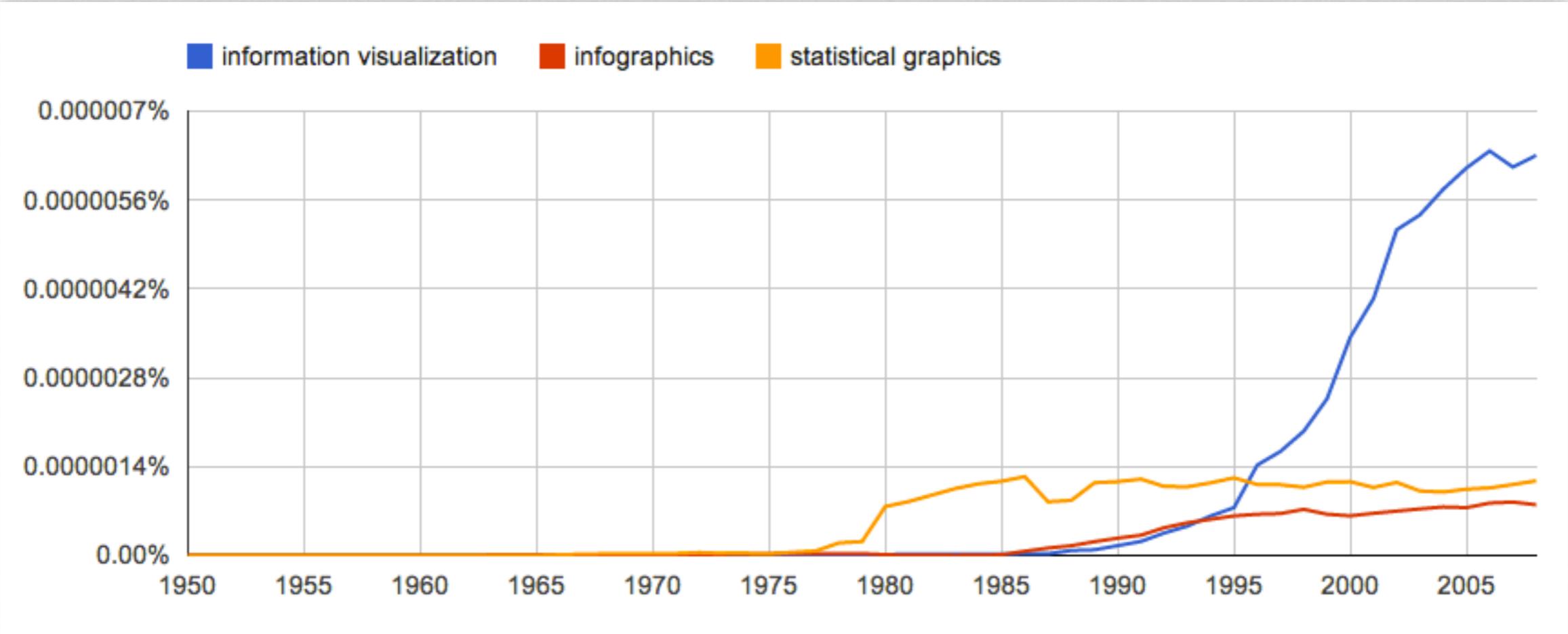


INFORMATION VISUALIZATION





OUTLINE



About Me

Definitions

History and Milestones

Techniques

Mixed Feelings

OUTLINE



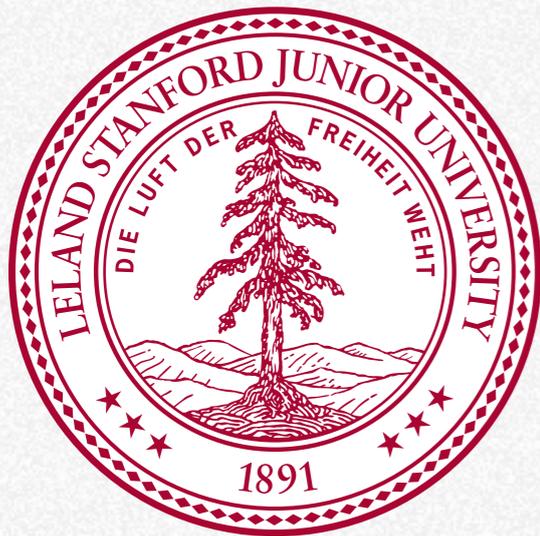
About Me

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WHY HOFI?

- + Lots of technologies fail regardless of how well they are designed ;)
- + There are patterns to the ways technologies are adopted (or not)
- + Going beyond any specific technology and looking at the human part of the equation

OUTLINE



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DEFINITION(S)

Visual representations of abstract data to amplify cognition

– Card, Mackinlay, Shneiderman, 1999

Visually displayed measured quantities by means of the combined use of points, lines, a coordinate system, numbers, symbols, words, shading and color.

– Tufte, 2001

Complex ideas communicated with clarity, precision, and efficiency.

– Tufte, 2001

The depiction of information using spatial or graphical representations, to facilitate comparison, pattern recognition, change detection, and other cognitive skills that make use of the visual system.

– Hearst, 2003

DEFINITION(s)

Visual

+ Data

+ Understanding

OUTLINE



About Me

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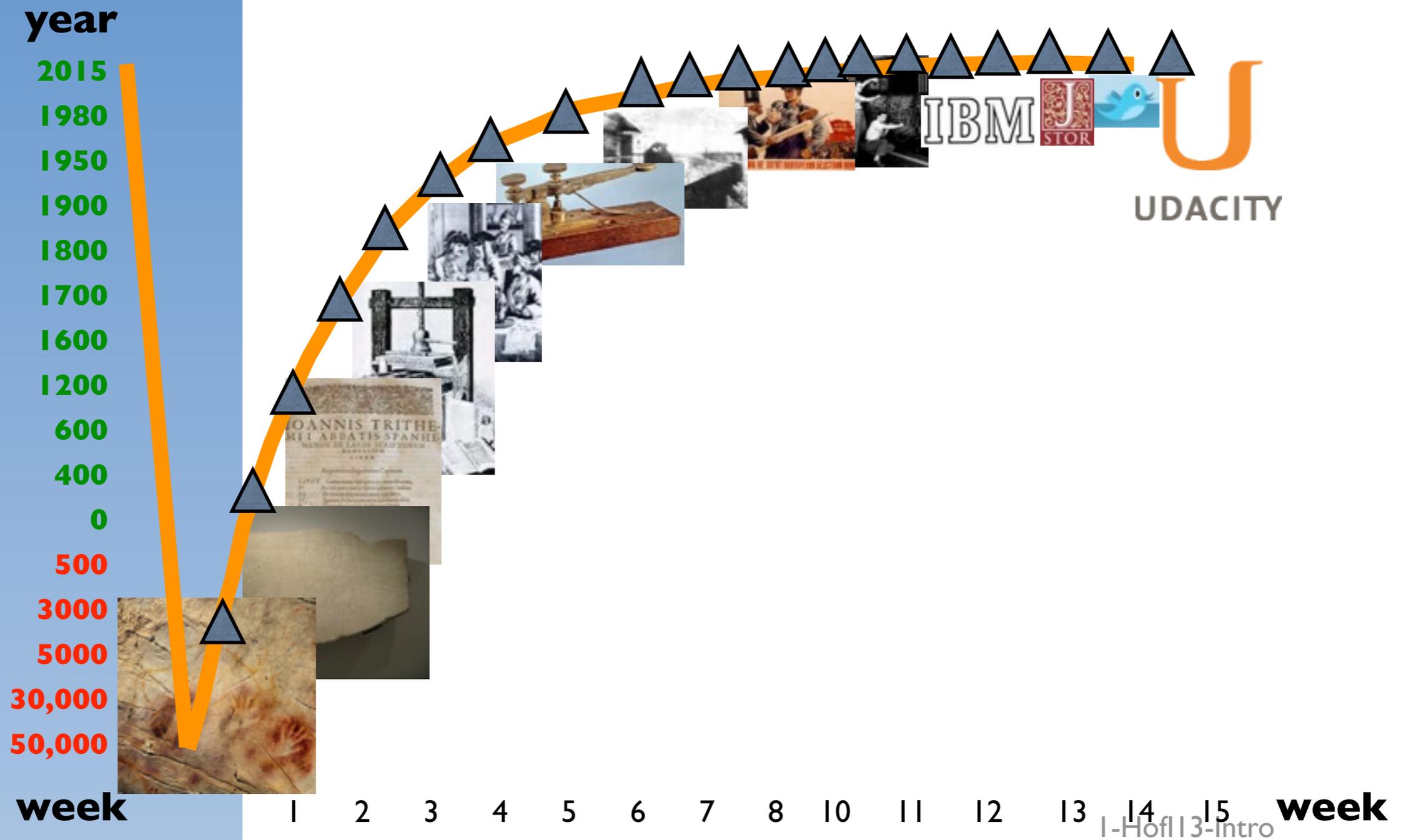
Mixed Feelings

THE TIMELINE

The linear metaphor is ubiquitous in everyday visual representations ... in almanacs, calendars, charts, and graphs of all sorts. So it comes as something of a surprise to discover that it was only quite recently that scholars first thought to represent chronological relationships among historical events by placing them on a measured timeline.

– Rosenberg, 2010

where are we going?





Joseph Priestley
(1733 – 1804)



William Playfair
(1759 – 1823)

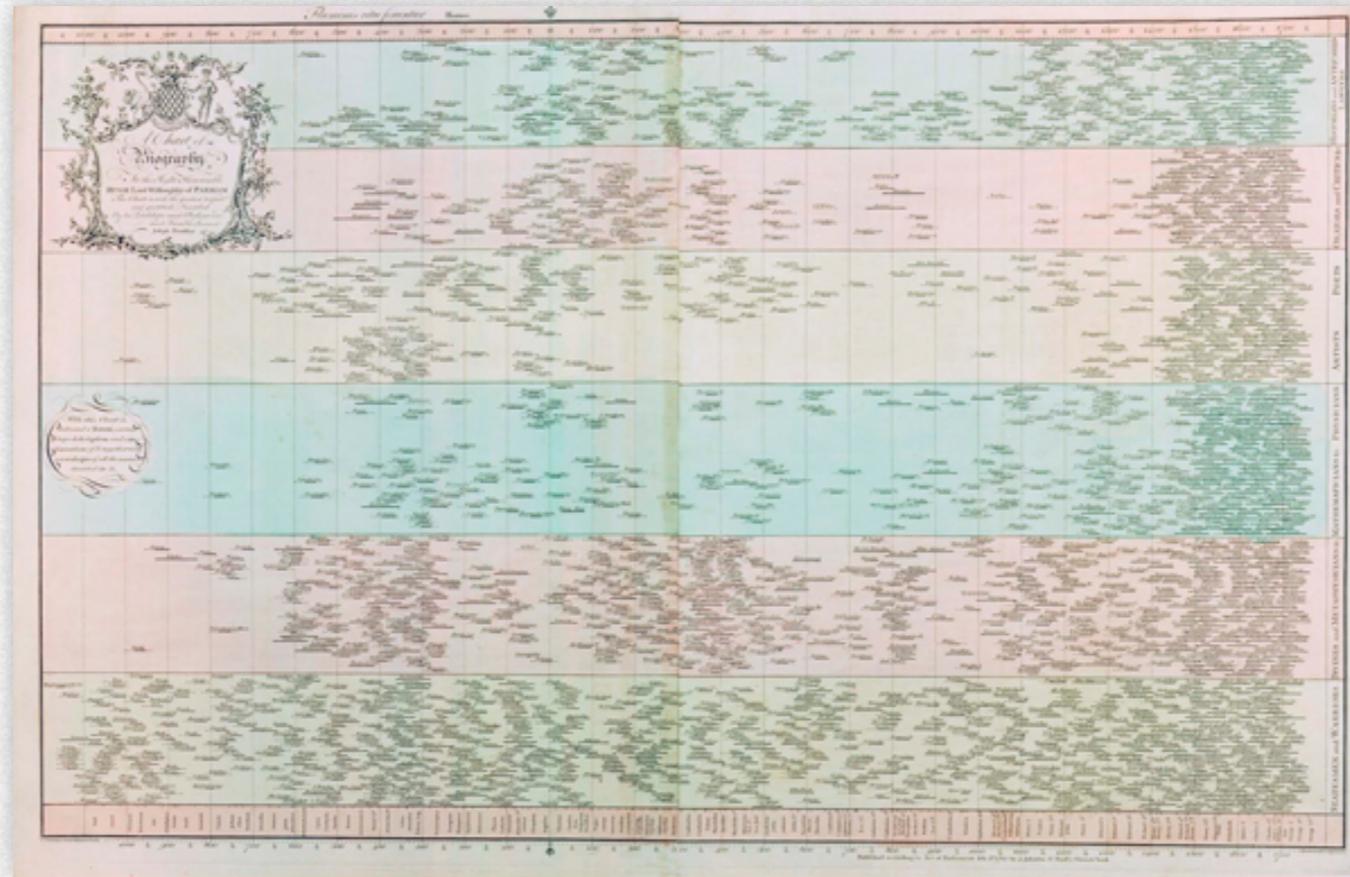
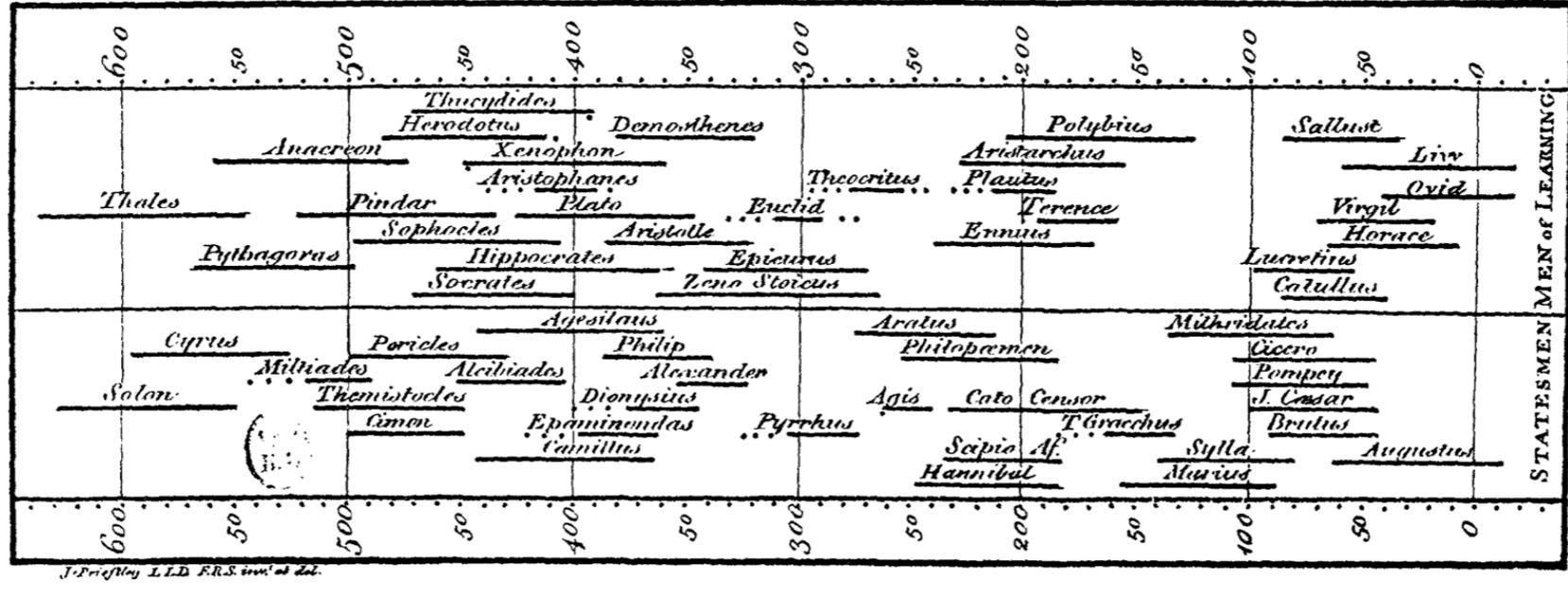


Joseph Priestley
(1733 – 1804)

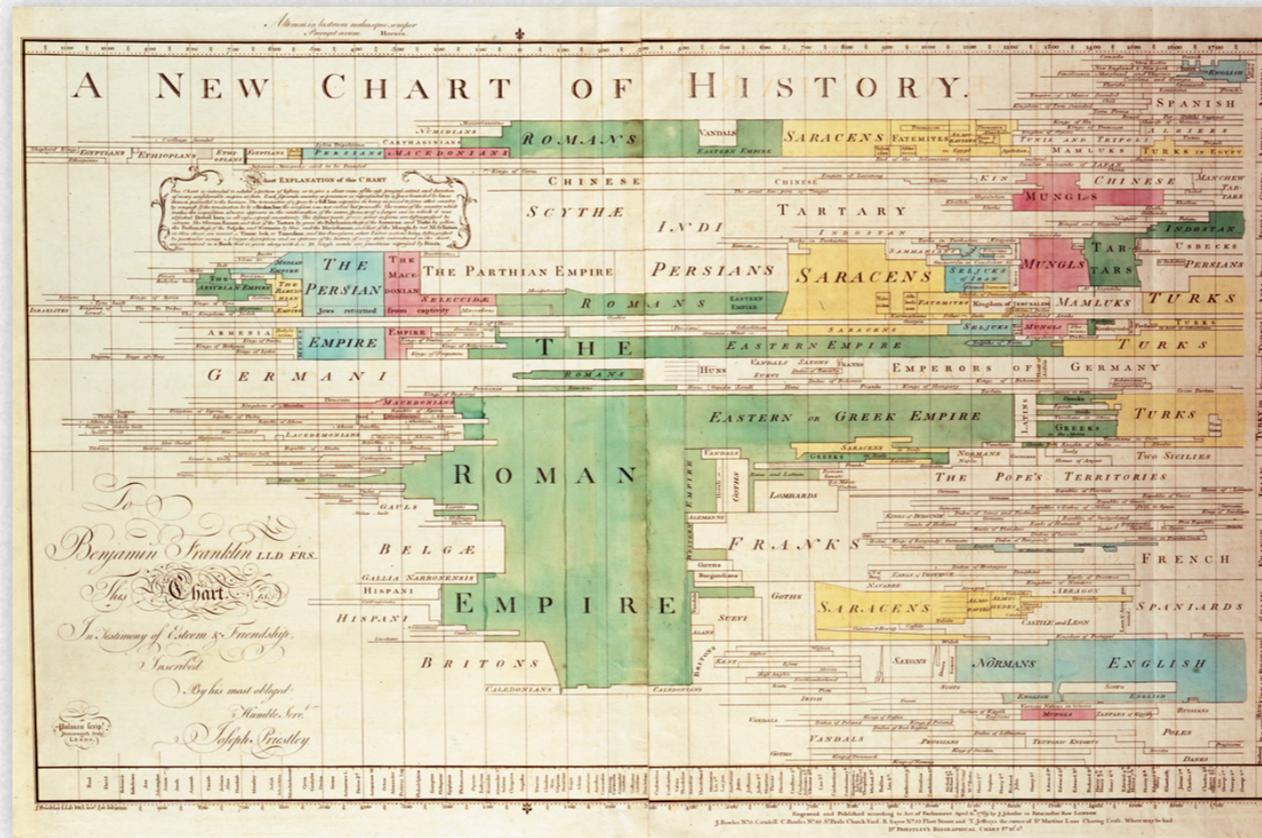
Joseph Priestley (1733 – 1804)

- + Member of the Royal Society
- + Perhaps better known for discovering oxygen
- + Typical Royal Society polymath
- + *Lectures on History and General Policy* (1788)
 - + Teaching aids to help students see history
- + *A Chart of Biography* (1765)
- + *New Chart of History* (1769)

A Specimens of a Chart of Biography.



A Chart of Biography (1765)



If the reader carry his eye vertically, he will see the contemporary state of all the empires subsisting in the world, at any particular time. He may observe which were then rising, which were flourishing, and which were upon the decline. Casting his eye a little on each side of the vertical line, he will see what empires had lately gone off the stage, and which were about to come on.

A New Chart of History (1769)

Annals of Saint Gall (Mid 9th Century)

omni reuerentia aut ministri altaris. n̄ liceat nisi in ipsa oratione complere. Siue officium ruffit. qui minister e templi di. Quod si aliquo casu lapsus e. & in eo quod dicitur reprobatus crimine. n̄ liceat ante eum qui preest. uel secundum complere. Nullo permittatur clerico in monasterio habitare. nisi eos tantum quos lapsus peccati ad humilitate deduxit. & est vulneratus. ut in monasterio humilitate medicinetur. Sane hęc uobis tenenda sufficiant. custodienda conueniunt. & esse in reprehensibiles.

A N N I D N I Annates Heptidanni.
-oec. viii. themisdura. Confredus dux moftuus.
y. v. Annus durus & deficient fructus.
y. vi.
y. xii. Aque inundauerunt valde.
y. xiii.
y. xiiii. Lippinus maior domus de fimerus.
y. xv.
y. xvi.
y. xvii.
y. xviii. Vastauit karolus saxonia. plaga magna.
y. xviii.

y. xxx. Pugnauit karolus contra saxonos.
y. xxxi. Hecit Iherudo saracenos de qurtania.
y. xxxii. Magna fertilitas.
y. xxxiii.
y. xxxiiii.
y. xxxv. Saraceni uenerunt primitus.
y. xxxvi.
y. xxxvii.
y. xxxviii.
y. xxxix.
y. l. Beatus beda pr̄br̄ obit. / die sabbato.
y. l. i. karolus pugnaui ctra saracenos ad pietaus.
y. l. ii.
y. l. iii.
y. l. iv. / dominu.
y. l. v. karol pugnaui ctra saracenos in golia in die.
y. l. vi. karol in saxonia.
y. l. vii.
y. l. viii.
y. l. ix. karolus moftuus.
y. l. x.
y. l. xi.

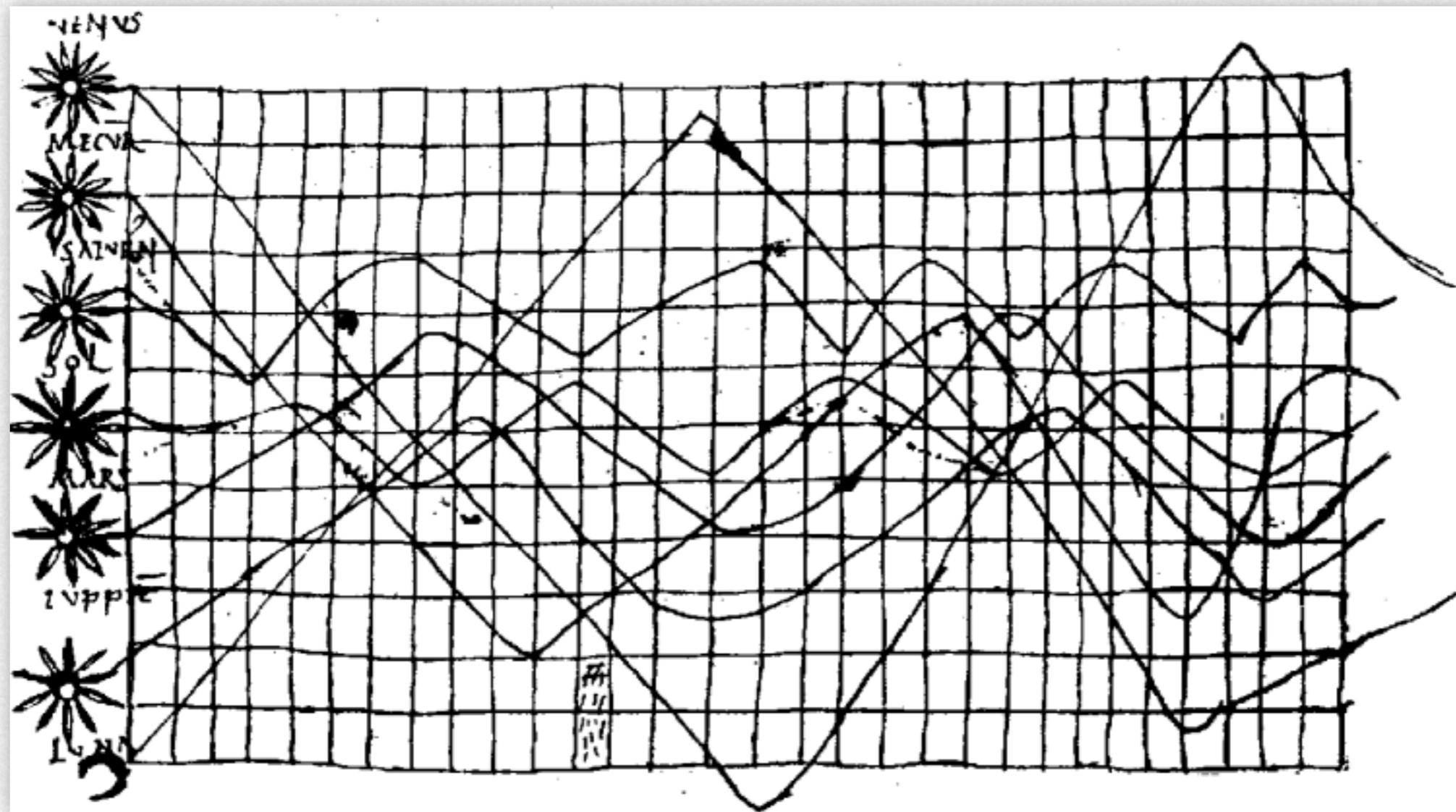
Annals of Saint Gall (Mid 9th Century)

- 709. Hard winter. Duke Gottfried died.
- 710. Hard year and deficient in crops.
- 711.
- 712. Flood everywhere.
- 713.
- 714. Pippin, Mayor of the Palace, died.
- 715. 716. 717.
- 718. Charles devastated the Saxon with great destruction.
- 719.
- 720. Charles fought against the Saxons.
- 721. Theudo drove the Saracens out of Aquitaine.
- 722. Great crops.
- 723.
- 724.
- 725. Saracens came for the first time.
- 726.
- 727.
- 728.
- 729.
- 730.
- 731. Blessed Bede, the presbyter, died.
- 732. Charles fought against the Saracens at Poitiers on Saturday.
- 733.
- 734.

A LIST OF LIST MAKING

- + Joseph Scaliger – *Thesaurus temporum* (1606)
- + James Ussher – *Annales veteris testamenti, a prima mundi origine deducti* (1648)
- + Christopher Helvig – *Historical and Chronological Theater* (1651)
- + Francis Tallents – *A View of Universal History* (1685)
- + Isaac Newton – *The Chronology of Ancient Kingdoms* (1728)
- + John Blair – *Chronology and History of the World, from the Creation to the Year of Christ 1753* (1753)

Graph of Planetary Movements (10th Century)





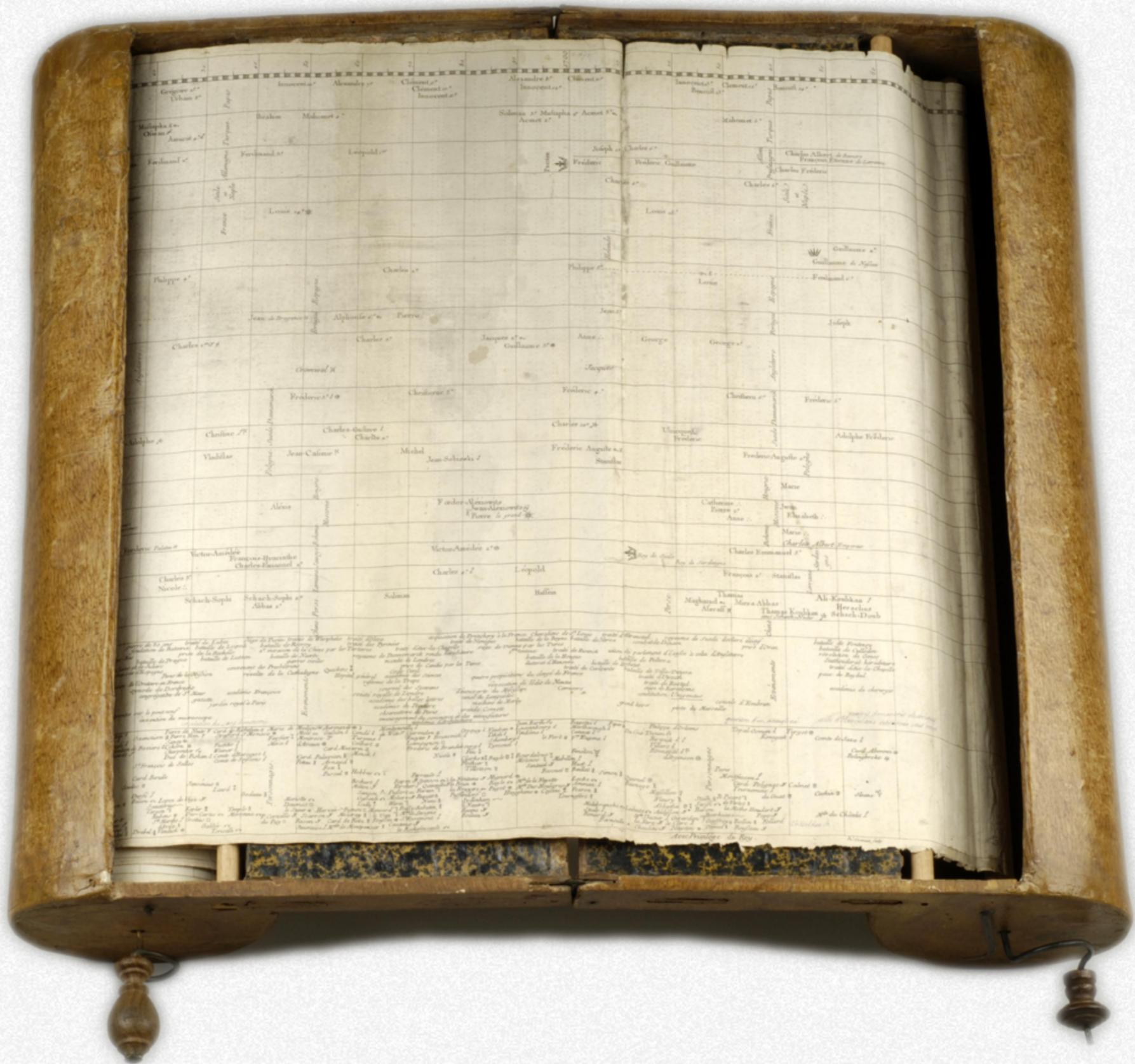
Jacques Barbeu-Dubourg
(1709 – 1779)

Jacques Barbeu-Dubourg (1709 – 1779)

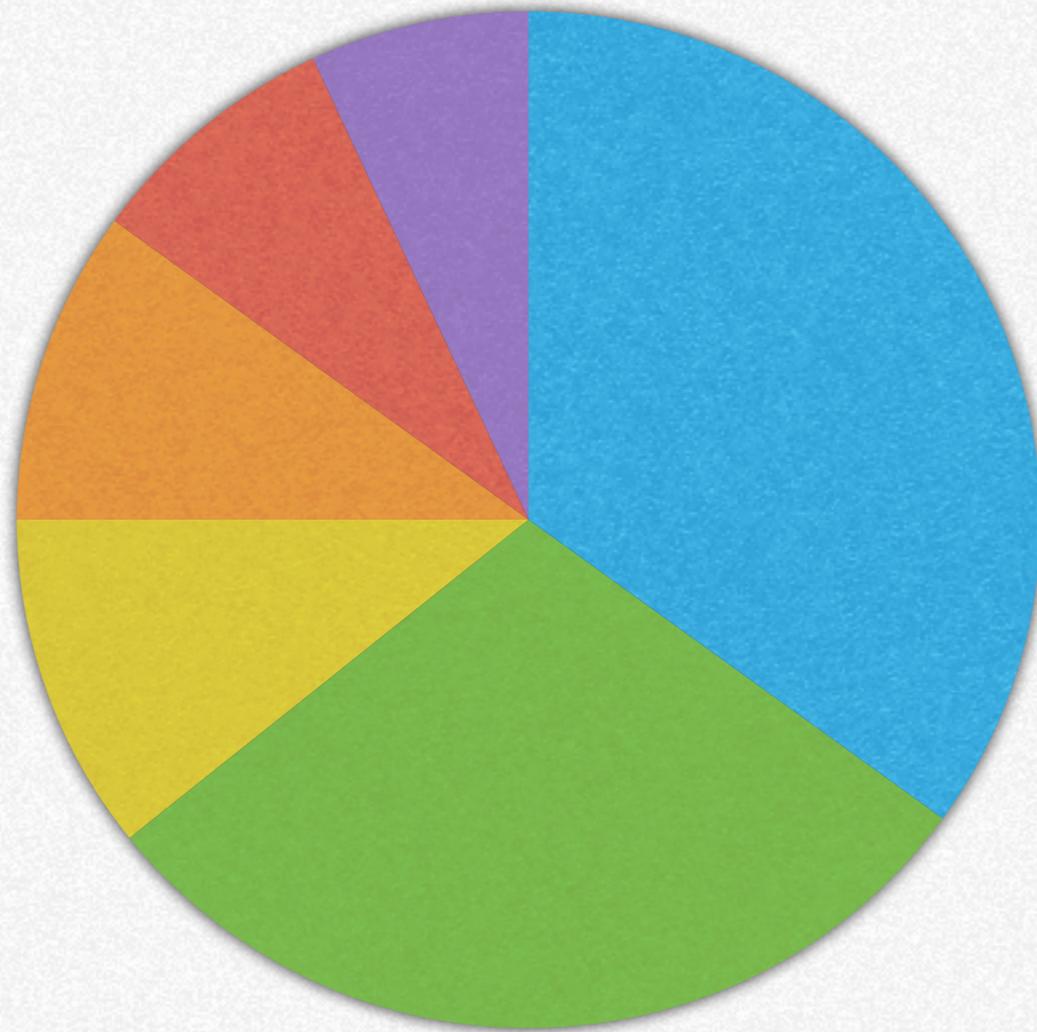
- + Physician, botanist, historian
- + Good friend of Benjamin Franklin
 - + Translated many of Franklin's works into French
- + *Carte Chronographique* (1753)
 - + Appears as an entry in Diderot's *Encyclopédie*

Imagine a combination of several component charts brought together to form a single large one. The height of this larger chart is hardly a foot; its length is necessarily very considerable. However long, it is divided [along the top edge] into small equal parts, alternately black and white, like those marking out degrees on the great circle around a globe. There are as many of these sections as the years which have elapsed from the creation of the world to our own time. Each of these sections marks one year of the world's existence. This chronological scale is formed by conjoining three great epochs; the first stretches from the creation of the world to the foundation of Rome; the second, from the foundation of Rome to the birth of Jesus Christ; the third, from the birth of Jesus Christ to our own time.





BEYOND THE LINE





William Playfair
(1759 – 1823)

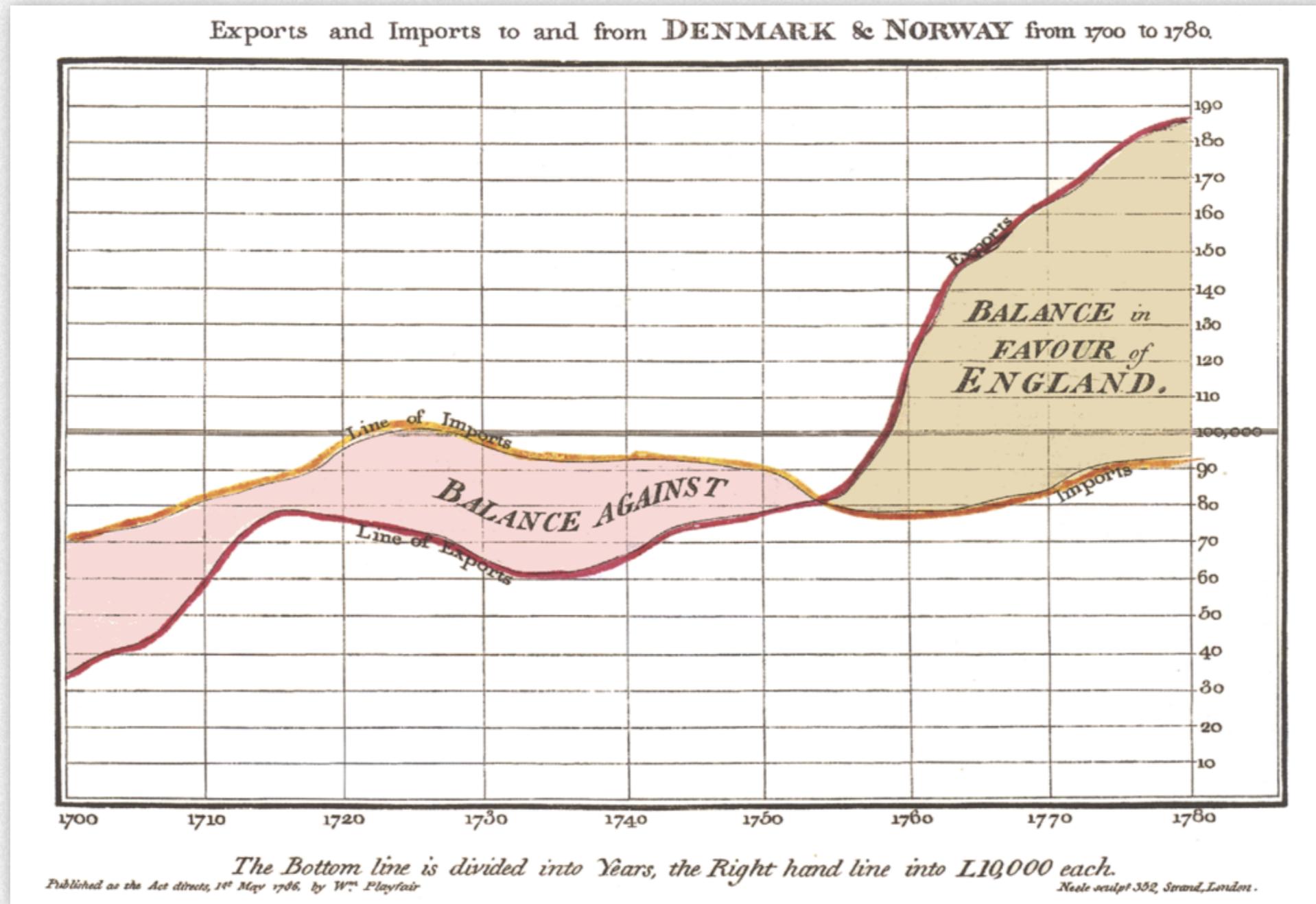
William Playfair (1759 – 1823)

- + Scottish engineer and political economist
- + Father of modern information visualization
 - + Bar chart, line graph, pie chart
 - + Influenced by Priestley and popularity of the timeline
 - + Model for clarity and simplicity
- + *The Commercial and Political Atlas* (1786)
- + *Statistical Breviary* (1801)

William Playfair (1759 – 1823)

On inspecting anyone of these charts attentively, a sufficiently distinct impression will be made, to remain unimpaired for a considerable time, and the idea which does remain will be simple and complete, at once including the duration and amount. Men of great rank or active business, can only pay attention to general outlines; nor is attention to particulars of use, any further than as they give a general information: And it is hoped, that with the assistance of these charts, such information will be got, without the fatigue and trouble of studying the particulars of which it is composed

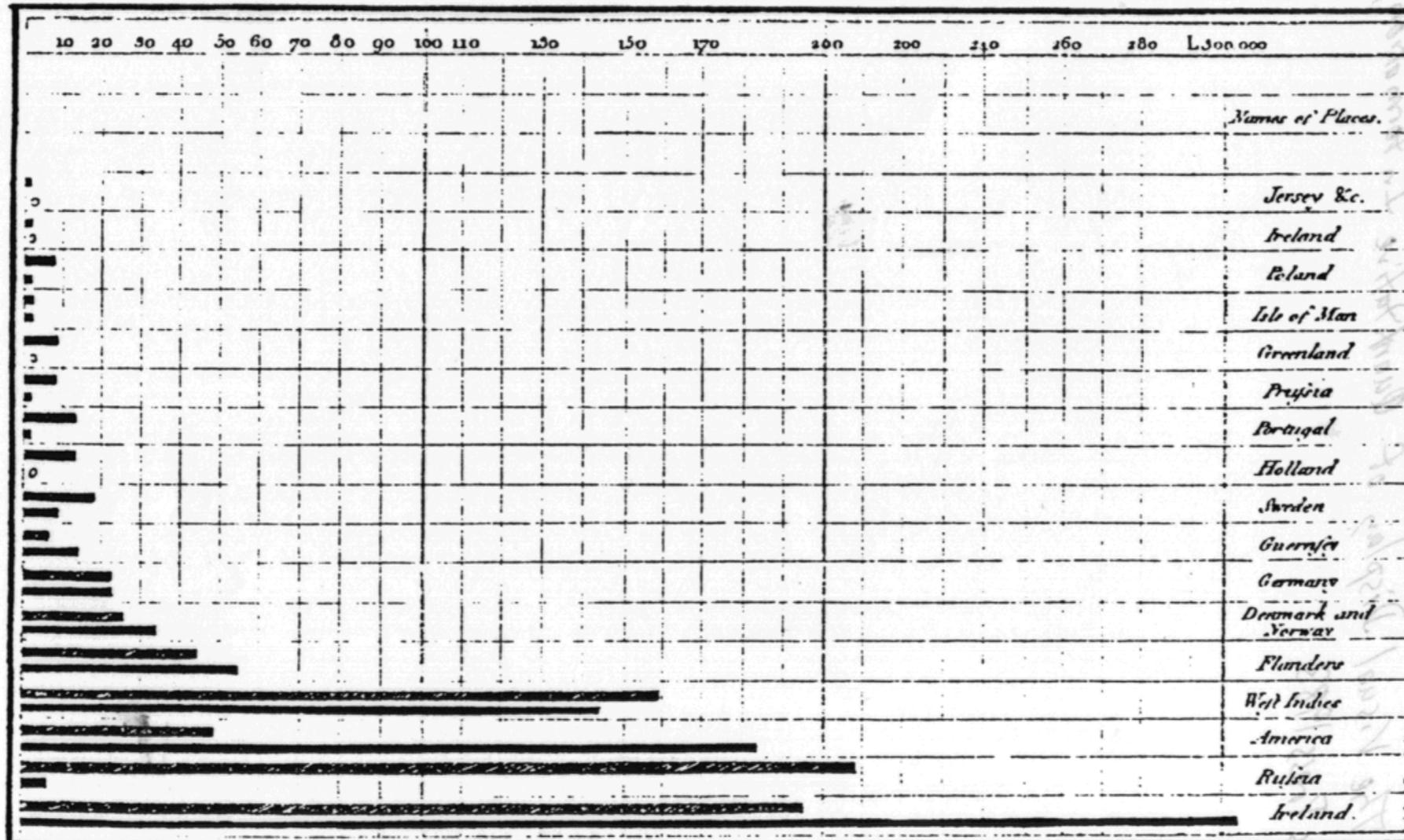
LINE GRAPH



The Commercial and Political Atlas (1786)

BAR CHART

Exports and Imports of SCOTLAND to and from different parts for one Year from Christmas 1780 to Christmas 1781.



The Upright divisions are Ten Thousand Pounds each. The Black Lines are Exports the Ribbed lines Imports.

Published as the Act above June 7th 1781 by W^m Flaxman

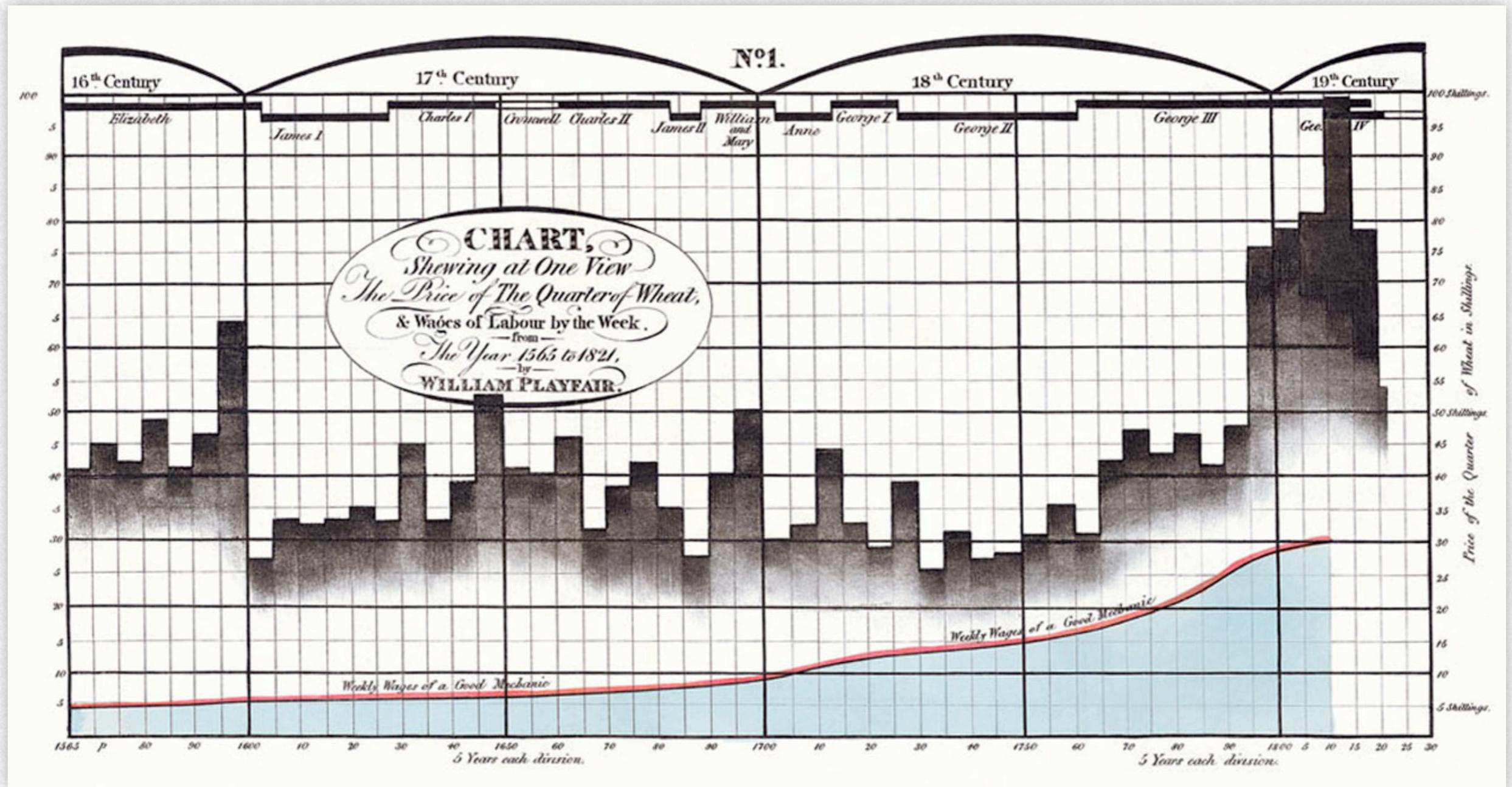
Printed by J. Smith, Strand, London.

PIE CHART



Statistical Breviary (1801)

BAR + LINE GRAPH



Letter on our agricultural distresses, their causes and remedies (1822)



Nicole Oresme
(132? – 1382)

PROTO BAR CHART

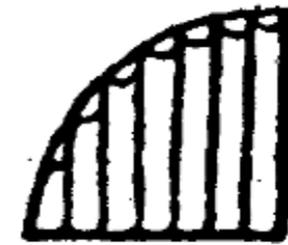
z

difformis uniformiter variatio reddit unifor
 miter difformiter difforme. ¶ Latitudo uni
 formis est dicitur est illa quae inter excessus graduum
 equidistantium fuerit eadem proportio etiam in e
 proportione equitatis. Nam si inter excessus graduum
 inter se equidistantium fuerent proportio equita
 tis sic est. autem uniformiter difformis ut per
 diffinitionibus membrorum secundae divisionis
 Rursus si nulla proportio seruetur tunc nulla
 potest attendi uniformitas in latitudine tali et
 sic non esset uniformiter difformis est difformis
 ¶ Latitudo difformiter difformiter difformis
 est illa quae inter excessus graduum equidistantium
 non seruet eandem proportionem sicut in se
 cunda parte patebit. Notandum tamen est
 quod sicut in supradictis diffinitionibus ubi loquitur
 de excessu graduum inter se equidistantium
 debet accipi distantia secundum partes latitudinis
 ordinatae et non inversa ut loquuntur de sine

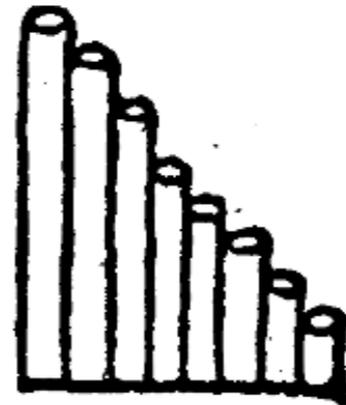
scilicet. et sicut ad usum



Difformiter difformis



Difformiter difformis



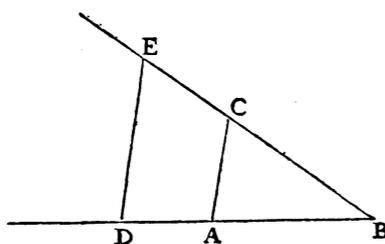


René Descartes
(1596 – 1650)

GRAPHING EQUATIONS

est a l'autre, ce qui est le mesme que la Diuision, ou enfin trouver vne, ou deux, ou plusieurs moyennes proportionnelles entre l'vnité, & quelque autre ligne; ce qui est le mesme que tirer la racine quarrée, on cubique, &c. Et ie ne craindray pas d'introduire ces termes d'Arithmetique en la Geometrie, afin de me rendre plus intelligible.

La Multiplication.

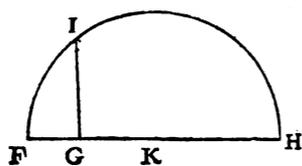


Soit par exemple AB l'vnité, & qu'il faille multiplier BD par BC, ie n'ay qu'a ioindre les points A & C, puis tirer DE parallele a CA, & BE est le produit de cete Multiplication.

La Diuision.

Oubien s'il faut diuifer BE par BD, ayant ioint les points E & D, ie tire AC parallele a DE, & BC est le produit de cete diuision.

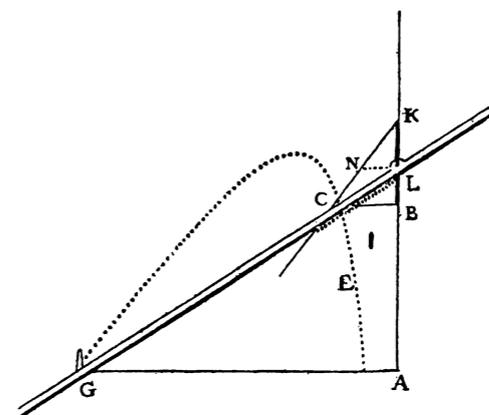
L'Extraction de la racine quarrée.



Ou s'il faut tirer la racine quarrée de GH, ie luy adiouste en ligne droite FG, qui est l'vnité, & diuifant FH en deux parties esgales au point K, du centre K ie tire le cercle F I H, puis esleuant du point G vne ligne droite iufques à I, à angles droits sur FH, c'est GI la racine cherchée. Ie ne dis rien icy de la racine cubique, ny des autres, à cause que i'en parleray plus commodement cy après.

Commēt on peut

Mais souuent on n'a pas besoin de tracer ainsi ces ligne

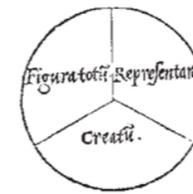
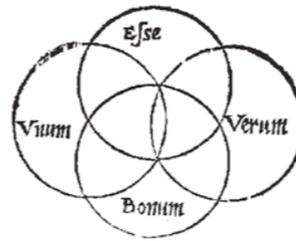


reigle GL, & du plan rectiligne CNKL, dont le costé KN est indefiniement prolongé vers C, & qui estant meu sur le plan de deffous en ligne droite, c'est a dire en telle forte que son diametre KL se trouue tousiours appliqué sur quelque endroit de la ligne BA prolongée de part & d'autre, fait mouuoir circulairement cete reigle GL autour du point G, a cause quelle luy est tellement iointe quelle passe tousiours par le point L. Ie choisie vne ligne droite, comme AB, pour rapporter a ses diuers points tous ceux de cete ligne courbe EC, & en cete ligne AB ie choisie vn point, comme A, pour commencer par luy ce calcul. Ie dis que ie choisie & l'vn & l'autre, a cause qu'il est libre de les prendre tels qu'on veult. car encore qu'il y ait beaucoup de choix pour rendre l'equation plus courte, & plus aysée; toutefois en quelle façon qu'on les prene, on peut tousiours faire que la ligne paroisse de mesme genre, ainsi qu'il est aysé a demonstret.

Aprés

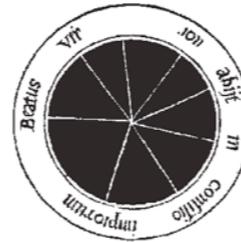
PROTO CIRCLES

Ramòn Llull
(1232 - 1316)

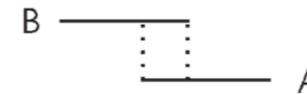
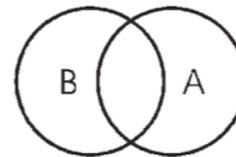


*TOTVM CREATVM EST CORPVS
sphaericum extra quod nihil
est.*

Giordano Bruno
(1548 - 1600)



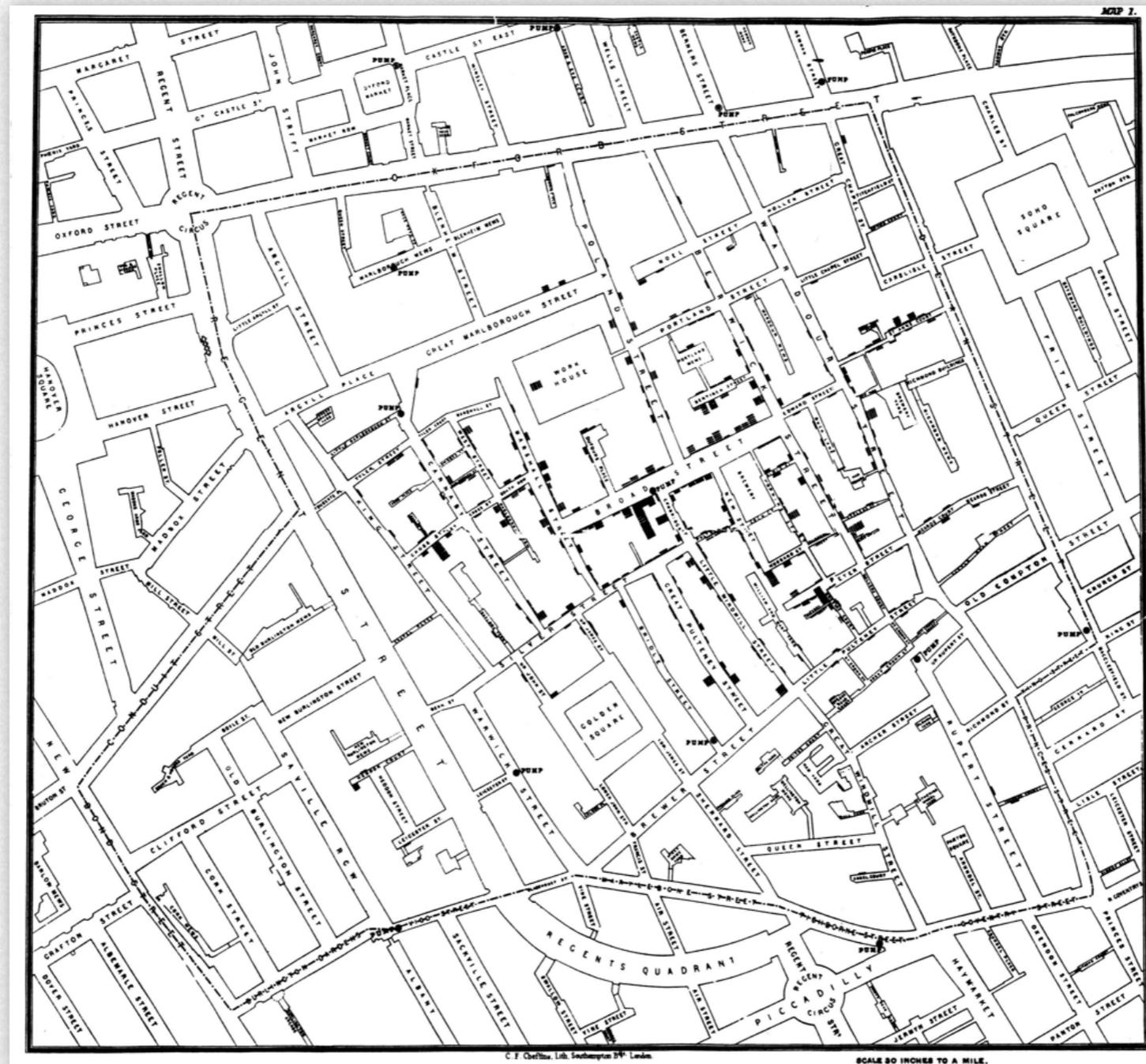
G.W. Leibniz
(1646 - 1716)



Leonhard Euler
(1707 - 1783)



JOHN SNOW



On the Mode of Communication of Cholera (1854)

FLORENCE NIGHTINGALE

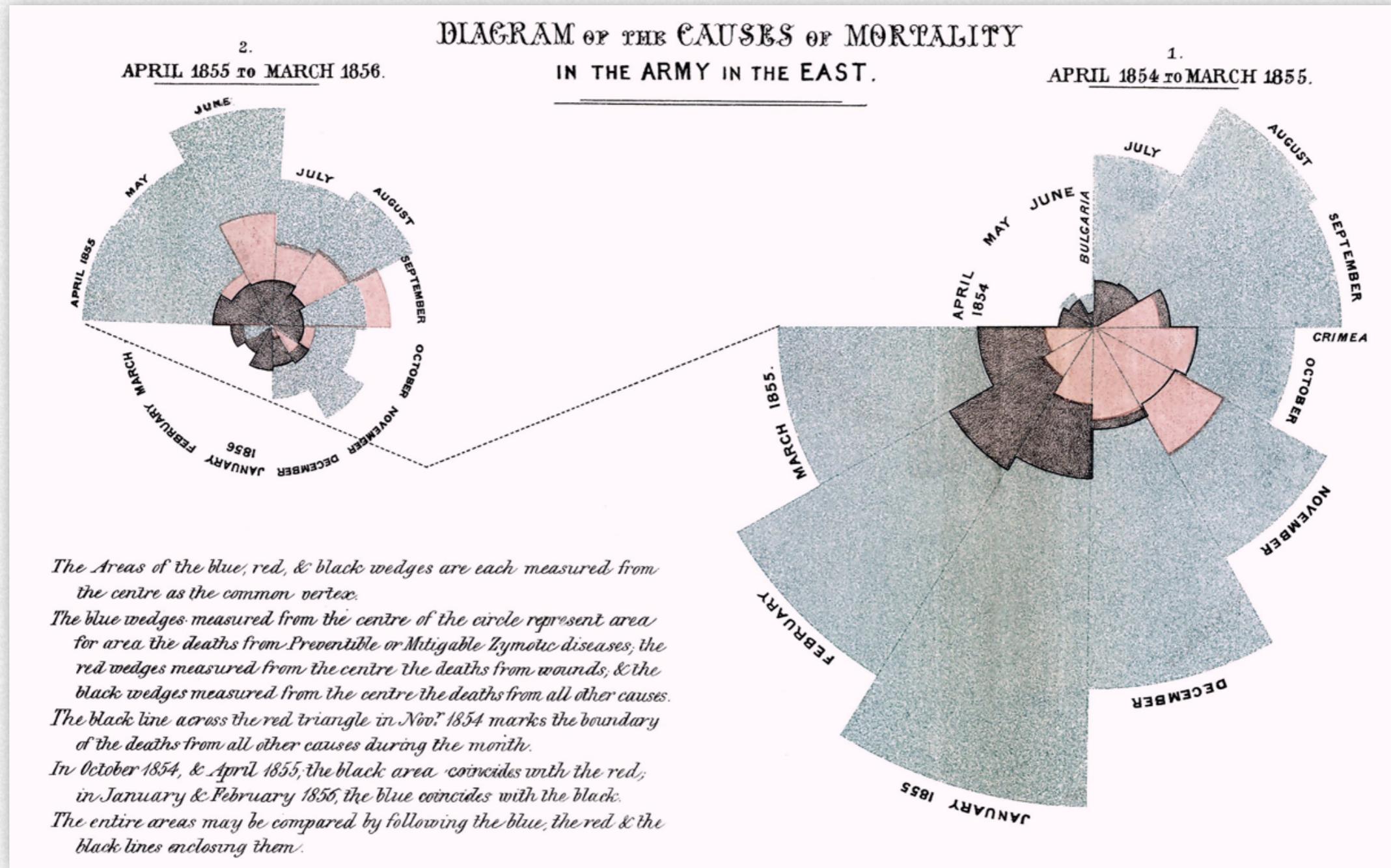


Diagram of the causes of mortality in the army in the East (1858)

CHARLES MINARD

Carte Figurative des pertes successives en hommes de l'Armée Française dans la campagne de Russie 1812-1813.

Dressée par M. Minard, Inspecteur Général des Ponts et Chaussées en retraite. Paris, le 20 Novembre 1869.

Les nombres d'hommes présents sont représentés par les largeurs des zones colorées à raison d'un millimètre pour dix mille hommes; ils sont de plus écrits en travers des zones. Le rouge désigne les hommes qui ont été en Russie, le noir ceux qui en sont sortis. — Les renseignements qui ont servi à dresser la carte ont été puisés dans les ouvrages de M. M. Chiers, de Ségur, de Fezensac, de Chambray et le journal inédit de Jacob, pharmacien de l'Armée depuis le 28 Octobre. Pour mieux faire juger à l'œil la diminution de l'armée, j'ai supposé que les corps du Prince Jérôme et du Maréchal Davout, qui avaient été détachés sur Minsk et Mohilow et ont rejoint vers Orscha et Witebsk, avaient toujours marché avec l'armée.

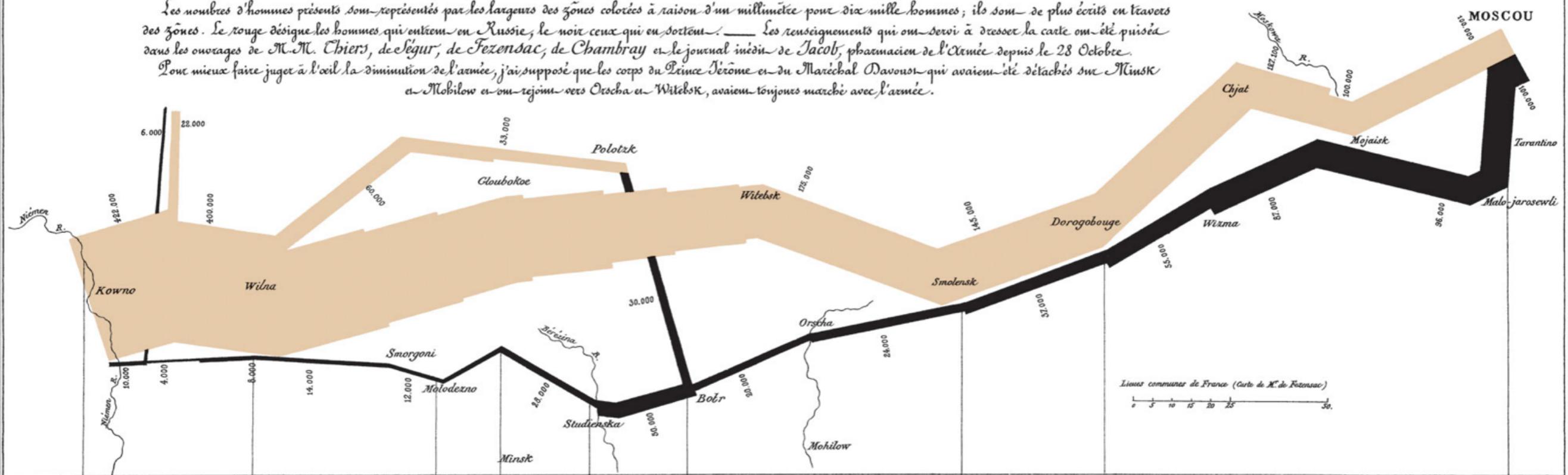
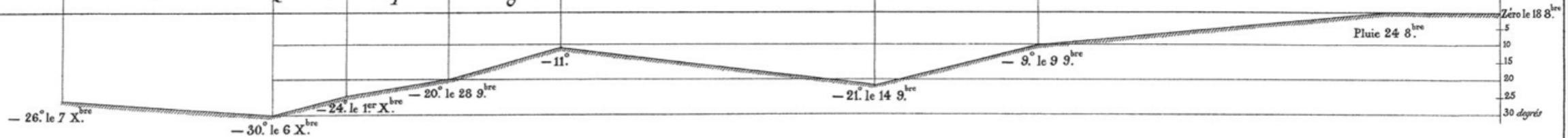


TABLEAU GRAPHIQUE de la température en degrés du thermomètre de Réaumur au dessous de zéro.



Les Cosaques passent au galop le Niemen gelé.

Carte figurative des pertes successives en hommes de l'Armée Française dans la campagne de Russie 1812-1813 (1869)

HANS ROSLING



Stats that reshape your worldview, TED (2006)

OUTLINE



About Me

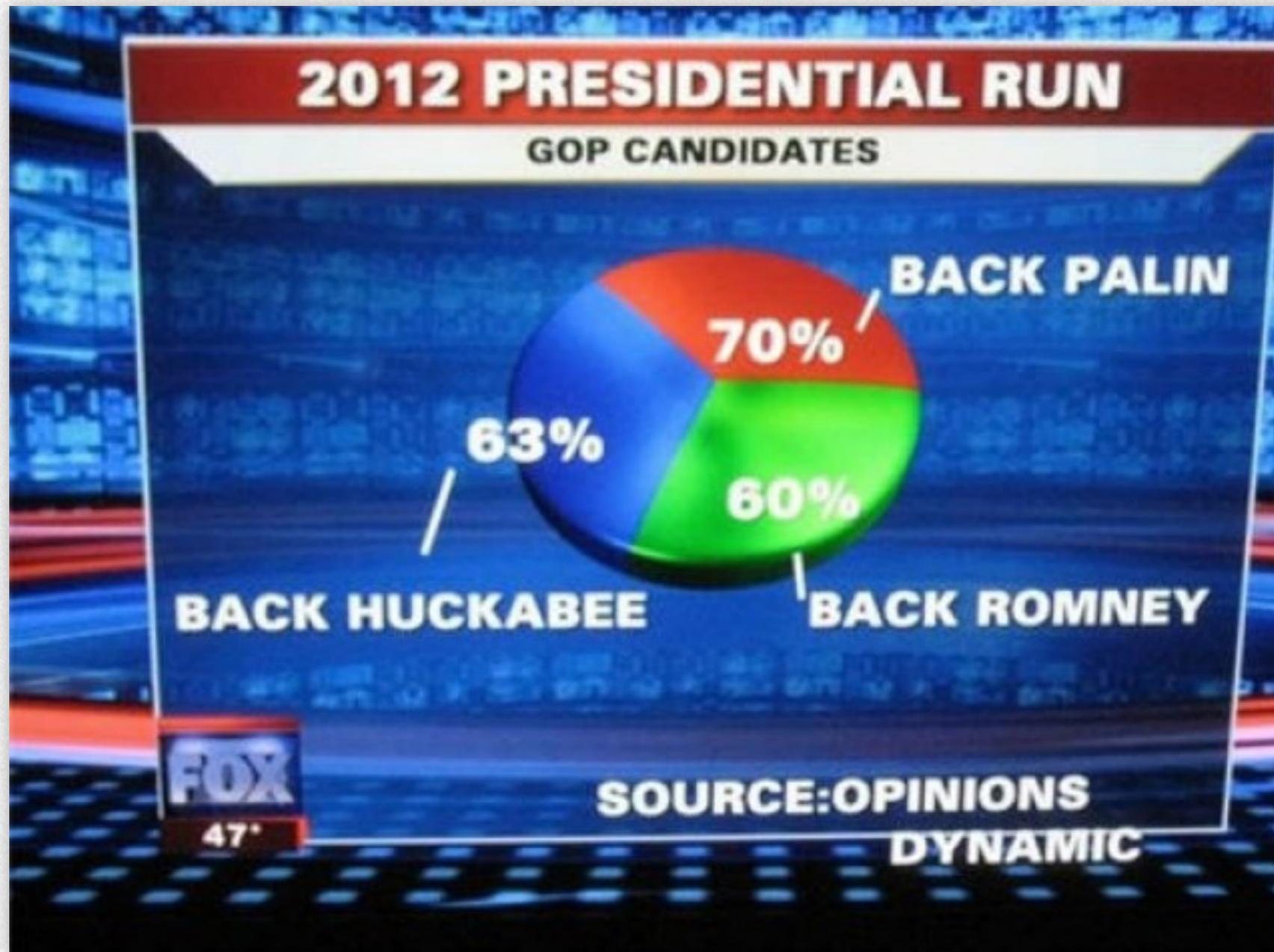
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GOOD VISUALIZATION



GOOD VISUALIZATION



Record



Analyze



Communicate

GOOD VISUALIZATION



VISUAL VARIABLES

- + Position (x, y)
- + Size
- + Color (Hue)
- + Intensity (Saturation)
- + Value (Brightness)
- + Texture
- + Orientation
- + Shape
- + Others?

	<i>Points</i>	<i>Lines</i>	<i>Areas</i>	<i>Best to show</i>
<i>Shape</i>		<i>possible, but too weird to show</i>	<i>cartogram</i>	<i>qualitative differences</i>
<i>Size</i>			<i>cartogram</i>	<i>quantitative differences</i>
<i>Color Hue</i>				<i>qualitative differences</i>
<i>Color Value</i>				<i>quantitative differences</i>
<i>Color Intensity</i>				<i>qualitative differences</i>
<i>Texture</i>				<i>qualitative & quantitative differences</i>

PRE ATTENTIVE

1281768756138976546985604982826762

9839858458224509856458940980943585

9091030209905959595775050678904567

8845789809821677654876360912949686

How Many 3's?

PRE ATTENTIVE

12817687561**3**8976546985604982826762

98**3**985845822450985645894098094**3**585

90910**3**0209905959595775050678904567

8845789809821677654876**3**60912949686

How Many 3's?

PRE ATTENTIVE

- + Line (blob) orientation
- + Length
- + Width
- + Size
- + Curvature
- + Number
- + Terminators
- + Intersection
- + Closure
- + Color (Hue)
- + Intensity
- + Flicker
- + Direction of movement
- + Binocular luster
- + Stereoscopic depth
- + 3-D depth cues
- + Lighting Direction

GRAPHICAL EXCELLENCE

- + Show the data
- + Focus on substance not methodology, graphic design, technology, production method, etc
- + Avoid distorting data
- + Present many numbers in a small space
- + Make large data sets coherent
- + Encourage the eye to compare values
- + Reveal data at different levels from broad overview to fine detail
- + Have a point

GRAPHICAL EXCELLENCE

- + The interior decoration of graphics generates a lot of ink that does not tell the viewer anything new. The purpose of decoration varies — to make the graphic appear more scientific and precise, to enliven the display, to give the designer an opportunity to exercise artistic skills. Regardless of its cause, it is all non-data-ink or redundant data-ink, and it is often **chartjunk**.

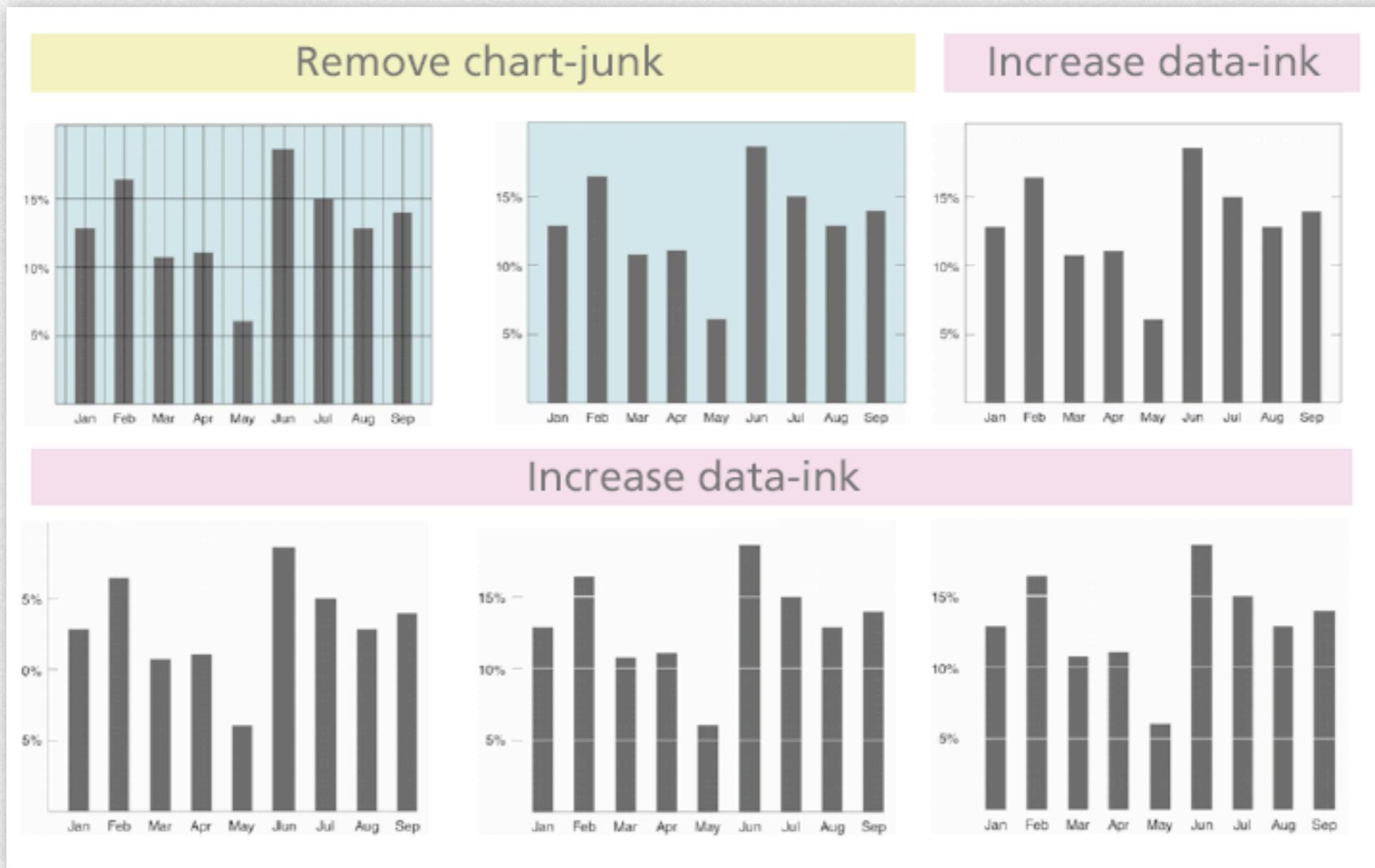


GRAPHICAL EXCELLENCE

- + Data-ink is the non-erasable core of a a graphic, the non-redundant ink arranged in response to variation in the numbers represented.

$$\text{data-ink ration} = \frac{\text{data-ink}}{\text{total ink used to print the graphic}}$$

GRAPHICAL EXCELLENCE



OUTLINE



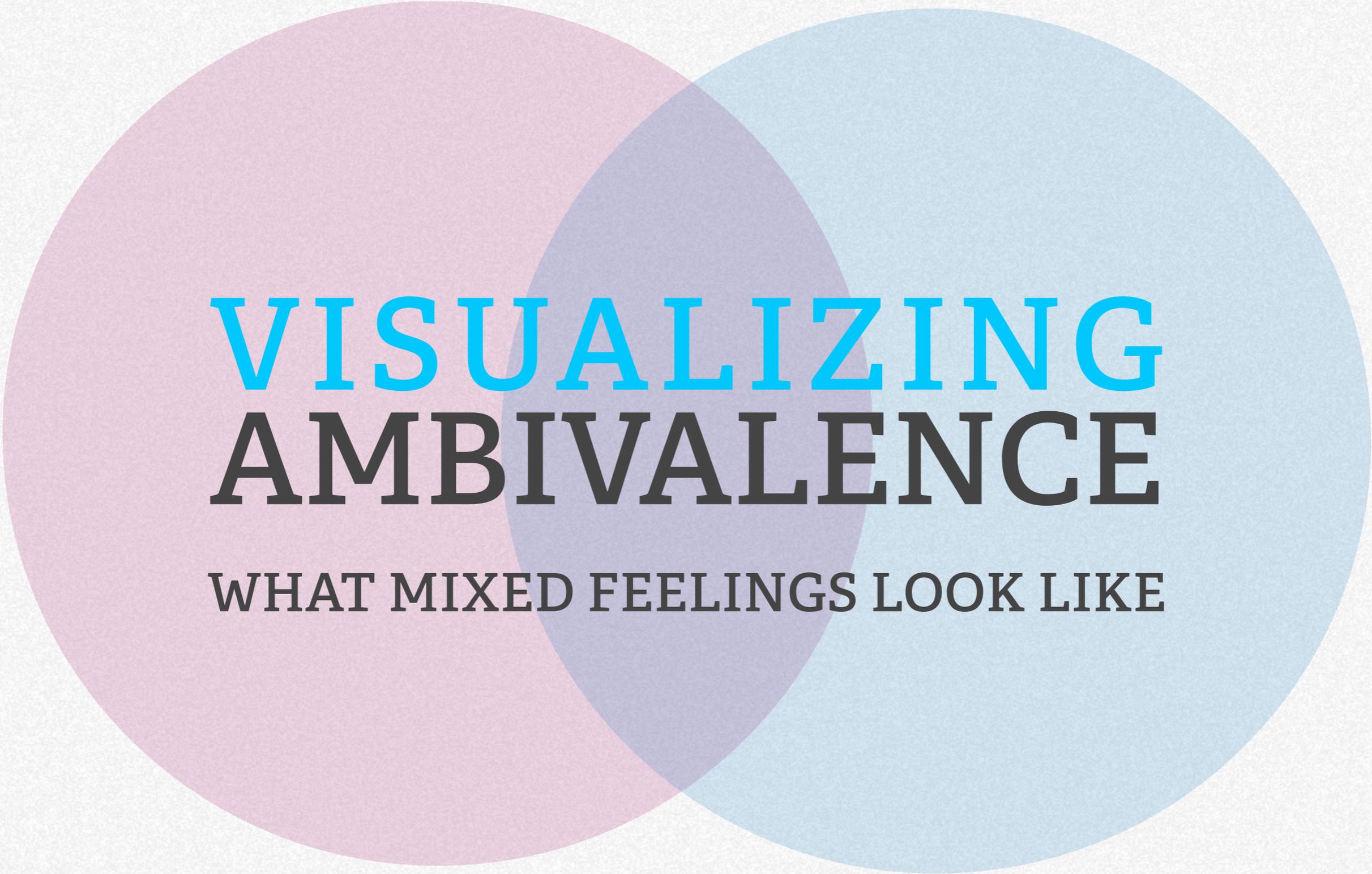
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VISUALIZING AMBIVALENCE

WHAT MIXED FEELINGS LOOK LIKE

www.mixedfeelings.us

AMBIVALENCE

The coexistence in one person of contradictory emotions or attitudes (as love and hatred) towards a person or thing.

– OED

Ambivalence != Indifference

MIXED FEELINGS



"The Problem of the Overstuffed Middle"
(Converse, 1995)

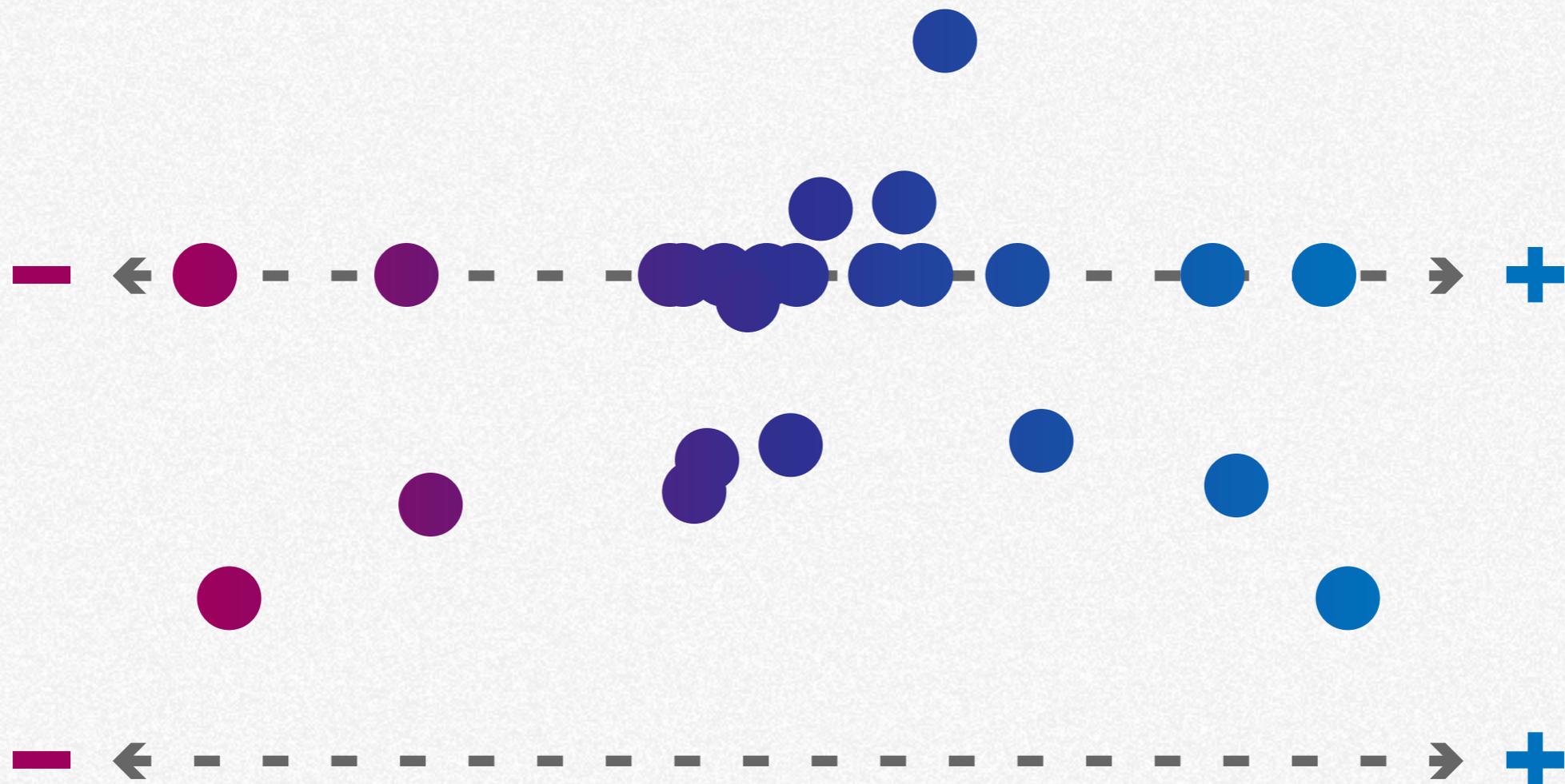
MIXED FEELINGS



MIXED FEELINGS

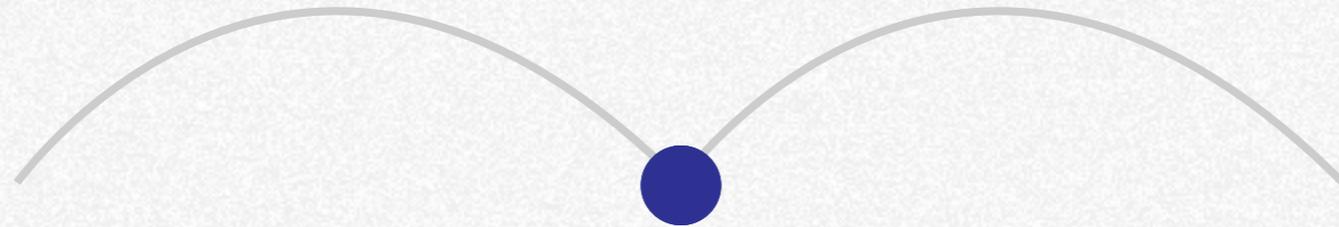
Our visualization demonstrates a way to “unstuff” the middle by measuring respondents positive and negative feelings separately.

MIXED FEELINGS



MIXED FEELINGS

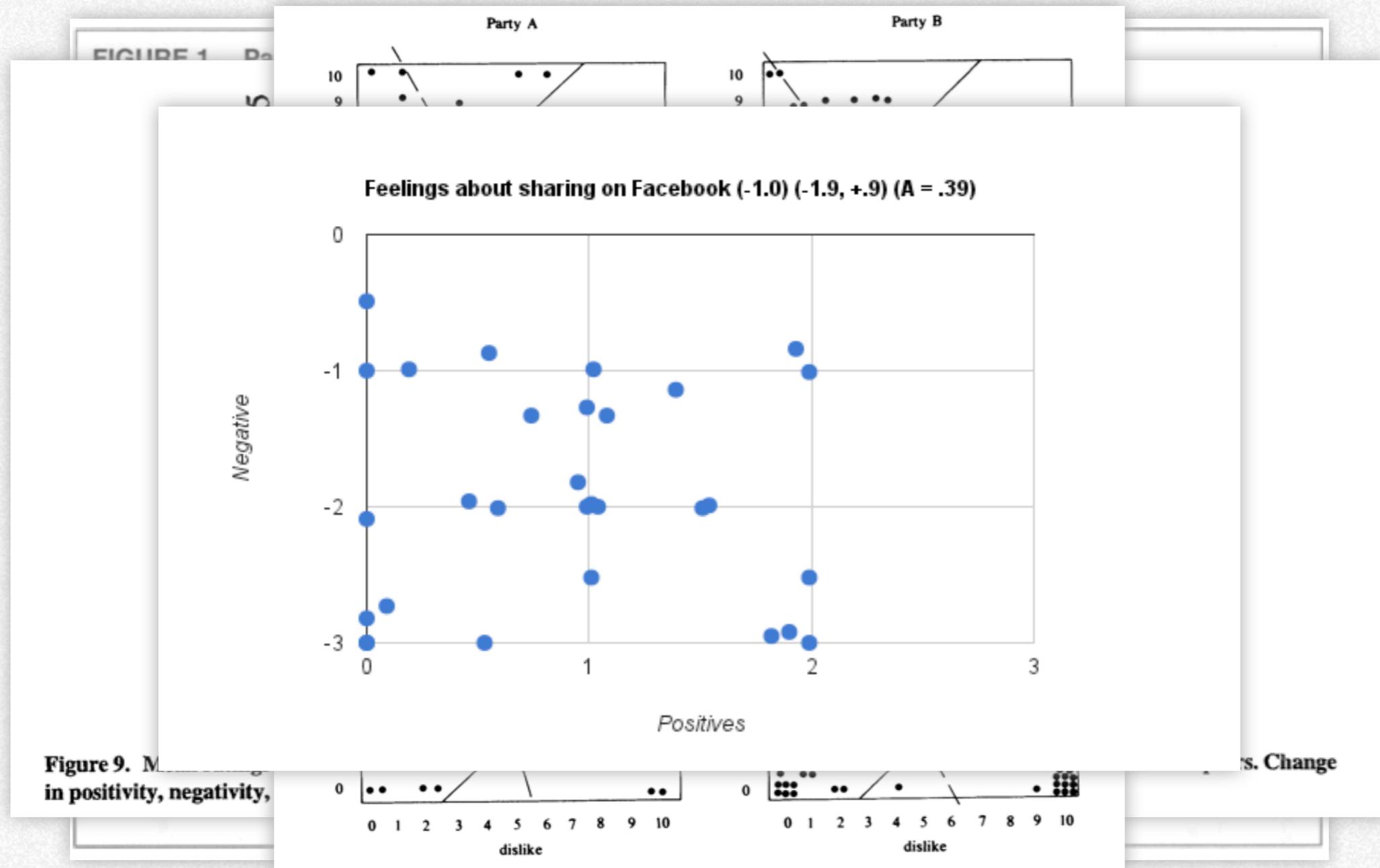
How do we make mixed feelings fun to explore?



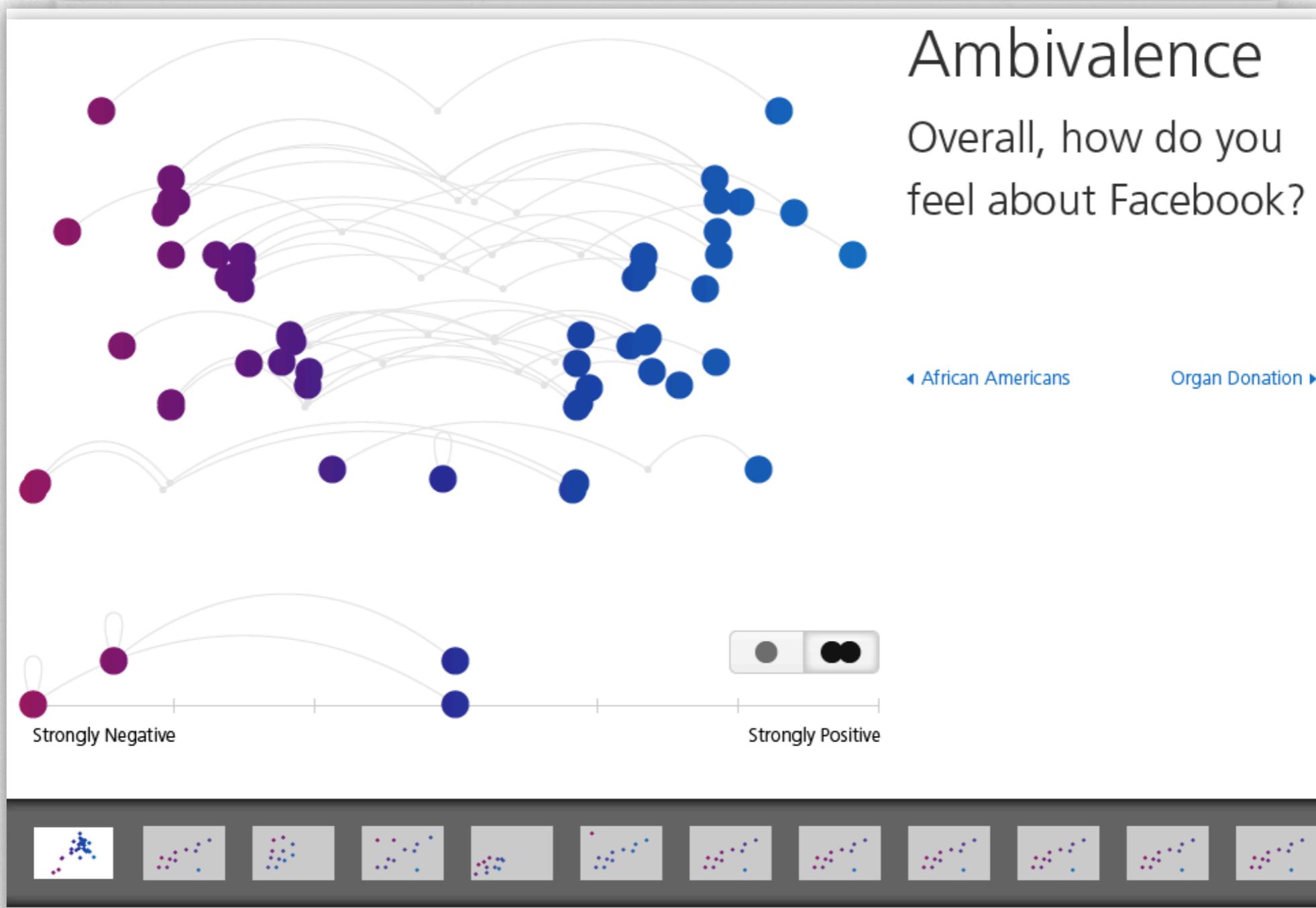
MIXED FEELINGS

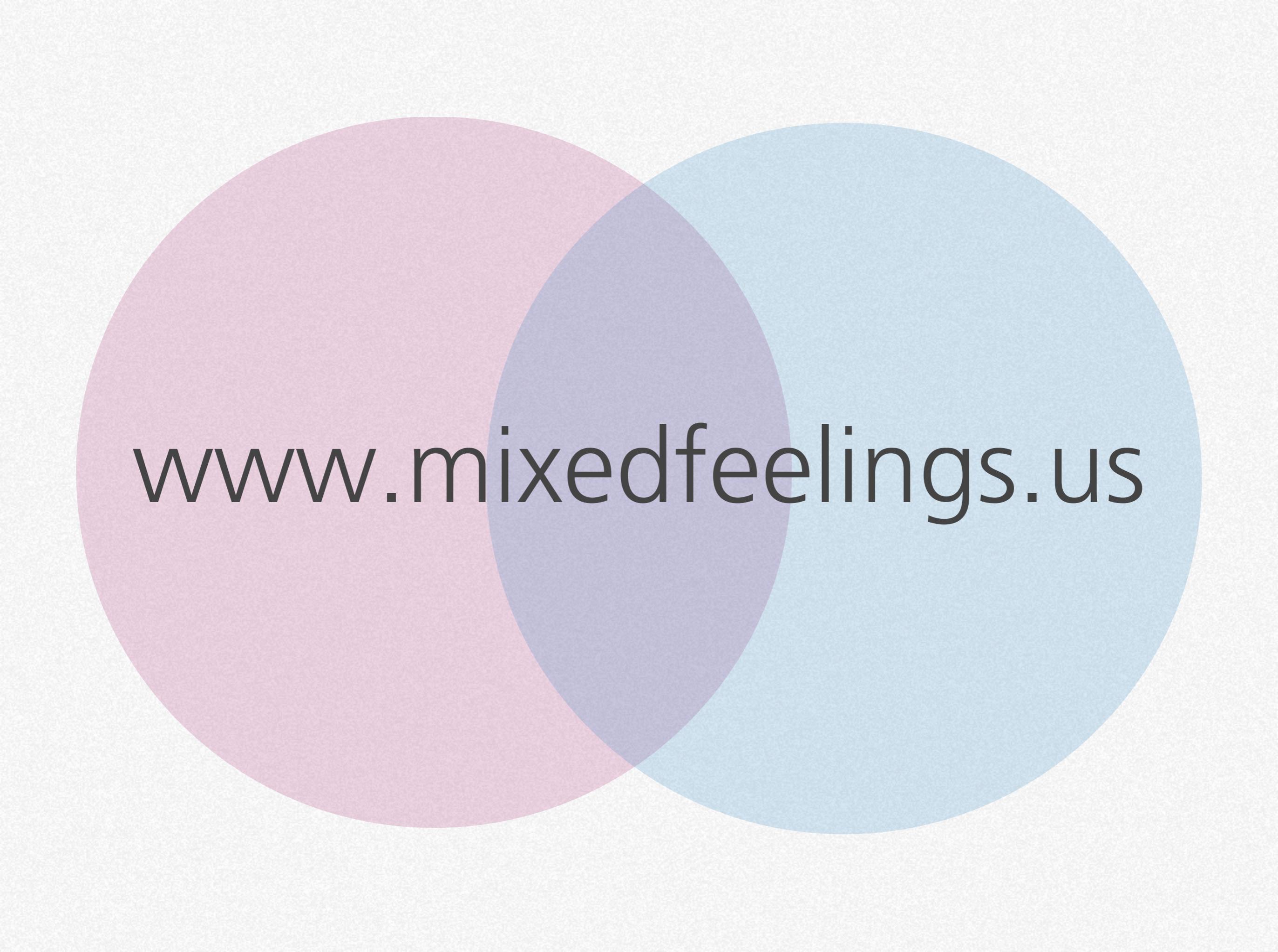
Let's take a look...

MIXED FEELINGS



MIXED FEELINGS





www.mixedfeelings.us

NEXT ASSIGNMENT

Due Tuesday 4/16, 8 PM on bSpace

In her recent book *Captive Audience*, the legal scholar Susan Crawford argues that broadband access in America has been hampered by the oligopoly/monopoly of the cable companies. As a result, she says, Americans pay more for slower access than people in other parts of the world, and many people still have no access at all. She concludes that broadband access should be regulated on the model of a public utility such as electric power.

Some have argued that Crawford is wrong: broadband access is not like a public utility, government regulation would be highly costly, strangle service and innovation, and things aren't as bad as Crawford says they are.

Read some material on both sides, and then decide whether, on the whole, you think more government regulation of broadband access is a good or bad idea. Is it appropriate to compare broadband to a public utility? Would deregulation be a better solution? Summarize your view in 3 points, in a total of no more than 350 words.

Once the assignments are in, we're going to ask the class to participate in an in-class debate, calling on a few people to present each side, then voting Oxford debate style. At the top of your assignment, indicate whether you want to opt out from presenting). No extra points, but the presiding spirit of class participation will be hovering close by.