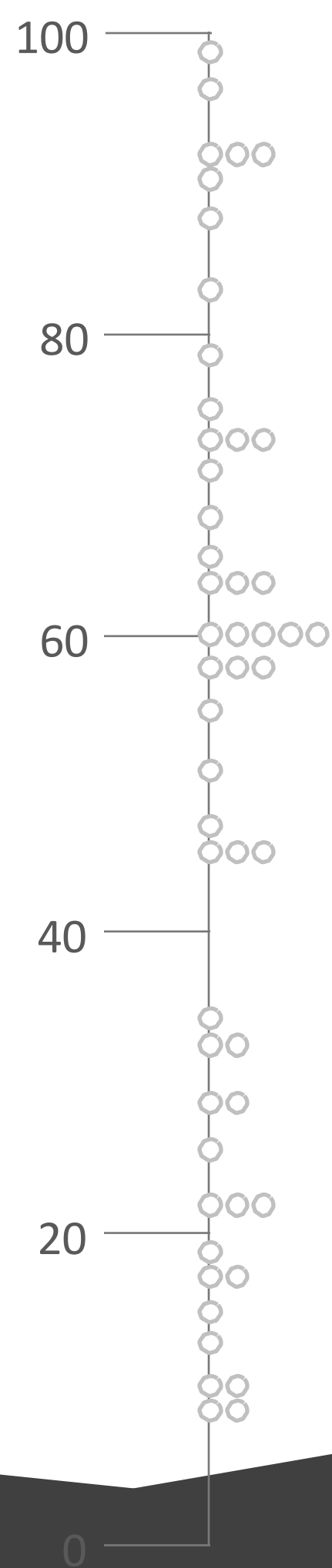
calculation exercise . . . $\begin{array}{r} 79 \\ \underline{\times 16} \end{array}$

calculation exercise . . . x 28 34

Visualization
uses pictures to enhance working
memory

15	19	60
33	11	75
57	34	79
18	51	92
73	22	13
71	60	22
17	10	68
73	18	55
65	46	29
60	73	22
46	92	97
10	58	46
57	17	83
26	99	33
88	92	60
91	29	57
96	12	47

given these numbers . . .
. . . what number
appears most often?



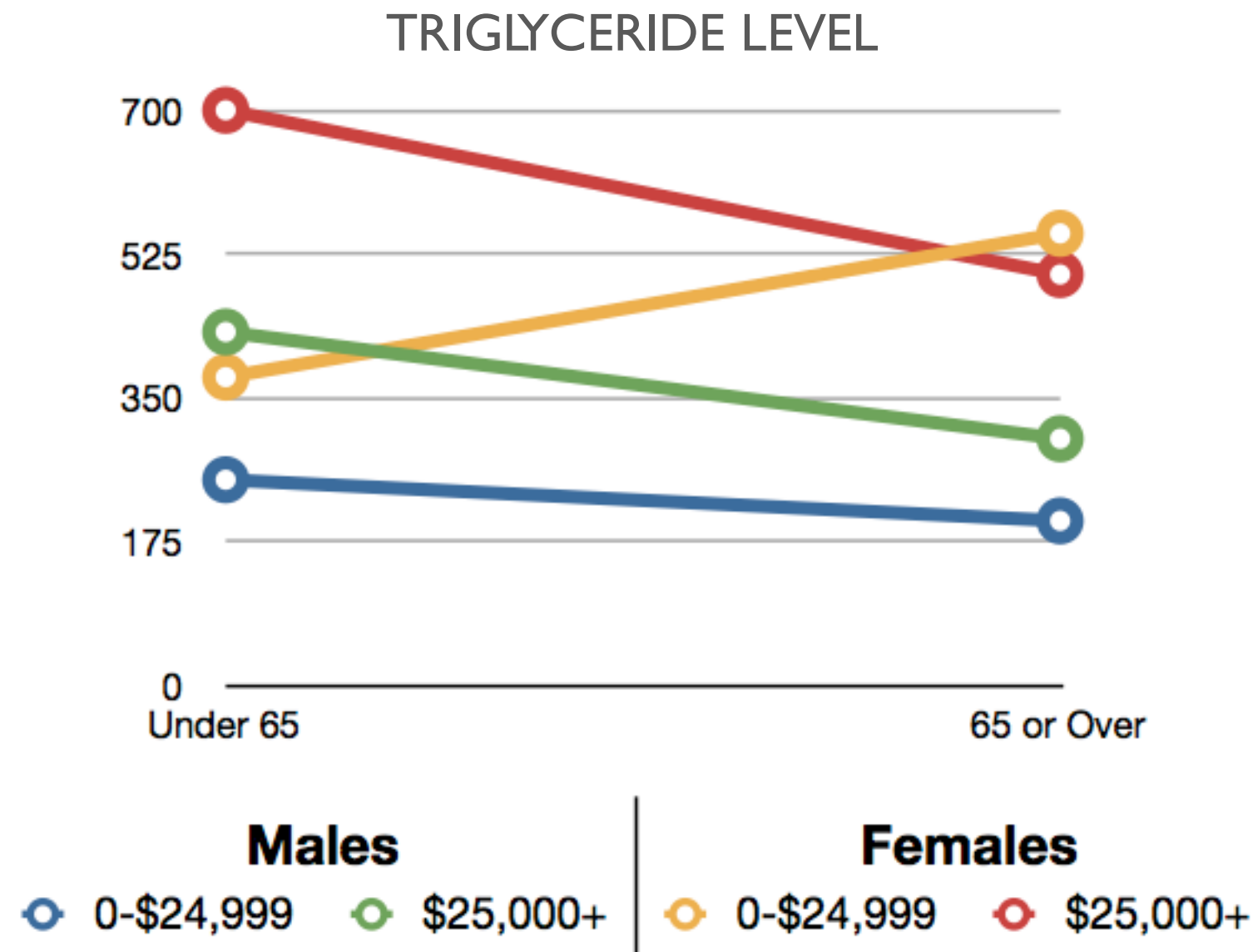
given these numbers . . .
. . . what number
appears most often?

query exercise . . .

TRIGLYCERIDE LEVEL

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

QUESTION: Which gender and income level shows a different effect of age on triglyceride levels?



QUESTION: Which gender and income level shows a different effect of age on triglyceride levels?

The **goal of this course** is to introduce students to the principles, methods, and techniques for effective visual analysis of data

We will discuss visualization **techniques for a broad range of data types.**

You will **gain experience in developing your own** interactive visualization tools.

This course requires independent knowledge and ability in HTML, CSS, and JavaScript. We will cover these topics but move quickly.

Alternative: COMP 5960 – Applied Data Visualization

- New Course!
- Designed for **Non-CS Students**
- Less focus on visualization research, more on practical data visualization
- How to use Python and Tableau for custom visualizations
- Requires less programming expertise
- <https://www.dataviscourse.net/2024-applied/>

