# Covid-19, fat tails & the city

The world is a complex system

- The world is a complex system – made up of **interdependencies** and **nonlinear responses**

- Humans are bad at seeing these connections and tend to think linearly

- Interdependencies are increasingly **hidden**

- Key concepts of feedback loops, self-organization, second-order effects, randomness and fat-tails

- **Paradigm shift: individual characteristics -> relationships between components**

Complexity is a wealth generator

Economic complexity of a country/city is a strong predictor of its future growth

Adam Smith understood the power of connections and the fact that they were hidden ('invisible hand')

Trade and division of labor and this is a very efficient way to organize the economy

New technologies and globalization allow for a deeper division of knowledge

Lessons from complexity

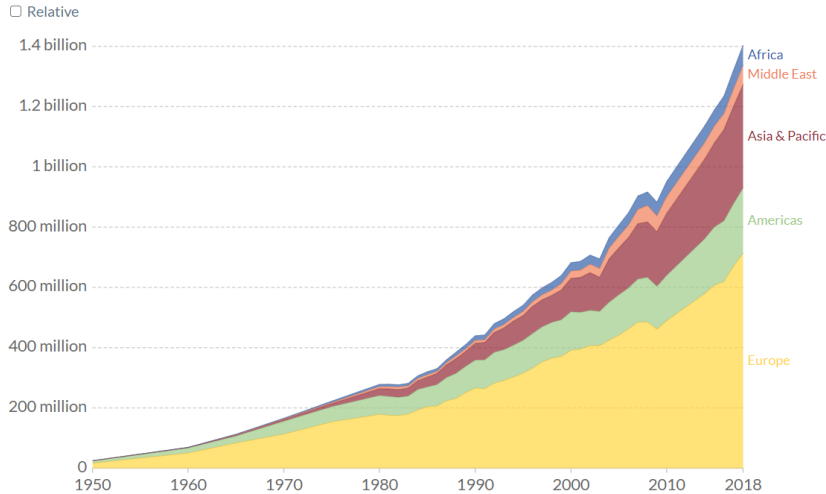1. Increasing economic complexity creates **extreme events**

Complex systems are dominated by fat tails
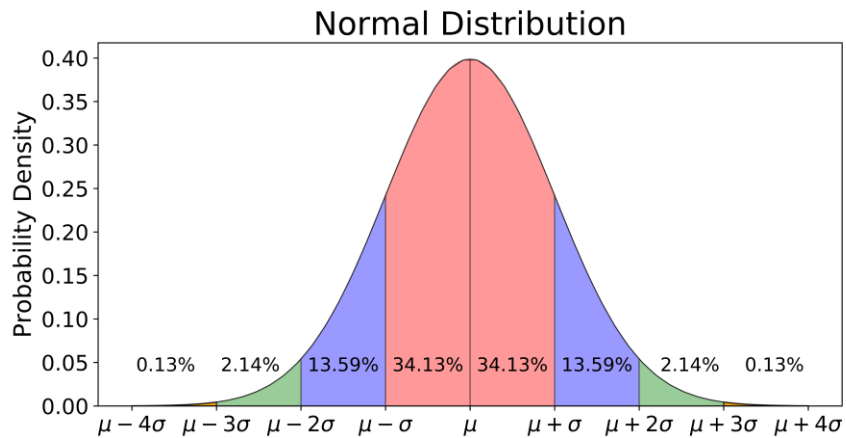
More complex societies are more vulnerable because of fat tails

Why complexity is also our biggest threat
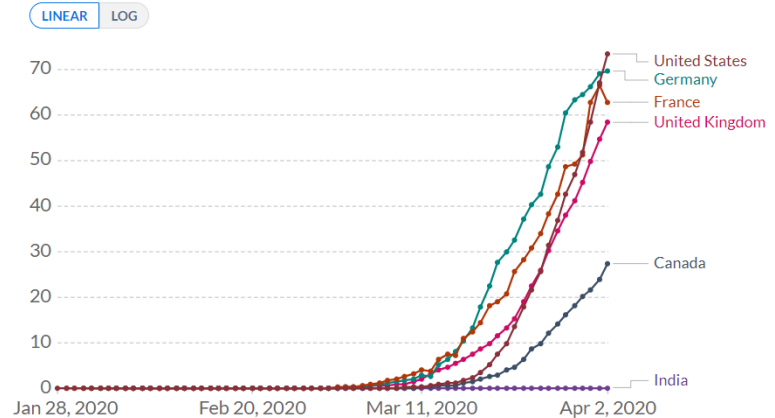
Dixson-Declève, S., Balland, P.A. et al. (2021) Transformation post-COVID, European Commission's Directorate-General for Research and Innovation.

Lessons from complexity

1. Increasing economic complexity creates **extreme events**
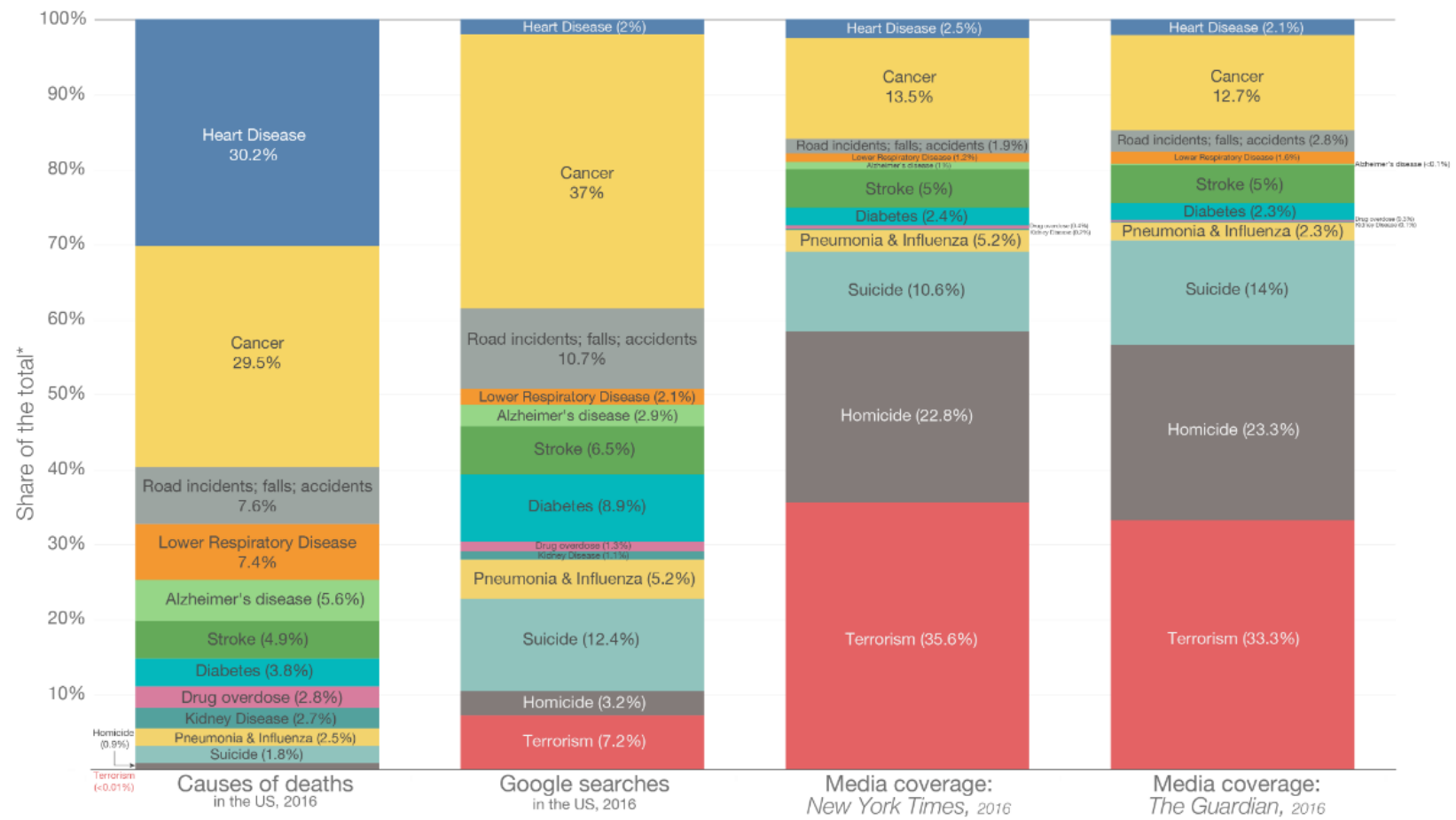2. Our brain is not made to **understand** non-linearities

The power of exponential growth

The all chessboard is over 1,600 times the global production of wheat (729 million metric tons)
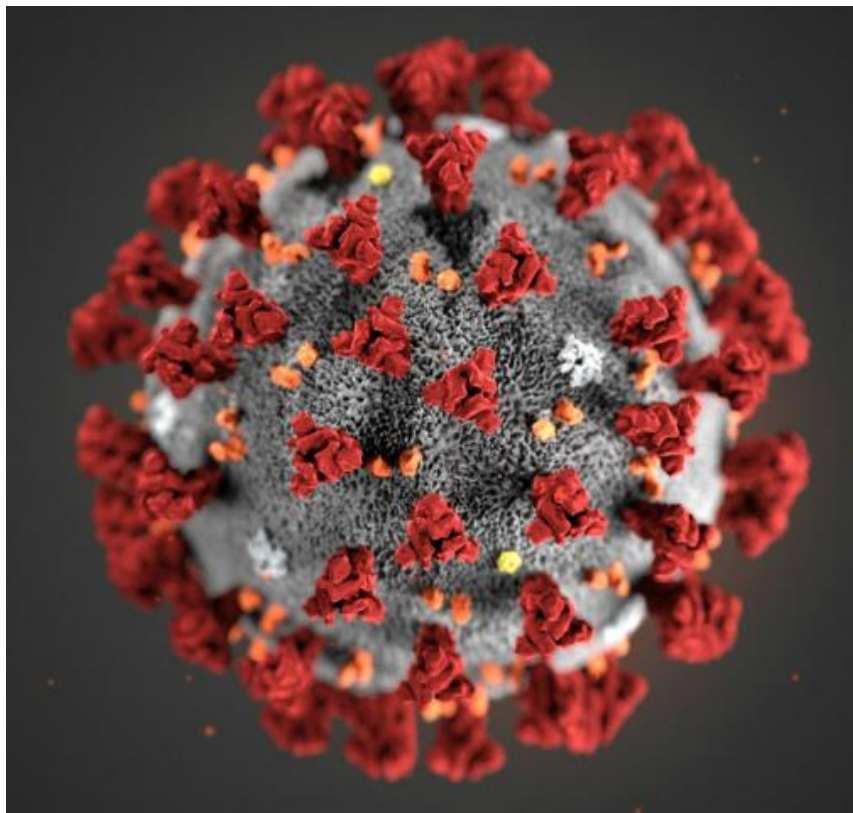
Causes of death in the US

What Americans die from, what they search on Google, and what the media reports on

Causes of deaths in the US, 2016:
- Heart Disease 30.2%
- Cancer 29.5%
- Road incidents; falls; accidents 7.6%
- Lower Respiratory Disease 7.4%
- Alzheimer's disease (5.6%)
- Stroke (4.9%)
- Diabetes (3.8%)
- Drug overdose (2.8%)
- Kidney Disease (2.7%)
- Pneumonia & Influenza (2.5%)
- Suicide (1.8%)
- Homicide (0.9%)
- Terrorism (<0.01%)

Google searches in the US, 2016:
- Heart Disease (2%)
- Cancer 37%
- Road incidents; falls; accidents 10.7%
- Lower Respiratory Disease (2.1%)
- Alzheimer's disease (2.9%)
- Stroke (6.5%)
- Diabetes (8.9%)
- Drug overdose (1.3%)
- Kidney Disease (1.1%)
- Pneumonia & Influenza (5.2%)
- Suicide (12.4%)
- Homicide (3.2%)
- Terrorism (7.2%)

Media coverage: New York Times, 2016:
- Heart Disease (2.5%)
- Cancer 13.5%
- Road incidents; falls; accidents (1.9%)
- Lower Respiratory Disease (1.2%)
- Alzheimer's disease (1%)
- Stroke (5%)
- Diabetes (2.4%)
- Drug overdose (0.4%)
- Kidney Disease (0.2%)
- Pneumonia & Influenza (5.2%)
- Suicide (10.6%)
- Homicide (22.8%)
- Terrorism (35.6%)

Media coverage: The Guardian, 2016:
- Heart Disease (2.1%)
- Cancer 12.7%
- Road incidents; falls; accidents (2.8%)
- Lower Respiratory Disease (1.6%)
- Alzheimer's disease (<0.1%)
- Stroke (5%)
- Diabetes (2.3%)
- Drug overdose (0.2%)
- Kidney Disease (0.1%)
- Pneumonia & Influenza (2.3%)
- Suicide (14%)
- Homicide (23.3%)
- Terrorism (33.3%)

Share of the total*

First, it should be evident that it is not appropriate to compare fatalities from multiplicative infectious diseases (fat-tailed, like a Pareto distribution) to those from car accidents, heart attacks or falls from ladders (thin-tailed, like a Gaussian). This remains a common (and costly) error in policy making, and in both the decision sciences and the journalistic literature. Some research papers even criticise the wider public's 'paranoia' with respect to pandemics, not appreciating that such a paranoia is merely responsible (and realistic) risk management in front of potentially destructive events. The main problem is that those articles—often relied upon for policy making—consistently use the wrong thin-tailed distributions, underestimating tail risk, so that every conservative or preventative reaction is bound to be considered an overreaction.

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2. Our brain is not made to **understand** non-linearities
3. We are bad at predicting **when** an extreme event will occur

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4. We maximize **short**-term efficiency over **long**-term resilience

COVID-19 Containment and Health Index, Dec 31, 2022

This is a composite measure based on thirteen policy response indicators including school closures, workplace closures, travel bans, testing policy, contact tracing, face coverings, and vaccine policy rescaled to a value from 0 to 100 (100 = strictest). If policies vary at the subnational level, the index is shown as the response level of the strictest sub-region.
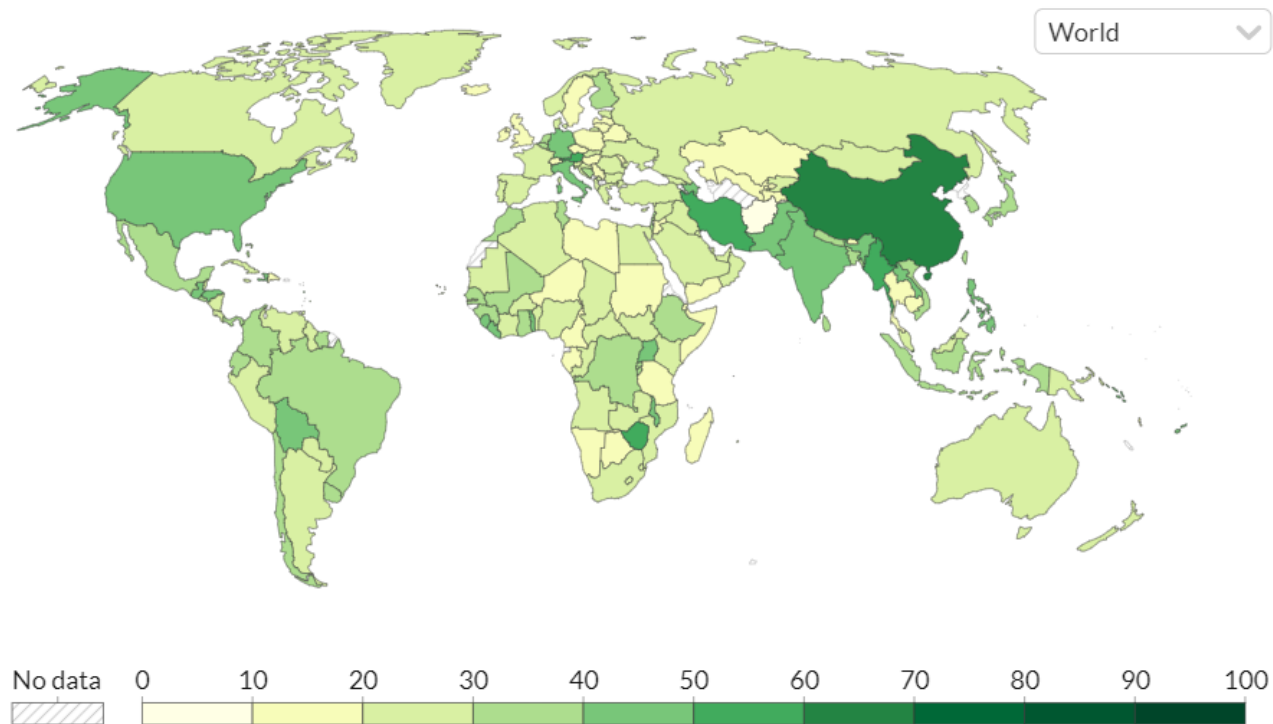
World ▼

| No data | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |

Covid-19, complexity & urban resilience

City level

Redesign urban infrastructure: public transportation, shared spaces & social distancing

Strengthen public health systems: should be well-prepared to respond to future pandemics

Prioritize digital infrastructure: provide services + economic opportunities remotely

Invest in social safety nets

Enhance food security & access to other essential goods

Prepare for the unexpected (extreme value theory)

…

National level

Early travel restrictions response (we need a complexity switch)

Enhancing public health systems

Strengthening infection prevention and control measures in healthcare settings.

Supporting research to develop effective treatments and vaccines.

Create a communication strategy

International collaboration and coordination.

Beyond AI: Tacit evolutionary knowledge, judgement & wisdom

You know but can't tell

You don't know you're using it

It has been done for a long time before you

Evolutionary collective wisdom (those who used it survive)

No science, no mathematical model – error and feedback loops

Heuristics sometimes encoded in religion

Can be re-discovered by science: intermittent fasting