

FAKE NEWS AND SCIENCE

A SOCIAL AND EDUCATIONAL CHALLENGE

Lorenzo Magnea

Università di Torino - INFN Torino

La Thuile - 28/02/2018



Outline

- Misinformation past and present
- The science of misinformation
- Misinformation about science
- Physics for Citizens

(MIS)INFORMATION

(MIS)INFORMATION



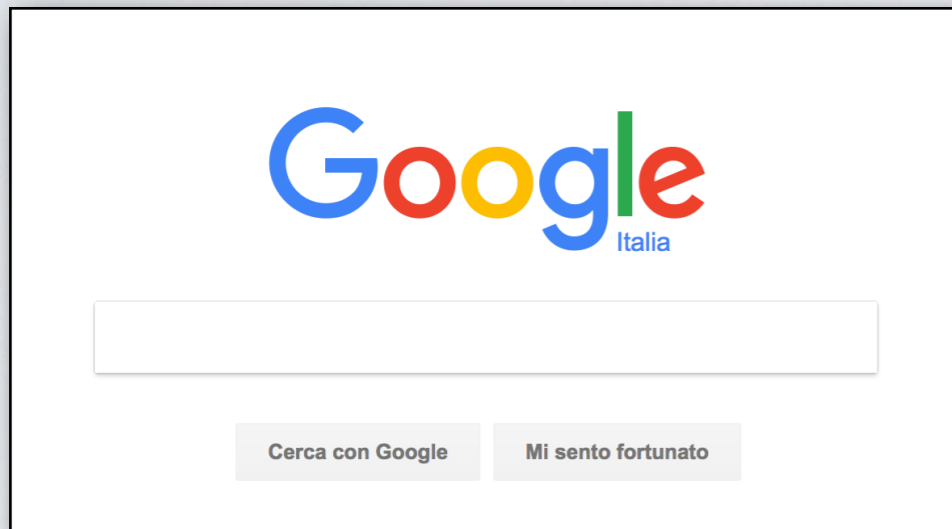
A paradox

A paradox

- The entire spectrum of human knowledge is available to us.

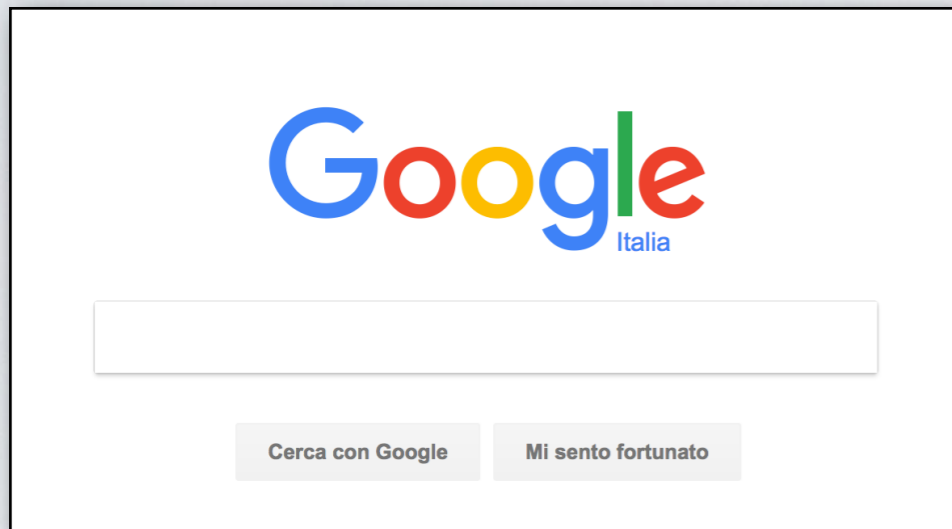
A paradox

- The entire spectrum of human knowledge is available to us.



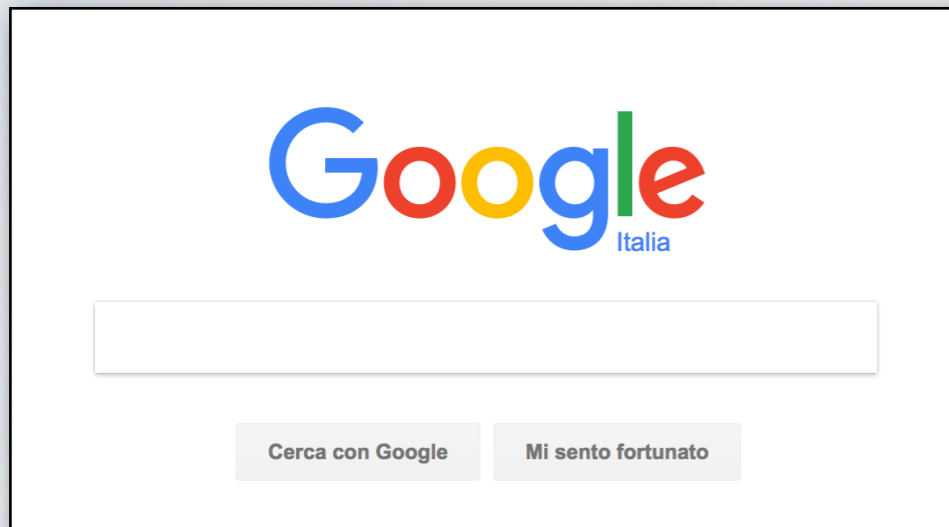
A paradox

- The entire spectrum of human knowledge is available to us.



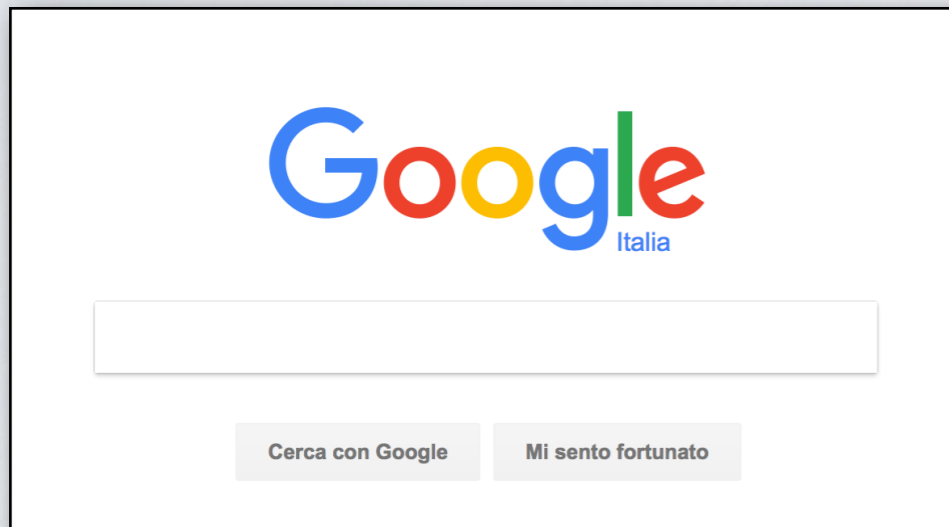
A paradox

- The entire spectrum of human knowledge is available to us.



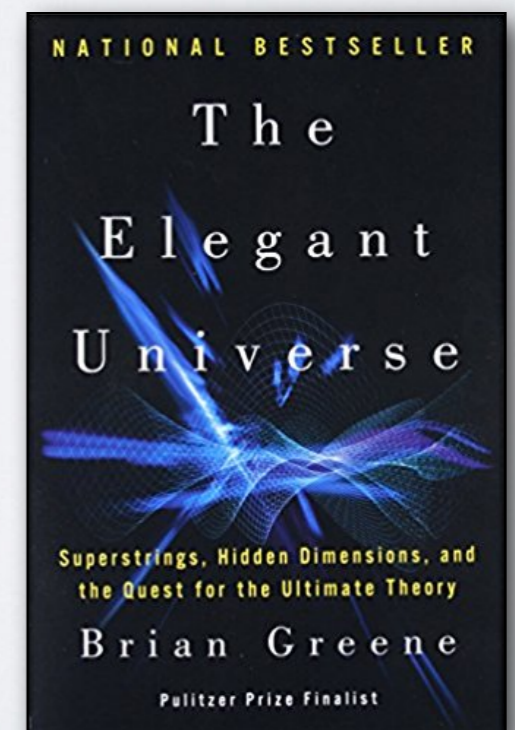
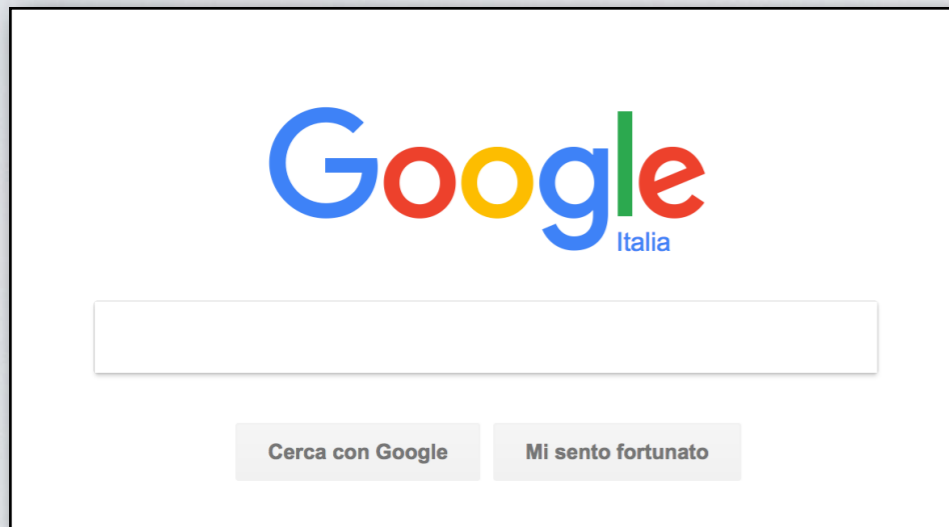
A paradox

- The entire spectrum of human knowledge is available to us.



A paradox

- The entire spectrum of human knowledge is available to us.



A paradox

A paradox

- But so are all fears, falsehoods and paranoid delusions.

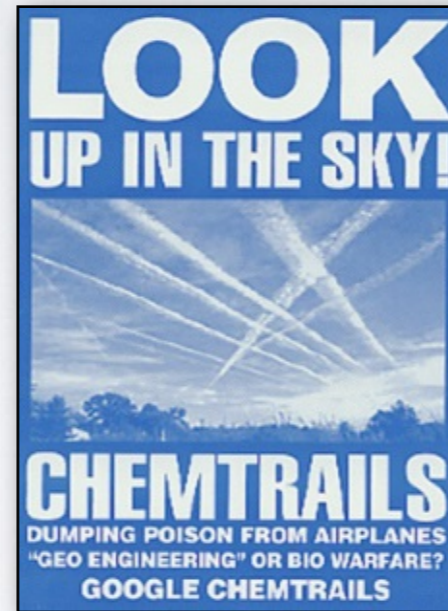
A paradox

- But so are all fears, falsehoods and paranoid delusions.



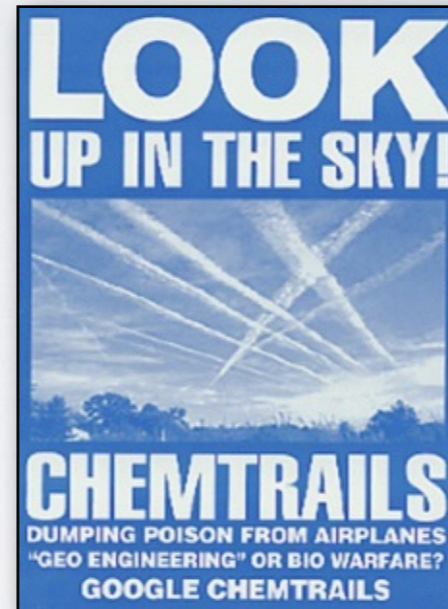
A paradox

- But so are all fears, falsehoods and paranoid delusions.



A paradox

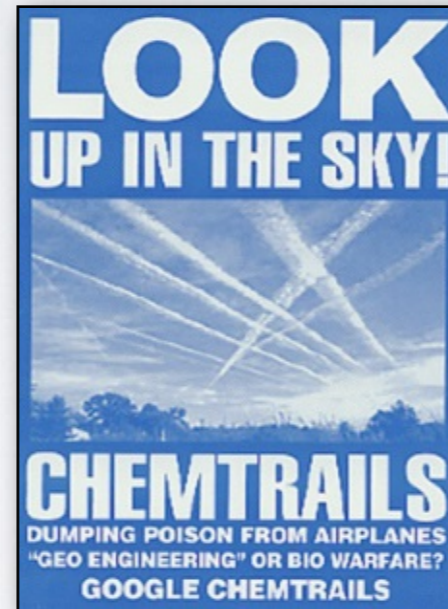
- But so are all fears, falsehoods and paranoid delusions.



'I saw aliens and Roswell UFO'
CIA agent in shock deathbed
confession on Area 51

A paradox

- But so are all fears, falsehoods and paranoid delusions.

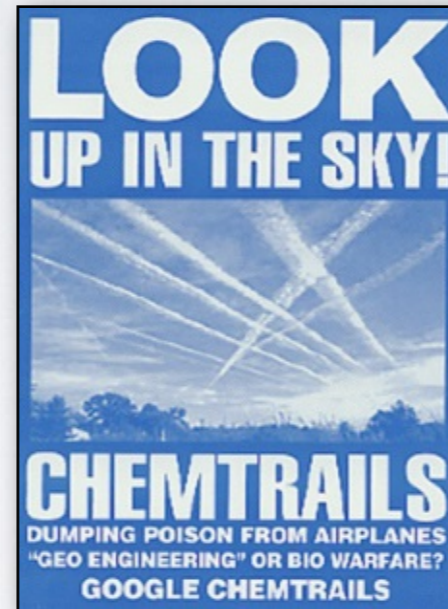


'I saw aliens and Roswell UFO'
CIA agent in shock deathbed
confession on Area 51



A paradox

- But so are all fears, falsehoods and paranoid delusions.



'I saw aliens and Roswell UFO'
CIA agent in shock deathbed
confession on Area 51



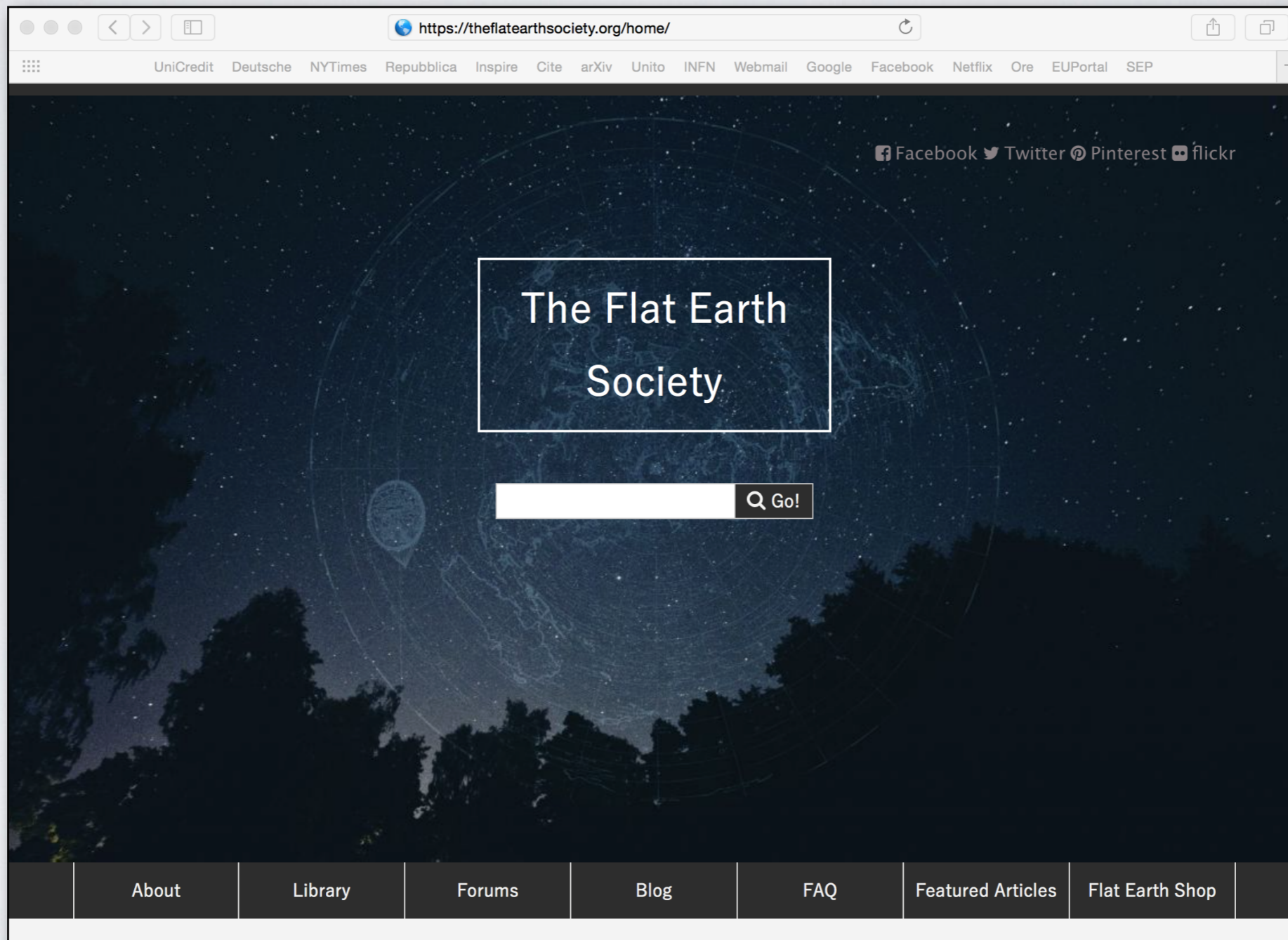
Edgar Welch

Internet is filterless

- For every bias there is a confirmation

Internet is filterless

- For every bias there is a confirmation



The web site of the Flat Earth Society

Internet is filterless


- For every bias there is a confirmation



Holohoax 101 - The Fundamentals of the Holocaust Hoax

The First Holohoax, During World War One

The book *The First Holocaust, Jewish Fund Raising Campaigns with Holocaust Claims During and After World War One* by Don Heddeshemer is documented with reprints of articles from the New York Times and other Jewish press that claimed that there was a holocaust of the Jews during World War One. For example, see the article by Martin Glynn, the former Mayor of New York, describing a holocaust of six million Jews published in 1919 at <http://codoh.com/library/document/871>. Heddeshemer missed the systematic and murderous extermination of six million Jews in 1906, as reported in the New York Times, see <http://exposing-the-holocaust-hoax-archive.blogspot.com/2010/01/ny-times-reports-in-1906-that-russias.html>.



From a review of the book on amazon.com, "I guess they would call it 'Chutzpah', to publicly use the same big lie twice within the span of twenty or so years." Note: Amazon removed the quoted review.

Rabbi Stephen Wise, founder of the American Jewish Congress and assistant to Supreme Court Justice Louis Brandeis, the leader of the Zionist movement in the US, was instrumental in creating the WW I hoax, and led the efforts to resurrect the hoax during WW II.

A Gas Chamber With a View

According to the USHMM website - "Between 1941 and 1944, Nazi German authorities deported millions of Jews from Germany, from occupied territories, and from the countries of many of its Axis allies to ghettos and to killing centers, often called extermination camps, where they were murdered in specially developed gassing facilities."

One of many web pages denying the Holocaust

Internet is filterless

- For every bias there is a confirmation



The screenshot shows a web browser window with the address bar displaying 'www.globalclimatescam.com'. The page features a large banner with a globe and the text 'GlobalClimateScam.com EXPOSING THE TRUTH ABOUT GLOBAL WARMING HYSTERIA'. Below the banner is a navigation menu with links: Home, About, Posting Comments, Ten Things You Can Do, Must-See Videos, and Contact Us. The main content area displays an article titled 'An Open Letter to President Elect Trump on Global Warming' by ElmerB, dated December 2, 2016. The article text begins with 'Dear President Elect Trump, First off let me say congratulations on your outstanding victory. I supported and voted for you and am privileged to be a part of this historic moment. The stock market is up, Carrier and Ford are keeping their plants here, peace is breaking out across the globe and [...]' and includes a link to 'Continue Reading 30 Comments'. Below the article is another article titled 'Why Donald Trump Won | Bill Mitchell and Stefan Molyneux' by ElmerB, dated November 10, 2016. The right sidebar contains a search bar, a 'Make a Donation' section with a 'Donate' button and logos for MasterCard, Visa, and American Express, and an 'Ad Links' section with links to 'BDVmanagement.com' and 'Rathishyam.com'. At the bottom right, there is a dark blue advertisement for '1° anno quota gratuita + € 100 di Voucher*'. The browser's address bar shows a search for 'climate change hoax' and the page title is 'Global Climate Scam'.

A web site denouncing the climate change 'hoax'

Fake News are no news

Fake News are no news

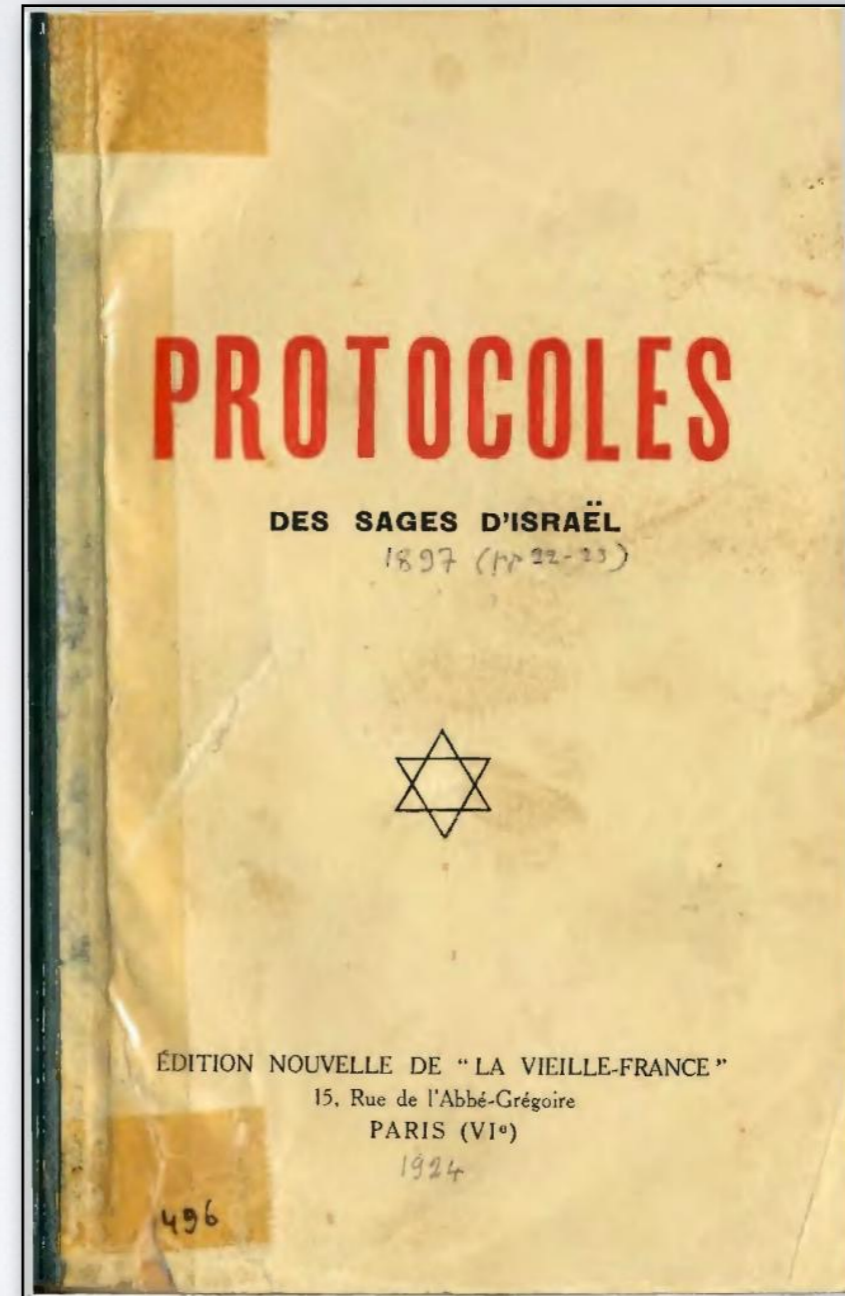


Joseph Goebbels

Fake News are no news



Joseph Goebbels



Fake news

Fake News are no news

Fake News are no news

... If any one had dared to suggest that it had been done in jest, or if any one had denied the existence of a dark plot, they would have passed for obstinate fools, or indeed they would have incurred the suspicion of having an interest in distracting the public from the truth, of being themselves accomplices, `smearers'. The word soon became common, solemn, terrible. With such a persuasion that there were `smearers', some were perforce to be found: all eyes were on the alert to discover the guilty; the most indifferent action excited suspicion. And suspicion easily became certainty, and certainty became rage.

Alessandro Manzoni, from "The Betrothed", Chap. 31

Fake News are no news



The punishment of 'smearers' (a XVII century print)

What has changed?

What has changed?

- Multiplication of sources

What has changed?

- Multiplication of sources
- Depletion of authority

What has changed?

- Multiplication of sources
- Depletion of authority

'disintermediation'

What has changed?

- Multiplication of sources
- Depletion of authority
- Influence delusion

'disintermediation'

What has changed?

- Multiplication of sources
- Depletion of authority
- Influence delusion
- Confirmation bias

'disintermediation'

What has changed?

- Multiplication of sources
- Depletion of authority
- Influence delusion
- Confirmation bias
- Viral propagation

'disintermediation'

What has changed?

- Multiplication of sources
- Depletion of authority
- Influence delusion
- Confirmation bias
- Viral propagation
- Necessity of responsible usage

'disintermediation'

What's Next?

What's Next?



Daisy Ridley?

What's Next?

Synthesizing Obama: Learning Lip Sync from Audio

Supasorn Suwajanakorn
Steven M. Seitz
Ira Kemelmacher-Shlizerman

University of Washington

SIGGRAPH 2017

<http://grail.cs.washington.edu/projects/AudioToObama/>

Barack Obama?







THE NEW SCIENCE OF (MIS)INFORMATION

facebook for developers | Products Docs Tools & Support News Videos

Search

Connect on a global scale.

Build, grow and monetize your apps with Messenger

- **Facebook Login**
Account Creation in two taps
- **Sharing on Facebook**
Promote your app or website organically
- **Facebook Analytics**
Understand and optimize customer behavior
- **Mobile Monetization**
Monetize your mobile app or mobile website with ads
- **Messenger Platform**
Build your bot to reach 1 billion people
- **Instagram Platform**
Build tools for businesses to help them manage their presence on Instagram

Computational Sociology

Computational Sociology

Digital Wildfires in a Hyperconnected World

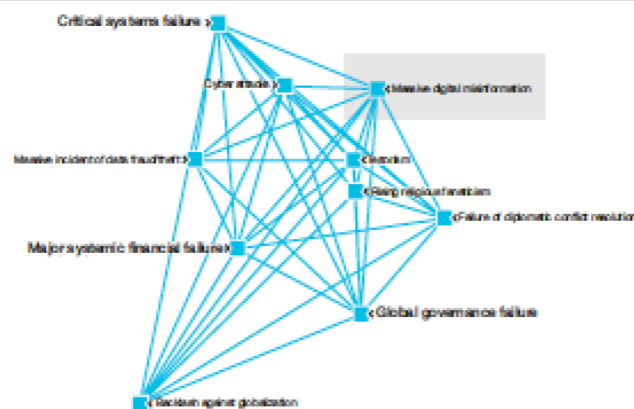
The global risk of massive digital misinformation sits at the centre of a constellation of technological and geopolitical risks ranging from terrorism to cyber attacks and the failure of global governance. This risk case examines how hyperconnectivity could enable “digital wildfires” to wreak havoc in the real world. It considers the challenge presented by the misuse of an open and easily accessible system and the greater danger of misguided attempts to prevent such outcomes.

In 1938, when radio had become widespread, thousands of Americans confused an adaptation of the H.G. Wells novel *War of the Worlds* with a news broadcast and jammed police station phone lines in the panicked belief that the United States had been invaded by Martians.

It is difficult to imagine a radio broadcast causing comparably widespread misunderstanding today. In part this is because broadcasters have learned to be more cautious and responsible, in part because the media is a regulated industry, and in part because listeners have learned to be more savvy and sceptical. Moreover, the news industry itself is undergoing a transformation as the Internet offers multiple options to confirm or refute a breaking news story. But the Internet, like radio in 1938, is a relatively young medium. The notion that a tweet, blog or video posting could drive a similar public panic today is not at all far-fetched.

The Internet remains an uncharted, fast-evolving territory. Current generations are able to communicate and share information instantaneously and at a scale larger than ever before. Social media increasingly allows information to spread around the world at breakneck speed. While the benefits of this are obvious and well documented, our hyperconnected world could also enable the rapid viral spread of information that is either intentionally or unintentionally misleading or provocative, with serious consequences. The chances of this happening are exponentially greater today than when the radio was introduced as a disruptive technology, despite our media sophistication. Radio was a communication channel of “one to many” while the Internet is that of “many to many”.

Figure 11: Digital Wildfires in a Hyperconnected World Constellation



Source: World Economic Forum

Global Risks 2013 29

- The **World Economic Forum** included “**Massive Digital Misinformation**” in its list of major geo-political **risks** in 2013.
- A **number of groups** have studied the phenomenon in subsequent years from **many disciplinary viewpoints**.
- The **massive amount of data** collected by social media platforms allows for **high-statistics analyses**.
- The **statistical mechanics** of social networks is looking for a suitable **thermodynamics**: what are the **relevant variables**?

Computational Sociology

Digital Wildfires in a Hyperconnected World

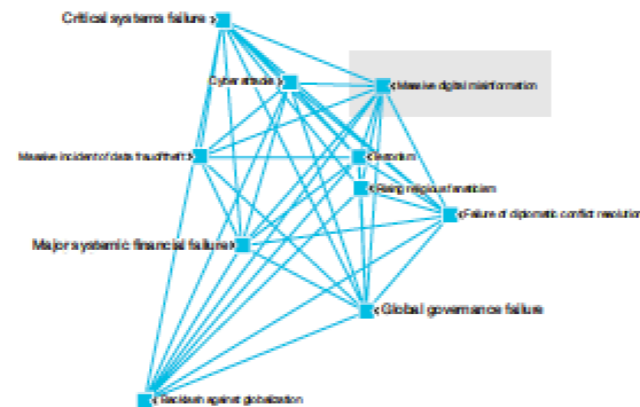
The global risk of massive digital misinformation sits at the centre of a constellation of technological and geopolitical risks ranging from terrorism to cyber attacks and the failure of global governance. This risk case examines how hyperconnectivity could enable "digital wildfires" to wreak havoc in the real world. It considers the challenge presented by the misuse of an open and easily accessible system and the greater danger of misguided attempts to prevent such outcomes.

In 1938, when radio had become widespread, thousands of Americans confused an adaptation of the H.G. Wells novel *War of the Worlds* with a news broadcast and jammed police station phone lines in the panicked belief that the United States had been invaded by Martians.

It is difficult to imagine a radio broadcast causing comparably widespread misunderstanding today. In part this is because broadcasters have learned to be more cautious and responsible, in part because the media is a regulated industry, and in part because listeners have learned to be more savvy and sceptical. Moreover, the news industry itself is undergoing a transformation as the Internet offers multiple options to confirm or refute a breaking news story. But the Internet, like radio in 1938, is a relatively young medium. The notion that a tweet, blog or video posting could drive a similar public panic today is not at all far-fetched.

The Internet remains an unchained, fast-evolving territory. Current generations are able to communicate and share information instantaneously and at a scale larger than ever before. Social media increasingly allows information to spread around the world at breakneck speed. While the benefits of this are obvious and well documented, our hyperconnected world could also enable the rapid viral spread of information that is either intentionally or unintentionally misleading or provocative, with serious consequences. The chances of this happening are exponentially greater today than when the radio was introduced as a disruptive technology, despite our media sophistication. Radio was a communication channel of "one to many" while the Internet is that of "many to many".

Figure 11: Digital Wildfires in a Hyperconnected World Constellation



Source: World Economic Forum

Computational Sociology

Digital Wildfires in a Hyperconnected World

The global risk of massive digital misinformation sits at the centre of a constellation of technological and geopolitical risks ranging from terrorism to cyber attacks and the failure of global governance. This risk case examines how hyperconnectivity could enable "digital wildfires" to wreak havoc in the real world. It considers the challenge presented by the misuse of an open and easily accessible system and the greater danger of misguided attempts to prevent such outcomes.

In 1938, when radio had become widespread, thousands of Americans confused an adaptation of the H.G. Wells novel *War of the Worlds* with a news broadcast and jammed police station phone lines in the panicked belief that the United States had been invaded by Martians.

It is difficult to imagine a radio broadcast causing comparably widespread misunderstanding today. In part this is because broadcasters have learned to be more cautious and responsible, in part because the media is a regulated industry, and in part because listeners have learned to be more savvy and sceptical. Moreover, the news industry itself is undergoing a transformation as the Internet offers multiple options to confirm or refute a breaking story. But the Internet, like radio in 1938, is a relatively unregulated medium. The notion that a tweet, blog or video post could cause a similar public panic today is not at all far-fetched.

The Internet remains an unregulated medium. Generations are growing up with instant access to information.

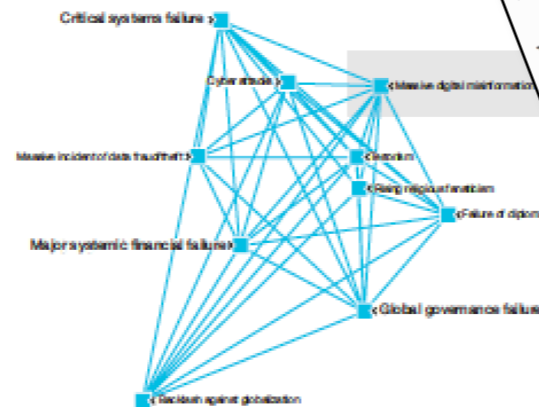
POLITICAL SCIENCE

Exposure to ideologically diverse news and opinion on Facebook

Eytan Bakshy,^{1*}† Solomon Messing,^{1†} Lada A. Adamic^{1,2}

Exposure to news, opinion, and civic information increasingly occurs through social media. How do these online networks influence exposure to perspectives that cut across ideological lines? Using deidentified data, we examined how 10.1 million U.S. Facebook users interact with socially shared news. We directly measured ideological homophily in friend networks and examined the extent to which heterogeneous friends could potentially expose individuals to cross-cutting content. We then quantified the extent to which individuals expose themselves to comparatively more or less diverse content while interacting with Facebook's algorithmically ranked News Feed and further studied users' choices to click through to ideologically discordant content. Compared with algorithmic ranking, individuals' choices played a stronger role in limiting exposure to cross-cutting content.

Figure 11: Digital Wildfires in a Hyperconnected World Constellation



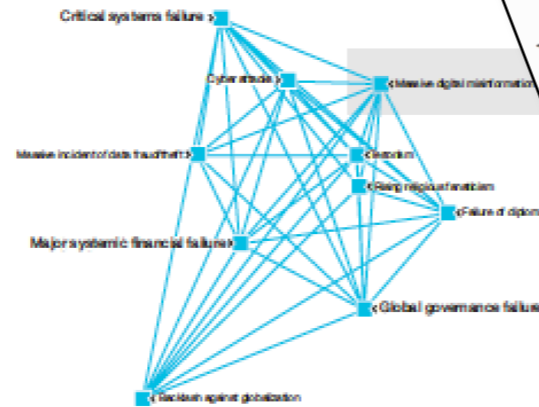
Source: World Economic Forum

Computational Sociology

Digital Wildfires Hyperconnecte

The global risk of massive digital misinformation sits at the centre of a constellation of technological and geopolitical risks ranging from terrorism to cyber attacks and the failure of global governance. This risk case examines how hyperconnectivity could enable "digital wildfires" to wreak havoc in the real world. It considers the challenge presented by the misuse of an open and easily accessible system and the greater danger of misguided attempts to prevent such outcomes.

Figure 11: Digital Wildfires in a Hyperconnected World Constellation



Source: World Economic Forum

Anatomy of news consumption on Facebook
 Ana Lucia Schmidt^a, Fabiana Zollo^{a,1}, Michela Del Vicario^a, Alessandro Bessi^b, Antonio Scala^{a,c}, Guido Caldarelli^{a,c}, H. Eugene Stanley^d, and Walter Quattrociocchi^{a,2}

^aLaboratory of Computational Social Science, Networks Department, IMT Alti Studi Lucca, 55100 Lucca, Italy; ^bIUSS Institute for Advanced Study, 27100 Pavia, Italy; ^cISC-CNR Uos "Sapienza," 00185 Rome, Italy; and ^dDepartment of Physics, Boston University, Boston, MA 02115

Edited by Susan T. Fiske, Princeton University, Princeton, NJ, and approved January 31, 2017 (received for review October 14, 2016)

Exposure to ideologically diverse news and opinion on Facebook
 Eytan Bakshy,^{1,*} Solomon Messing,^{1,†} Lada A. Adamic^{1,2}

Exposure to news, opinion, and civic information increasingly occurs through social media. How do these online networks influence exposure to perspectives that cut across ideological lines? Using deidentified data, we examined how 10.1 million U.S. Facebook users interact with socially shared news. We directly measured ideological homophily in friend networks and examined the extent to which heterogeneous friends could potentially expose individuals to cross-cutting content. We then quantified the extent to which individuals encounter comparatively more or less diverse content while interacting via Facebook's algorithmically ranked News Feed and further studied users' choices to click through to ideologically discordant content. Compared with algorithmic ranking, individuals' choices played a stronger role in limiting exposure to cross-cutting content.

POLITICAL SCIENCE

CrossMark
 click for updates

Computational Sociology

The spreading of misinformation online

Michela Del Vicario^a, Alessandro Bessi^b, Fabiana Zollo^a, Fabio Petroni^c, Antonio Scala^{a,d}, Guido Caldarelli^{a,d}, H. Eugene Stanley^e, and Walter Quattrociocchi^{a,1}

^aLaboratory of Computational Social Science, Networks Department, IMT Alti Studi Lucca, 55100 Lucca, Italy; ^bIUSS Institute for Advanced Study, 27100 Pavia, Italy; ^cSapienza University, 00185 Rome, Italy; ^dISC-CNR Uos "Sapienza," 00185 Rome, Italy; and ^eBoston University, Boston, MA 02115

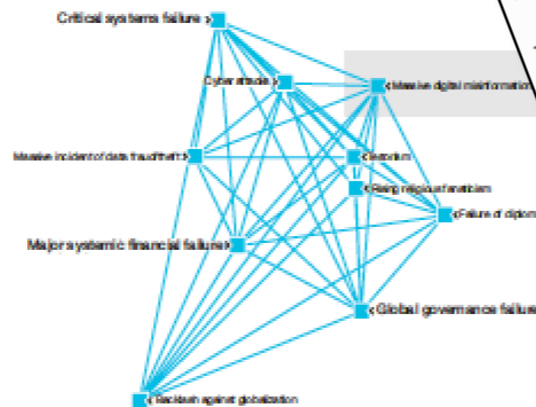
Edited by Matjaz Perc, University of Maribor, Maribor, Slovenia, and accepted by the Editorial Board December 4, 2015 (received for review September 1, 2015)



Digital Wildfires

...examines how digital connectivity could enable "digital wildfires" to wreak havoc in the real world. It considers the challenge presented by the misuse of an open and easily accessible system and the greater danger of misguided attempts to prevent such outcomes.

Figure 11: Digital Wildfires in a Hyperconnected World Const...



Source: World Economic Forum

News consumption on Facebook

Michela Del Vicario^a, Alessandro Bessi^b, Antonio Scala^{a,c}, Guido Caldarelli^{a,c}, and Walter Quattrociocchi^{a,2}

^aNetworks Department, IMT Alti Studi Lucca, 55100 Lucca, Italy; ^bIUSS Institute for Advanced Study, 27100 Pavia, Italy; ^cDepartment of Physics, Boston University, Boston, MA 02115

Approved January 31, 2017 (received for review October 14, 2016)



POLITICAL SCIENCE

Exposure to ideologically diverse news and opinion on Facebook

Eytan Bakshy,^{1,*} Solomon Messing,^{1,†} Lada A. Adamic^{1,2}

Exposure to news, opinion, and civic information increasingly occurs through social media. How do these online networks influence exposure to perspectives that cut across ideological lines? Using deidentified data, we examined how 10.1 million U.S. Facebook users interact with socially shared news. We directly measured ideological homophily in friend networks and examined the extent to which heterogeneous friends could potentially expose individuals to cross-cutting content. We then quantified the extent to which individuals encounter comparatively more or less diverse content while interacting with Facebook's algorithmically ranked News Feed and further studied users' choices to click through to ideologically discordant content. Compared with algorithmic ranking, individuals' choices played a stronger role in limiting exposure to cross-cutting content.



Computational Sociology

Digital Wildfires



The spreading of misinformation online

Michela Del Vicario^a, Alessandro Bessi^b, Fabiana Zollo^a, Fabio Petroni^c, Antonio Scala^{a,d}, Guido Caldarelli^{a,d},
H. E. Stanley^e, and Walter Quattrociocchi^{a,1}

News consumption on Facebook

Michela Del Vicario^a, Alessandro Bessi^b, Antonio Scala^{a,c}, Guido Caldarelli^{a,c},
Quattrociocchi^{a,2}



Debunking vaccination myths: Strong risk negations can increase perceived vaccination risks.

EXPORT Add To My List

Betsch, Cornelia Sachse, Katharina

Citation
Betsch, C., & Sachse, K. (2013). Debunking vaccination myths: Strong risk negations can increase perceived vaccination risks. *Health Psychology, 32*(2), 146-155.
<http://dx.doi.org/10.1037/a0027387>

...examines how ... could enable "digital wildfires" to wreak havoc in the real world. It considers the challenge presented by the misuse of an open and easily accessible system and the greater danger of misguided attempts to prevent such outcomes.

...difficult to imagine a radio broadcast... widespread misunderstanding today. In part because the media is a regulated industry, and in part because listeners have learned to be more savvy and sceptical. Moreover, the news industry itself is undergoing a transformation as the Internet offers multiple options to confirm or refute a breaking news story. But the Internet, like radio in 1938, is a relatively new medium. The notion that a tweet, blog or video post can trigger a similar public panic today is not at all far-fetched.

POLITICAL SCIENCE

Exposure to ideologically diverse news and opinion on Facebook

Solomon Messing^{1,†}, Lada A. Adamic^{1,2}

...opinion, and civic information increasingly occurs through social media. ... networks influence exposure to perspectives that cut across ideological ... data, we examined how 10.1 million U.S. Facebook users interact with ... directly measured ideological homophily in friend networks and ... which heterogeneous friends could potentially expose individuals to ... We then quantified the extent to which individuals encounter ... or less diverse content while interacting via Facebook's algorithmically ... ed and further studied users' choices to click through to ideologically discordant ... pared with algorithmic ranking, individuals' choices played a stronger role in ... exposure to cross-cutting content.

Database: PsycARTICLES Journal Article

Health Psychology
Editor Kenneth E. Freedland, PhD
Journal TOC

Big Data

The screenshot shows the Facebook for developers website. At the top, there is a navigation bar with the 'facebook for developers' logo, links for 'Products', 'Docs', 'Tools & Support', 'News', and 'Videos', a search bar, and a 'Get Started' button. Below the navigation bar, a breadcrumb trail reads 'Docs / Graph API / Overview / On This Page'. The main content area is titled 'Graph API Overview' and contains an introductory paragraph: 'The Graph API is the primary way to get data out of, and put data into, Facebook's platform. It's a low-level HTTP-based API that you can use to programmatically query data, post new stories, manage ads, upload photos, and perform a variety of other tasks that an app might implement.' Below this, a section titled 'The Basics' explains that the Graph API is named after the idea of a 'social graph' - a representation of the information on Facebook composed of:

- **nodes** - basically "things" such as a User, a Photo, a Page, a Comment
- **edges** - the connections between those "things", such as a Page's Photos, or a Photo's Comments
- **fields** - info about those "things", such as a person's birthday, or the name of a Page

A left-hand sidebar lists various Graph API topics: Overview, Using the Graph API, Reference, Common Scenarios, Other APIs, Webhooks, Advanced, Changelog, and Server-Sent Events. An upward-pointing arrow is visible on the right side of the main content area.

Facebook makes publicly available powerful tools for statistical analyses of user data, which can be freely applied by anyone to all content classified as 'public'.

A selection of first results

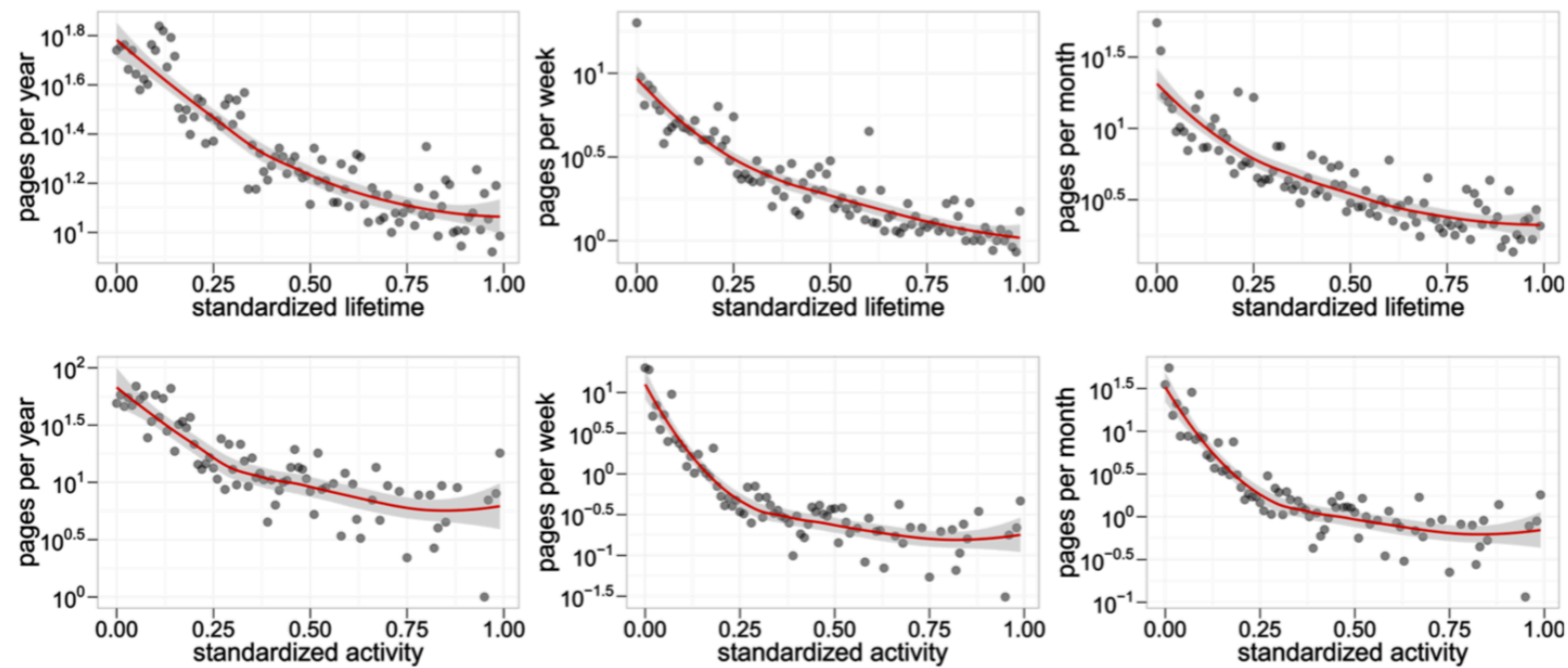


Fig. 1. Users' attention patterns. (Top) Maximum number of unique news sources that users with increasing levels of standardized lifetime interacted with monthly, weekly, and yearly. (Bottom) Maximum number of unique news outlets which users with increasing levels of standardized activity interacted with monthly, weekly, and yearly.

The number of independent news sources sampled by Facebook users decreases with the increasing intensity and persistence of their activity.

(from: Schmidt et al., Proceedings of the National Academy of Sciences, 2017)

$$\rho = \frac{x - y}{x + y}$$

A selection of first results

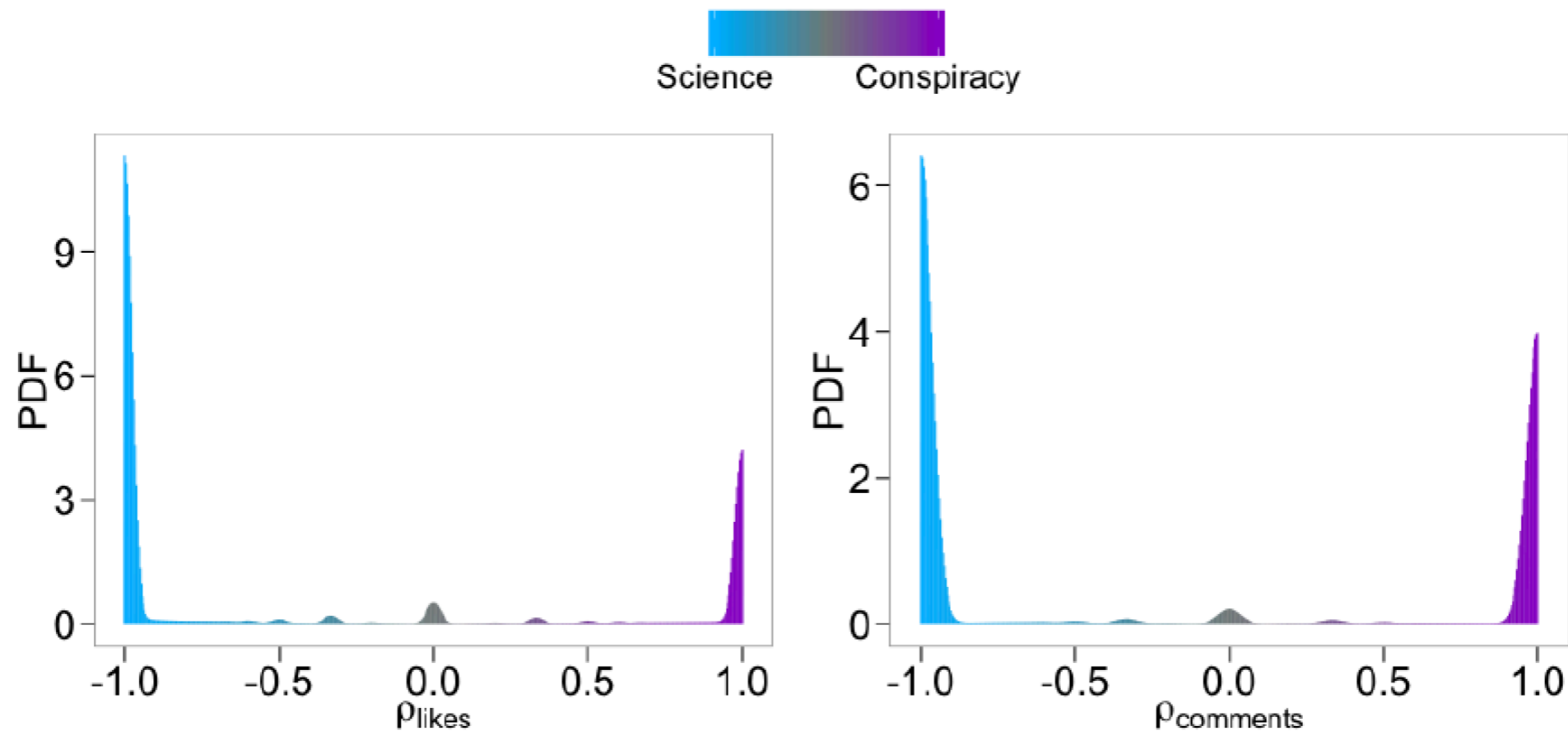


Figure 1: **Users polarization.** Probability density functions (PDFs) of the polarization of all users computed on likes (*left*) and comments (*right*).

Considering popular science web sites and fake-news web sites, it is possible to define a 'user polarisation', ρ . The ρ distribution is extreme: it describes two disconnected communities.

(from Zollo et al., arXiv:1510.04267)

$$\rho_{ij} = \rho_i \rho_j$$

A selection of first results

(from Del Vicario et al., Proceedings of the National Academy of Sciences 2015)

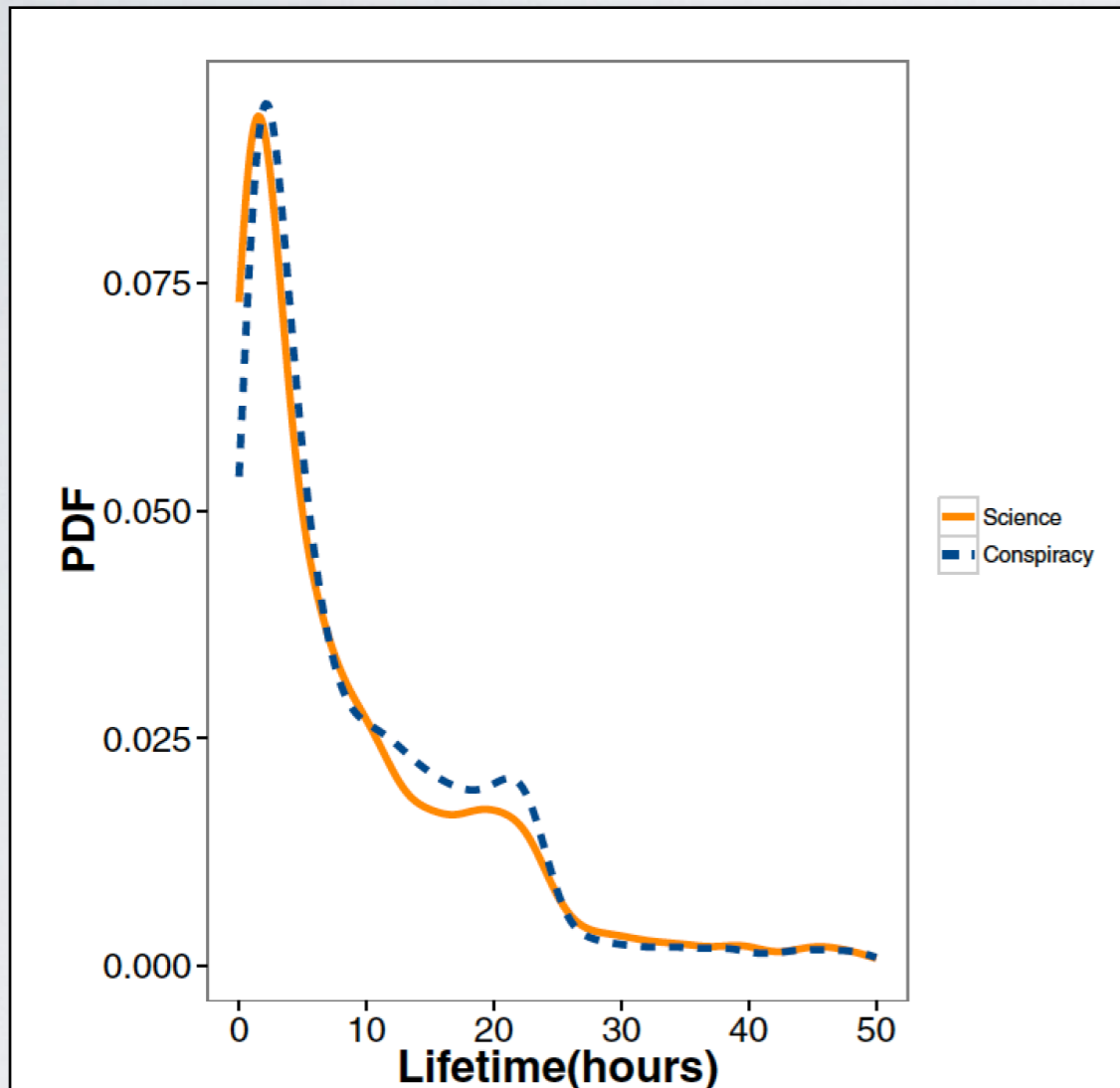


Fig. 1. PDF of lifetime computed on science news and conspiracy theories, where the lifetime is here computed as the temporal distance (in hours) between the first and last share of a post. Both categories show a similar behavior.

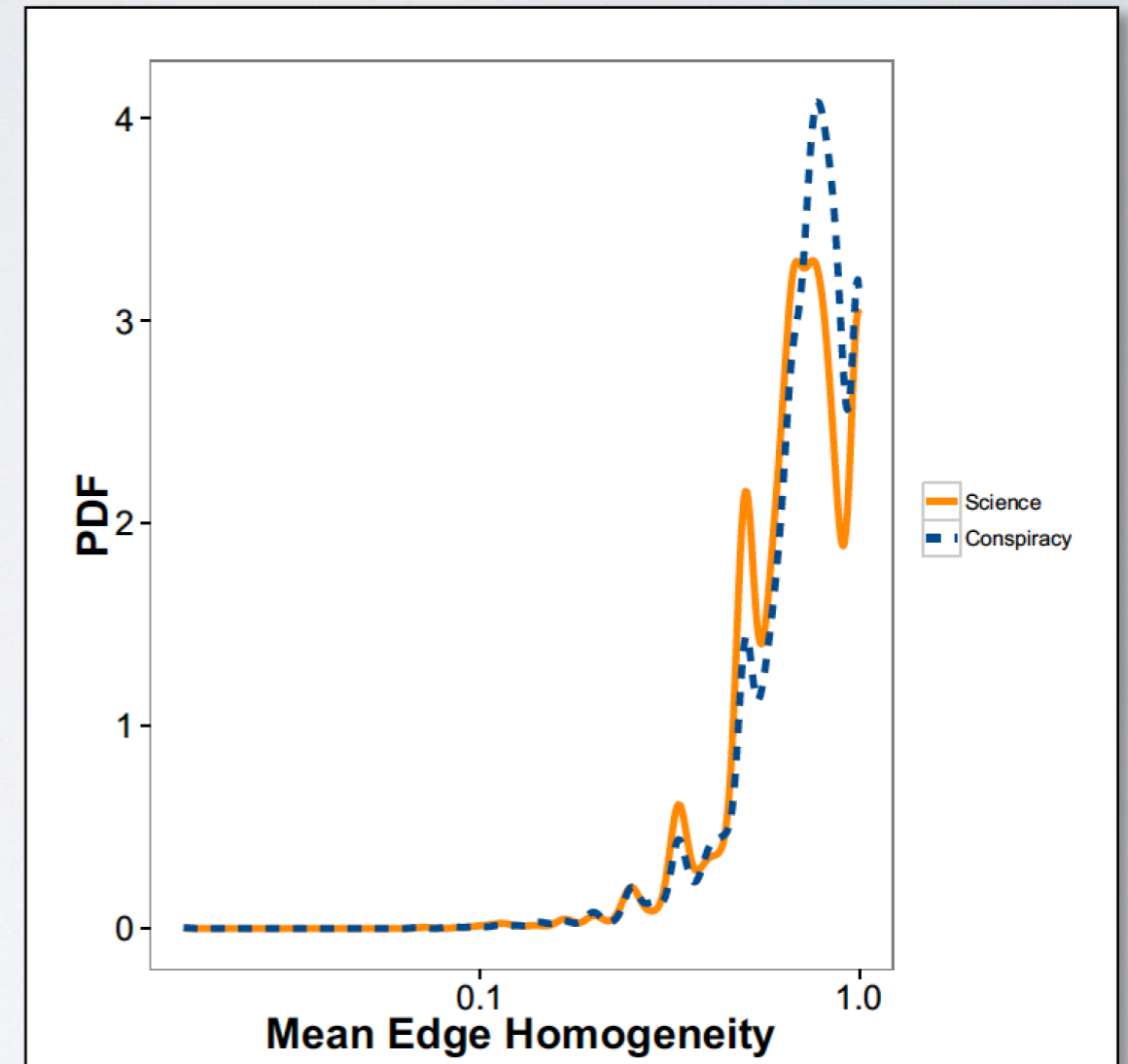


Fig. 3. PDF of edge homogeneity for science (orange) and conspiracy (blue) news. Homogeneity paths are dominant on the whole cascades for both scientific and conspiracy news.

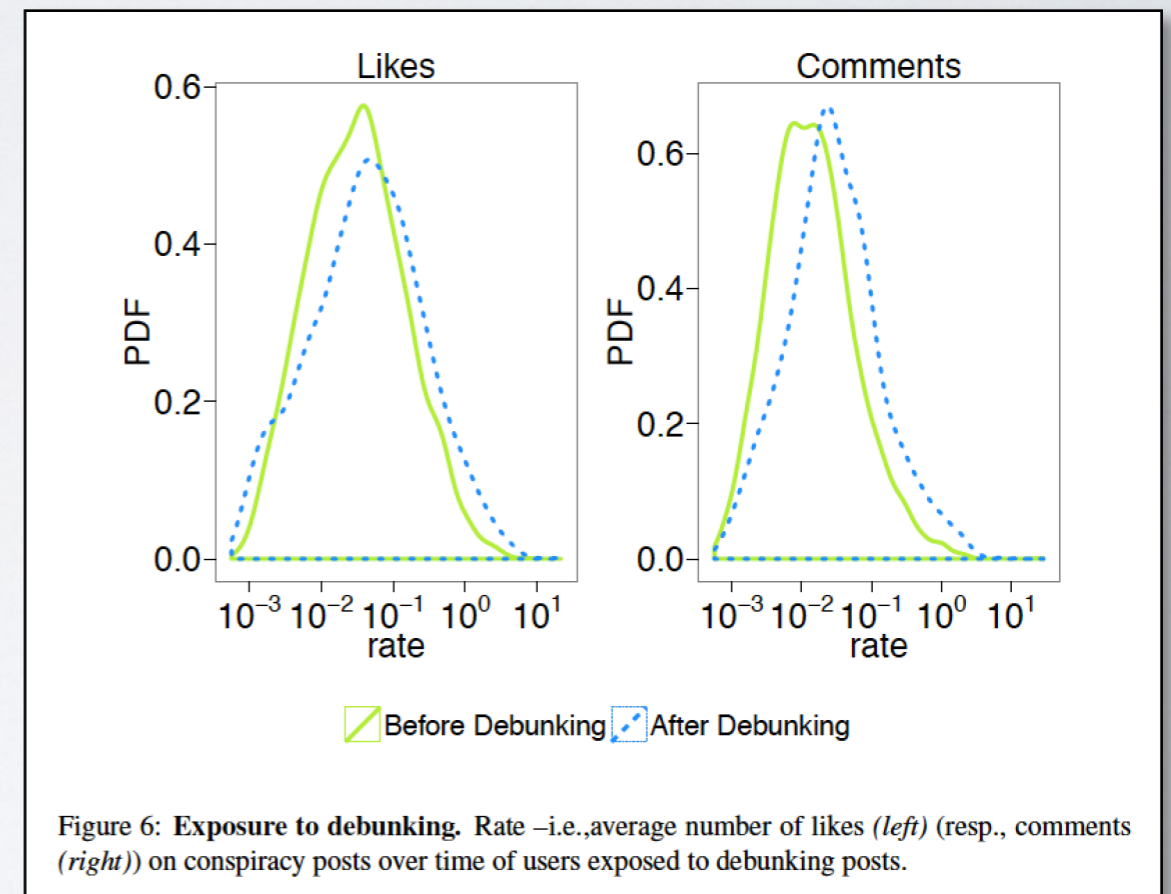
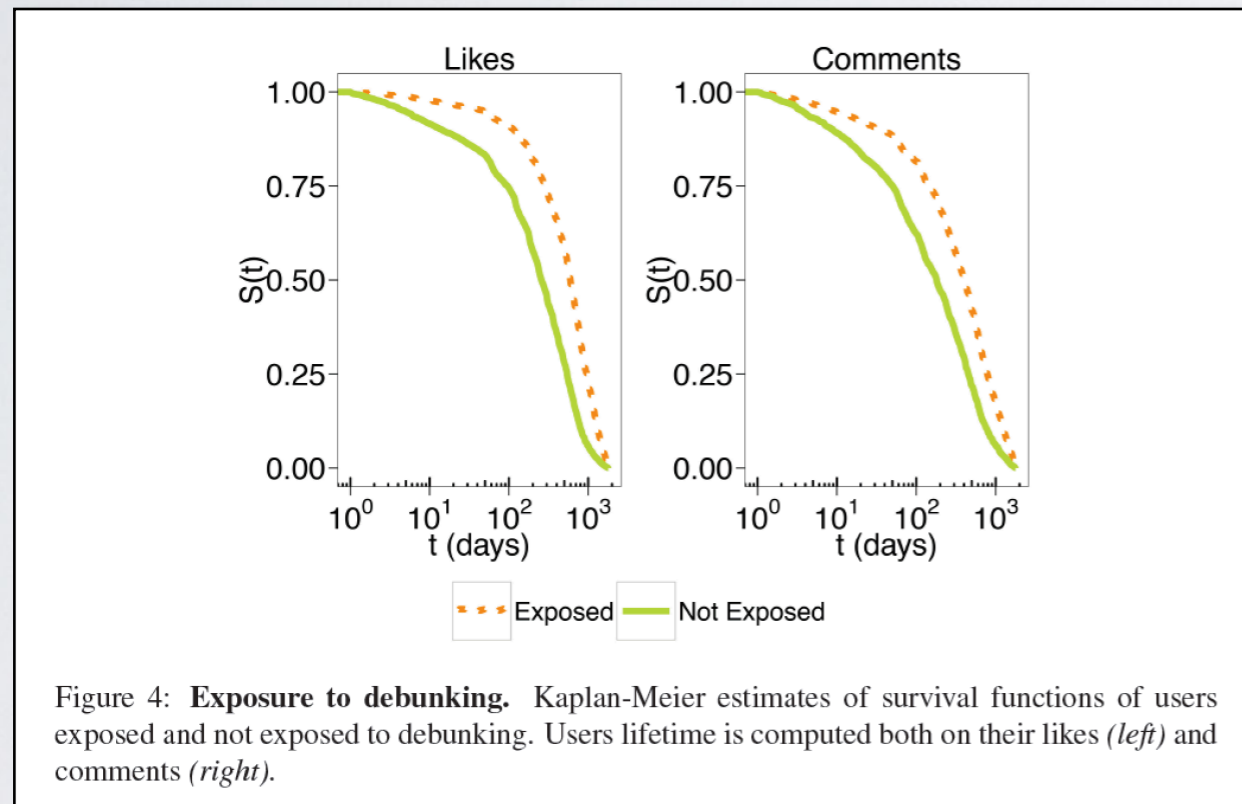
The propagation of science news and conspiracy related fake news follows very similar patterns.

News propagate almost exclusively between sites sharing priori homogeneous positions.

A selection of first results

Users who are polarised on fake news web sites, after being exposed to correct scientific information, tend to amplify their involvement with conspiracy theories.

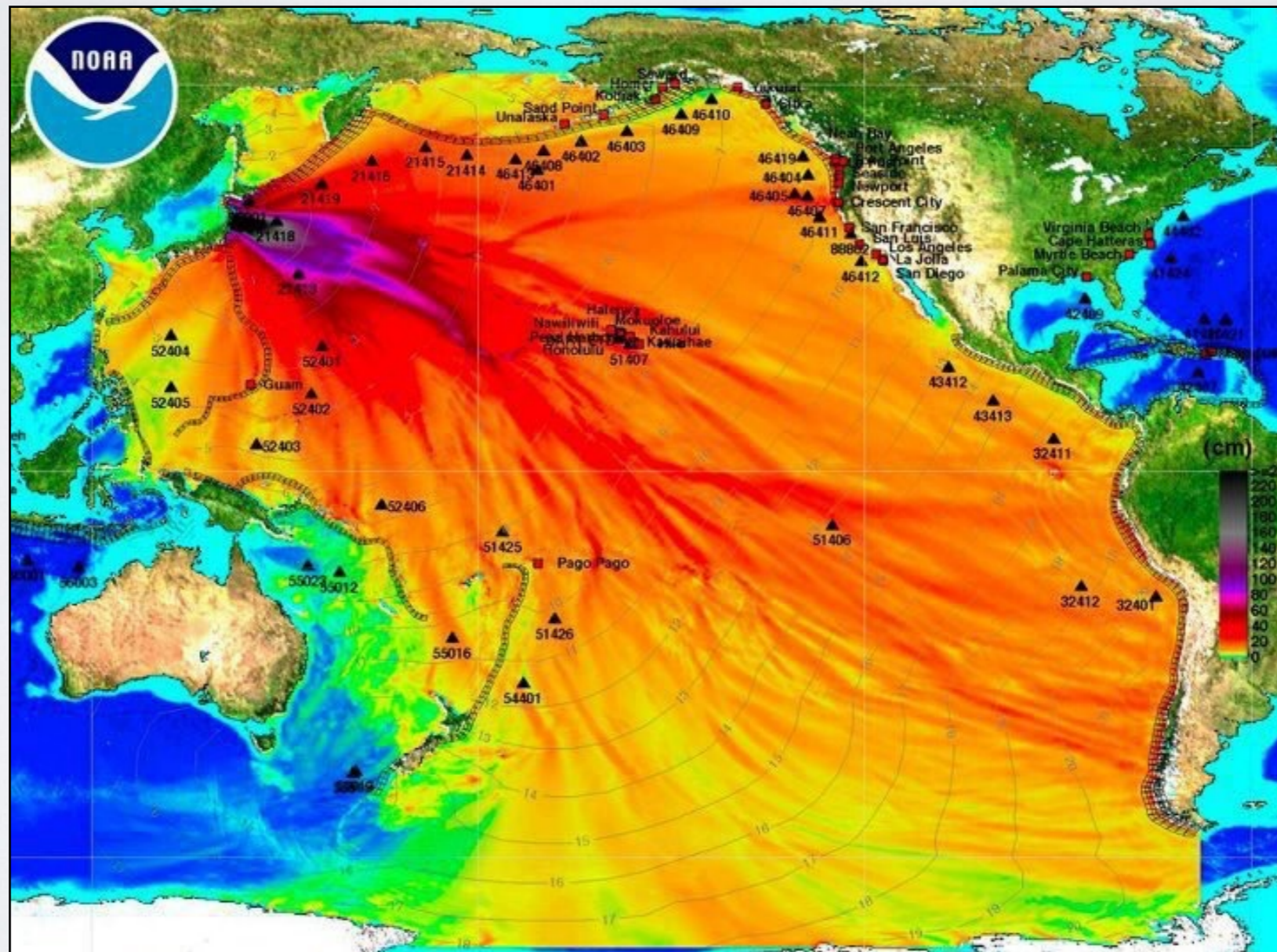
(da Zollo et al., arXiv:1510.04267)



The lifetime of users on fake news web sites increases after they are exposed to debunking.

The number of 'likes' and user comments on fake news sites increases after the users are exposed to debunking.

(MIS)INFORMATION ABOUT SCIENCE



Science and the City

In recent decades, a growing number of science-related issues has gained prominence in public and political discussions. In a democracy, the informed opinion of citizens should be crucial in deciding about such issues: this however presupposes a widespread understanding of at least basic science. Without this understanding, opinions can be easily manipulated by mass media and social media, searching for high-impact news, but also by political actors, attempting to take advantage of fears and prejudices which often lack a factual basis. Examples of such issues are energy and environmental policies, climate change and vaccination campaigns.

Science and the City

- **Citizen problems** that are related to **science** are **ubiquitous**.

Space

Meteorology

Hydrogen

Climate

Privacy

Genetics

Homeopathy

Nuclear Weapons

Diet

Vaccines

Renewables

Nuclear Energy

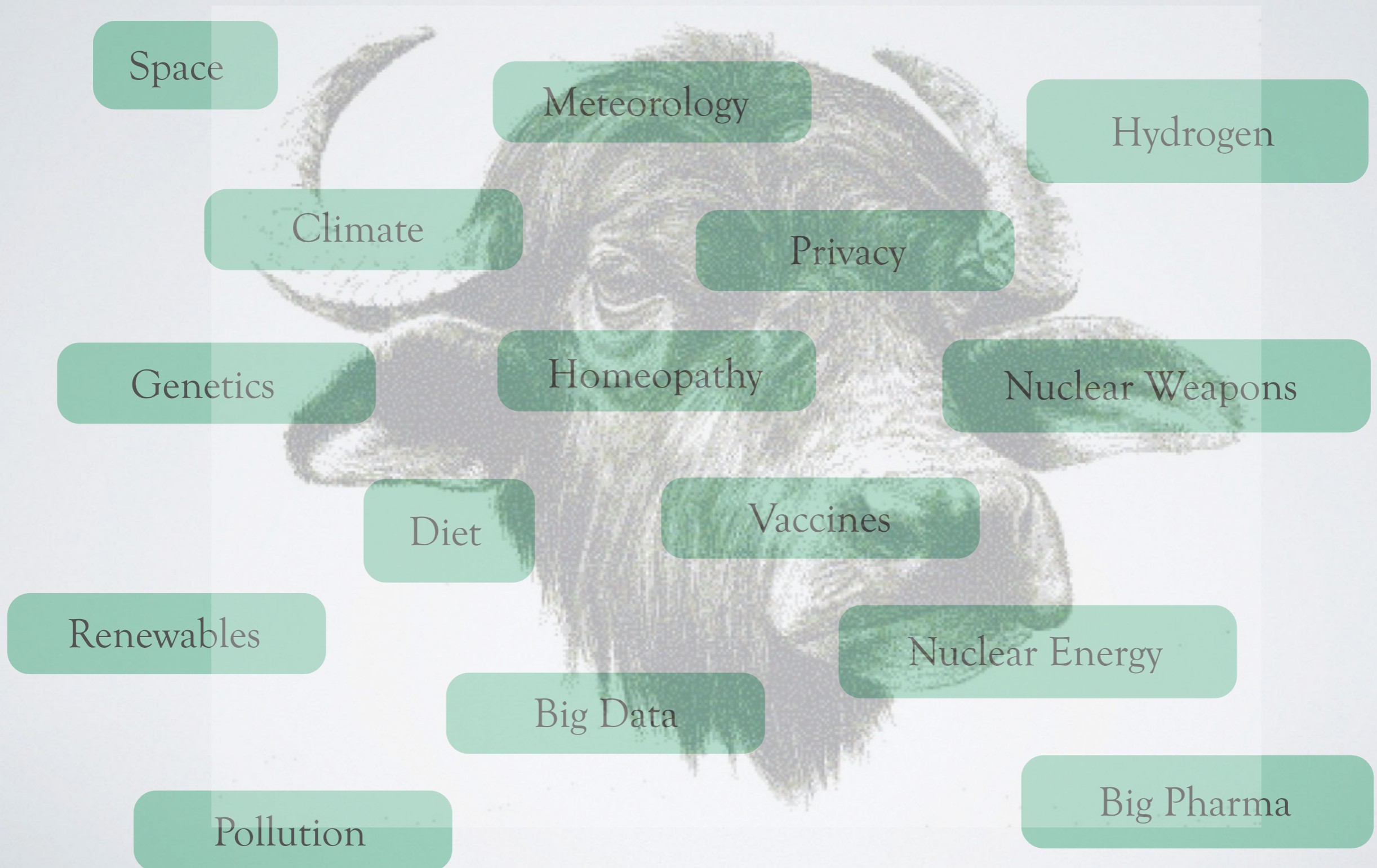
Big Data

Pollution

Big Pharma

Science and the City

- **Citizen problems** that are related to **science** are **ubiquitous**.



Solutions?

Solutions?

- Let's all become scientists!

Solutions?

- Let's all become scientists! **NO**

Solutions?

- Let's all become scientists! **NO**
- Let's have a government of scientists!

Solutions?

- Let's all become scientists! **NO**
- Let's have a government of scientists! **NO**

Solutions?

- Let's all become scientists! **NO**
- Let's have a government of scientists! **NO**
- Let's delegate technical decisions to scientists!

Solutions?

- Let's all become scientists! **NO**
- Let's have a government of scientists! **NO**
- Let's delegate technical decisions to scientists! **NO**

Solutions?

- Let's all become scientists! **NO**
- Let's have a government of scientists! **NO**
- Let's delegate technical decisions to scientists! **NO**
- Disseminate basic science knowledge.

Solutions?

- Let's all become scientists! **NO**
- Let's have a government of scientists! **NO**
- Let's delegate technical decisions to scientists! **NO**
- Disseminate basic science knowledge. **Yes!**

Solutions?

- Let's all become scientists! **NO**
- Let's have a government of scientists! **NO**
- Let's delegate technical decisions to scientists! **NO**
- Disseminate basic science knowledge. **Yes!**
- Provide tools and methods for fact checking.

Solutions?

- Let's all become scientists! **NO**
- Let's have a government of scientists! **NO**
- Let's delegate technical decisions to scientists! **NO**
- Disseminate basic science knowledge. **Yes!**
- Provide tools and methods for fact checking. **Yes!**

Solutions?

- Let's all become scientists! **NO**
- Let's have a government of scientists! **NO**
- Let's delegate technical decisions to scientists! **NO**
- Disseminate basic science knowledge. **Yes!**
- Provide tools and methods for fact checking. **Yes!**
- Promote ethical usage of information.

Solutions?

- Let's all become scientists! **NO**
- Let's have a government of scientists! **NO**
- Let's delegate technical decisions to scientists! **NO**
- Disseminate basic science knowledge. **Yes!**
- Provide tools and methods for fact checking. **Yes!**
- Promote ethical usage of information. **Yes!**

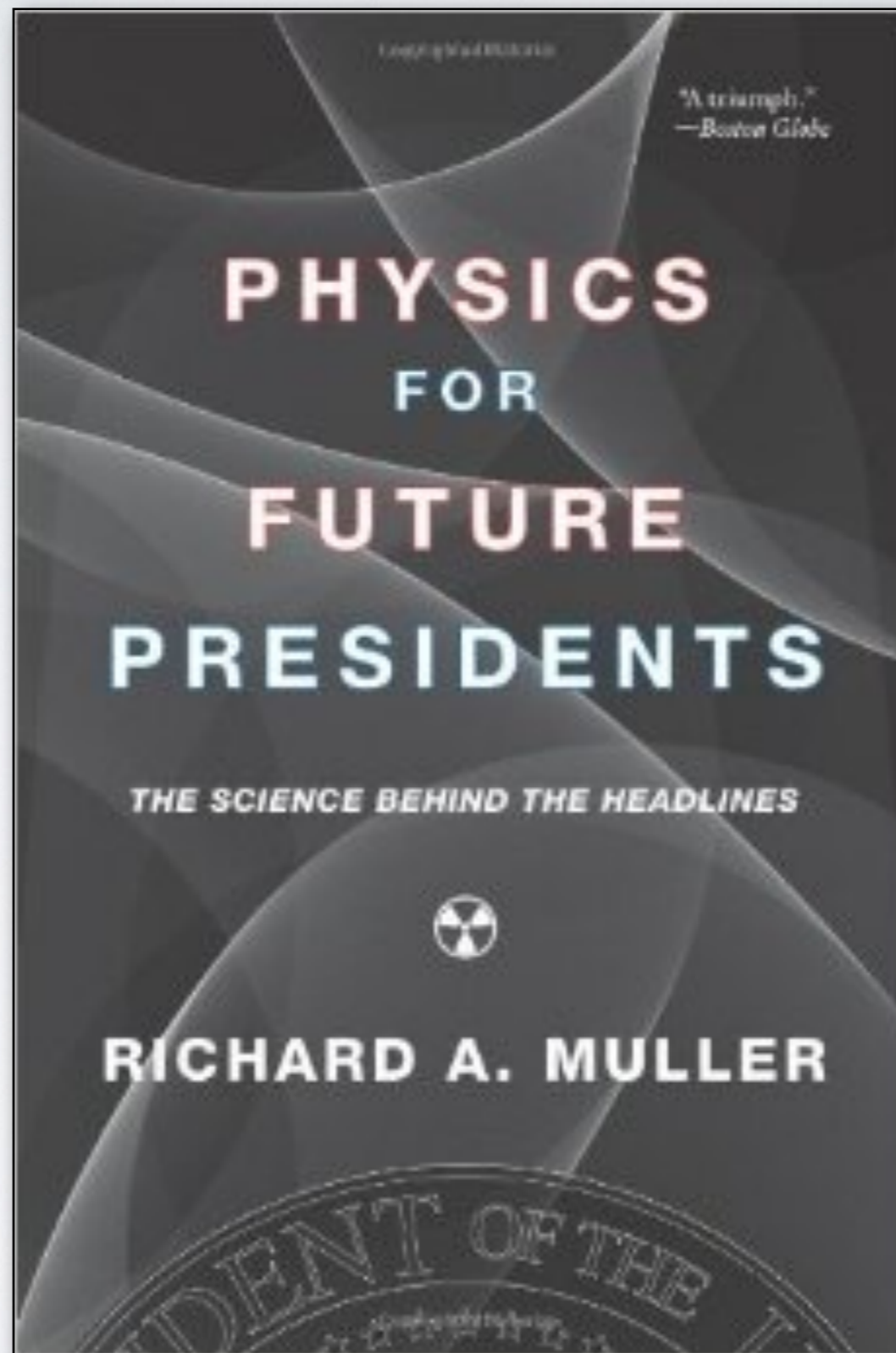
Solutions?

- Let's all become scientists! **NO**
- Let's have a government of scientists! **NO**
- Let's delegate technical decisions to scientists! **NO**
- Disseminate basic science knowledge. **Yes!**
- Provide tools and methods for fact checking. **Yes!**
- Promote ethical usage of information. **Yes!**
- Also: understand **psychology** and **sociology** of information.

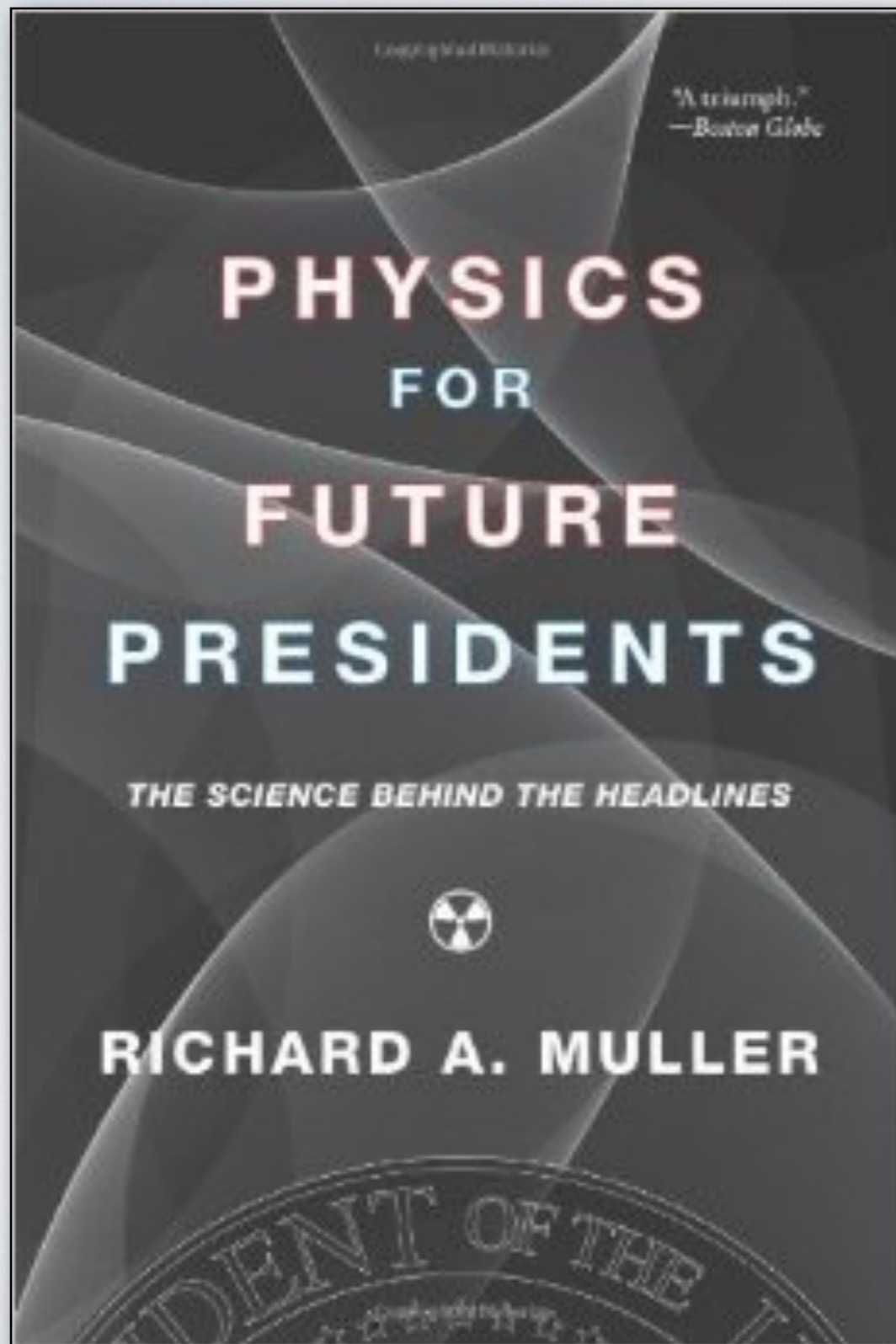
PHYSICS FOR CITIZENS



Inspiration



Inspiration



Many, if not most, important decisions today have a high-tech component. How can you lead your country into a clean-energy future if you don't understand solar power or how coal could be converted into gasoline? How can you decide important issues about research funding, arms control treaties, threats from North Korea or Iran, spying, and surveillance, if you understand only the political issues and not the technical ones? Even if you don't plan to be a world leader, how can you vote intelligently without understanding these issues?

What we discuss

What we discuss

A Toolbox

Estimating orders of magnitude.

Fermi's famous question and many many more.

Reading graphs.

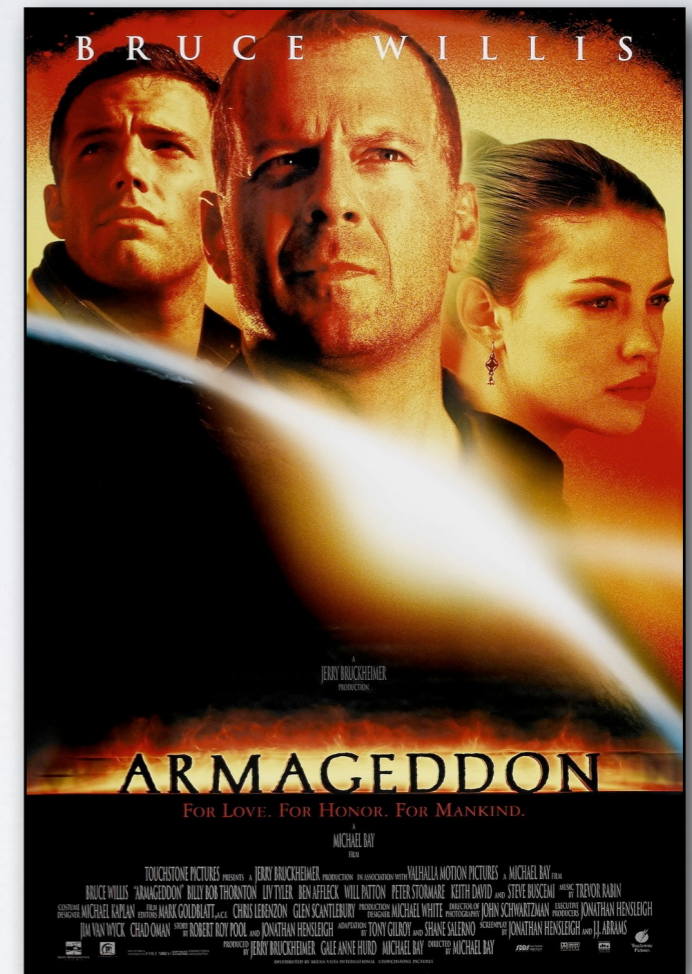
Examples of graphical (dis)information.

Errors and Uncertainties.

Lotteries, exit polls, correlations and other sins

Orders of Magnitude

The ability to **estimate** orders of magnitude its **important** at the **movies** and in **life**



Manipulating graphs

Manipulating graphs

VOTEZ MAINTENANT!

Une Suisse à 10 millions d'habitants?

Year	Total Population (millions)	Birth Citizens (millions)	Foreigners (millions)	Naturalized since 1980 (millions)
1980	6,3	4,0	1,4	0,0
1985	6,4	4,0	1,4	0,0
1995	7,0	4,0	1,4	0,0
2005	7,5	4,0	1,4	0,0
2014	8,2	4,0	1,4	0,0
2030	10,0	5,2	2,8	2,0

Sources: OFS, SEM

Augmentation de la population de la Suisse entre 1980 et 2030

ENGAGEZ-VOUS CONTRE UNE IMMIGRATION SANS LIMITE, UNE MENACE SUR NOS PLACES DE TRAVAIL ET LES ABUS DANS L'AIDE SOCIALE !

Rester libre!

Votez UDC.

Des questions au sujet des élections?
Hotline gratuite: 0800 002 444

Manipulating graphs

- What's wrong with this graph?

VOTEZ MAINTENANT!

Une Suisse à 10 millions d'habitants?

Year	Total Population (millions)	Swiss-born (millions)	Foreigners (millions)	Naturalized since 1980 (millions)
1980	6,3	4,0	1,3	0,0
1985	6,4	5,4	1,0	0,0
1995	7,0	5,4	1,6	0,0
2005	7,5	5,4	2,1	0,0
2014	8,2	5,2	3,0	0,0
2030	10,0	5,2	4,8	0,0

Sources: OFS, SEM

Augmentation de la population de la Suisse entre 1980 et 2030

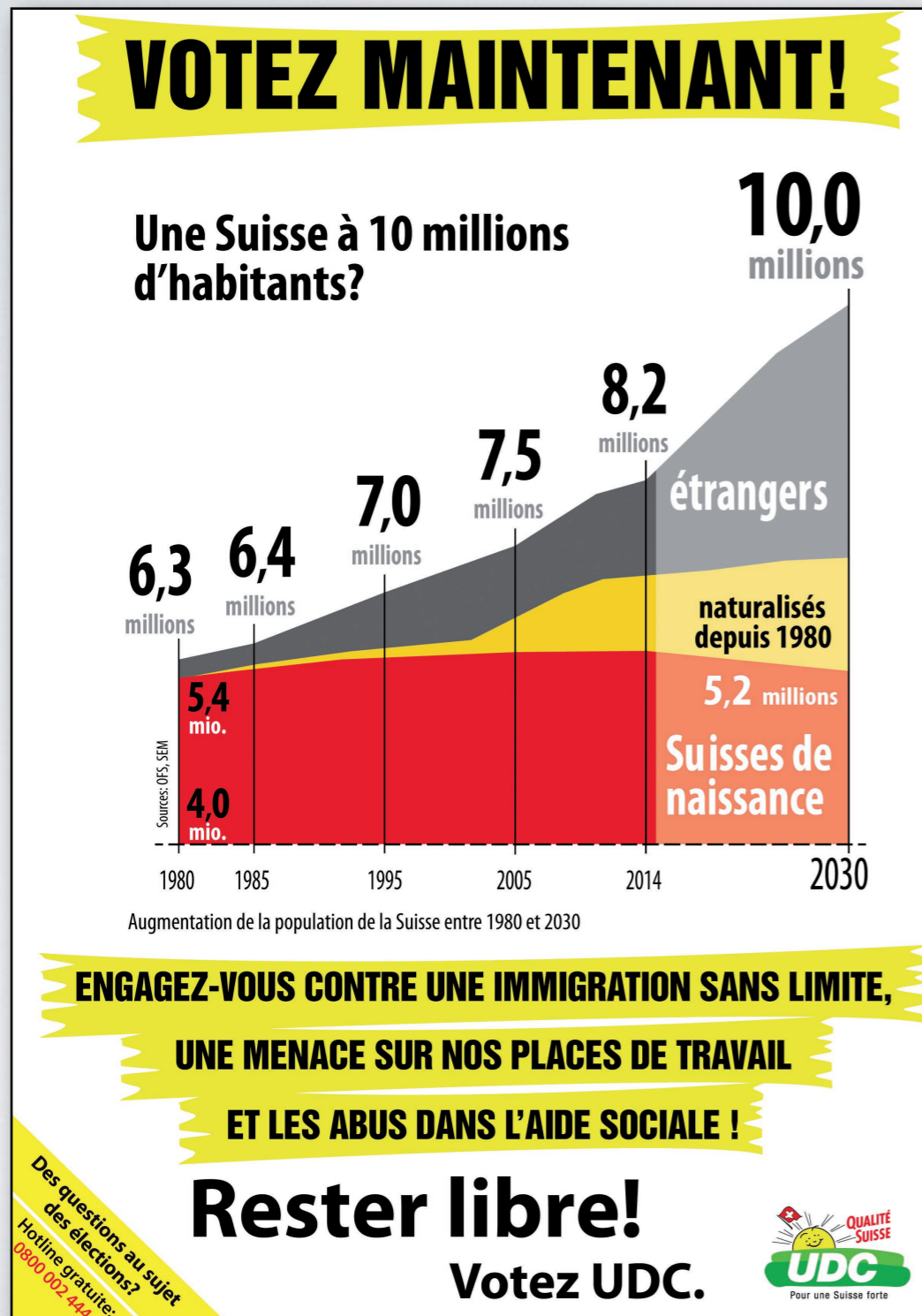
ENGAGEZ-VOUS CONTRE UNE IMMIGRATION SANS LIMITE, UNE MENACE SUR NOS PLACES DE TRAVAIL ET LES ABUS DANS L'AIDE SOCIALE !

Rester libre!

Votez UDC.

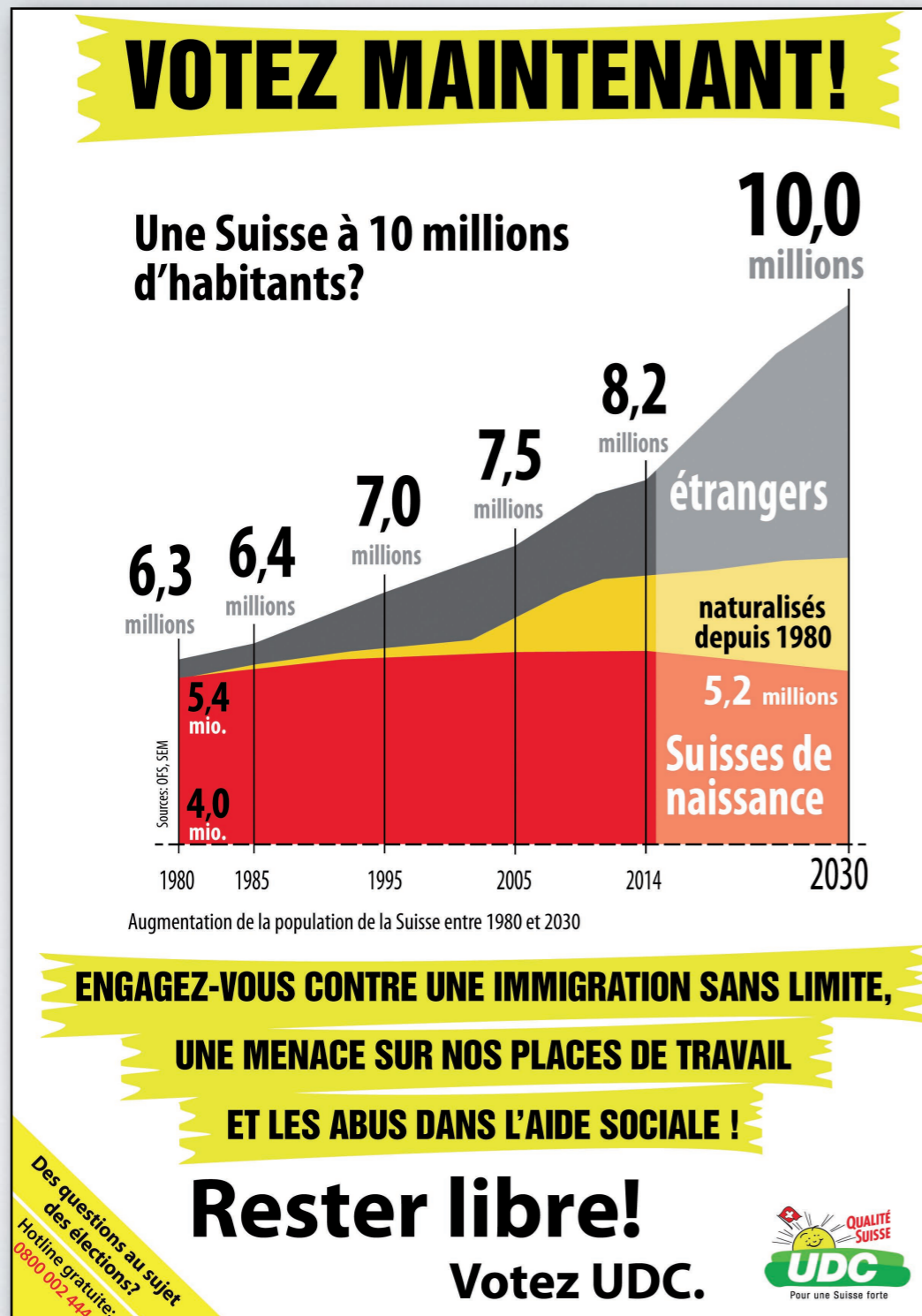
Des questions au sujet des élections?
Hotline gratuite: 0800 002 444

Manipulating graphs



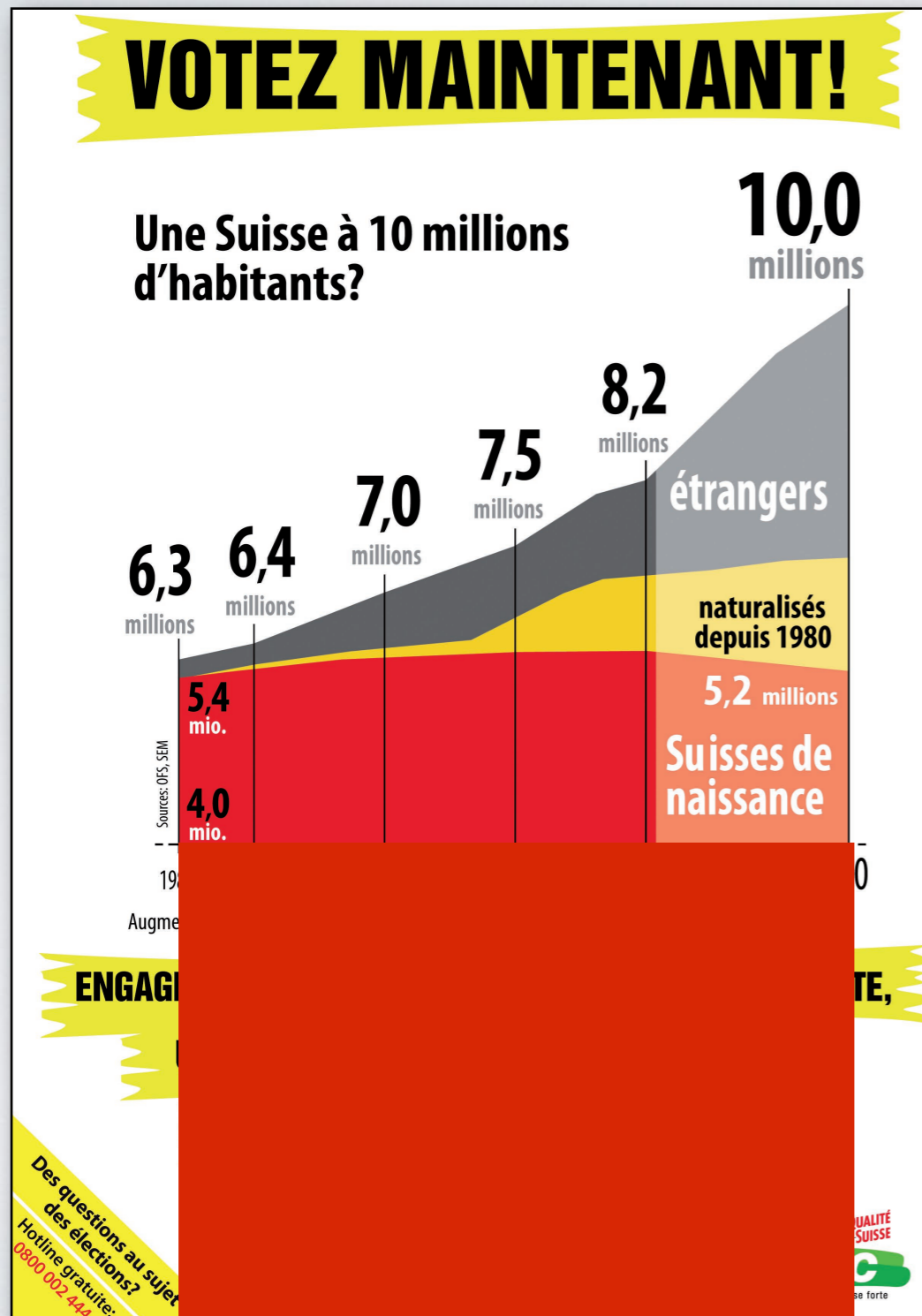
- What's wrong with this graph?
- Proportions are not respected

Manipulating graphs



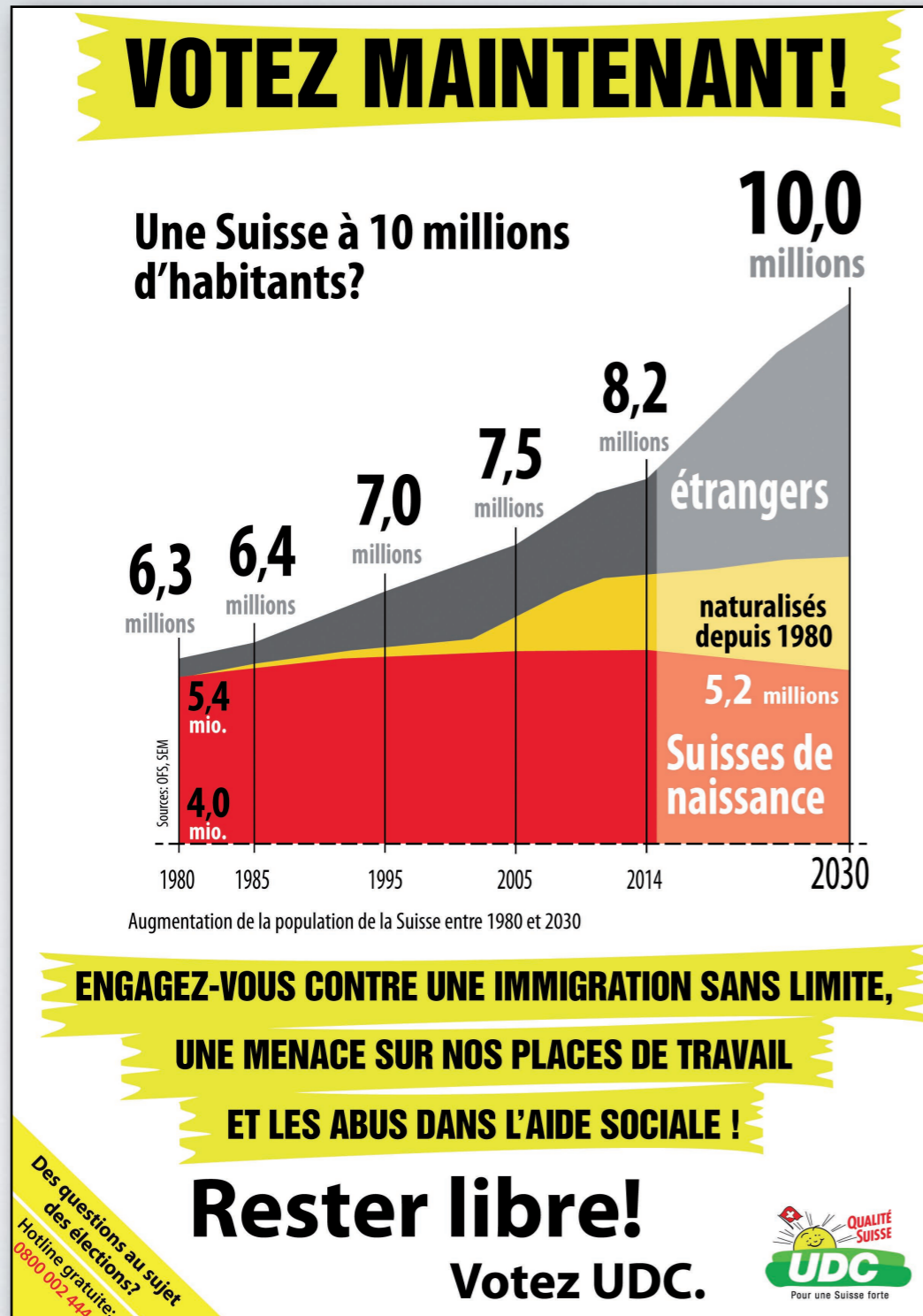
- What's wrong with this graph?
- Proportions are not respected
- The vertical scale starts from 4.0

Manipulating graphs



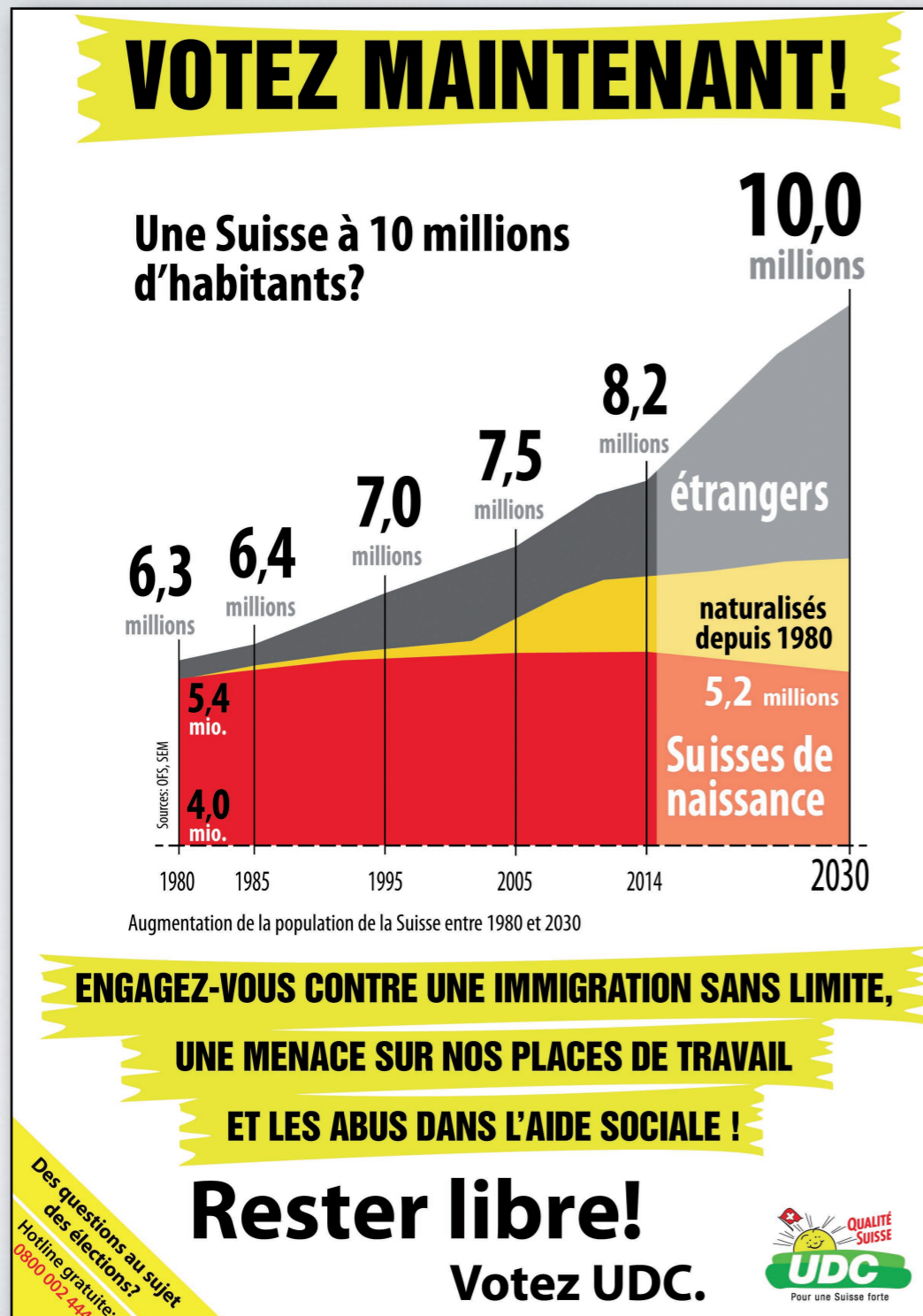
- What's wrong with this graph?
- Proportions are not respected
- The vertical scale starts from 4.0

Manipulating graphs



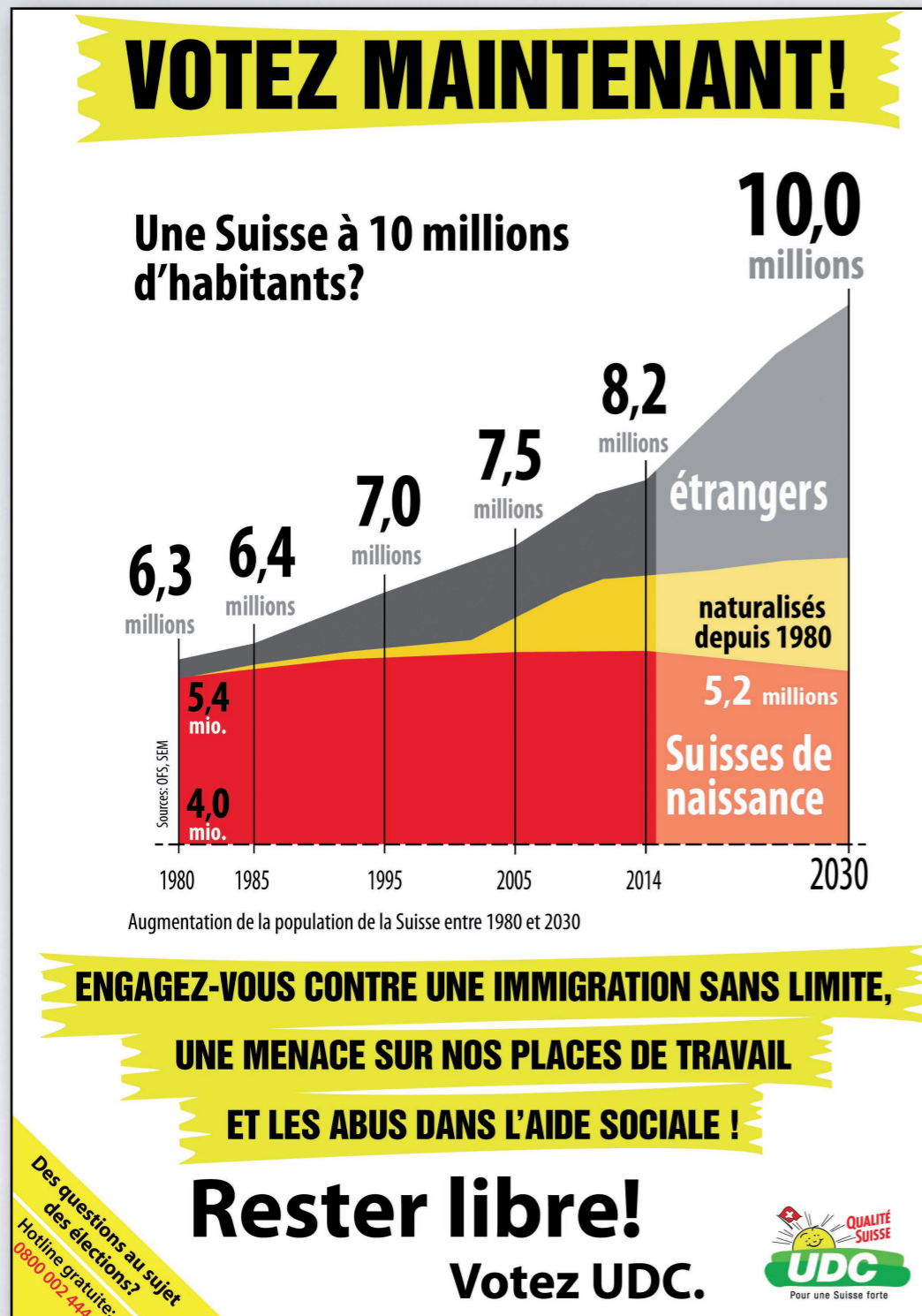
- What's wrong with this graph?
- Proportions are not respected
- The vertical scale starts from 4.0
- Graph = Scientific Authority

Manipulating graphs



- What's wrong with this graph?
- Proportions are not respected
- The vertical scale starts from 4.0
- Graph = Scientific Authority
- Small distortions change the message

Manipulating graphs

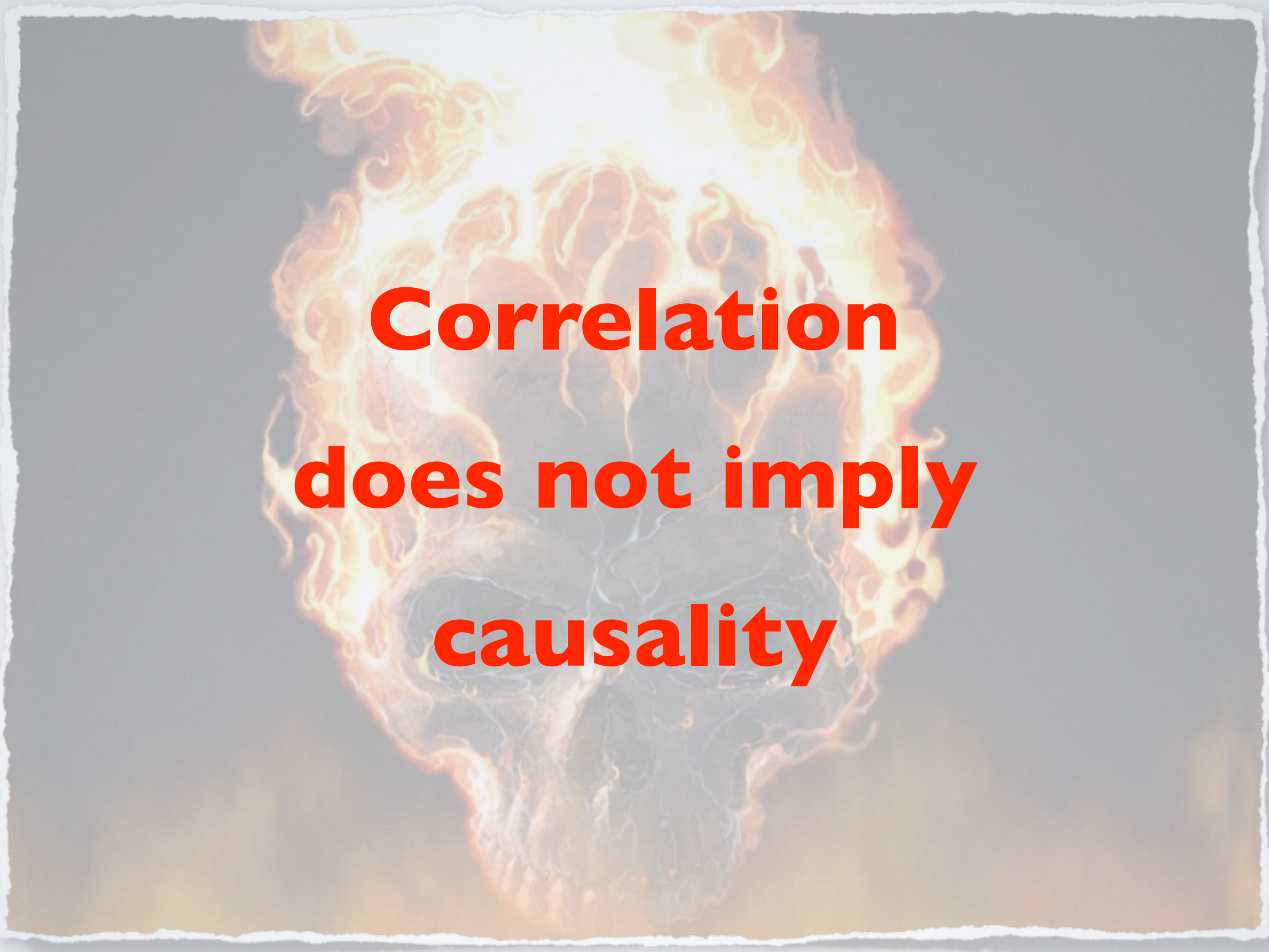


- What's wrong with this graph?
- Proportions are not respected
- The vertical scale starts from 4.0
- Graph = Scientific Authority
- Small distortions change the message
- **Decoding graphs is important!**

Correlation between two quantities

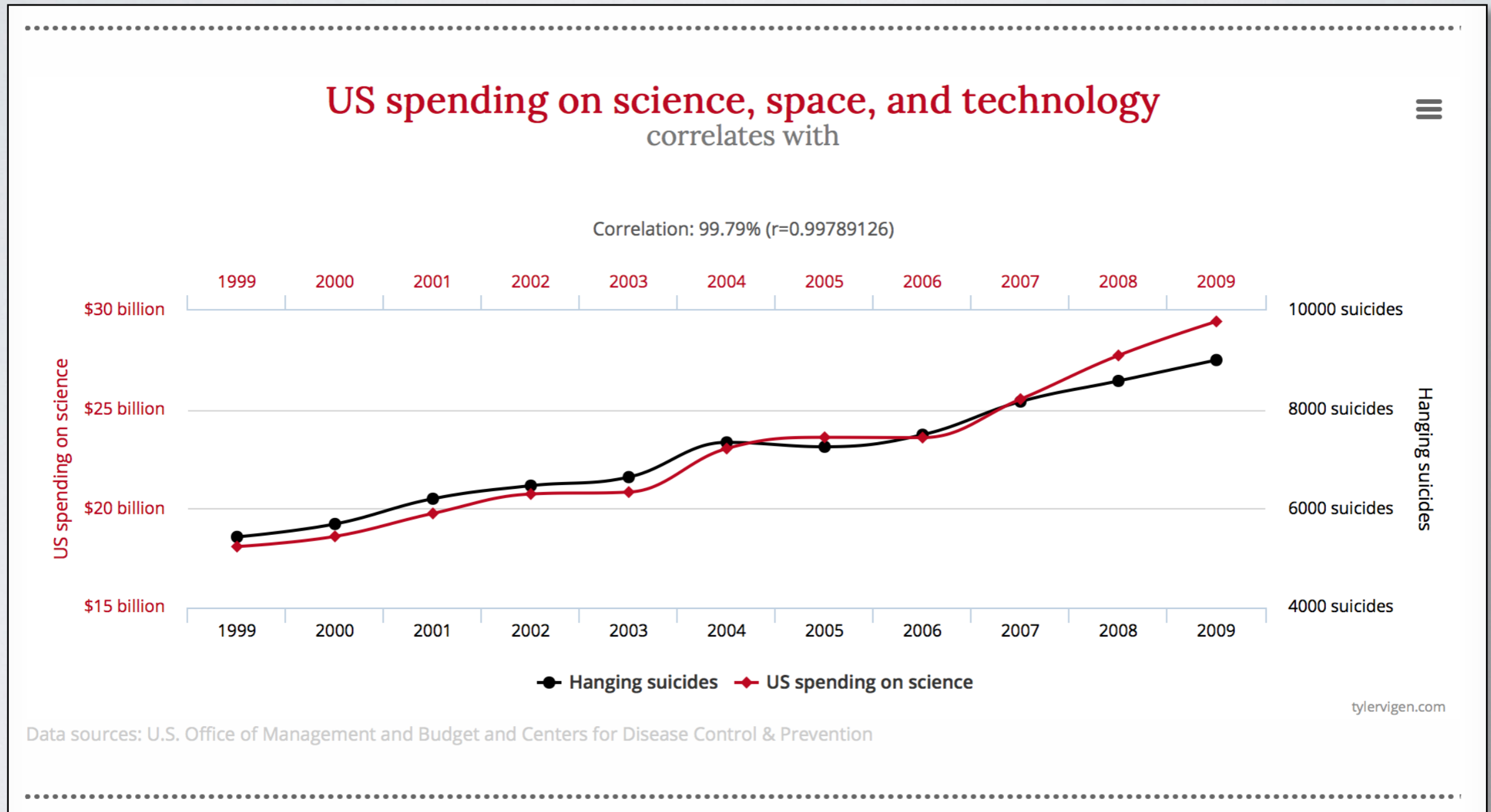
does not imply a causal relationship.

**Correlation
does not imply
causality**

A photograph of a human skull engulfed in bright orange and yellow flames. The skull is positioned centrally, and the fire is intense, with a bright white-yellow core and darker orange-red outer edges. The background is a dark, smoky grey. The entire image is framed by a white, torn-paper-like border.

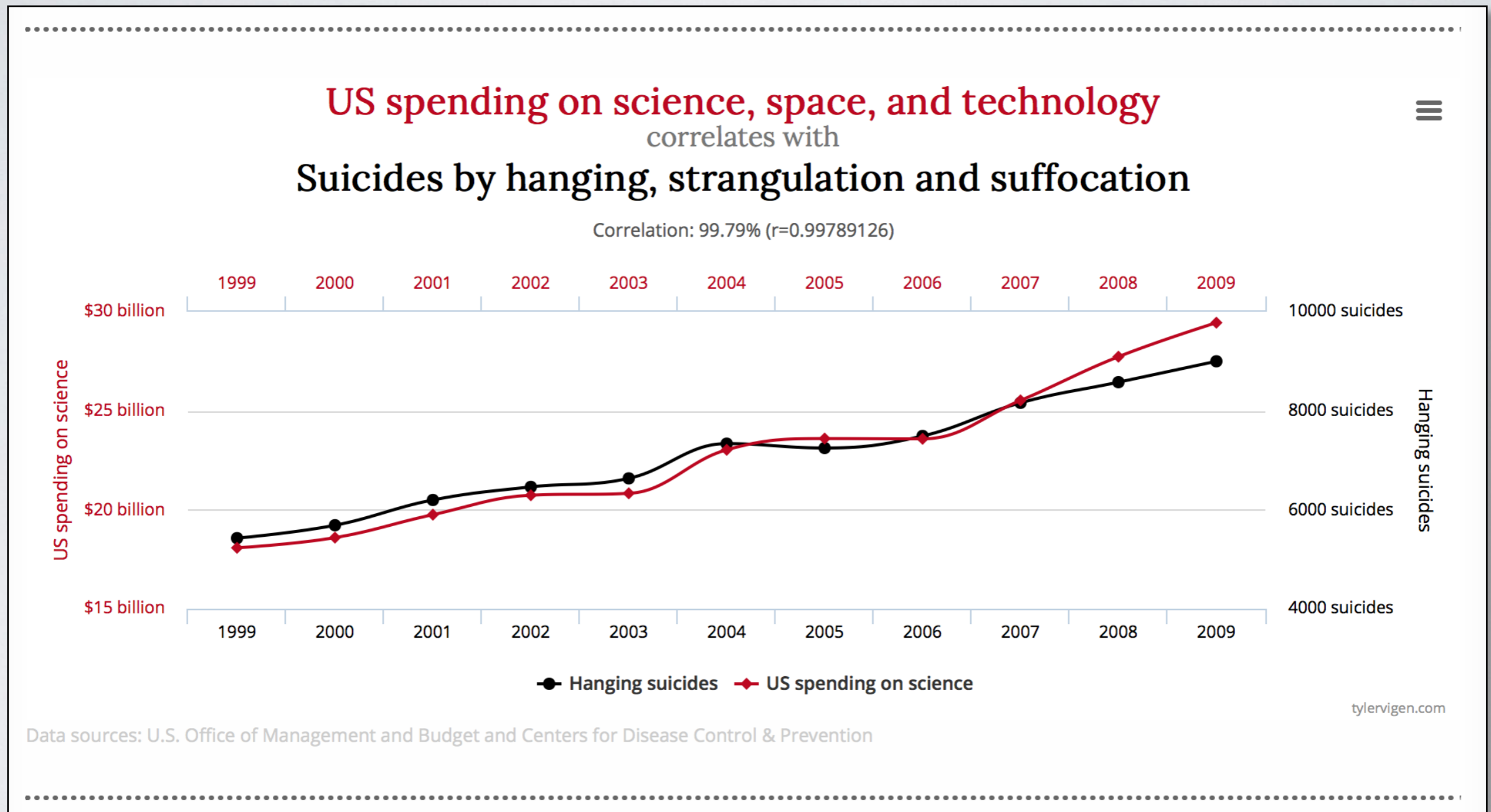
**Correlation
does not imply
causality**

Correlated variables



What about the correlation between US spending on science, space and technology ...

Correlated variables



What about the correlation between US spending on science, space and technology ...
... and the number of suicides by hanging, strangulation and suffocation?

What we discuss

In Search of Energy

Energy and power in physics and in life.

Energy content of (many) things.

Energy facts

Why we love gasoline so much.

Energy Sources

Black like coal, yellow like the sun.

What we discuss

Nuclear dreams and nightmares

Nuclei for citizens.

Alpha, beta and gamma rays, but no C-beams.

Radioactivity.

Radiation and cancer: fears and risks.

Nuclear weapons.

Fat Man, Little Boy and Mike.

Nuclear Power.

Chicago, Chernobyl, Three Mile Island, Fukushima, Cadarache.

What we discuss

Global Warming (and the cold outside)

Greenhouse effect

A brief history of climate.

The evidence

Reading IPCC reports.

(Non) solutions

Comfortable conservation.



Giuseppe Tipaldo

What we discuss

Politics, Media and Science

Science as a symbolic construction ...

... and its relationship with the media and the public.

The form of fake news ...

... and their viral propagation.

Beyond dissemination of science

Psychology and sociology of distributed information.

Beyond Fake News

Beyond Fake News

- An attempt to bridge a **psychological gap**.

Beyond Fake News

- An attempt to bridge a **psychological gap**.
- Focusing on **sharing methods, building good faith**.

Beyond Fake News

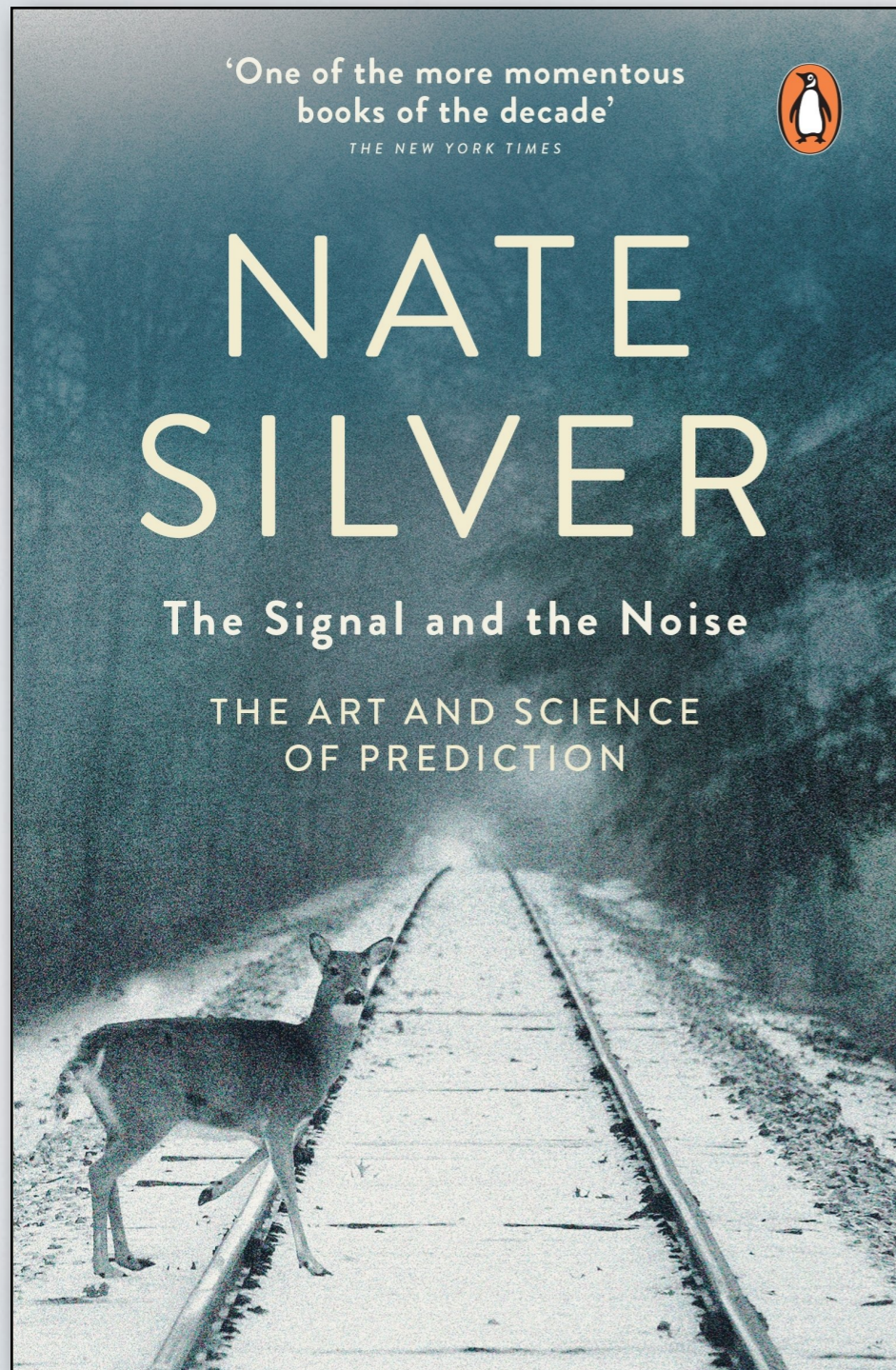
- An attempt to bridge a **psychological gap**.
- Focusing on **sharing methods, building good faith**.
- A small step towards a **evidence-based citizenship**.

Beyond Fake News

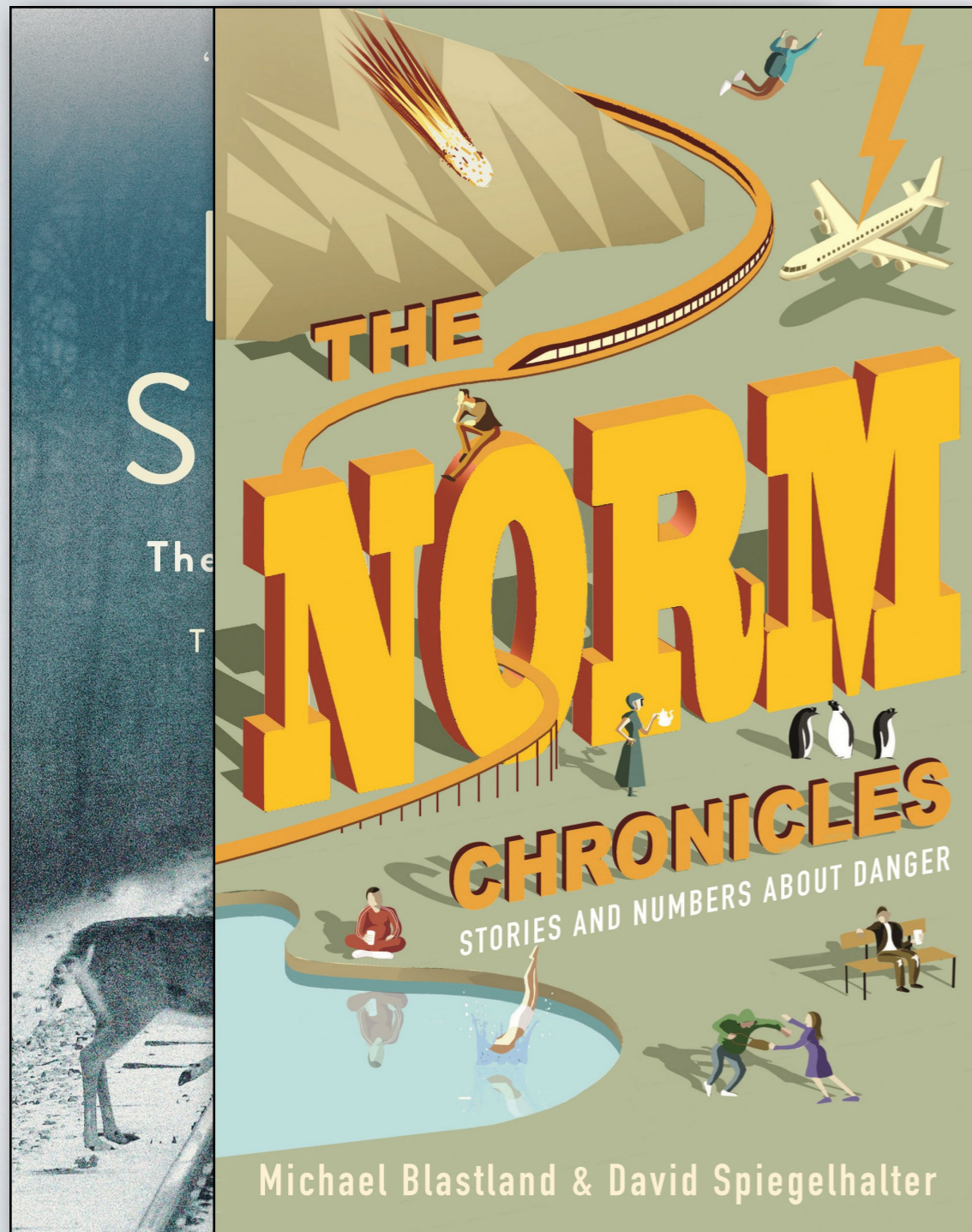
- An attempt to bridge a **psychological gap**.
- Focusing on **sharing methods, building good faith**.
- A small step towards a **evidence-based citizenship**.
- A pilot experience of **cross-curricular learning**.

Many wonderful books

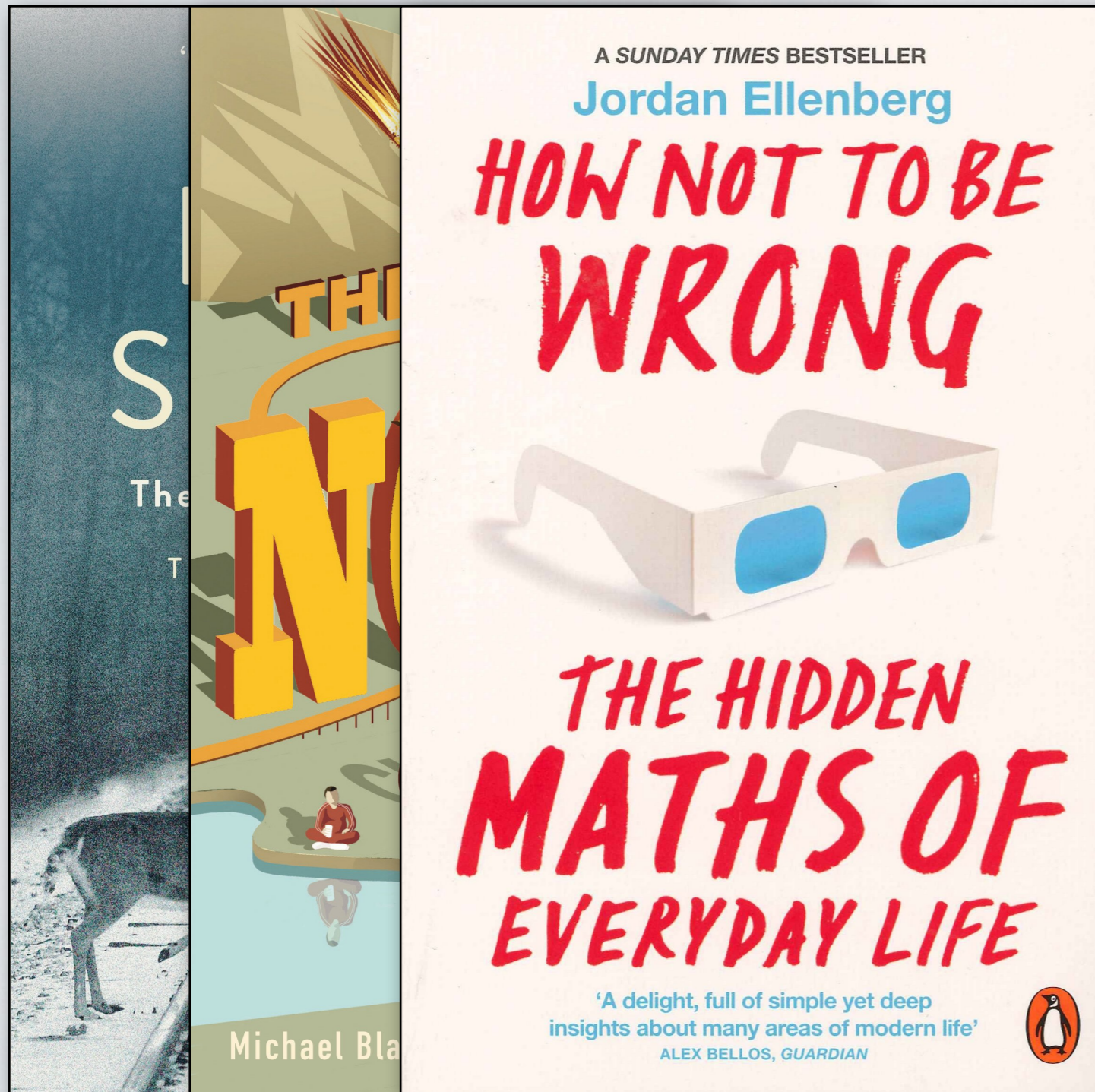
Many wonderful books



Many wonderful books



Many wonderful books



Many wonderful books



Many wonderful books



Many wonderful books



Many wonderful books



'A lifetime's worth of wisdom'
Steven D. Levitt, co-author of *Freakonomics*

The International
Bestseller

Thinking,
Fast and Slow



Daniel Kahneman
Winner of the Nobel Prize



I wish everybody would read
not for everyone to be a poet
but for no one to be a slave

Gianni Rodari - La grammatica della fantasia

I wish everybody would read
not for everyone to be a poet
but for no one to be a slave

Gianni Rodari - La grammatica della fantasia

the Truth will set you free

John's Gospel - 8,32

THANK YOU FOR YOUR ATTENTION!