FAKE NEWS AND SCIENCE

A SOCIAL AND EDUCATIONAL CHALLENGE

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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.

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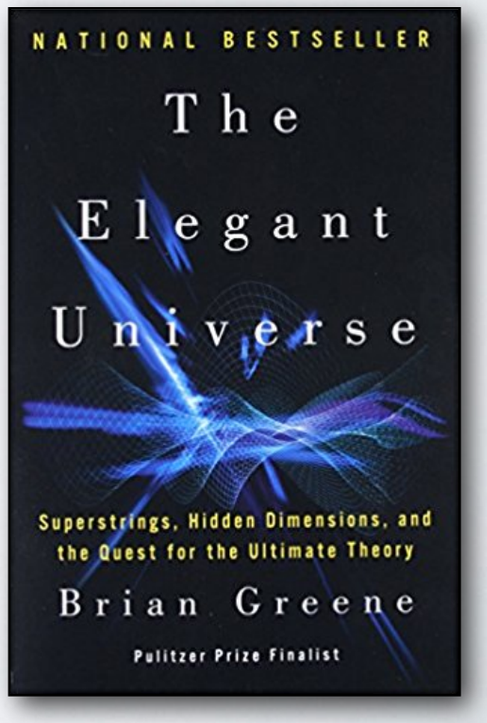

A paradox

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

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

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Election officials in Franklin County, Ohio are reportedly stumped over what one maintenance worker found in a dilapidated downtown Columbus warehouse earlier this week.

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Edgar Welch

Internet is filterless

- For every bias there is a confirmation

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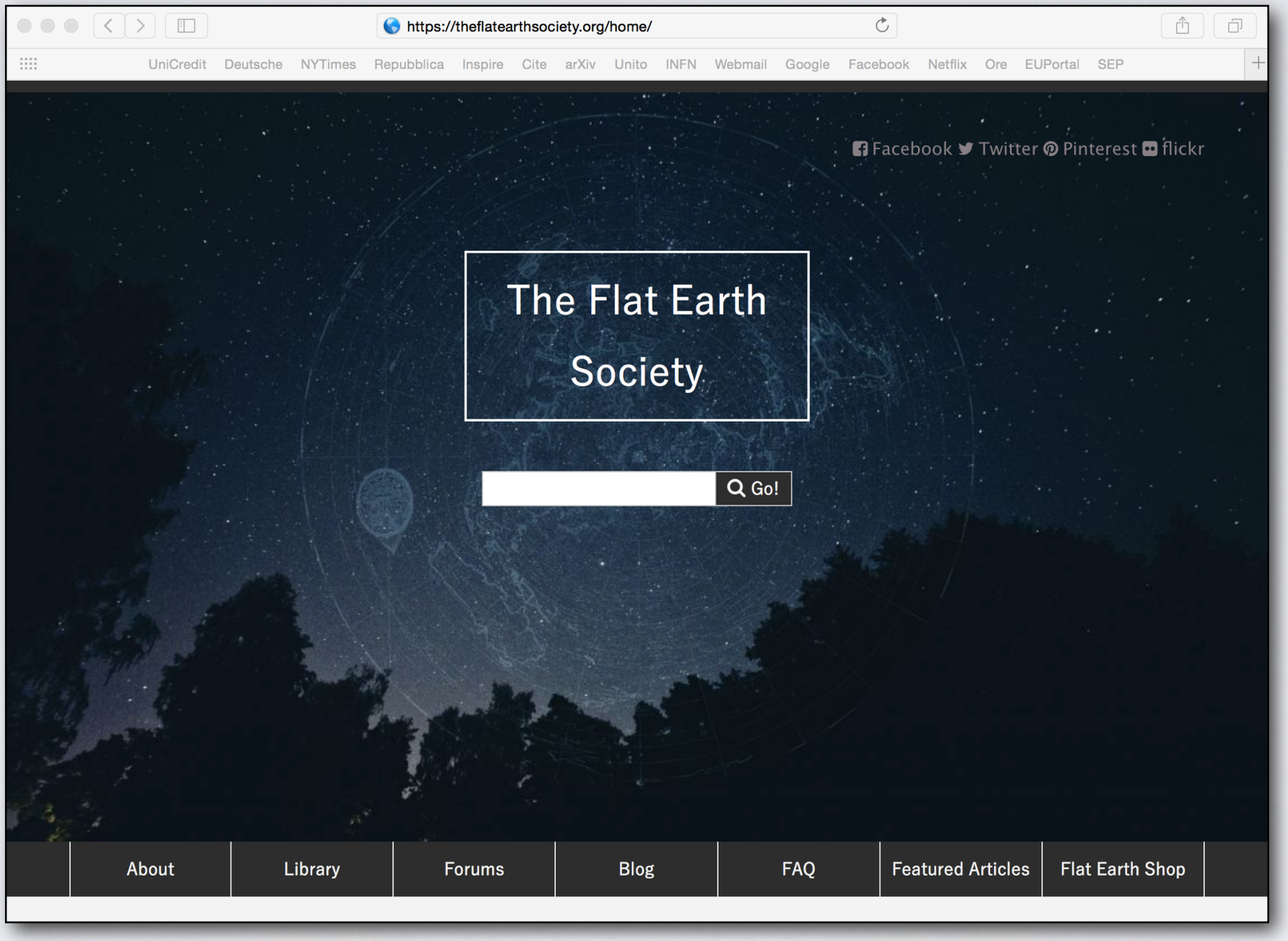

The web site of the Flat Earth Society

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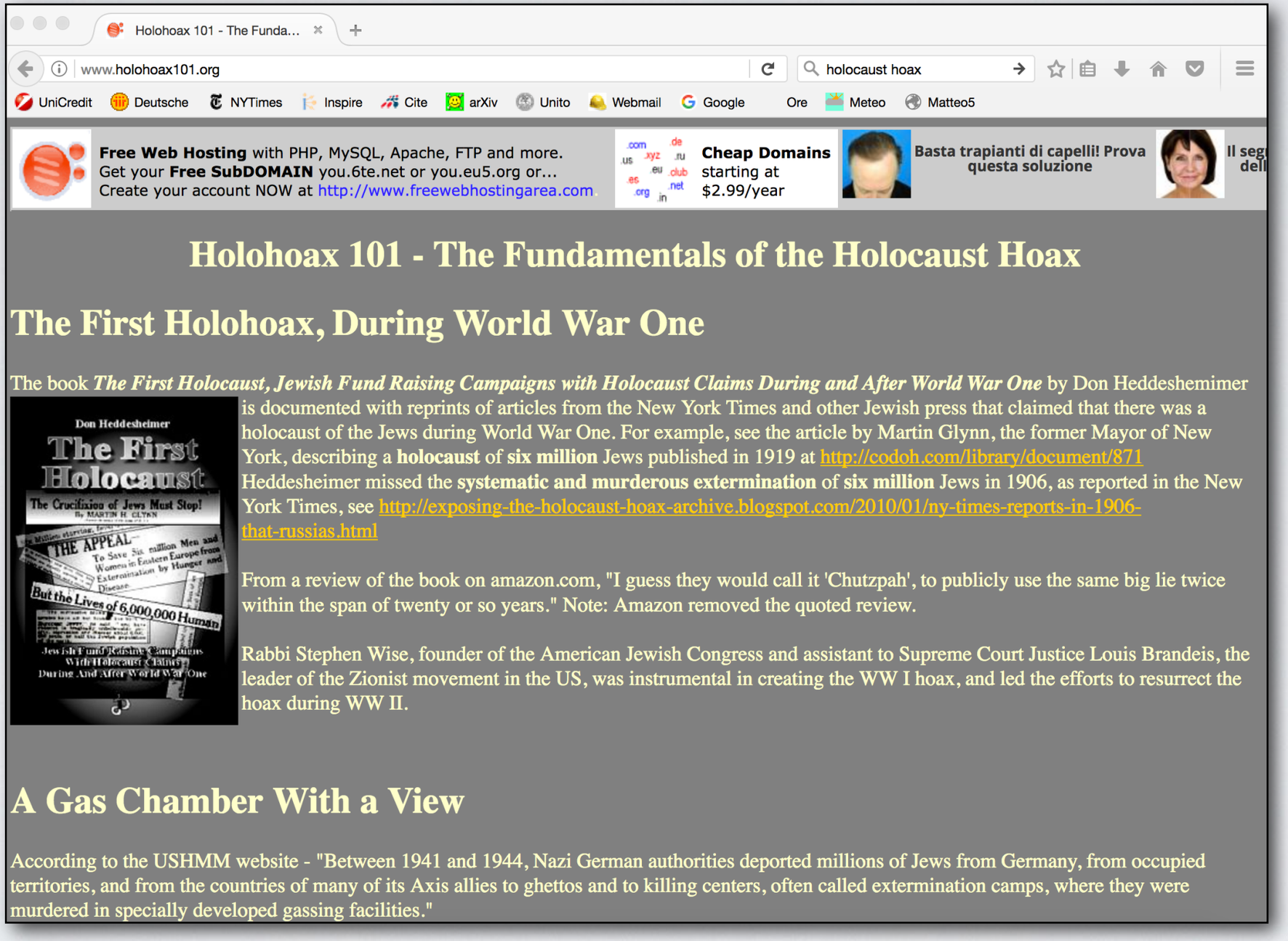

One of many web pages denying the Holocaust

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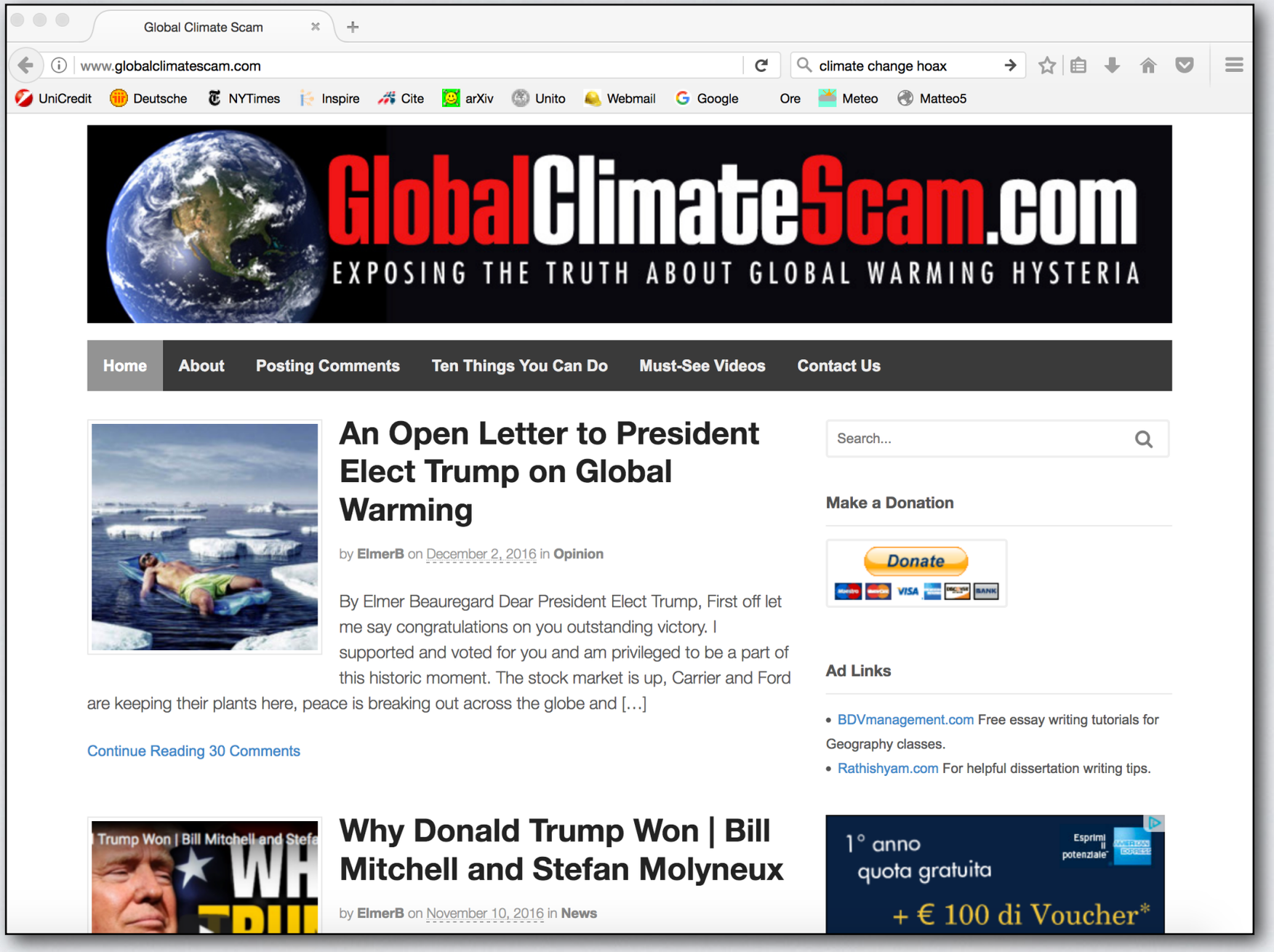


A web site denouncing the climate change `hoax'

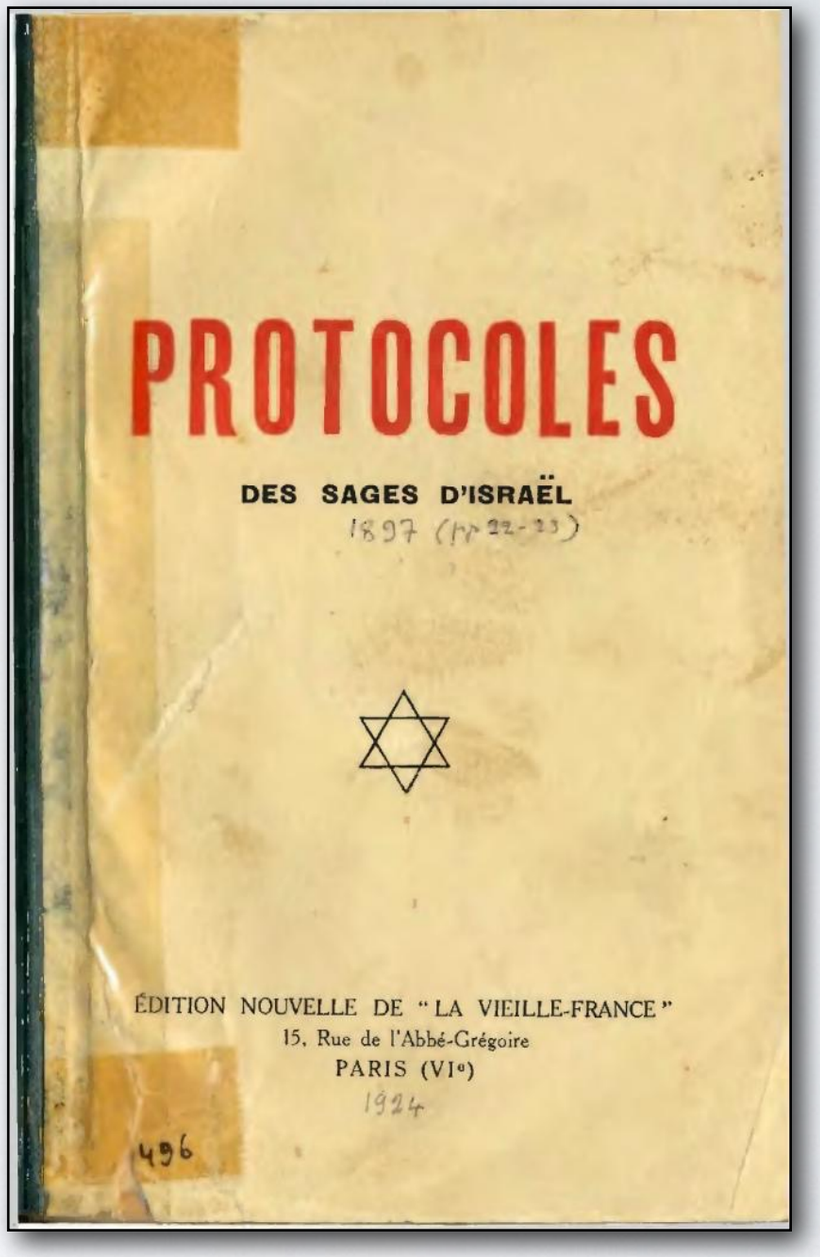
Fake News are no news

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 Bethroted", 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

`*disintermediation*'

- Depletion of authority
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- Confirmation bias

What has changed?

- Multiplication of sources

`disintermediation'

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

What has changed?

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

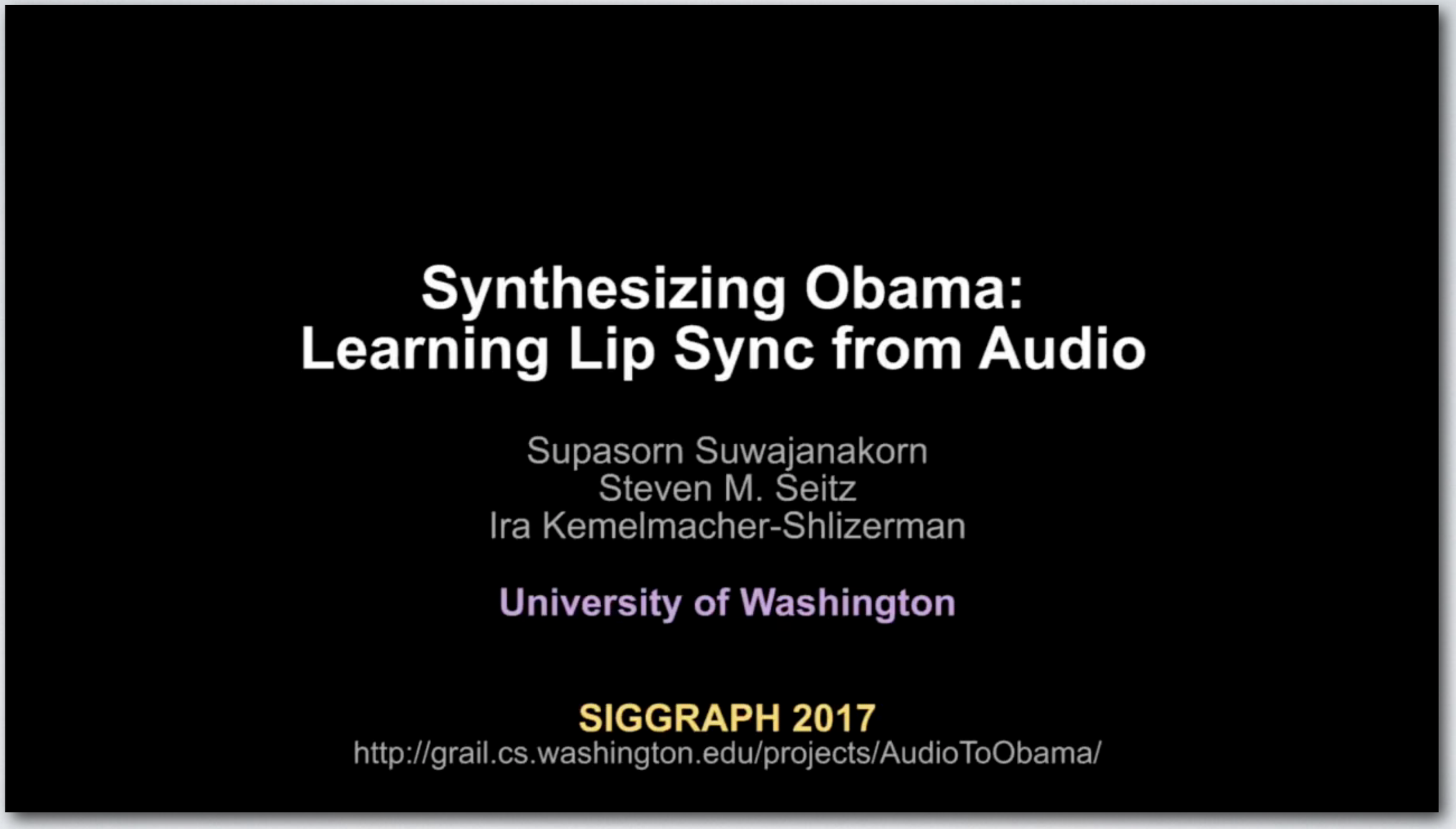
`disintermediation'

What's Next?

What's Next?

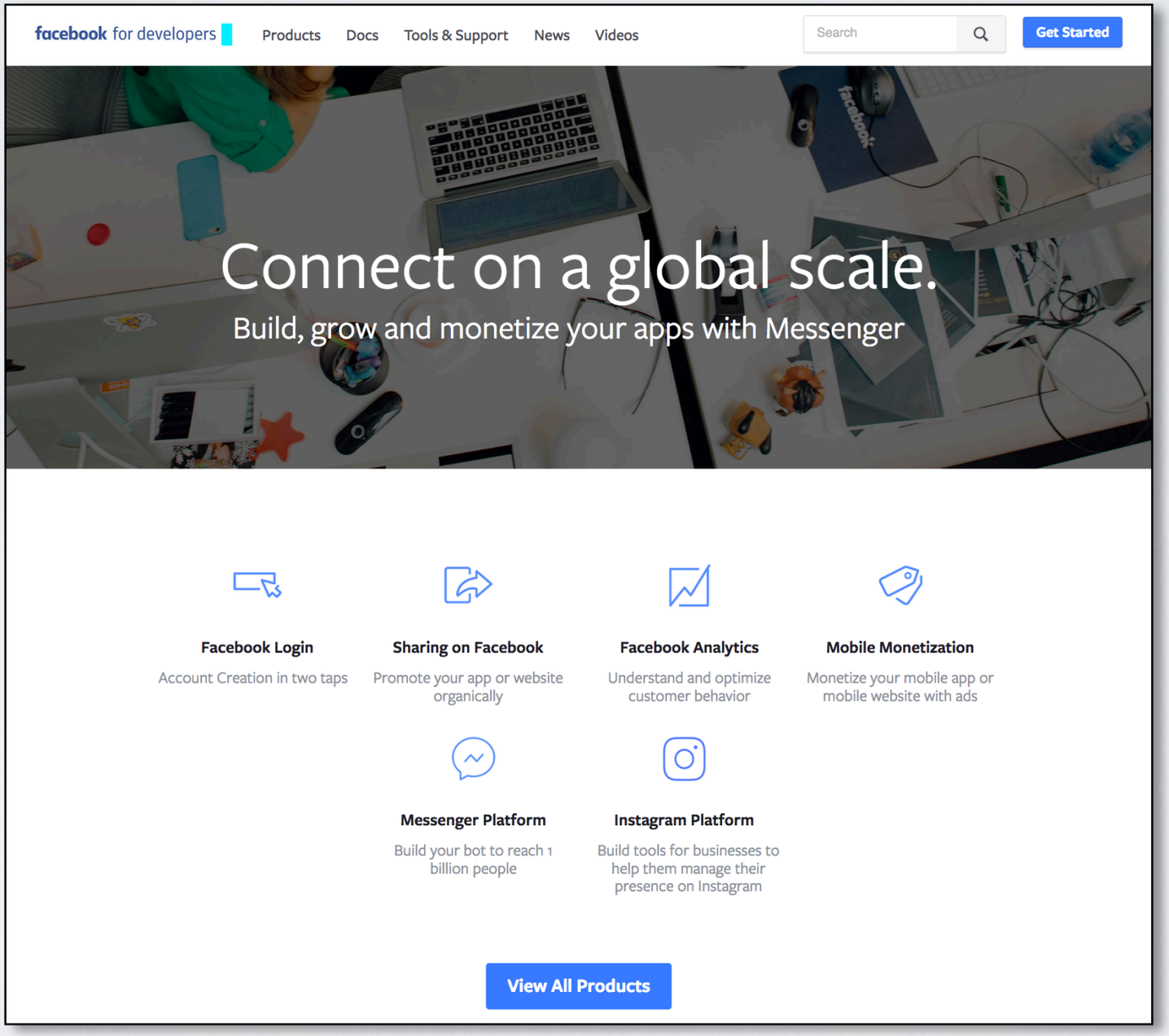
Daisy Ridley?

What's Next?



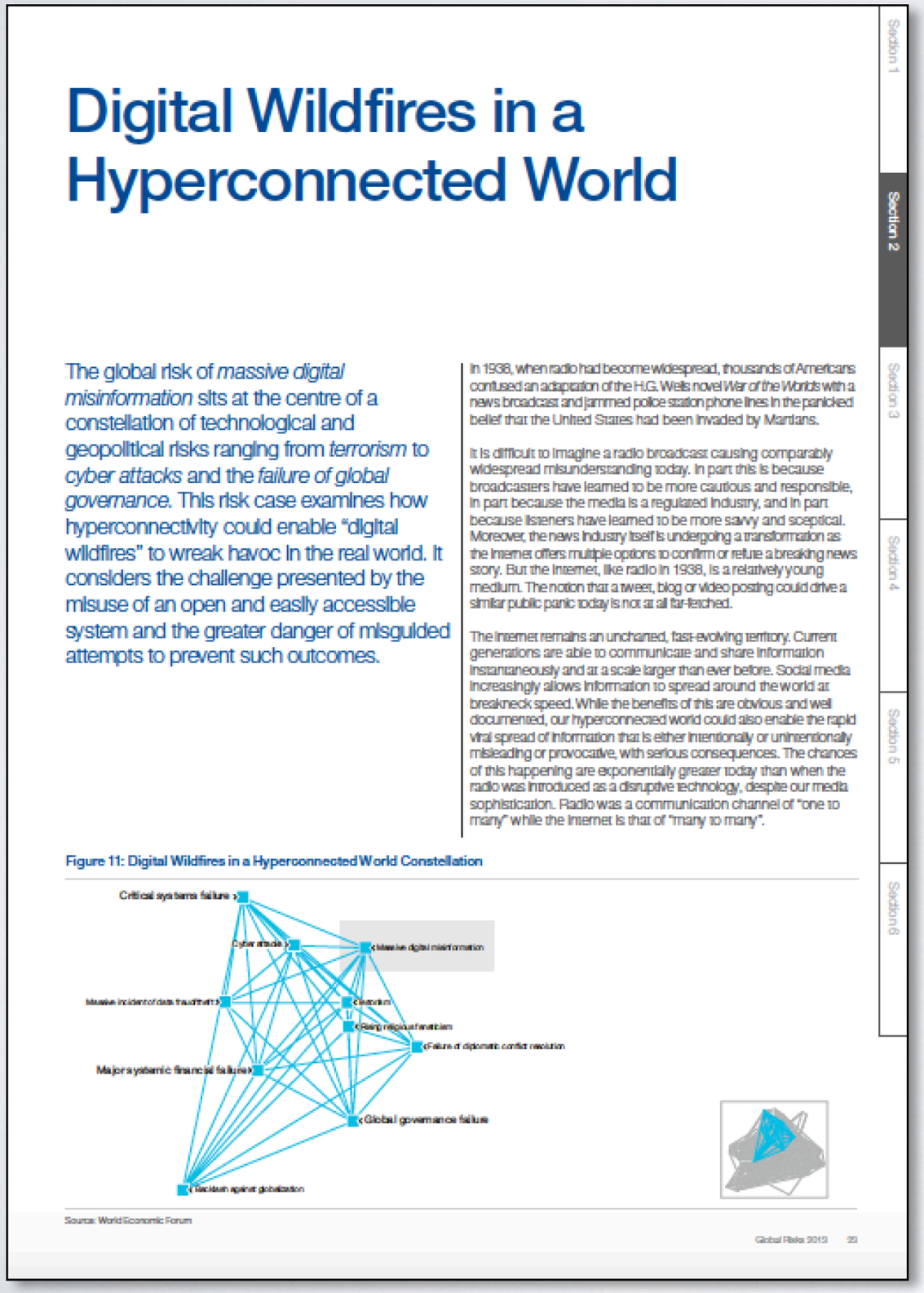
Barack Obama?

THE NEW SCIENCE OF (MIS)INFORMATION



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 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

- 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

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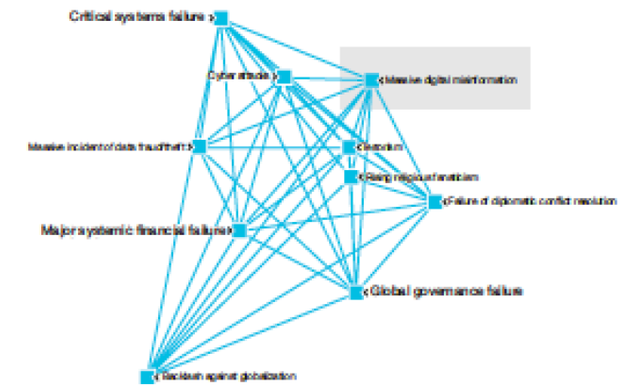

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Computational Sociology

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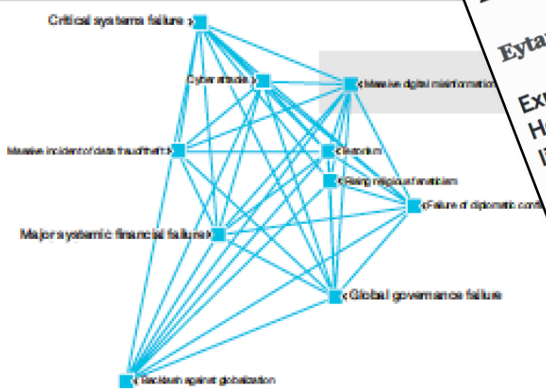


Source: World Economic Forum

Section 1 | Section 2 | Section 3

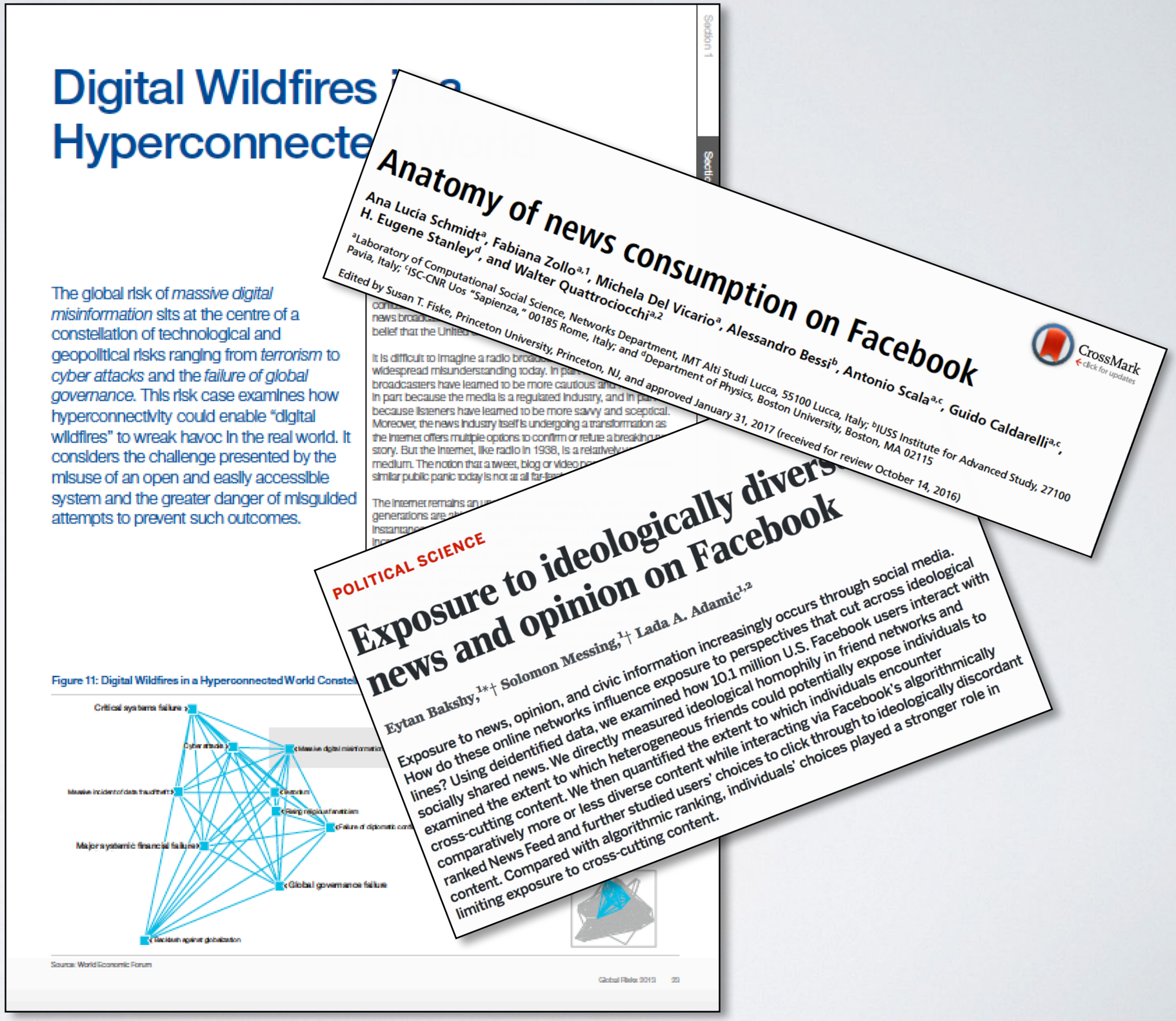
POLITICAL SCIENCE

Exposure to ideologically diverse news and opinion on Facebook

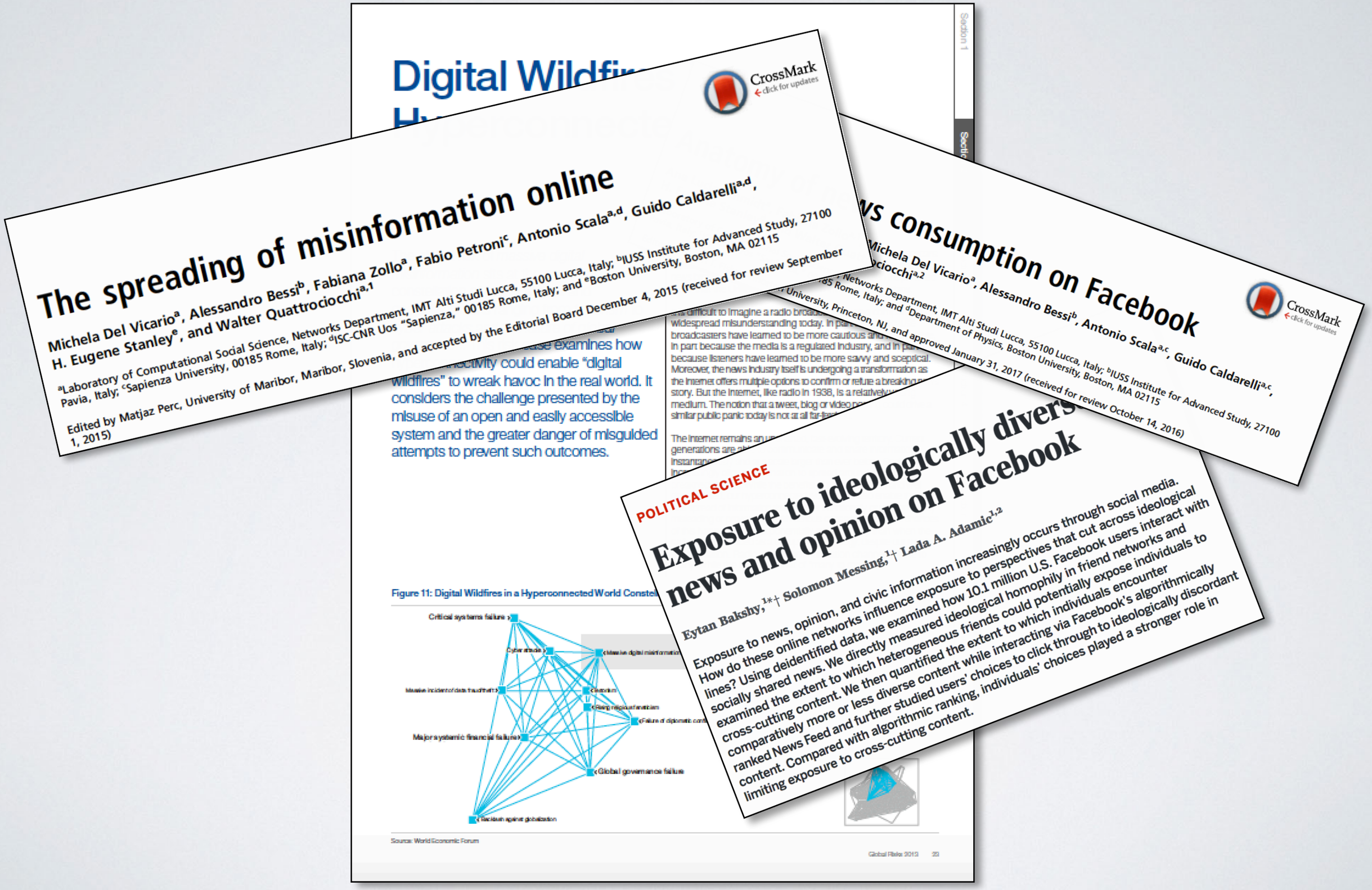
Eytan Bakshy,[1*†] Solomon Messing,[1†] Lada A. Adamic[1,2]

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 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.

Computational Sociology



Computational Sociology



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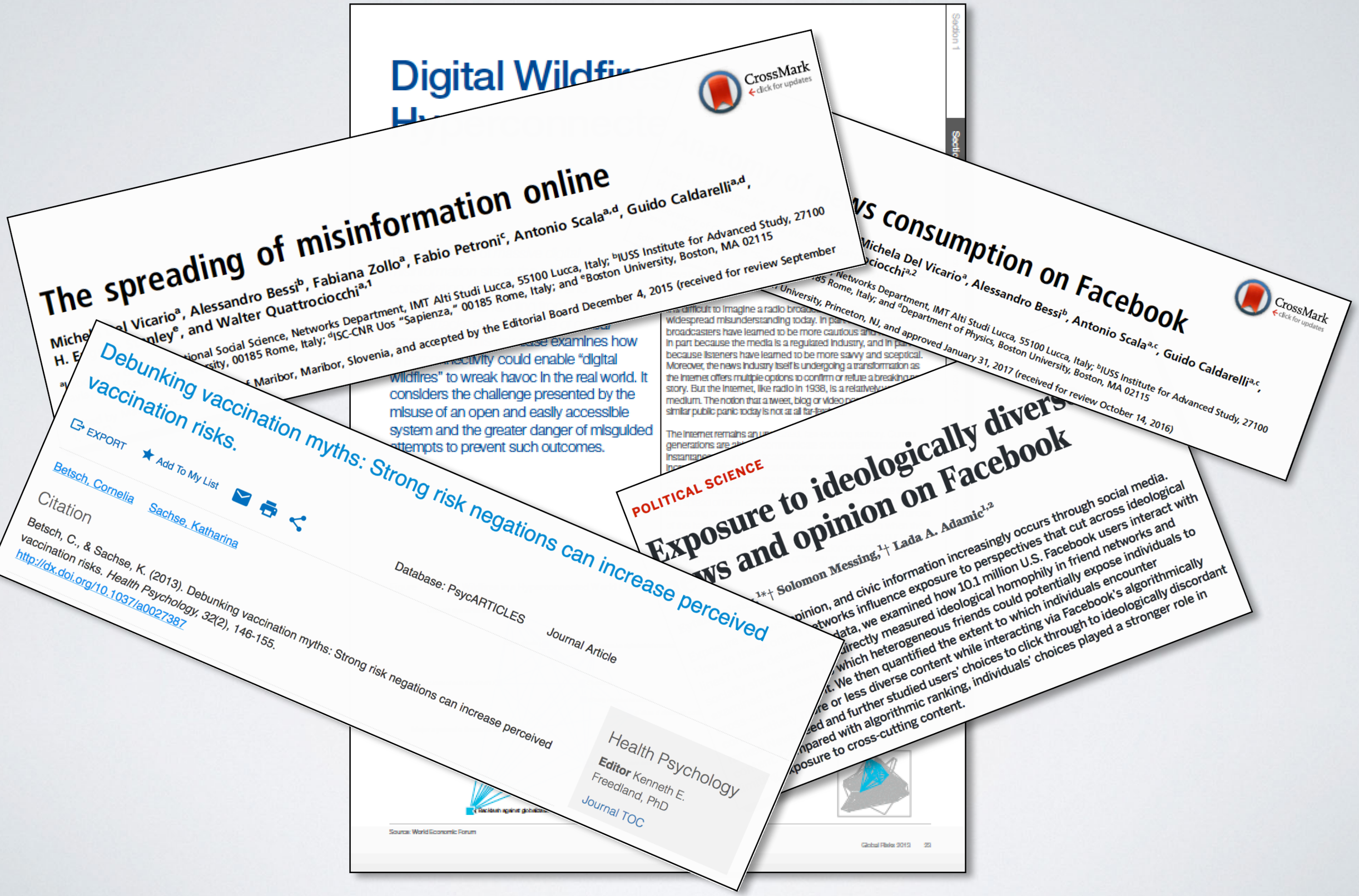
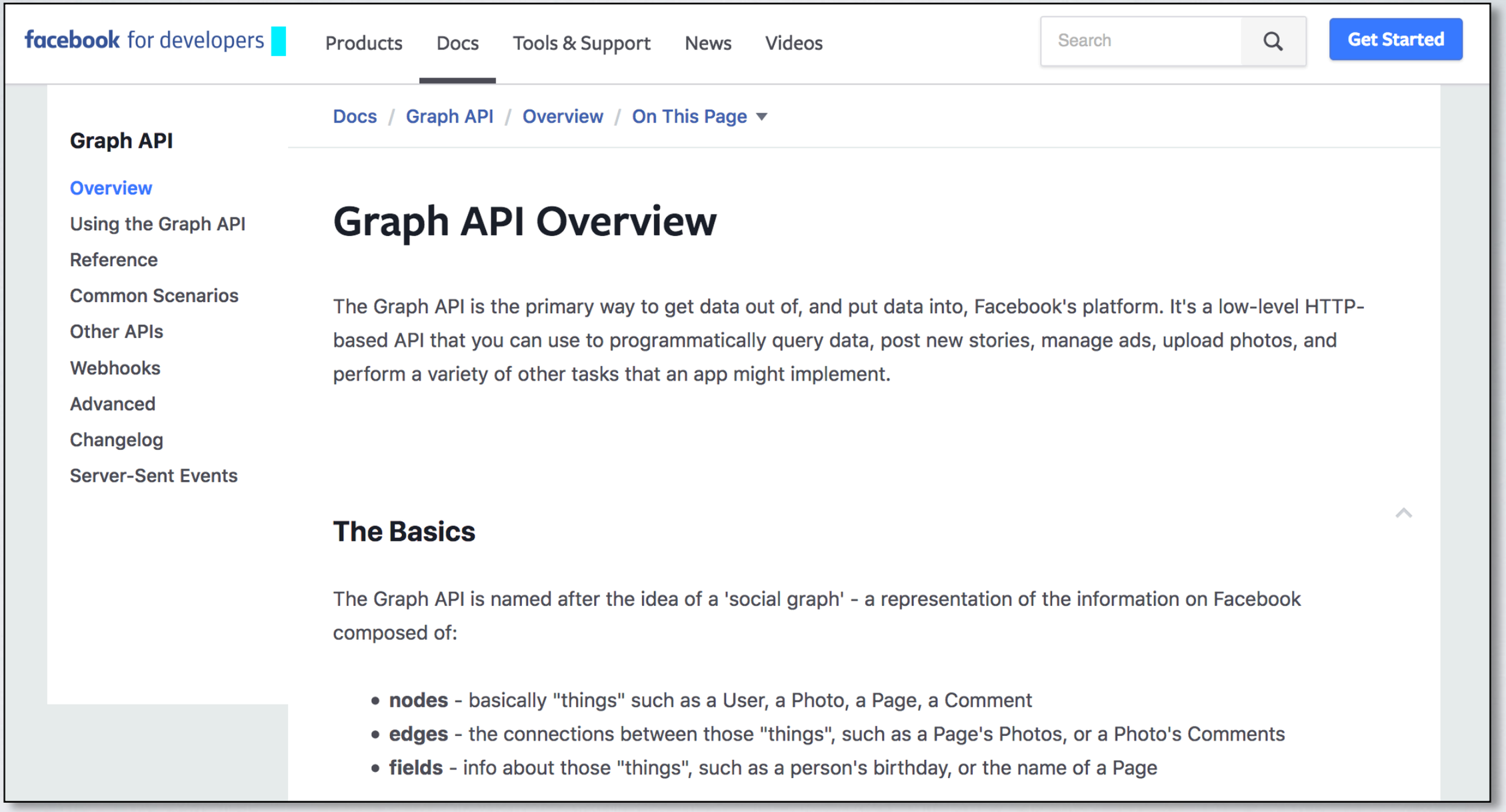


Big Data



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

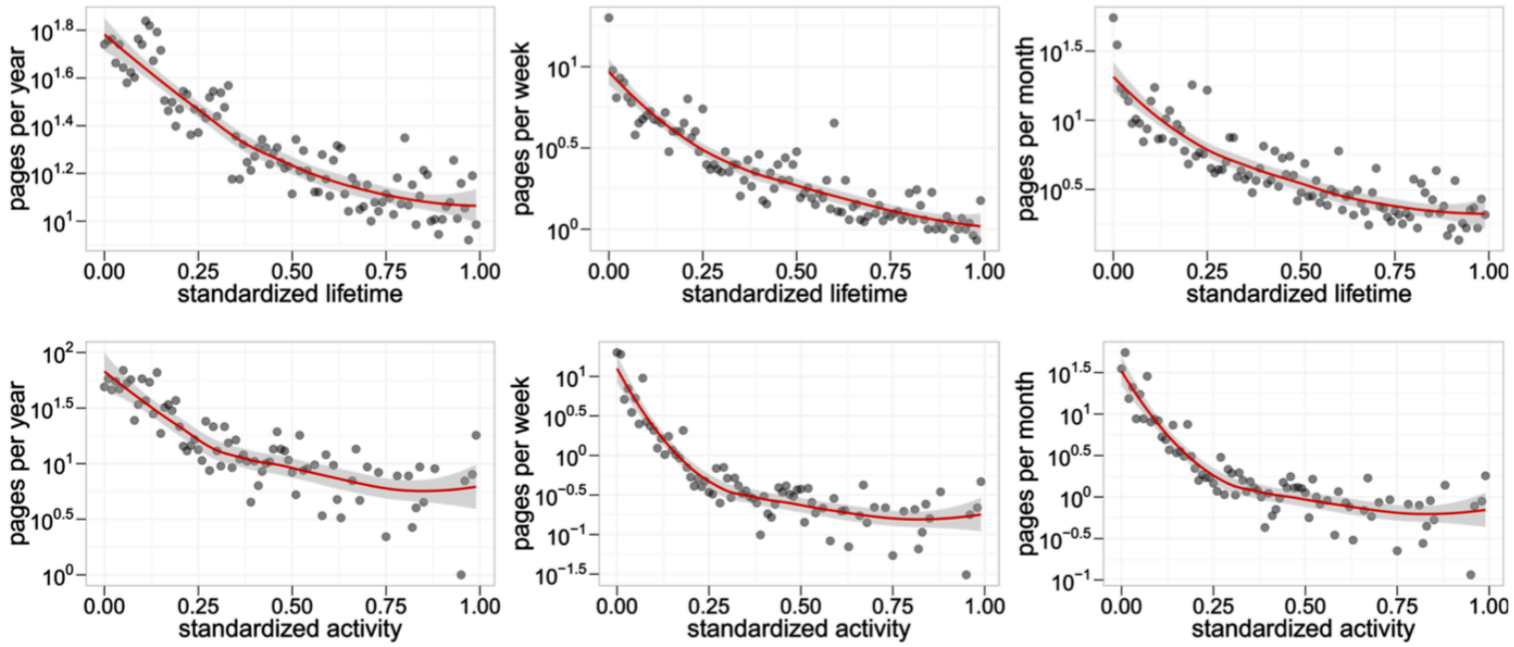


Fig. 1. Users' attention patterns. (*Top*) Maximum number of unique news sources that users with increasing levels of standardized lifetime interacted with monthly, weekly, and yearly. (*Bottom*) Maximum number of unique news outlets which users with increasing levels of standardized activity interacted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

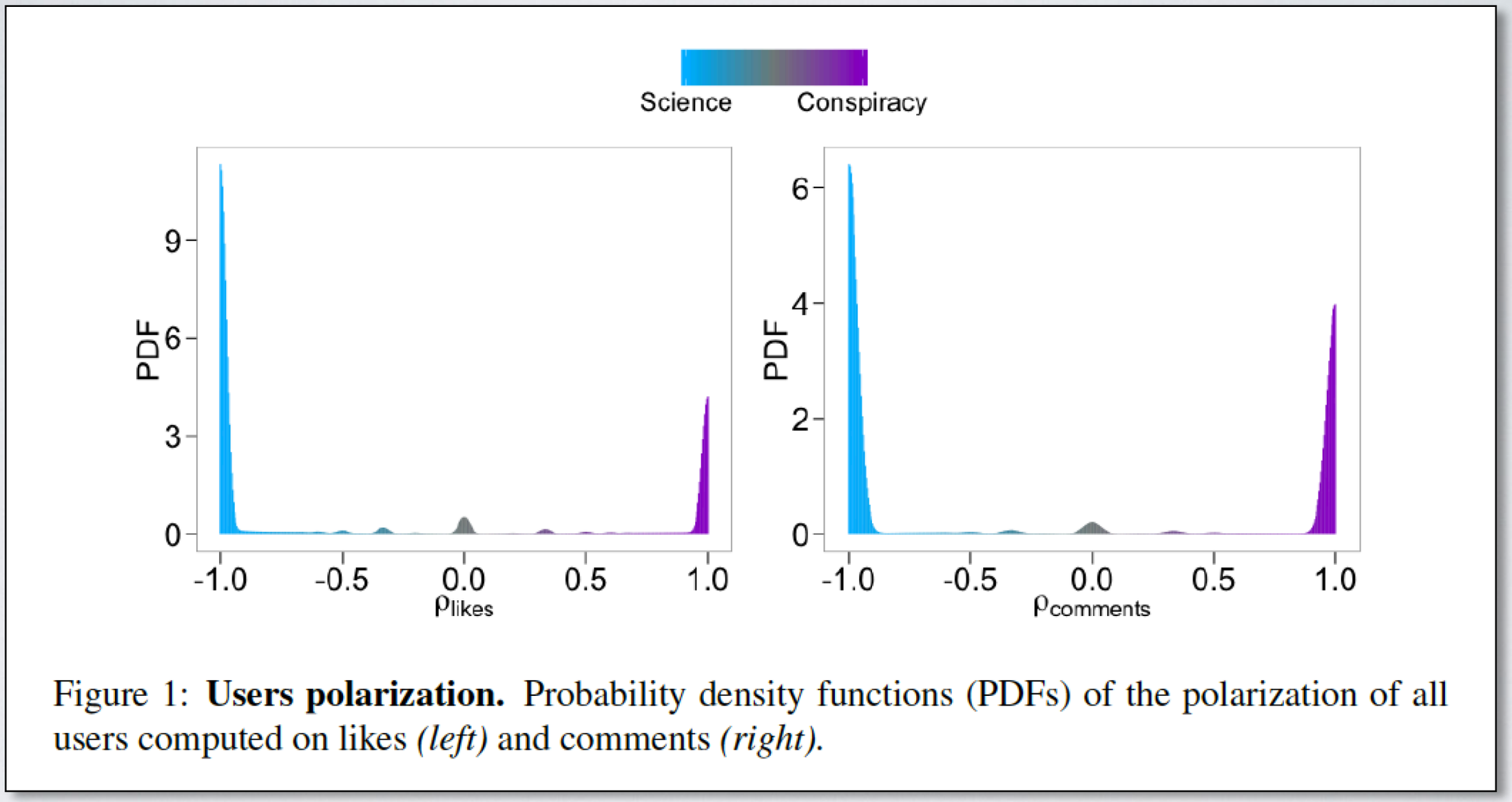


Figure 1: **Users polarization.** Probability density functions (PDFs) of the polarization of all users computed on likes *(left)* and comments *(right)*.

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)

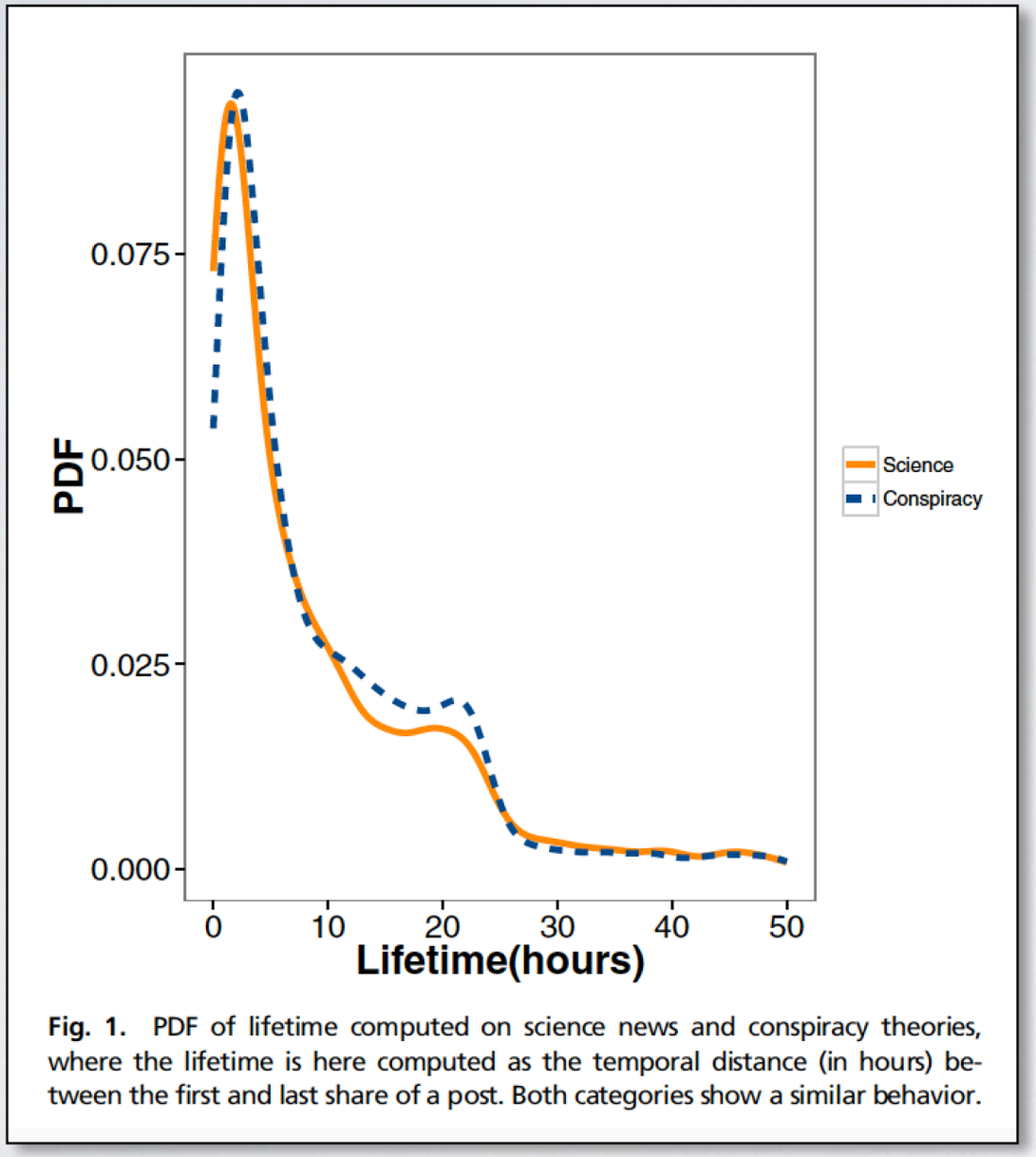


Fig. 1. PDF of lifetime computed on science news and conspiracy theories, where the lifetime is here computed as the temporal distance (in hours) between the first and last share of a post. Both categories show a similar behavior.

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

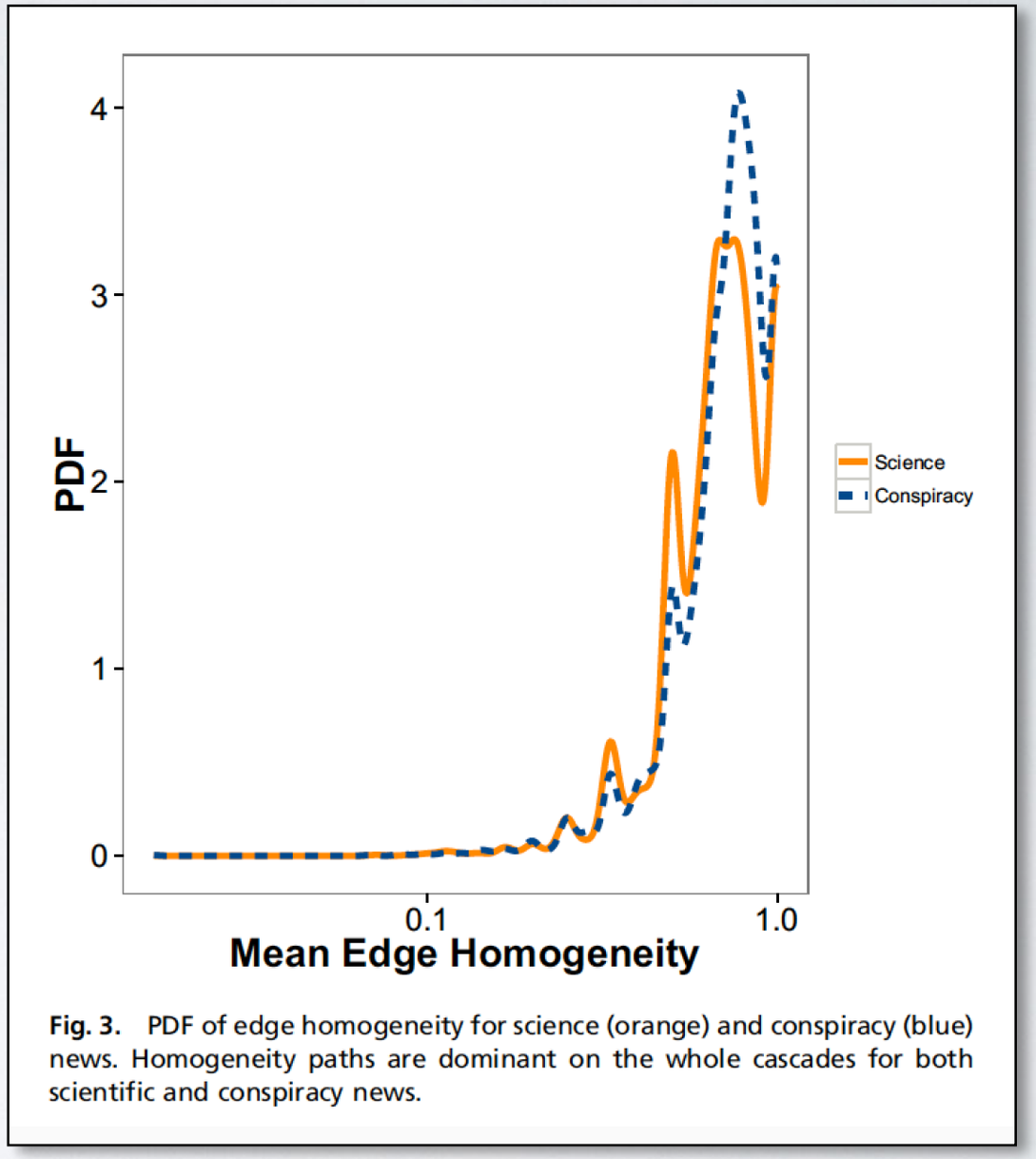


Fig. 3. PDF of edge homogeneity for science (orange) and conspiracy (blue) news. Homogeneity paths are dominant on the whole cascades for both scientific and conspiracy news.

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)

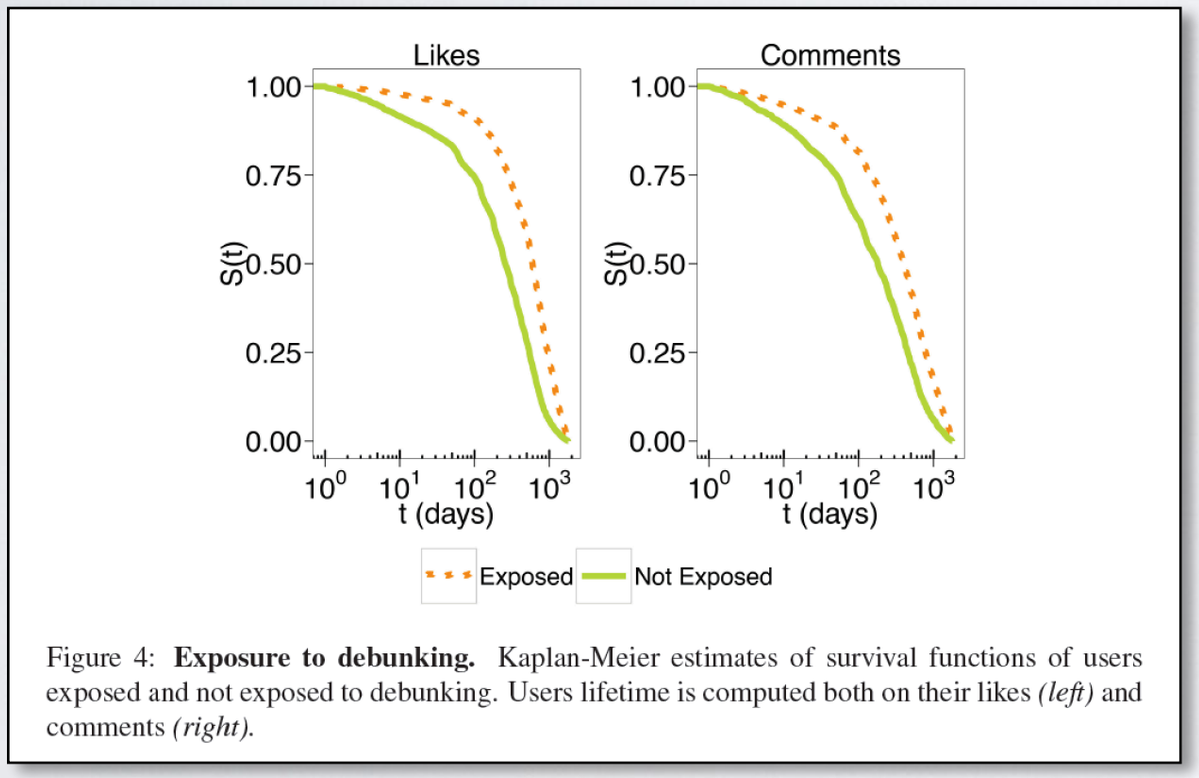


Figure 4: **Exposure to debunking.** Kaplan-Meier estimates of survival functions of users exposed and not exposed to debunking. Users lifetime is computed both on their likes *(left)* and comments *(right)*.

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

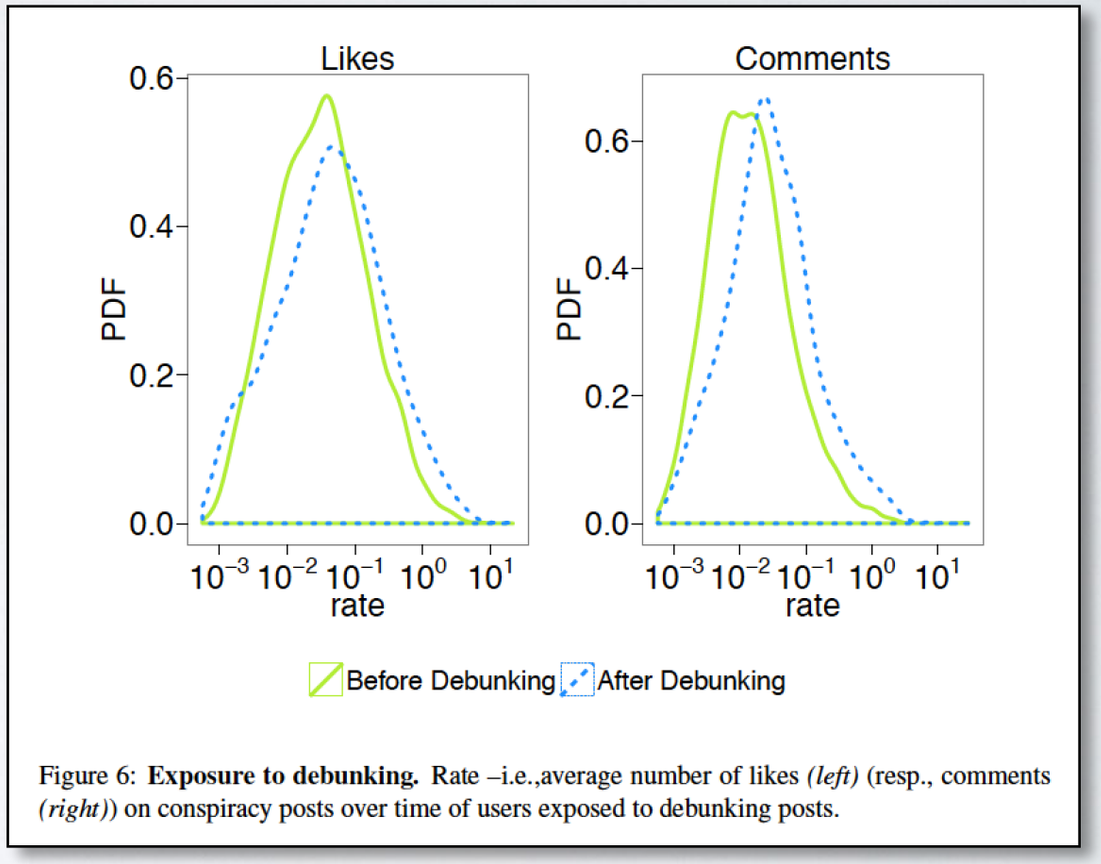
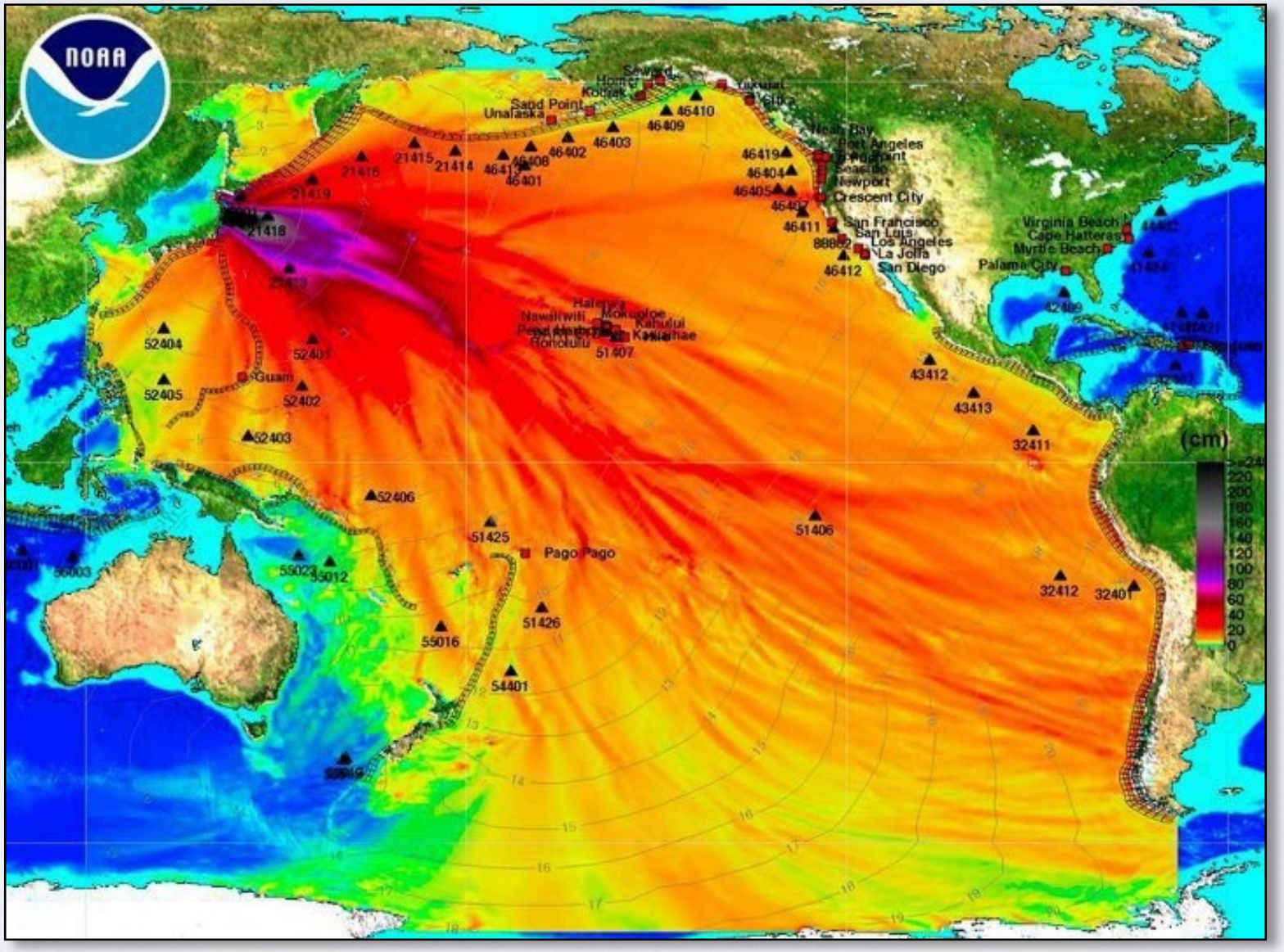


Figure 6: **Exposure to debunking.** Rate –i.e.,average number of likes *(left)* (resp., comments *(right)*) on conspiracy posts over time of users exposed to debunking posts.

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

Big Pharma

Pollution

Science and the City

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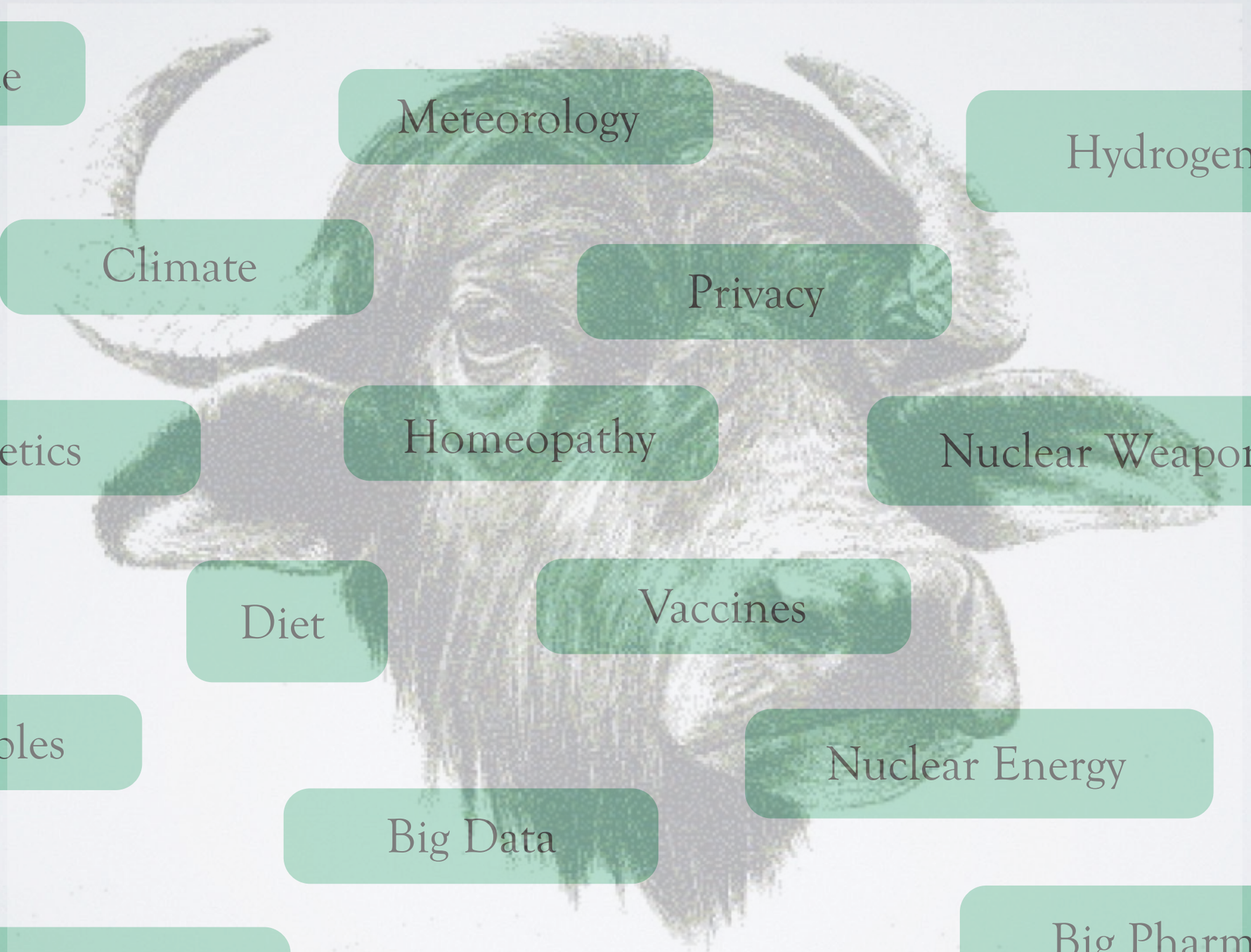

Solutions?

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**
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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?

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Solutions?

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- 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**

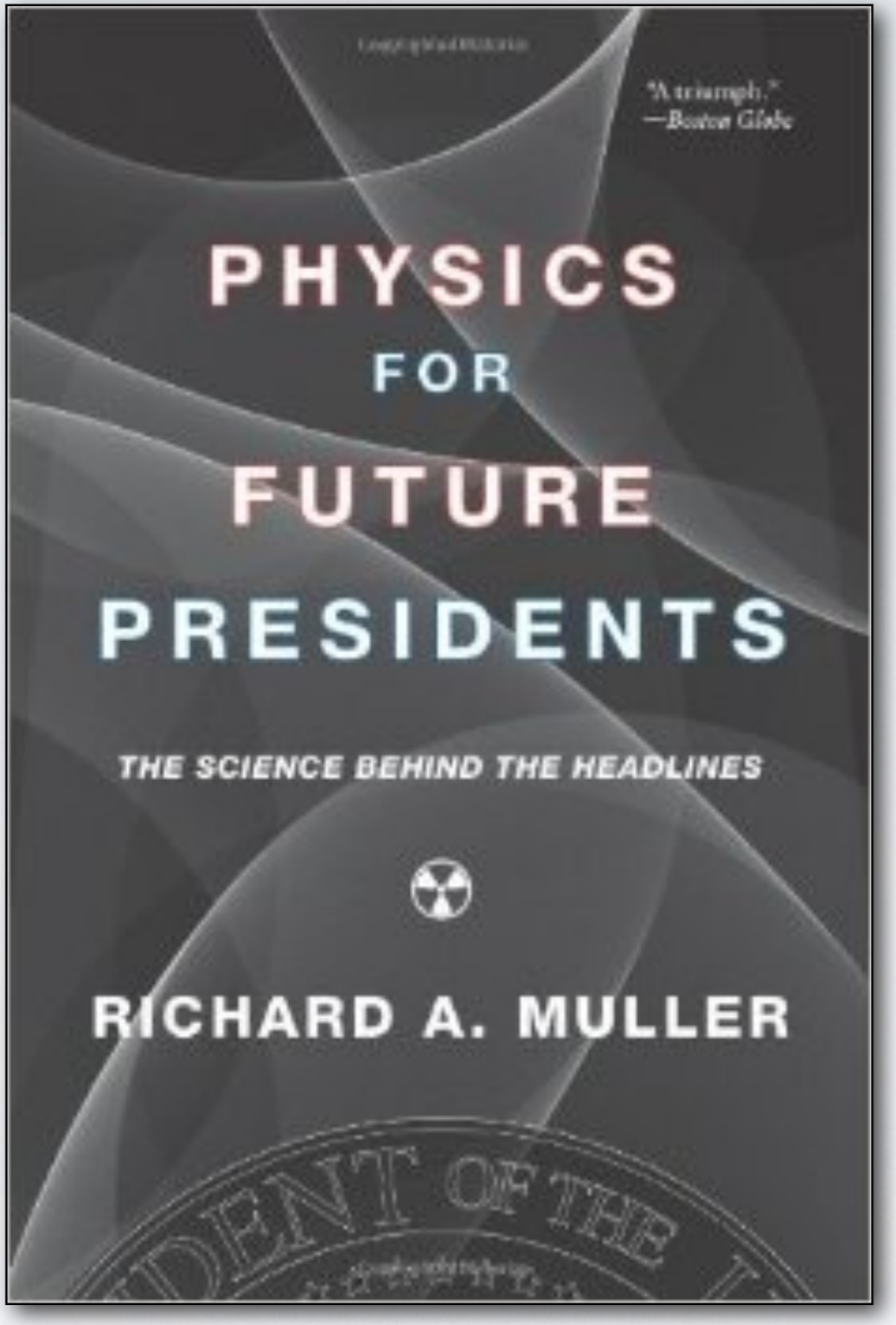
- Disseminate basic science knowledge. **Yes!**
- Provide tools and methods for fact checking. **Yes!**
- Promote ethical usage of information. **Yes!**

Solutions?

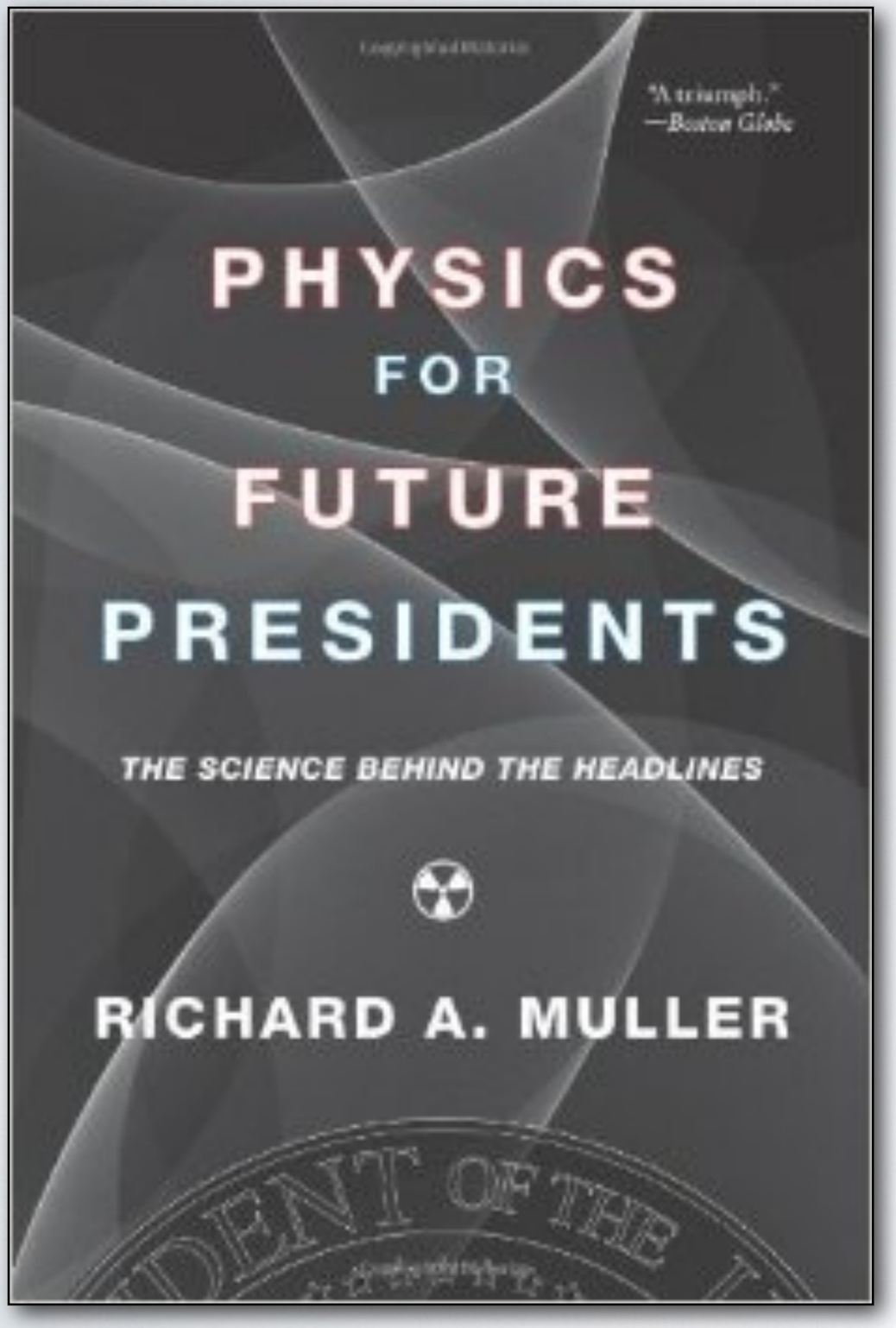
- Let's all become scientists! …. **NO**
- Let's have a government of scientists! …. **NO**
- Let's delegate technical decisions to scientists! …. **NO**
- Disseminate basic science knowledge. **Yes!**
- Provide tools and methods for fact checking. **Yes!**
- Promote ethical usage of information. **Yes!**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

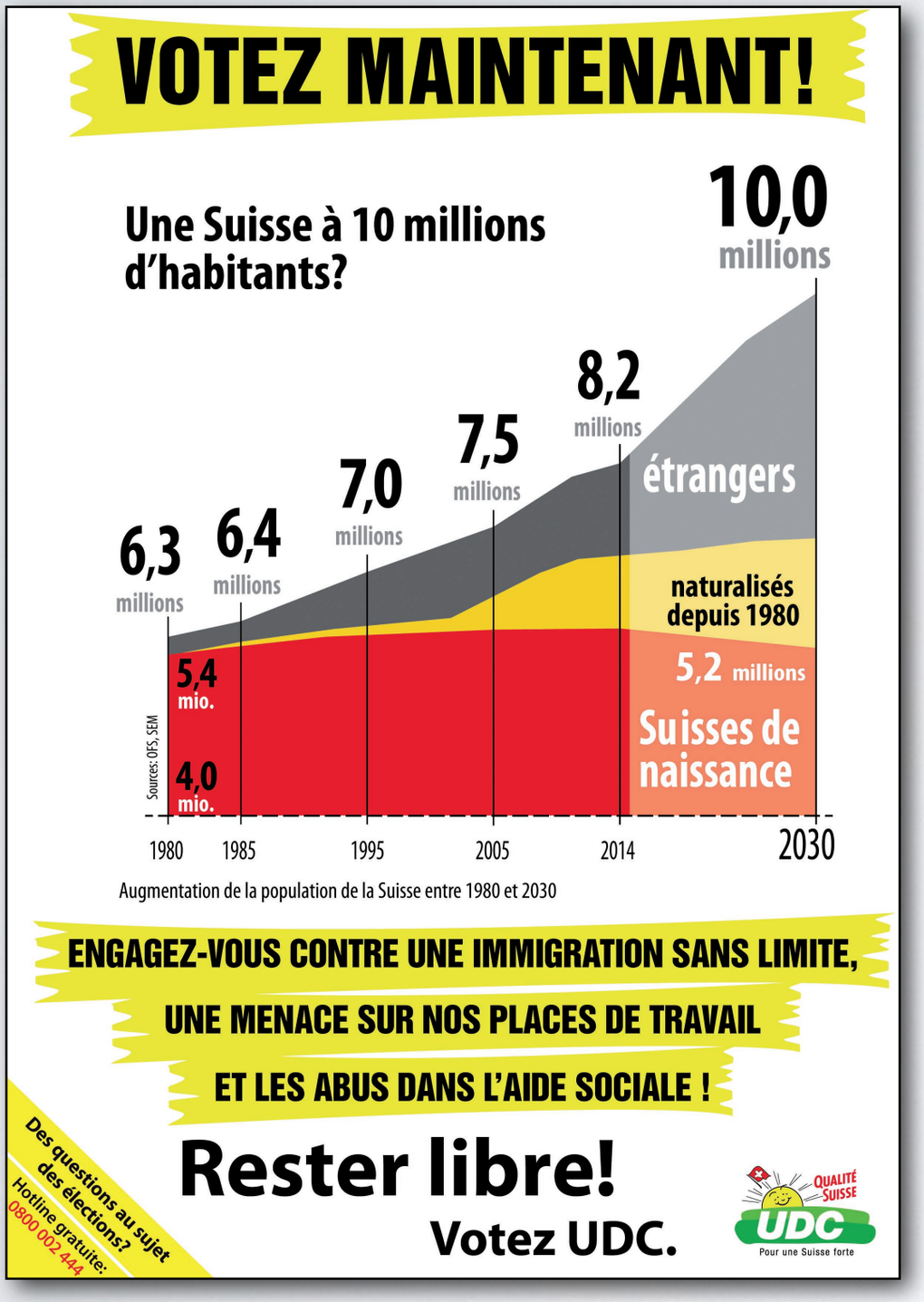
Lotteries, exit polls, correlations and other sins

Orders of Magnitude

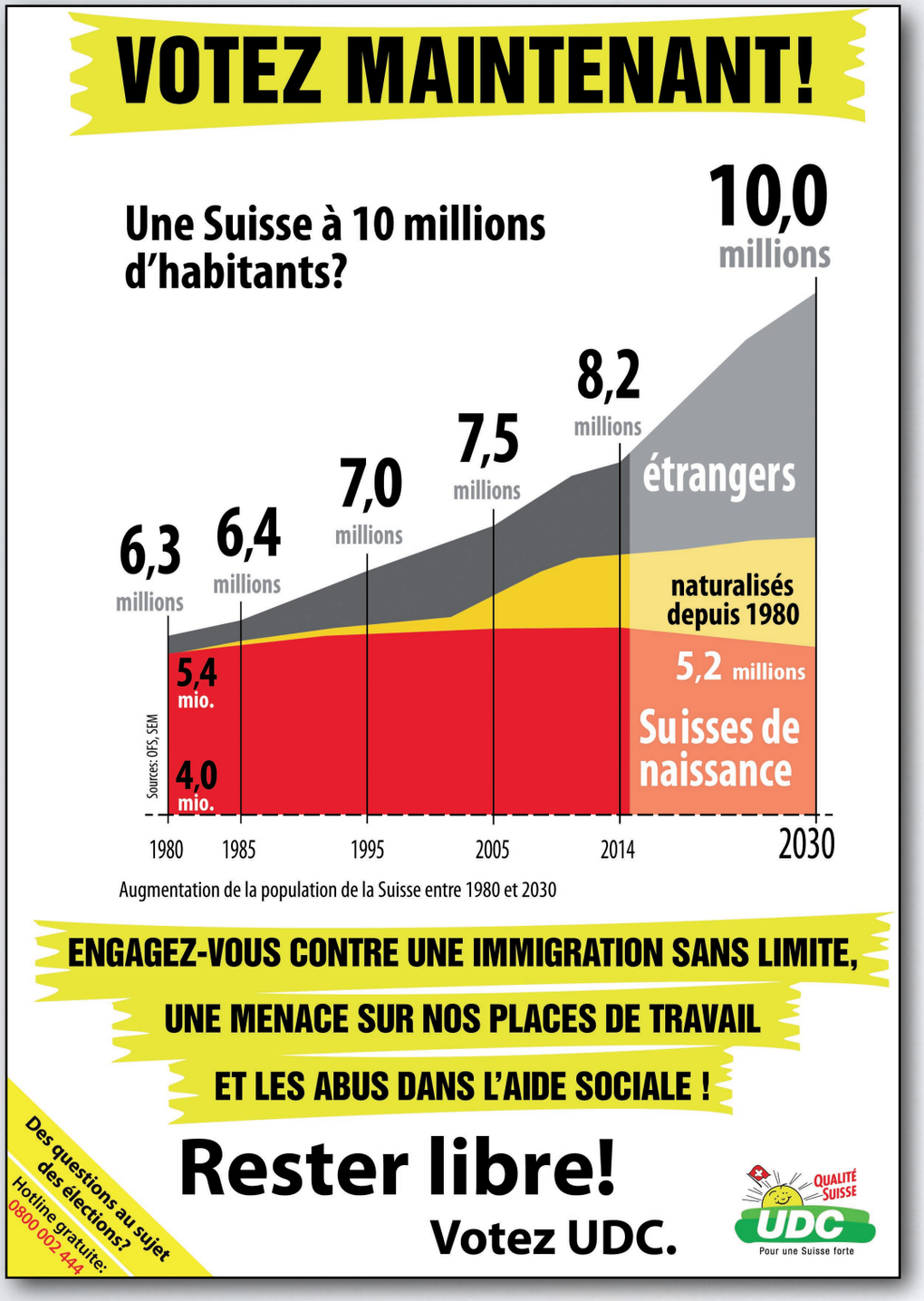
The ability to estimate orders of magnitude its important at the movies and in life

Manipulating graphs

Manipulating graphs

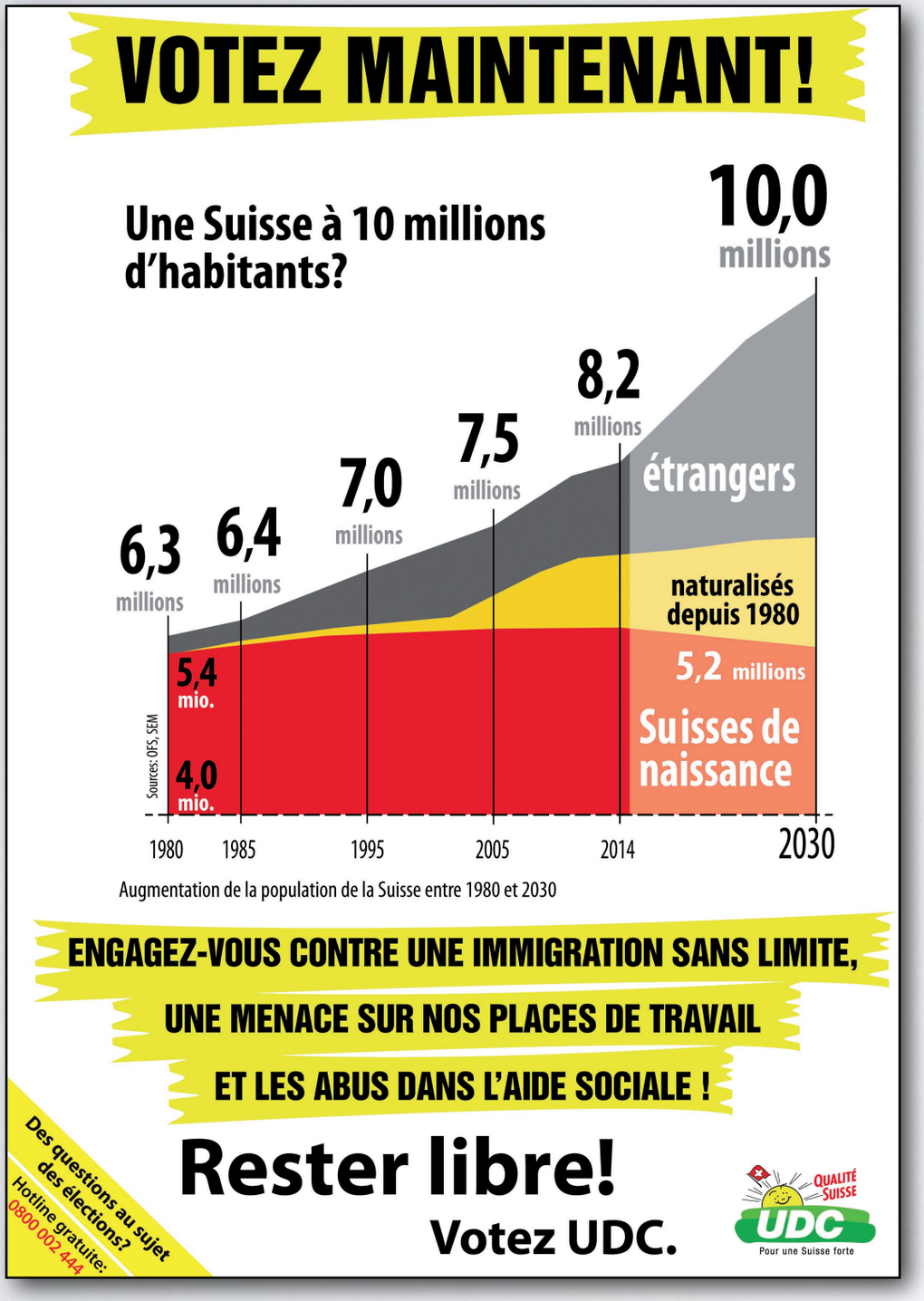


Manipulating graphs



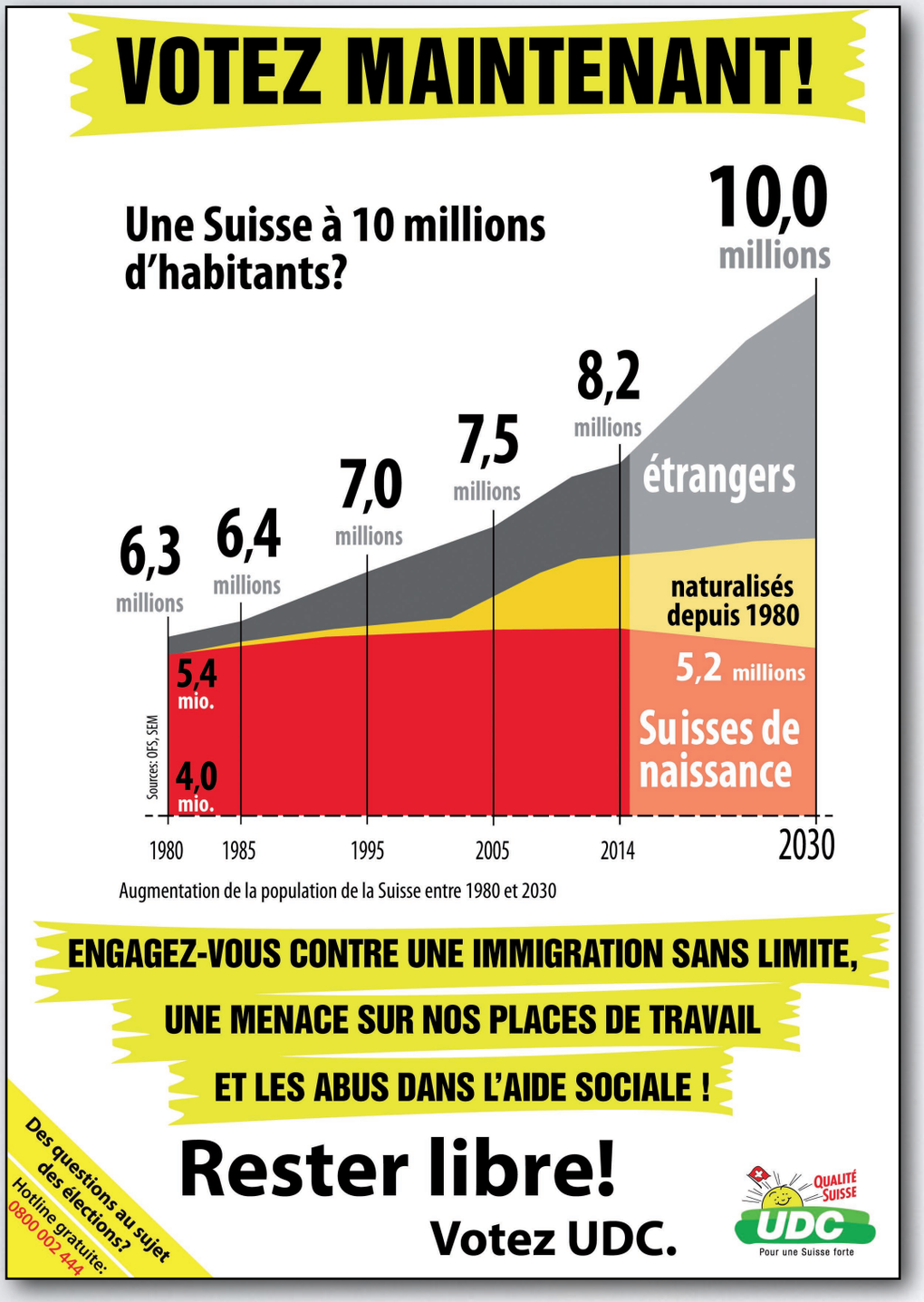
- What's wrong with this graph?

Manipulating graphs



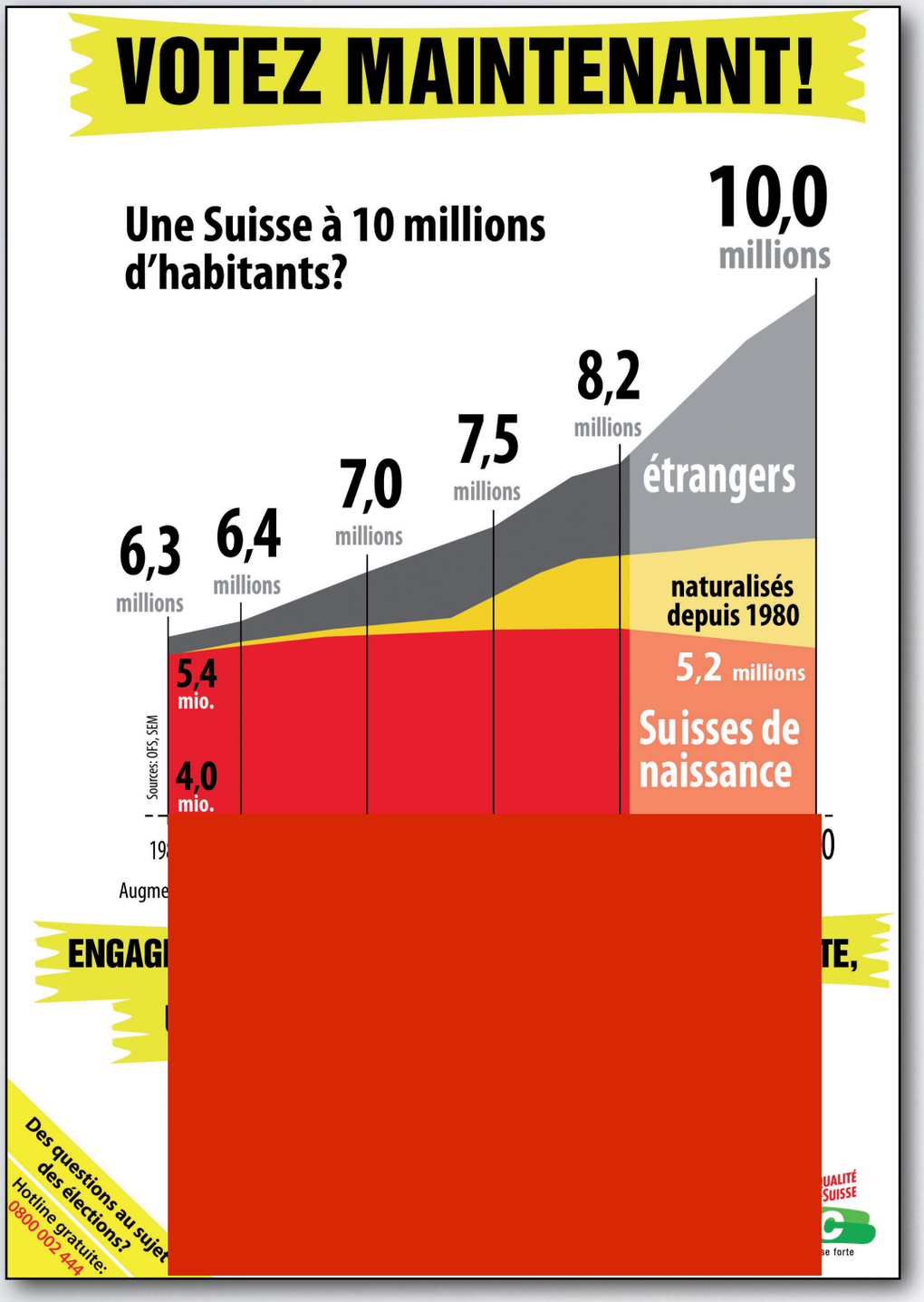
- What's wrong with this graph?
- Proportions are not respected

Manipulating graphs



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

Manipulating graphs



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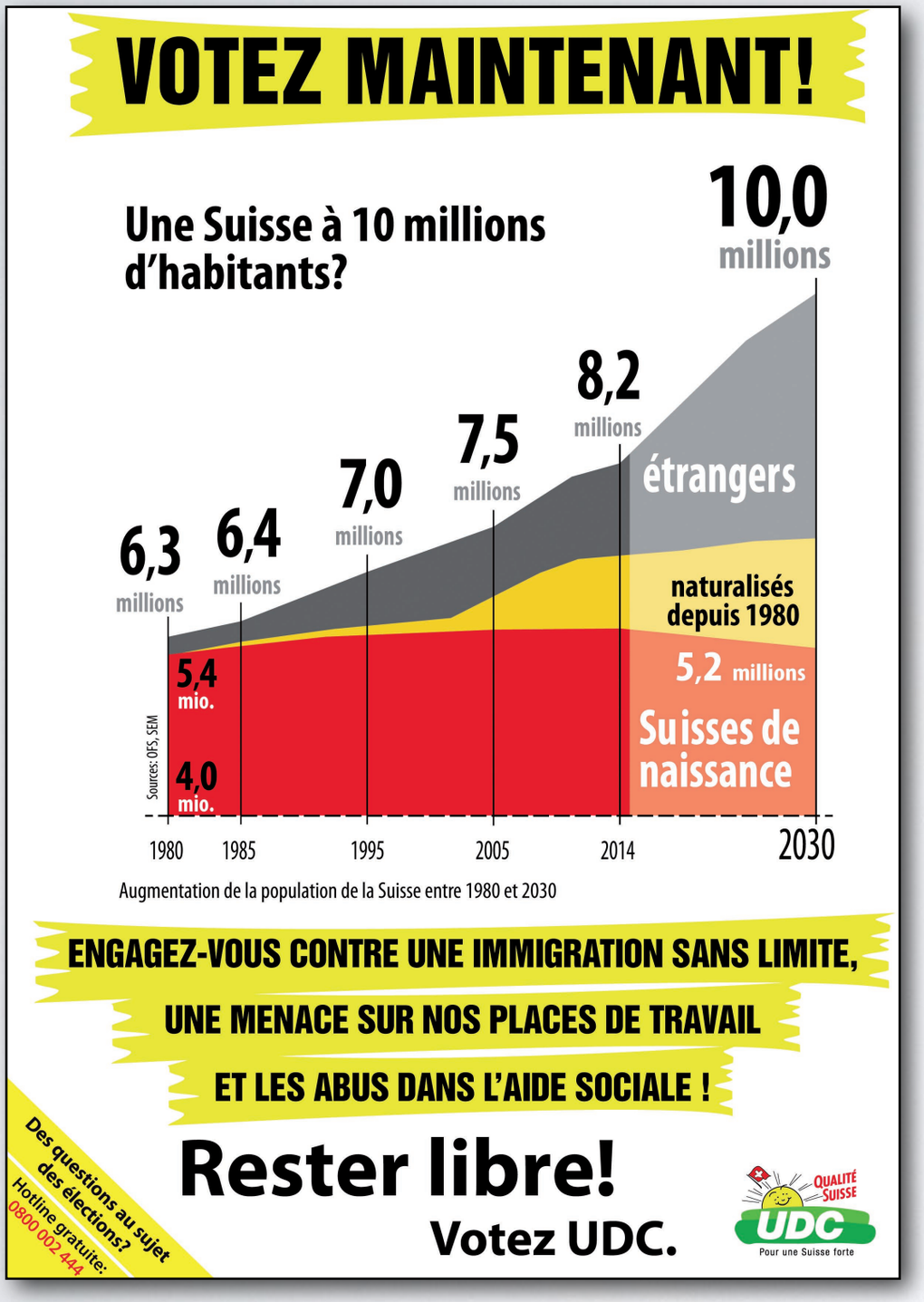
Manipulating graphs



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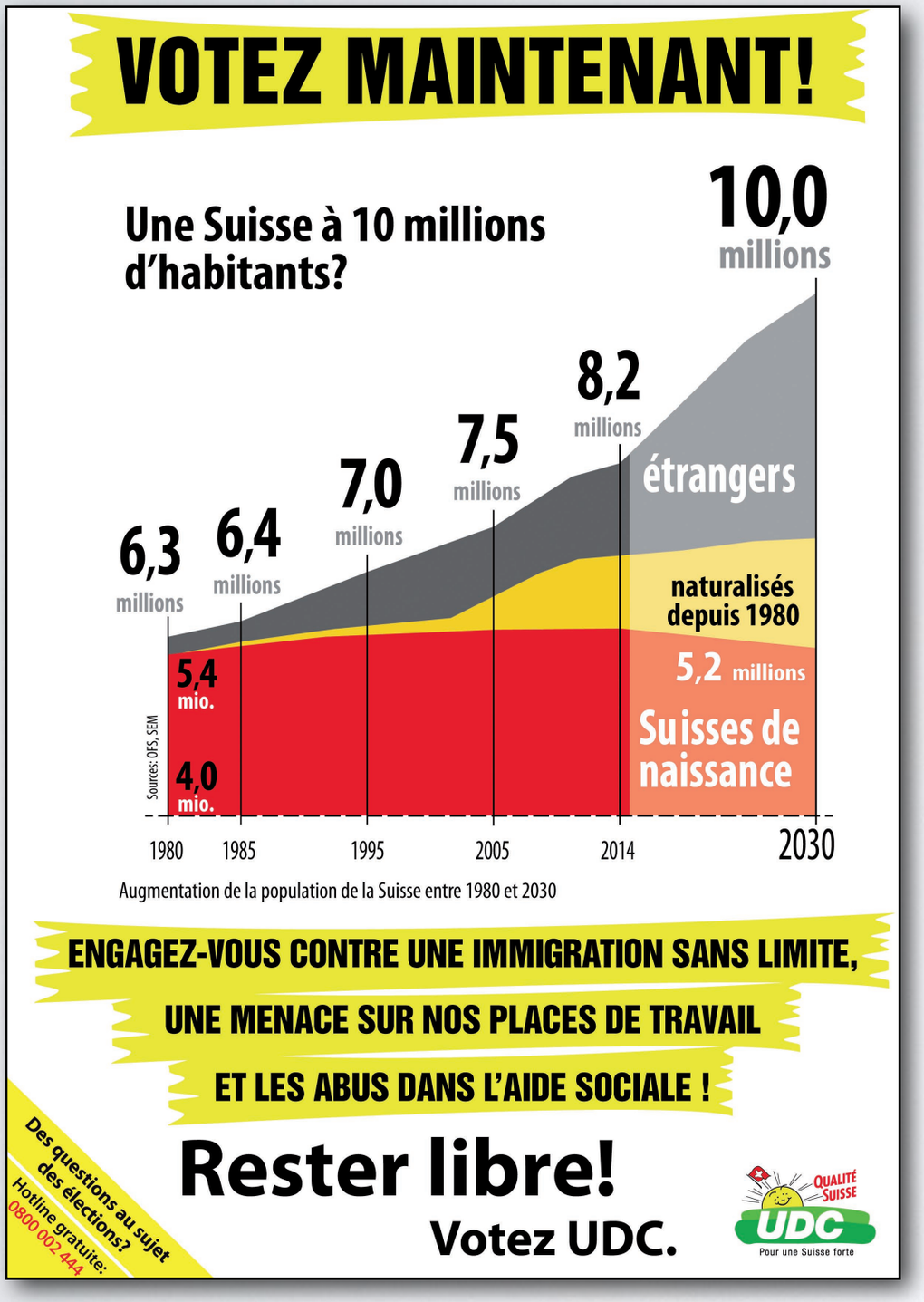
- Graph = Scientific Authority

Manipulating graphs



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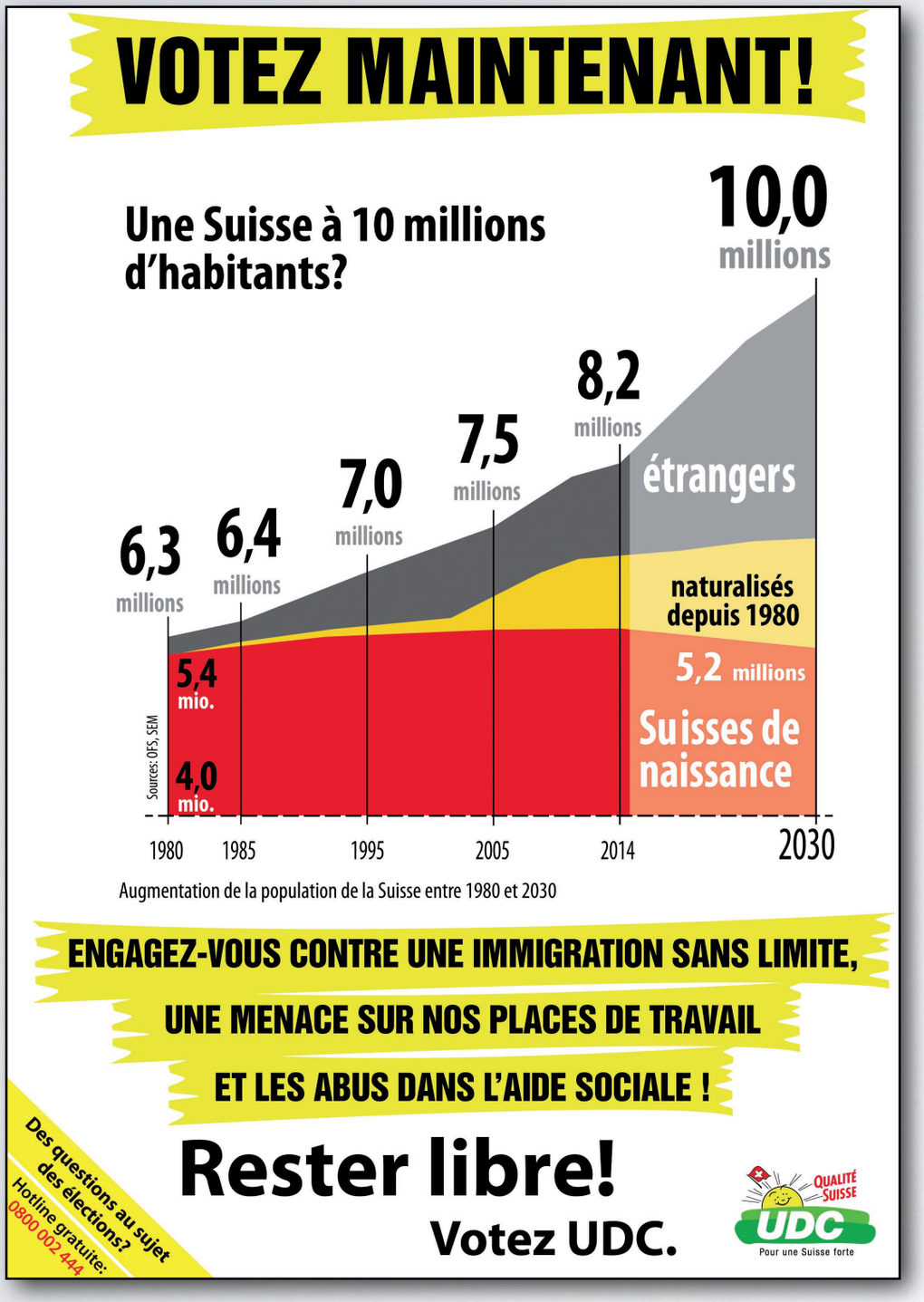
Manipulating graphs

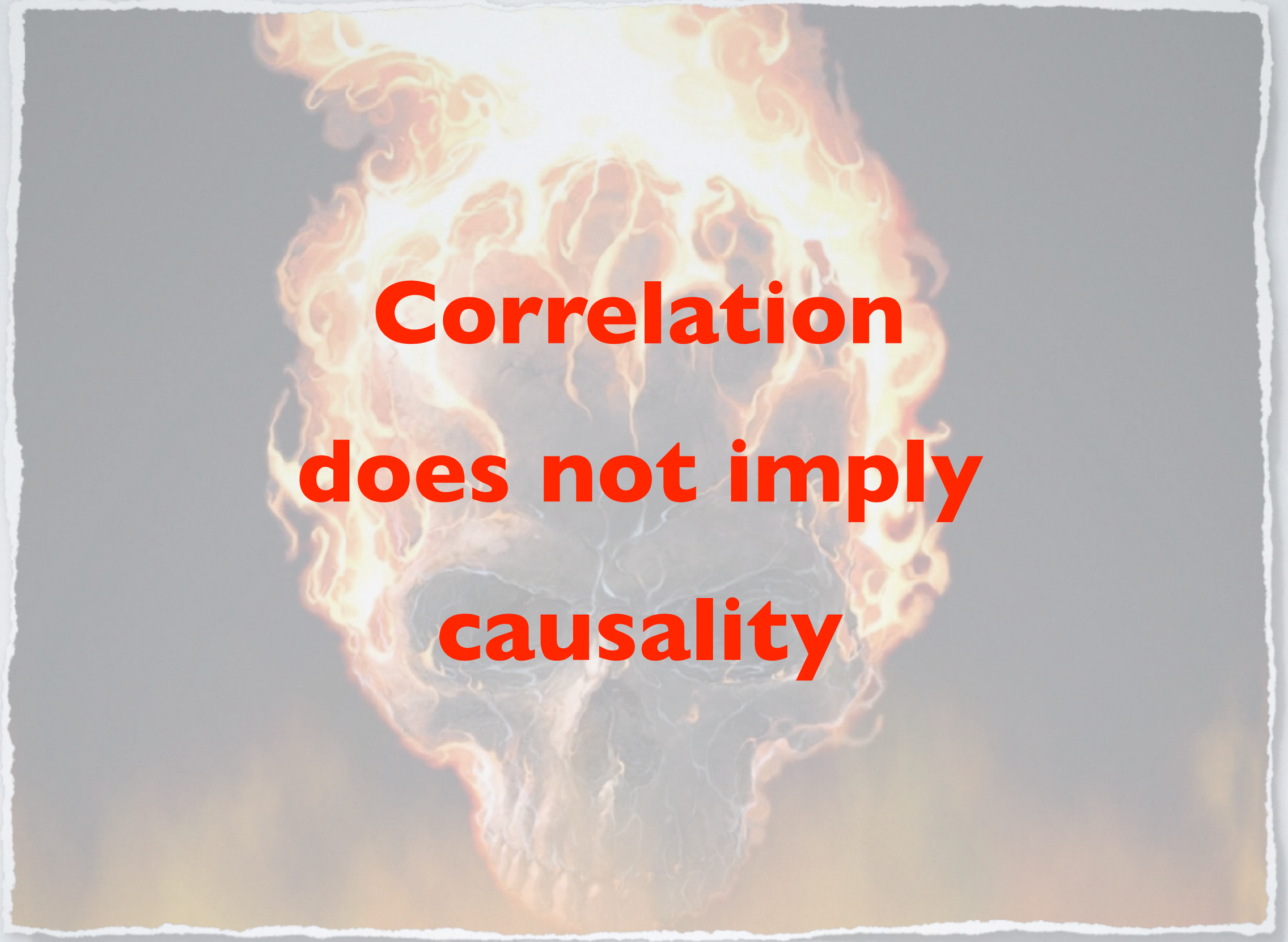


- What's wrong with this graph?
- Proportions are not respected
- The vertical scale starts from 4.0
- Graph = Scientific Authority
- Small distortions change the message
- ***Decoding graphs is important!***

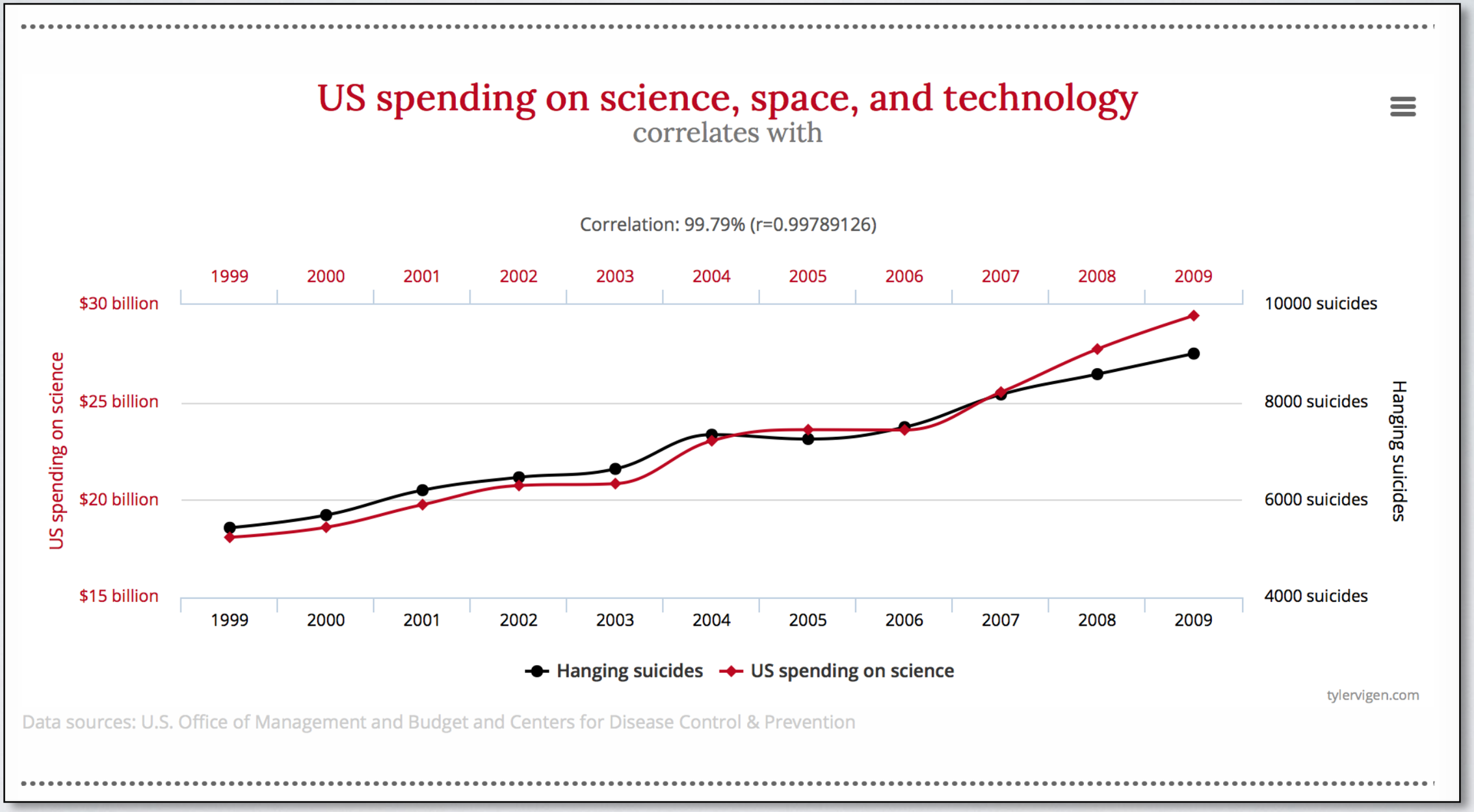
Correlation between two quantities

does not imply a causal relationship.

Correlation does not imply causality

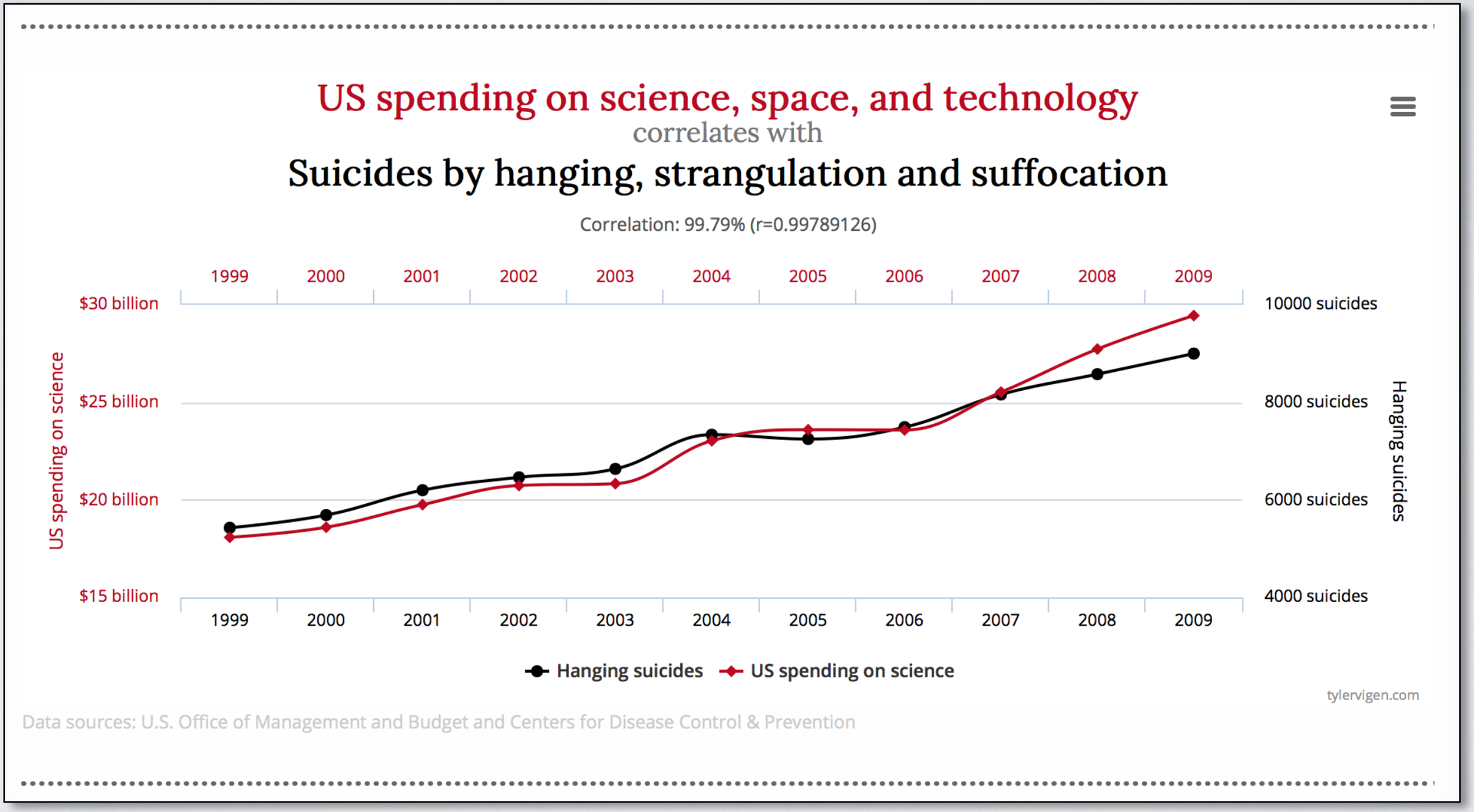

Correlation
does not imply
causality

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.

What we discuss

Giuseppe Tipaldo

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.

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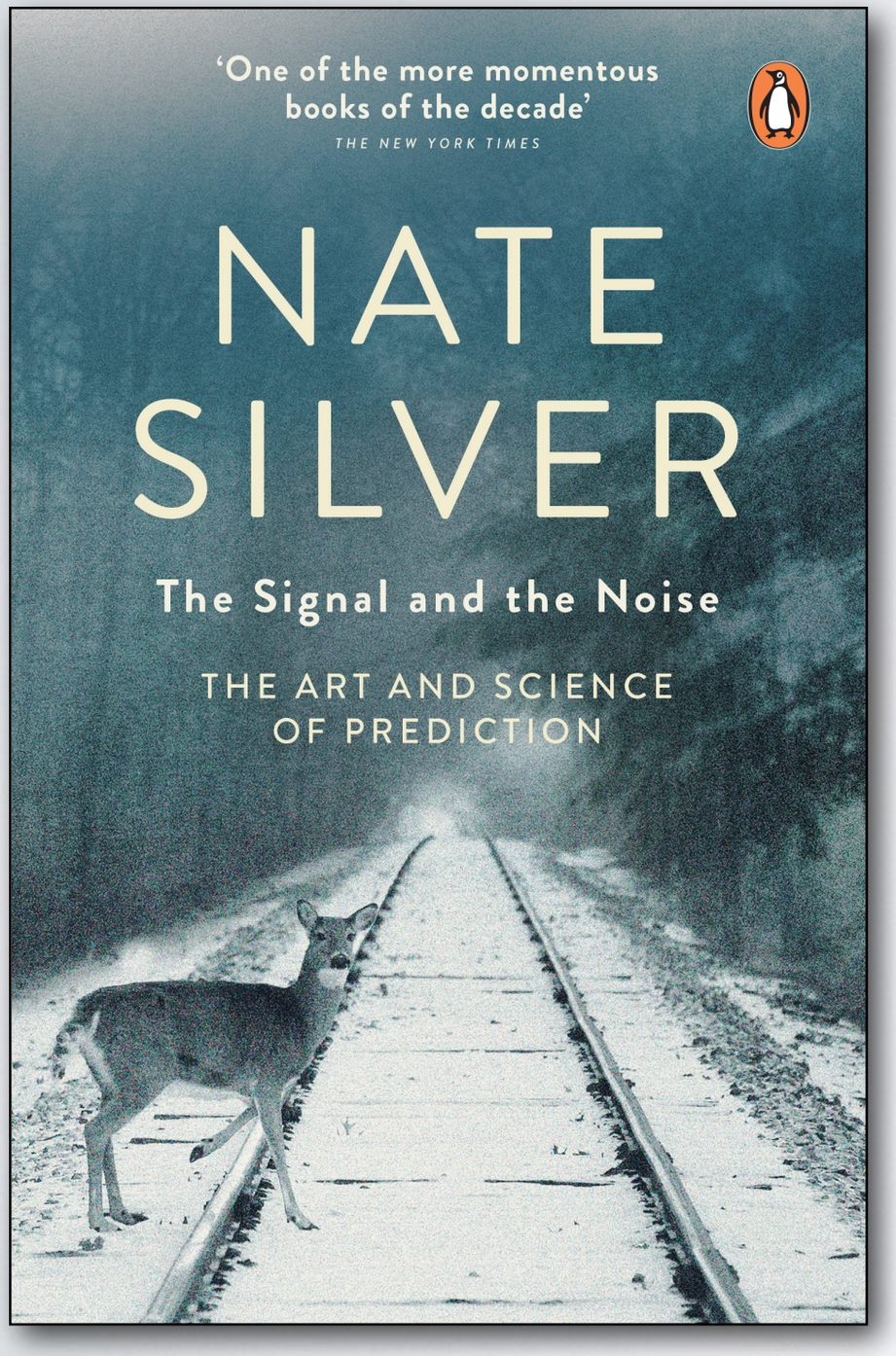
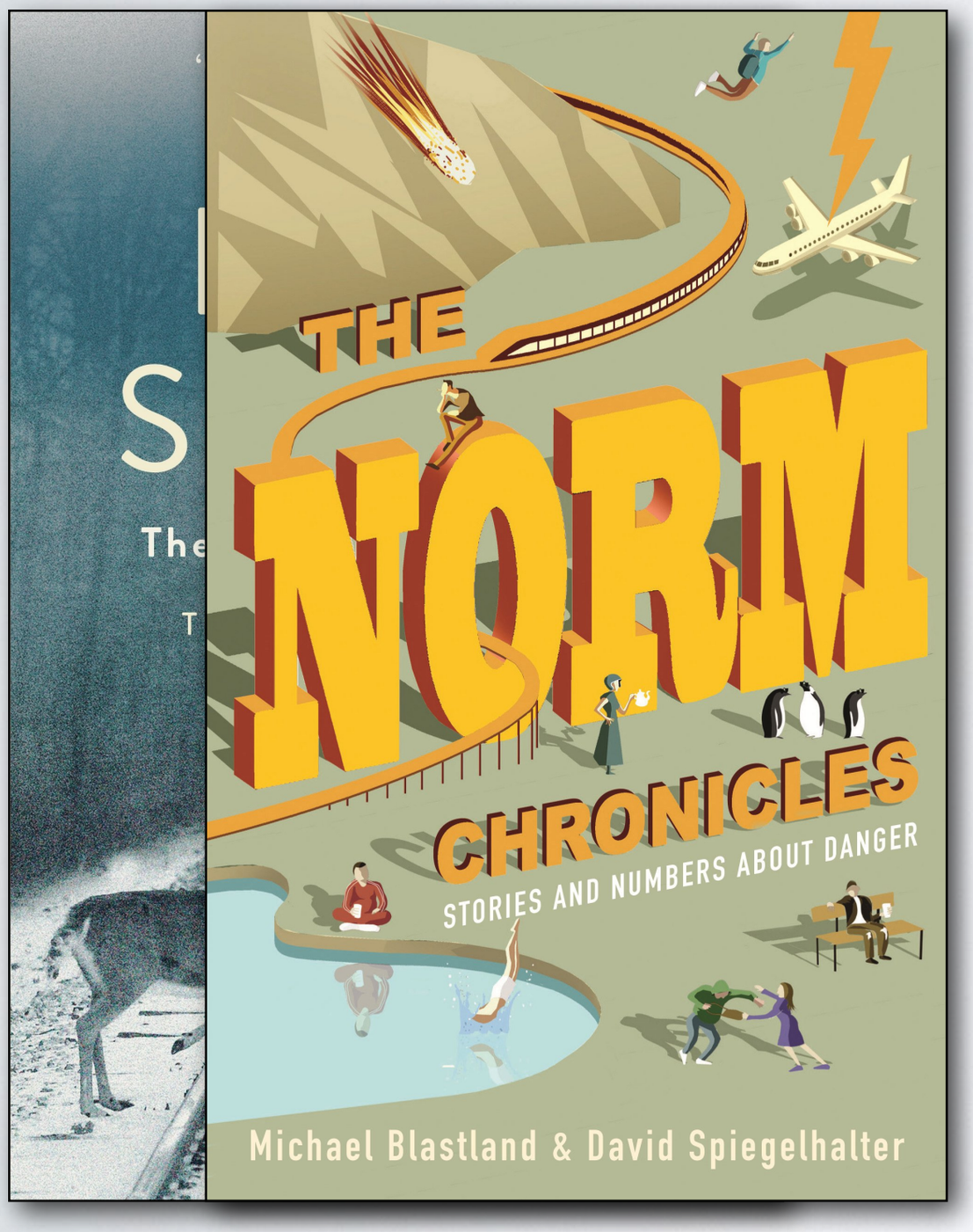
- A pilot experience of cross-curricular learning.

Many wonderful books

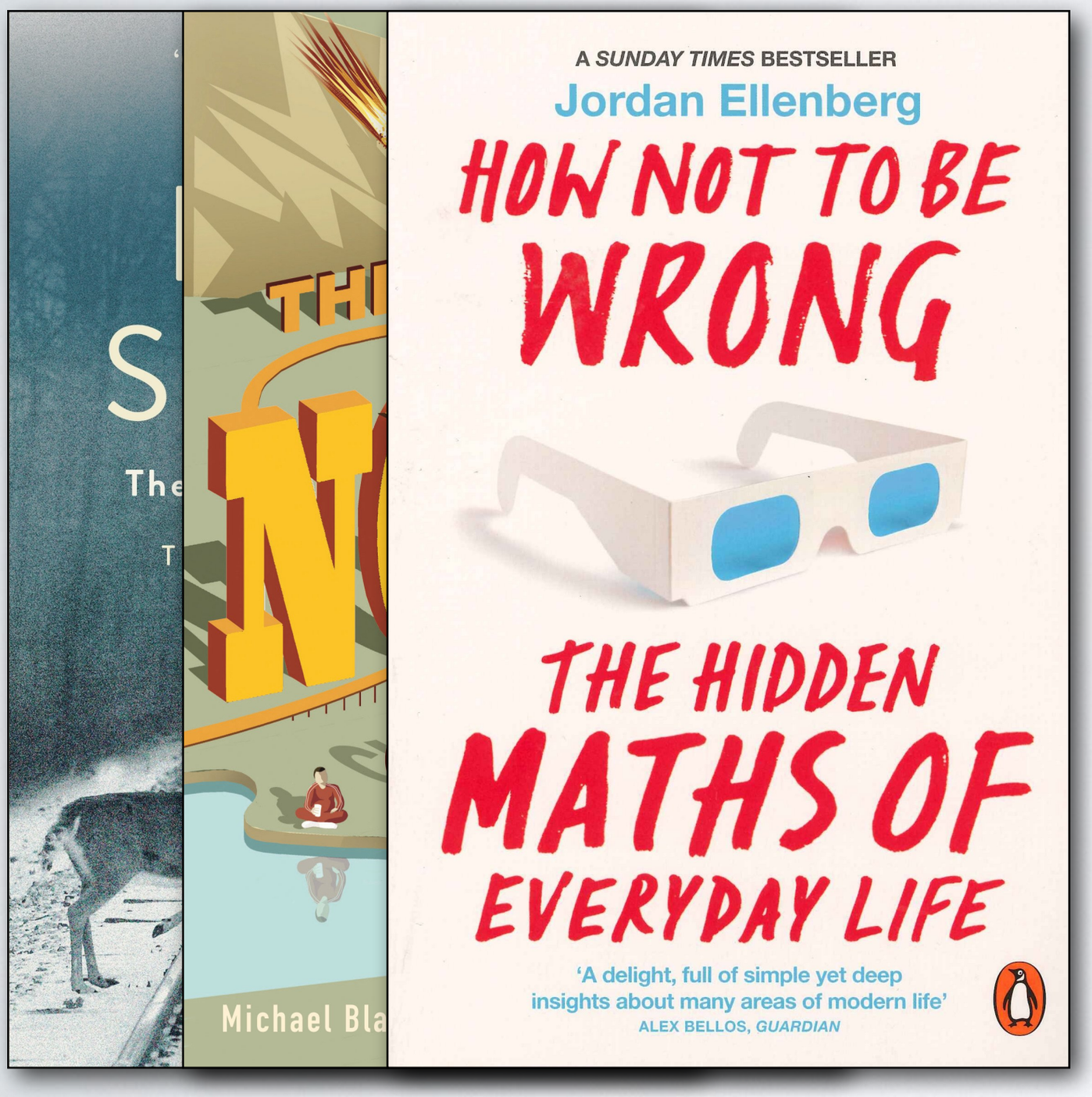
Many wonderful books



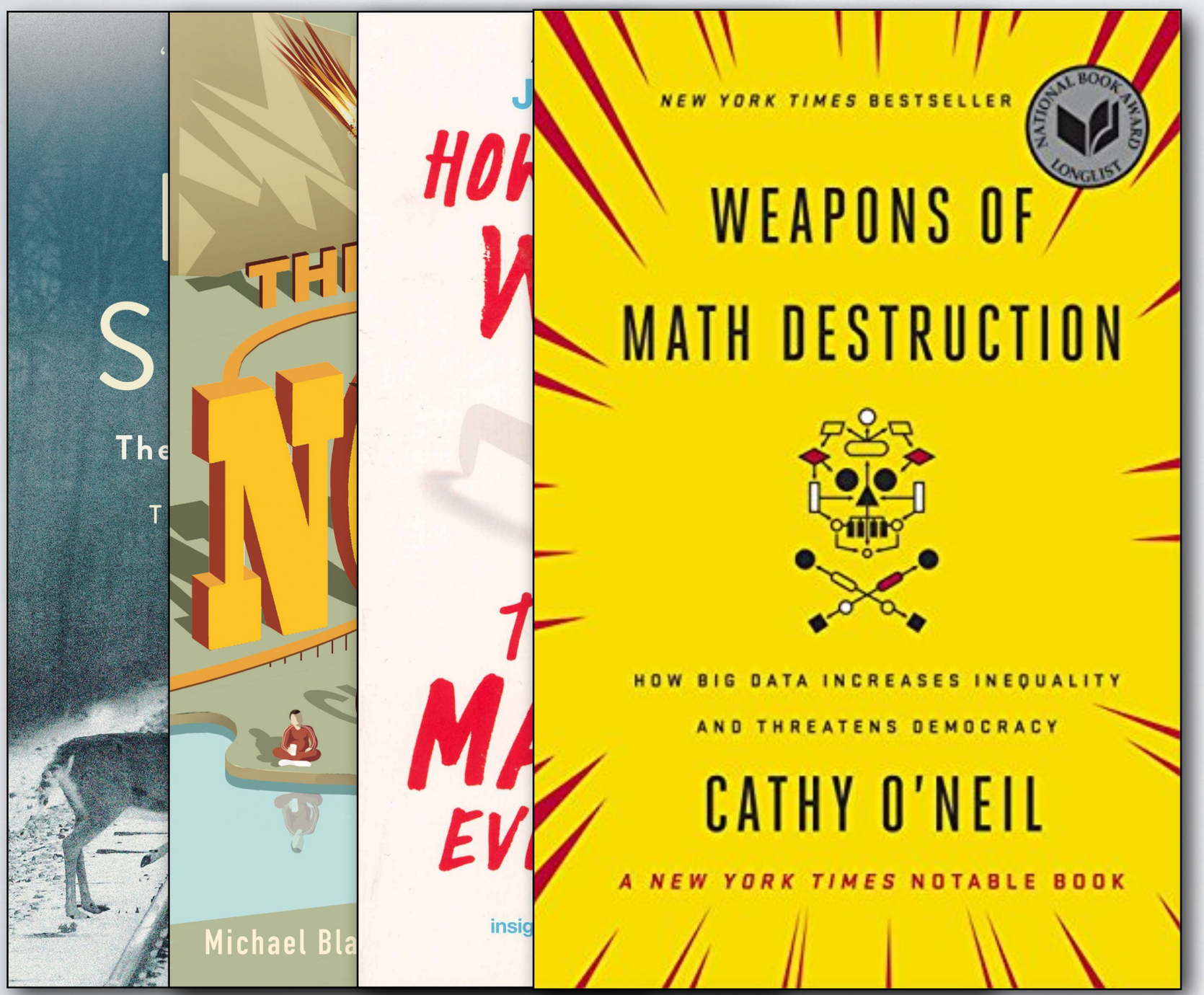
Many wonderful books



Many wonderful books



Many wonderful books



Many wonderful books

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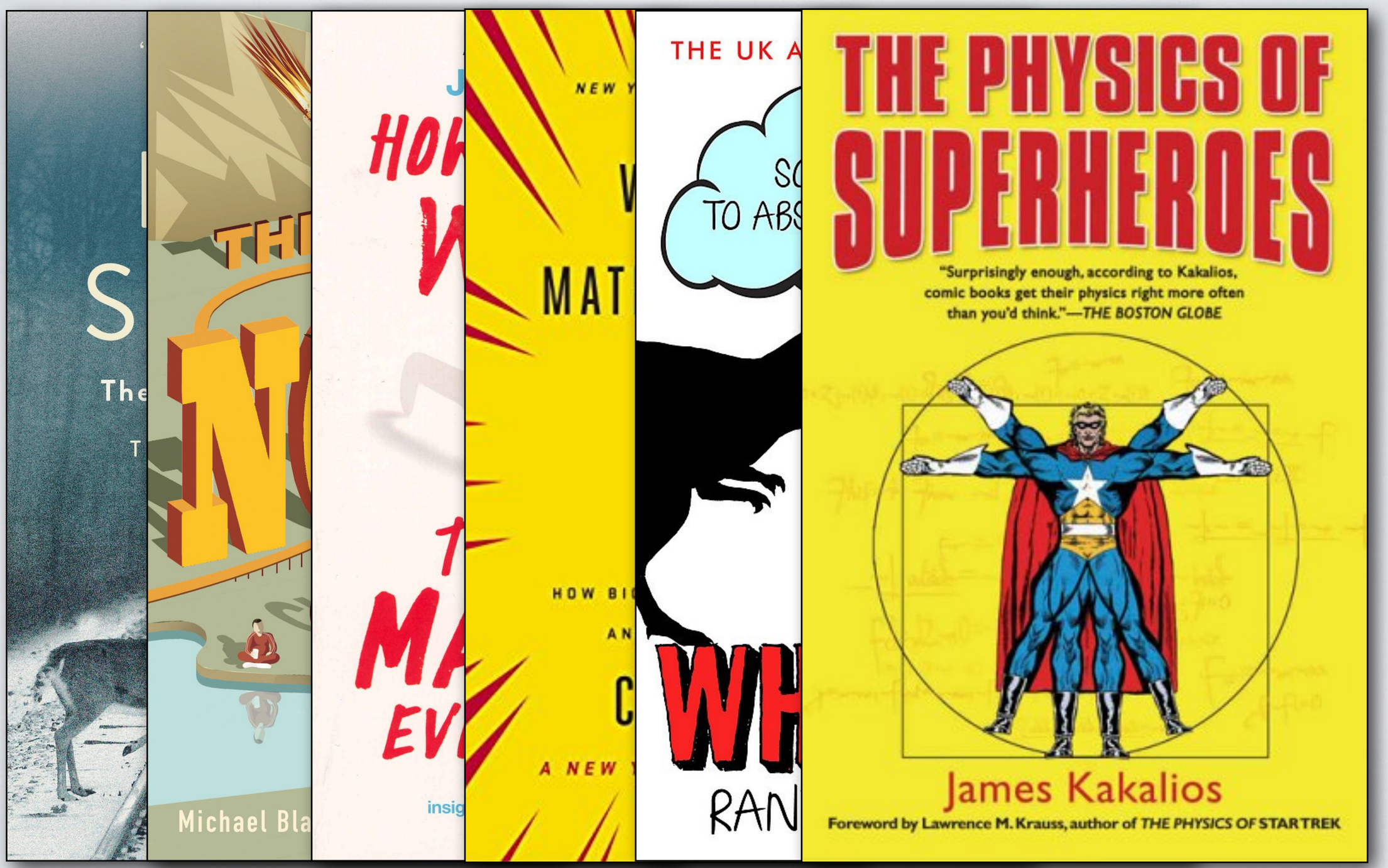

Many wonderful books

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!