Connections 2050 | dvrpc Delaware Valley Regional Planning Commission

GREATER PHILADELPHIA

FUTURES GROUP

DIALOGUE. COLLABORATION. KNOWLEDGE-SHARING.

Complex Adaptive Systems

September 4, 2020

Complex Adaptive Systems (CASs)

Agenda

- ➔ Welcome and Introductions
- ➔ Complex Adaptive Systems
- ➔ Facilitated Exercise
- ➔ Member Updates

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Collaborative Planning

PHILOSOPHY

1. **Urban areas are made up of complex adaptive (sub)systems.**
2. **Social conditions can be reconsidered and social transformation can be achieved through:**

PROCESS

1. Ongoing Dialogue
With diverse stakeholders and public.

2. Shared Values & Goals
Recognizing a diversity of perspectives, which cannot be fully reconciled.

3. Decision Making
Guided by values and goals.

TOOLS

Scenario Planning
To obtain views of multiple plausible futures through:

- Stakeholder dialogue,
- research & technical analysis, and
- evaluation criteria to compare scenarios.

Indicators
To track progress over time.

Evaluation
Did the plan influence decisionmaking?

Source: adapted from Goodspeed, 2020.

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Complex

→ Difficult to understand or predict.

Adaptive

→ Constantly changing to respond to environment or conditions.

Systems

→ A set of parts or things that work together as a unitary whole or interconnected network.

Complex Adaptive Systems

Dr. Simon Levin
James S. McDonnell Distinguished University Professor in Ecology and Evolutionary Biology

Department of Ecology and Evolutionary Biology, Princeton University

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Facilitated Exercise

MARISSA DENKER
Co-Director and Co-Founder

KIERSTEN MAILLER
Manager of Strategic Planning & Design

Connect the Dots designs equitable stakeholder engagement & public involvement processes. The firm develops tailored strategies and expert insights to help build cities, regions, and entities focused on sustainability and equity for people and planet. The work is based on the knowledge that the careful engagement of all voices, in a collaborative and thoughtful way, is critical when engaging with challenges we are facing and to moving forward with confidence and trust.

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Member Updates

- ➔ Please use the **Raise Hand** button at the bottom of the Zoom interface to be called on.
- ➔ Or make an announcement in the chat box.

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www.dvrpc.org/longrangeplan/futuresgroup

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

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CASs are Unknowable

- Urban areas are influenced by a myriad of actions at different scales, which evolve over time.
- Assessing an intervention requires determining how things would unfold without it.
  - + Butterfly Effect: Small changes can have major & unexpected impacts.
- The optimal or desired future state is not knowable, and today's desires are likely to shift in the future.

Source: adapted from Stephen Marshall, 2012; via Goodspeed, 2020.

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Lessons from evolution for anticipating and coping with extreme events

Carbonbrief.org.

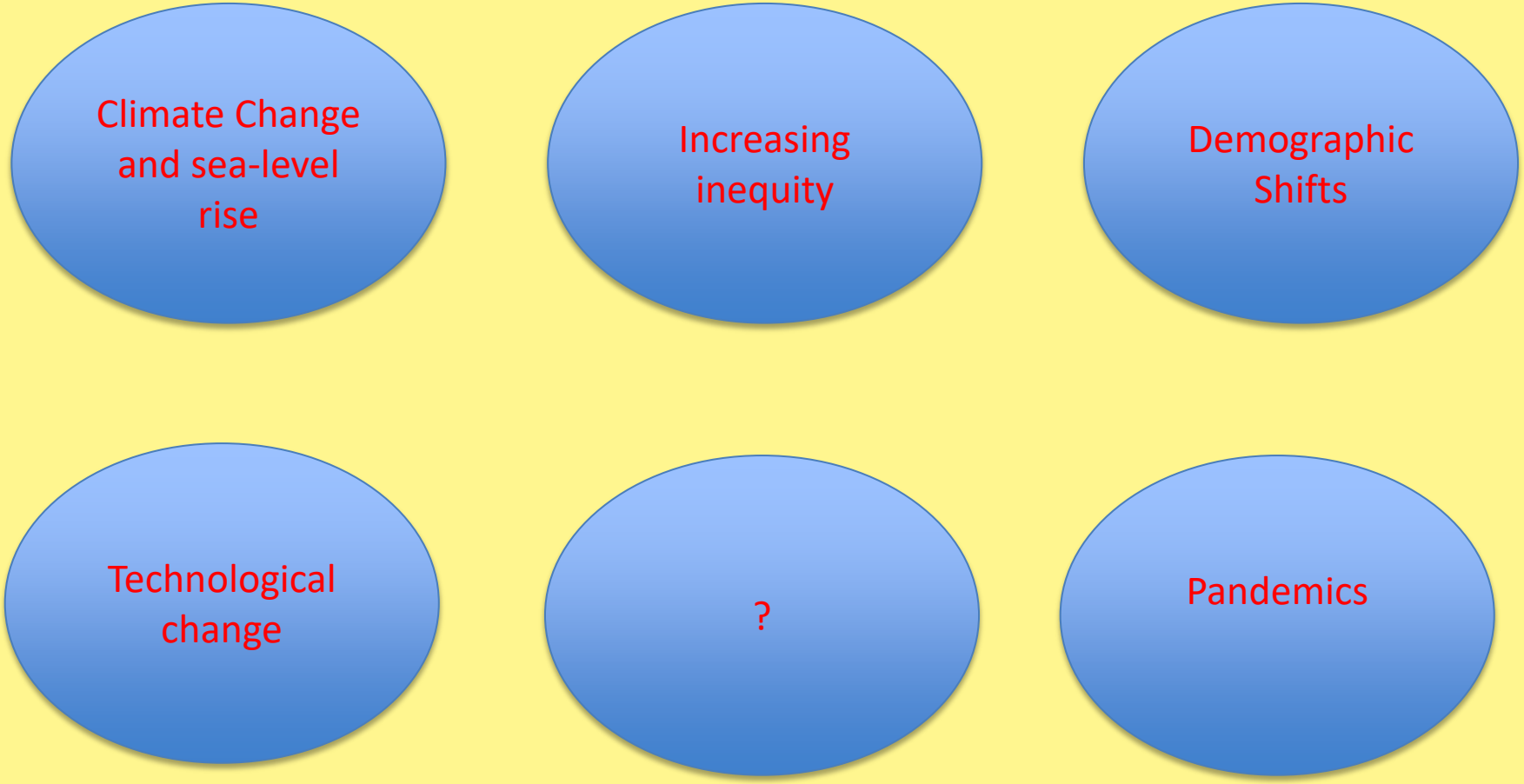
DELAWARE VALLEY

September 4, 2020

Simon Levin

With thanks to

The Delaware Valley, as all other regions, will be facing diverse and interlocking challenges in the coming decades

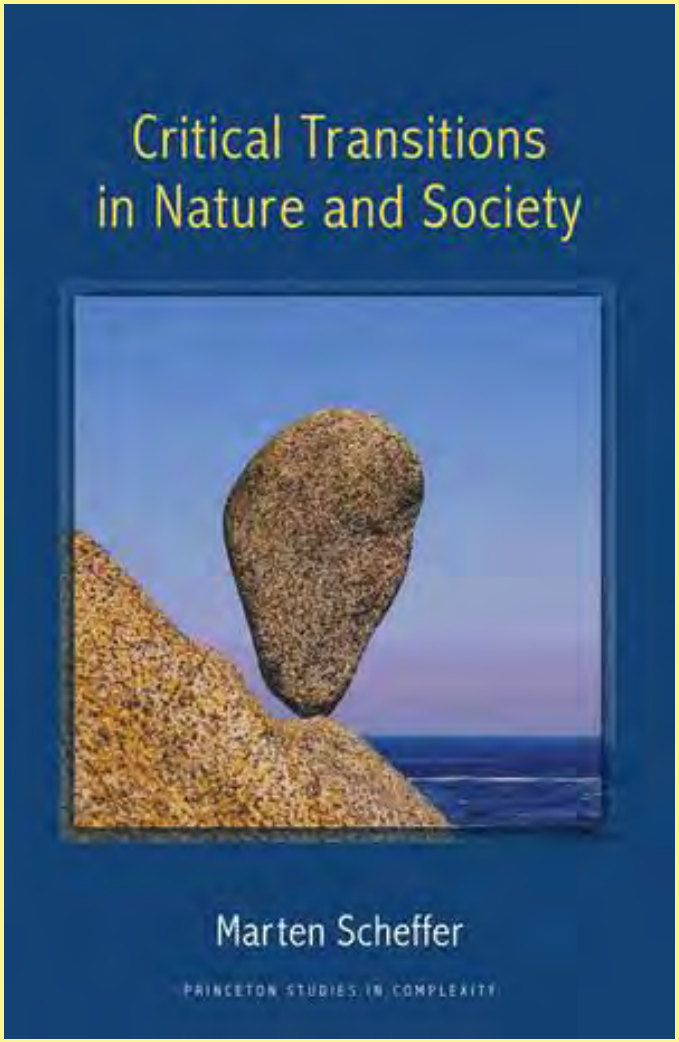


One of the greatest challenges facing us is how to deal with extreme events

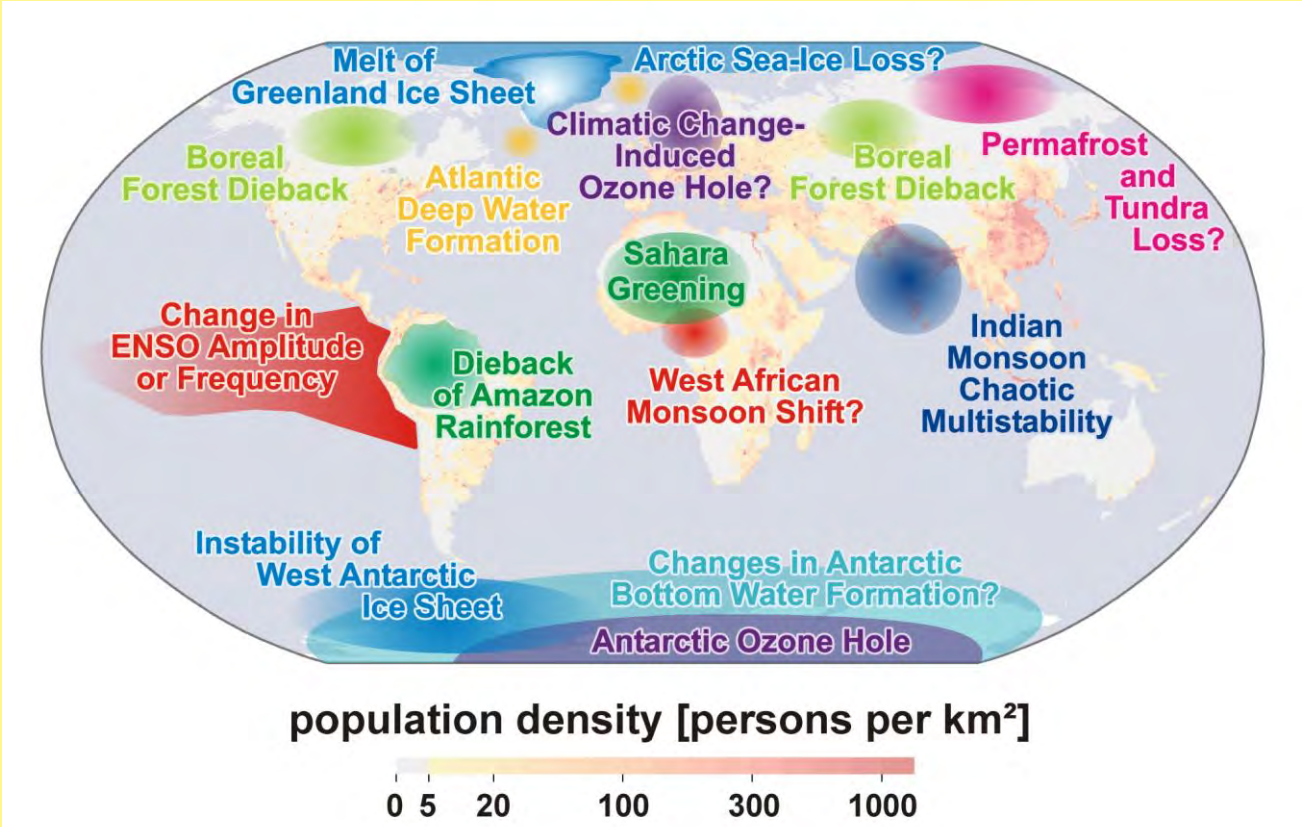
Black Death
History.com

COVID19
Scroll.in

…and to avoid system collapse



There are likely tipping elements in the climate system



UNIVERSITY OF EXETER

Lenton et al. (2008) *PNAS* 105(6): 1786-1793

Stock markets crash

Such challenges are the norm over evolutionary time

But extinction is not the usual evolutionary outcome…adaptive strategies emerge through natural selection

Environmental unpredictability and inbreeding depression select for mixed dispersal syndromes

Jorge Hidalgo[1,2], Rafael Rubio de Casas[3,4,5*] and Miguel Á. Muñoz[1]

Abstract

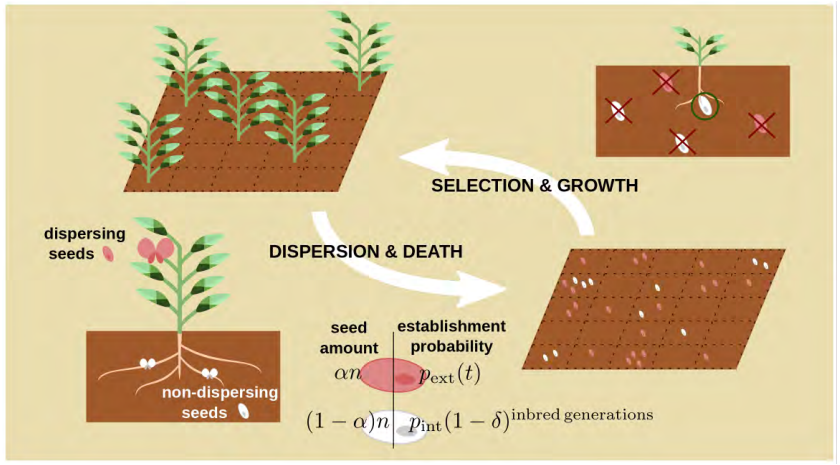
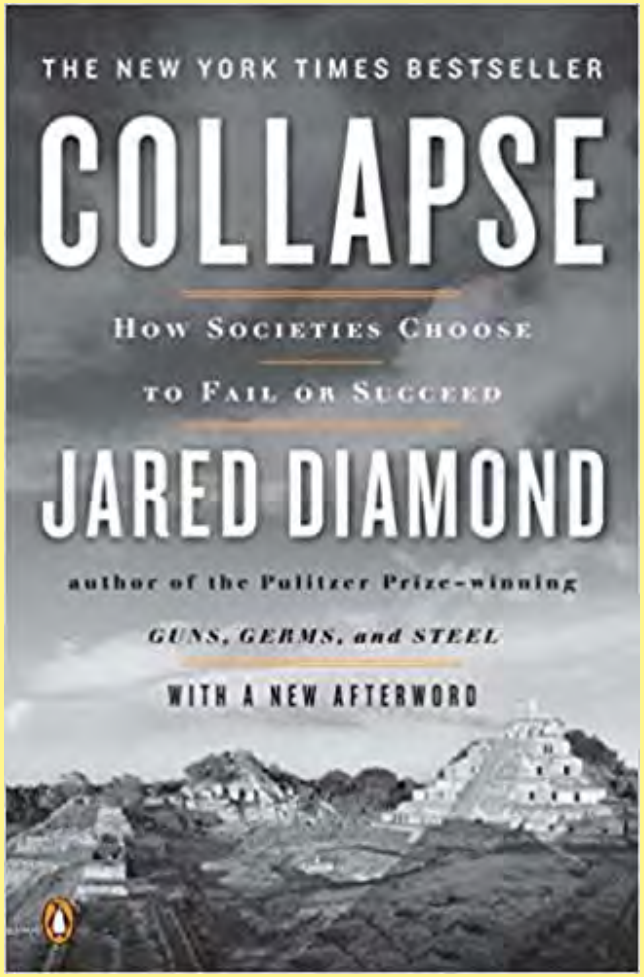


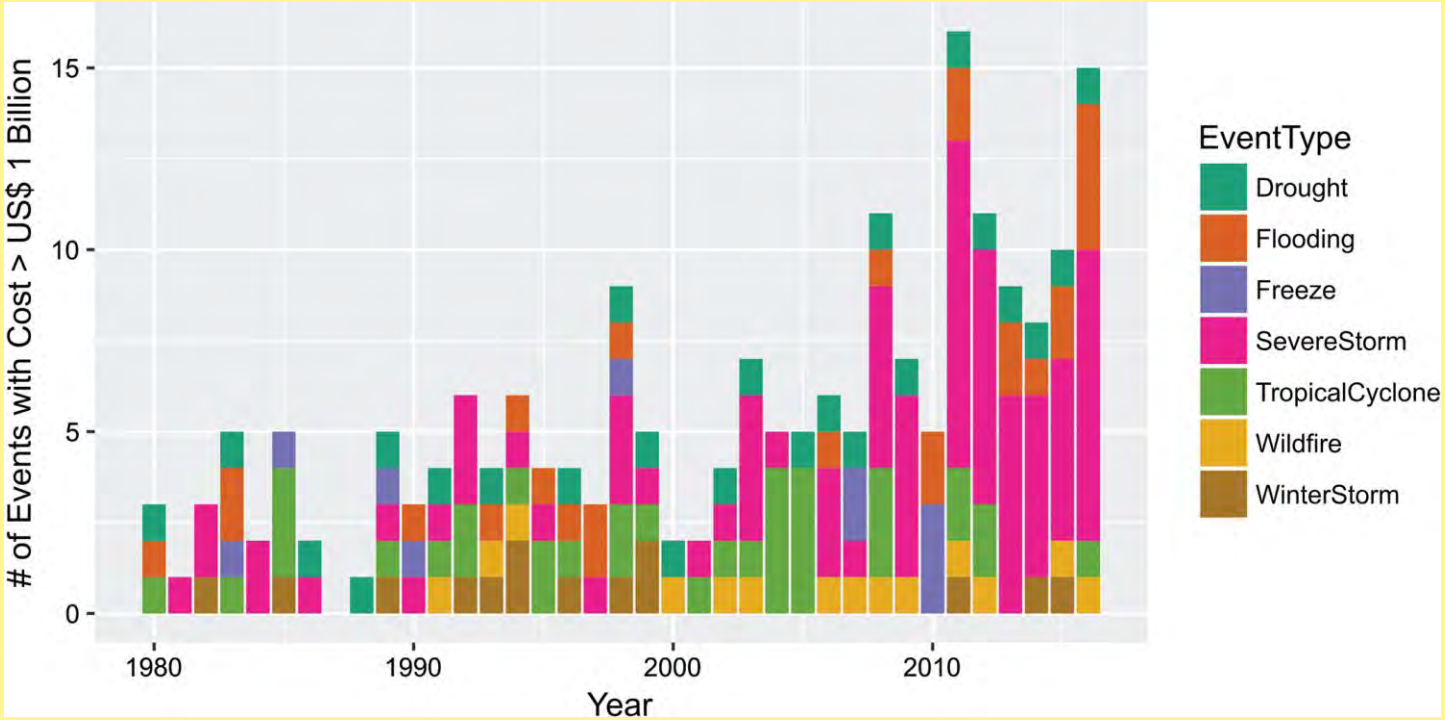
Figure 2 Community of plants with mixed dispersal phenotypes. Each plant is located at a cell of a square lattice of size $L \times L$. Each individual plant produces the same fixed number of seeds, n; seeds can be of two different types: "dispersing" and "non-dispersing", marked in red and white respectively in the sketch. Each produced seed is external/ dispersing with probability α, or internal/ non-dispersing with probability, $1 - \alpha$, where α is the dispersal propensity parameter. After reproduction, all adult plants are removed from the community. Regardless of their origin, dispersing seeds can randomly arrive to any cell in the lattice where they get established with probability $p_{\mathrm{ext}}(t)$ which is environment-dependent. On the other hand, non-dispersing seeds can only establish themselves at the maternal location or in its adjacent lattice cells. Then, for cells with more than one established seed, one of these is chosen at random and the rest die. The establishment probability p_{int} of non-dispersing seeds is assumed to be independent from environmental variability (and thus, it does not depends on time). In the simplest case, dispersing seeds are produced by outcrossing, whereas non-dispersing seeds are the product of selfing. Thus, their quality, q, is reduced after each inbreeding event by a penalization factor $q \to (1-\delta)q$. In our formulation, inbreeding depression is approximated in a manner that can be assimilated to the interaction

We must hope that we can also manage to adapt rather than disappear



What events are extreme?

- Low probability?
- Very high impact?



Defining Extreme Events: A Cross-Disciplinary Review
Lauren E. McPhillips et al. 2018

What are extreme events?

- ***Low probability?***
- ***Very high impact?***

  – What once were low-probability high-impact events are increasing in frequency

The Washington Post
Democracy Dies in Darkness

Houston is experiencing its third '500-year' flood in 3 years. How is that possible?

By **Christopher Ingraham**

August 29, 2017 at 7:30 a.m. EDT

Picture from
Houston.eater.com

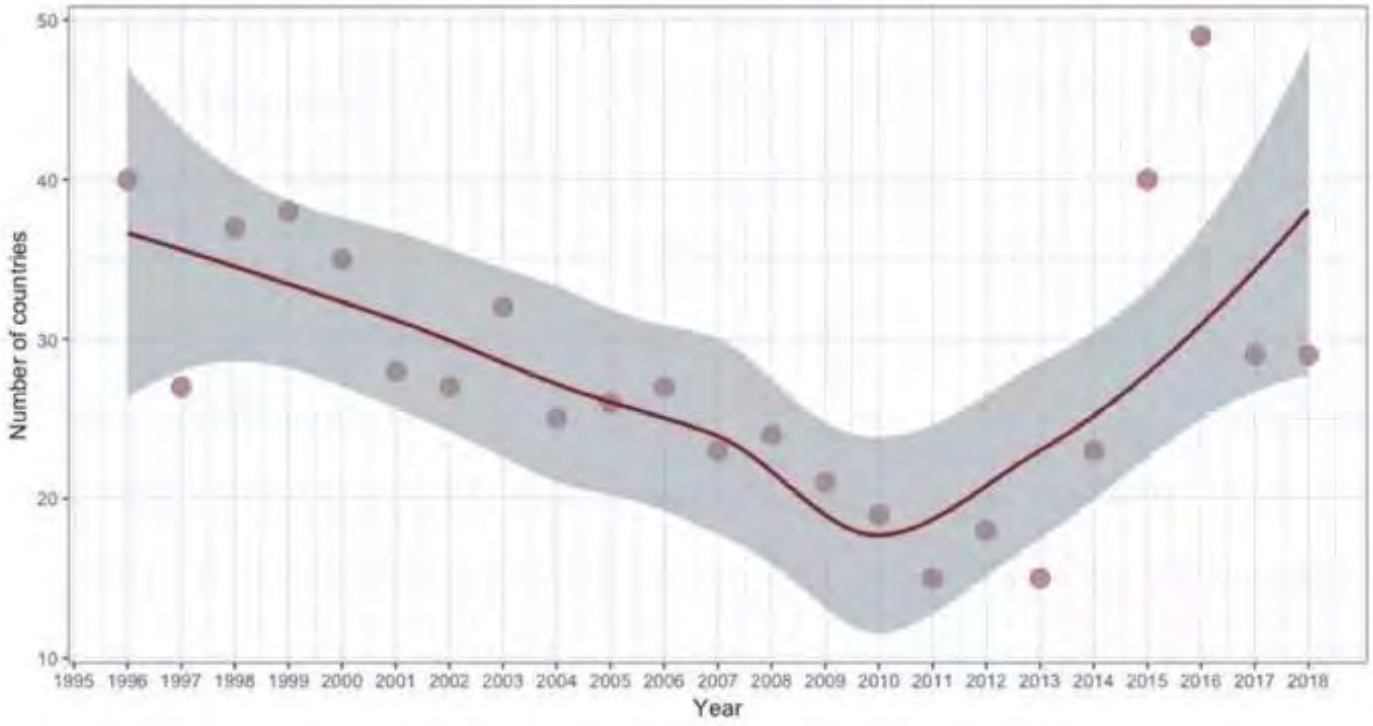
Coronavirus isn't an outlier, it's part of our interconnected viral age

Globalization and interconnectedness is leading to a increase in epidemics. Image: REUTERS/Kham

04 Mar 2020

Kate Whiting
Senior Writer, Formative Content

Figure 1: Number of countries experiencing significant disease outbreaks, 1995-2018

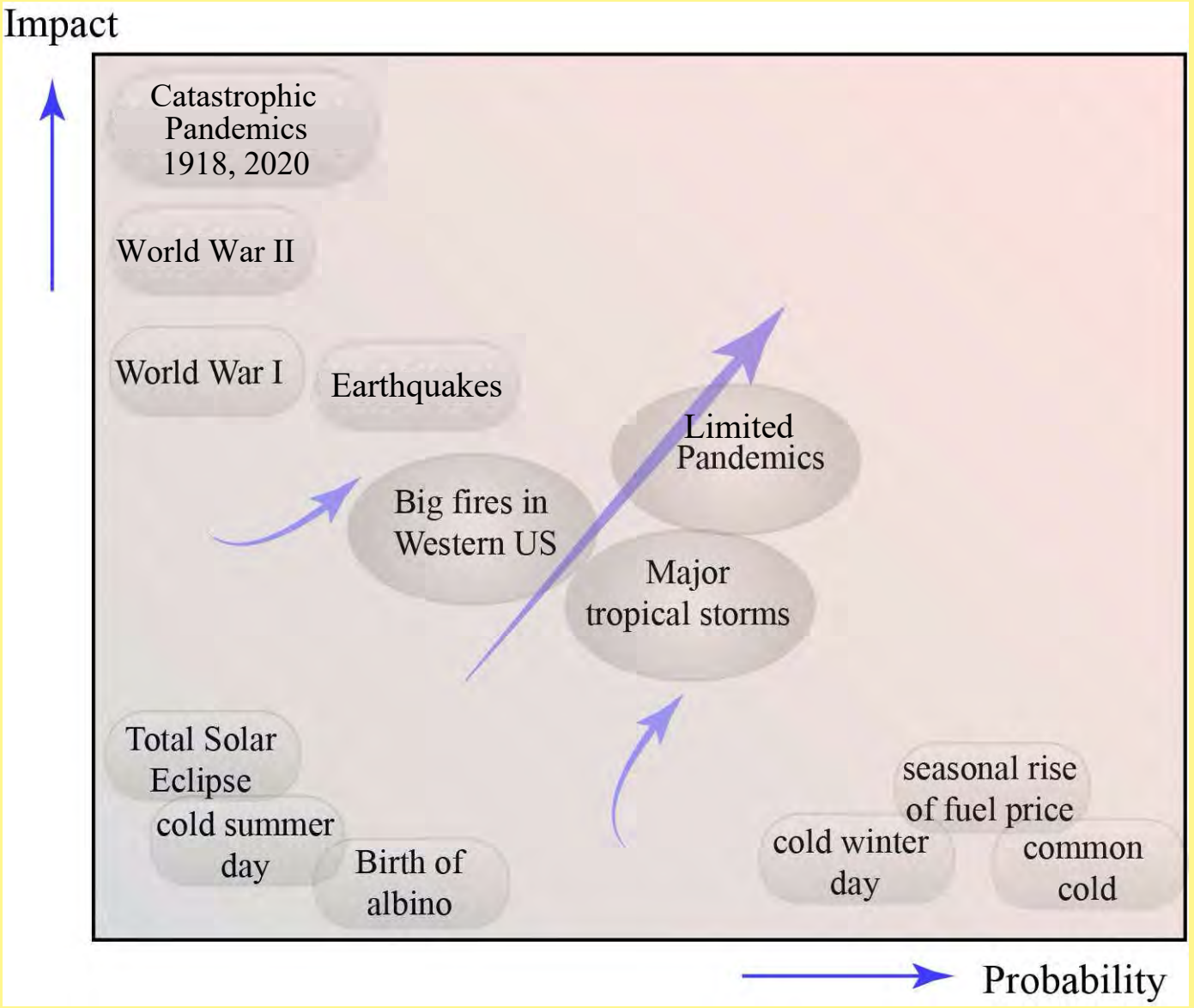


Source: Harvard Global Health Institute/World Economic Forum analysis of data from WHO Disease Outbreak News (http://www.who.int/csr/don/en/)

The number of countries experiencing significant disease outbreaks 1995-2018.

Image: Outbreak Readiness and Business Impact Report 2019

From Levin at al. in review: A classification scheme



RESEARCH ARTICLE

CRITICAL TRANSITIONS

Cascading regime shifts within and across scales

Juan C. Rocha[1,2]*, Garry Peterson[1], Örjan Bodin[1], Simon Levin[1,2,3,4]

Regime shifts are large, abrupt, and persistent critical transitions in the function and structure of ecosystems. Yet, it is unknown how these transitions will interact, whether the occurrence of one will increase the likelihood of another or simply correlate at distant places. We explored two types of cascading effects: Domino effects create one-way dependencies, whereas hidden feedbacks produce two-way interactions. We compare them with the control case of driver sharing, which can induce correlations. Using 30 regime shifts described as networks, we show that 45% of regime shift pairwise combinations present at least one plausible structural interdependence. The likelihood of cascading effects depends on cross-scale interactions but differs for each type. Management of regime shifts should account for potential connections.

Regime shifts occur across a wide range of social-ecological systems (1–3). They are difficult to predict and reverse (4, 5) and often produce sustained shifts in the availability of ecosystems services (6). When a system undergoes a regime shift, it moves from one set of self-reinforcing processes and structures to another (2, 7–9). Changes in a key variable (for example, temperature in coral reefs) often make a system more susceptible to shifting regimes when exposed to shock events (such as hurricanes) or the action of external drivers (such as fishing) (10). More than 30 different regime shifts in social-ecological systems have been documented (3), and similar nonlinear dynamics are seen across societies, finance, language, neurological diseases, and climate (11, 12). As humans increase their pressure on the planet, regime shifts are likely to occur more often and more severely (13–15).

An emergent challenge for science and practice is that regime shifts can potentially lead to subsequent regime shifts. We define a regime shift as cascading when its occurrence may affect the occurrence of another regime shift. A variety of causal pathways connecting regime shifts have been identified (table S1). For example, eutrophication is often reported as a regime shift preceding hypoxia or dead zones in coastal areas (16). Similarly, hypoxic events have been reported to affect the resilience of coral reefs to warming and other stressors in the tropics (17). If, why, and how a regime shift somewhere in the world could affect the occurrence of another regime shift remain largely open questions and a key frontier of research (18, 19).

Research on regime shifts is often confined to well-defined branches of science, reflecting empirical, theoretical (20), or predictive approaches (10, 21). These approaches require a deep knowledge of the causal structure of the system or a high quality of spatiotemporal data. Hence, research on regime shifts has generally focused on the analysis of individual types of regime shifts rather than potential interactions across systems. We took another approach and instead explored potential cascading effects among a large set of regime shifts. We investigated two types of interconnections: domino effects and hidden feedbacks. Domino effects occur when the feedback processes of one regime shift affect the drivers of another regime shift, creating a one-way dependency (10, 19, 22). A feedback mechanism is a self-amplifying or -dampening process

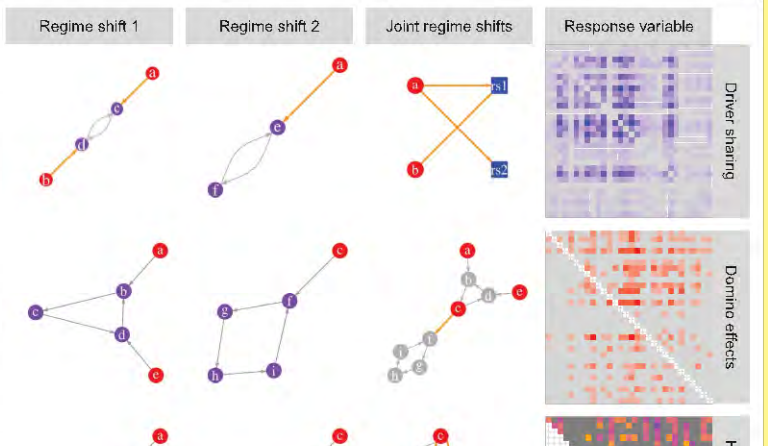
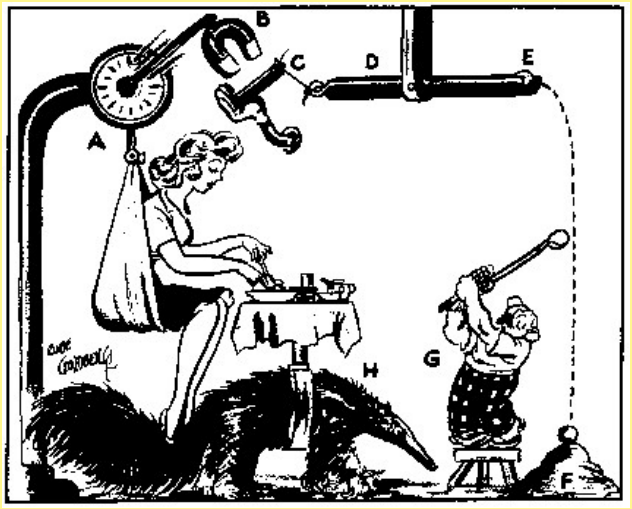


Fig. 1. Method scheme. Pairs of regime shift causal networks were merged to create a response variable matrix that accounted for drivers shared, domino effects, or hidden feedbacks. In all examples, two minimal regime shifts are depicted as causal diagrams, drivers are red, and variables belonging to feedbacks are purple. For driver sharing, the joint network is simplified as a two-mode network that allows us to study the co-occurrence of drivers (in red) across regime shifts (in blue). Driver a is shared by regime shifts 1 and 2, but driver b is not. The response variable matrix counts the number of drivers shared by all pairwise combinations of regime shifts. For domino effects, two regime shift networks are joined together, where driver c in regime shift 2 is also part of a feedback process in regime shift 1, creating a one-way dependency (orange link) between the two regime shifts. The response variable matrix counts all the one-way causal

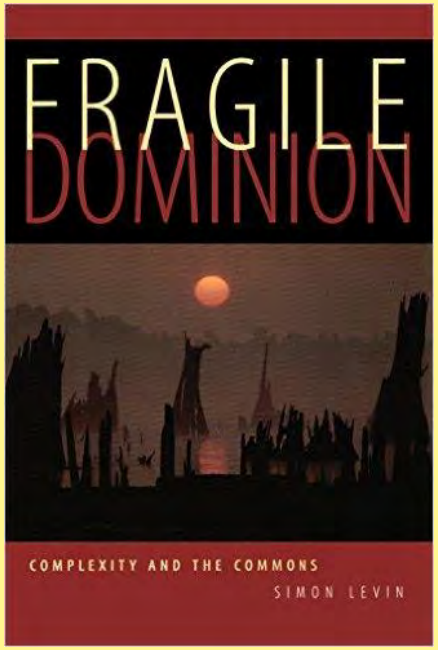
So how can we make our systems robust as we face these challenges?

Techcrunch.com

What leads to robustness in complex adaptive systems?



license.cae.uwm.edu/rube

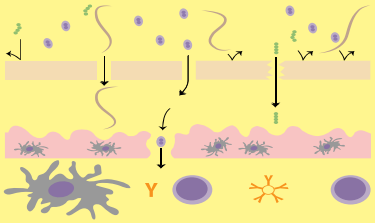


Seiganto-ji, 593 C.E.

Image credit Natee.Chalermtiragool/Shutterstock.com

First Buddhist Temple in Japan

Long-lived systems in nature and society share common principles…

Natural systems		Social systems		Business systems	
 Human immune system		ALMA MATER STUDIORUM UNIVERSITÀ DI BOLOGNA	>900 yrs	株式会社金剛組 Kongō Gumi	>1400 yrs[1]
		UNIVERSITY OF OXFORD	>800 yrs	MARINELLI	>900 yrs
 Forest ecosystem		 Western Roman Empire	>600 yrs	Weihenstephan	>900 yrs
		 Han Dynasty	>400 yrs	STORAENSO	>600 yrs

BCG: Ueda, Reeves, Levin

NEWS & VIEWS

Nature 2008

COMPLEX SYSTEMS

Ecology for bankers

Robert M. May, Simon A. Levin and George Sugihara

There is common ground in analysing financial systems and ecosystems, especially in the need to identify conditions that dispose a system to be knocked from seeming stability into another, less happy state.

'Tipping points', 'thresholds and breakpoints', 'regime shifts' — all are terms that describe the flip of a complex dynamical system from one state to another. For banking and other financial institutions, the Wall Street Crash of 1929 and the Great Depression epitomize such an event. These days, the increasingly complicated and globally interlinked financial markets are no less immune to such system-wide (systemic) threats. Who knows, for instance, how the present concern over sub-prime loans will pan out?

Well before this recent crisis emerged, the US National Academies/National Research Council and the Federal Reserve Bank of New York collaborated[1] on an initiative to "stimulate fresh thinking on systemic risk". The main event was a high-level conference held in May 2006, which brought together experts from various backgrounds to explore parallels between systemic risk in the financial sector and in selected domains in engineering, ecology and other fields of science. The resulting report[1] was published late last year and makes stimulating reading.

Catastrophic changes in the overall state of a system can ultimately derive from how it is organized — from feedback mechanisms within it, and from linkages that are latent and often unrecognized. The change may be initiated by some obvious external event, such as a war, but is more usually triggered by a seemingly minor happenstance or even an unsubstantial rumour. Once set in motion, however, such changes can become explosive and afterwards will typically exhibit some form of hysteresis, such that recovery is much slower than the collapse. In extreme cases, the changes may be irreversible.

As the report[1] emphasizes, the potential for such large-scale catastrophic failures is widely applicable: for global climate change, as the greenhouse blanket thickens; for 'ecosystem services', as species are removed; for fisheries, as stocks are overexploited; and for electrical grids or the Internet, as increasing demands are

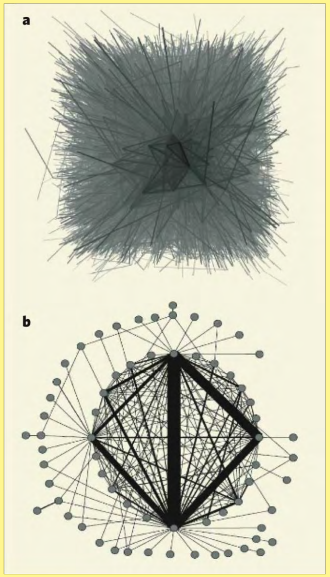


Figure 1 | The Fedwire interbank payment network. a, This 'furball' depiction takes in thousands of banks and tens of thousands of links representing US$1.2 trillion in daily transactions. **b,** The core of the network, with 66 banks accounting for 75% of the daily value of transfers, and with 25 of the banks being completely connected. Every participating bank, and every transaction, in the full network is known (akin to an ecologist knowing all species in an ecosystem, and all flows of energy and nutrients). So the behaviour of the system can be analysed in great detail, on different timescales and, for example, in response to events such as 9/11. (Reproduced from ref. 9.)

that enhance stability against inevitable minor

spent on studying systemic risk as compared with that spent on conventional risk management in individual firms? Second, how expensive is a systemic-risk event to a national or global economy (examples being the stock market crash of 1987, or the turmoil of 1998 associated with the Russian loan default, and the subsequent collapse of the hedge fund Long-Term Capital Management)? The answer to the first question is "comparatively very little"; to the second, "hugely expensive".

An analogous situation exists within fisheries management. For the past half-century, investments in fisheries science have focused on management on a species-by-species basis (analogous to single-firm risk analysis). Especially with collapses of some major fisheries, however, this approach is giving way to the view that such models may be fundamentally incomplete, and that the wider ecosystem and environmental context (by analogy, the full banking and market system) are required for informed decision-making. It is an example of a trend in many areas of applied science acknowledging the need for a larger-system perspective.

But to what extent can study of ecosystems inform the design of financial networks in, for instance, their robustness against perturbation? Ecosystems are robust by virtue of their continued existence. They have survived eons of change — continental drift, climate fluctuations, movement and evolution of constituent species — and show some remarkable constancies in structure that have apparently persisted for hundreds of millions of years: witness, for example, the constancy in predator–prey ratios in different situations[2]. Identifying structural attributes shared by these diverse systems that have survived rare systemic events, or have indeed been shaped by them, could provide clues about which characteristics of complex systems correlate with a high degree of robustness.

An example of this kind emerges from work on the network structure of communities of

2008

COMPLEX SYSTEMS

Ecology for bankers

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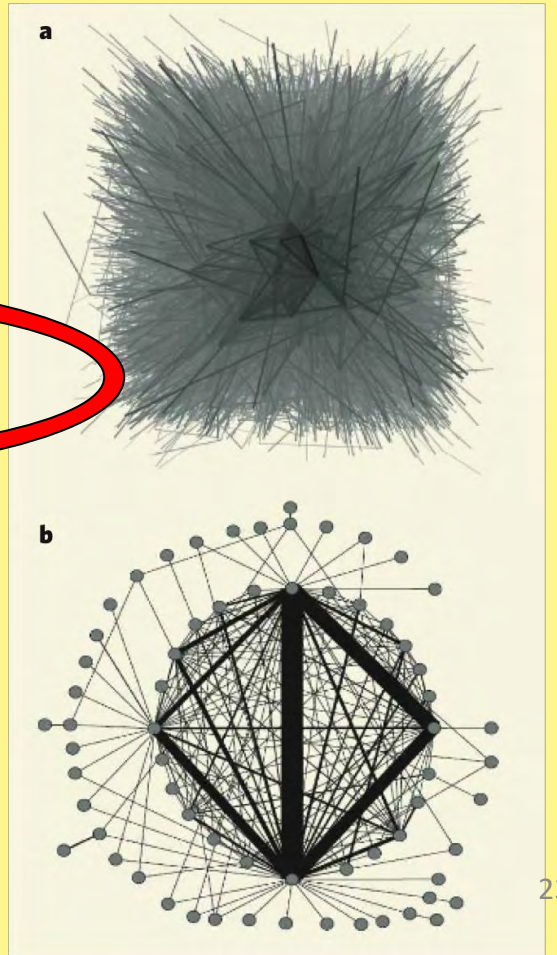

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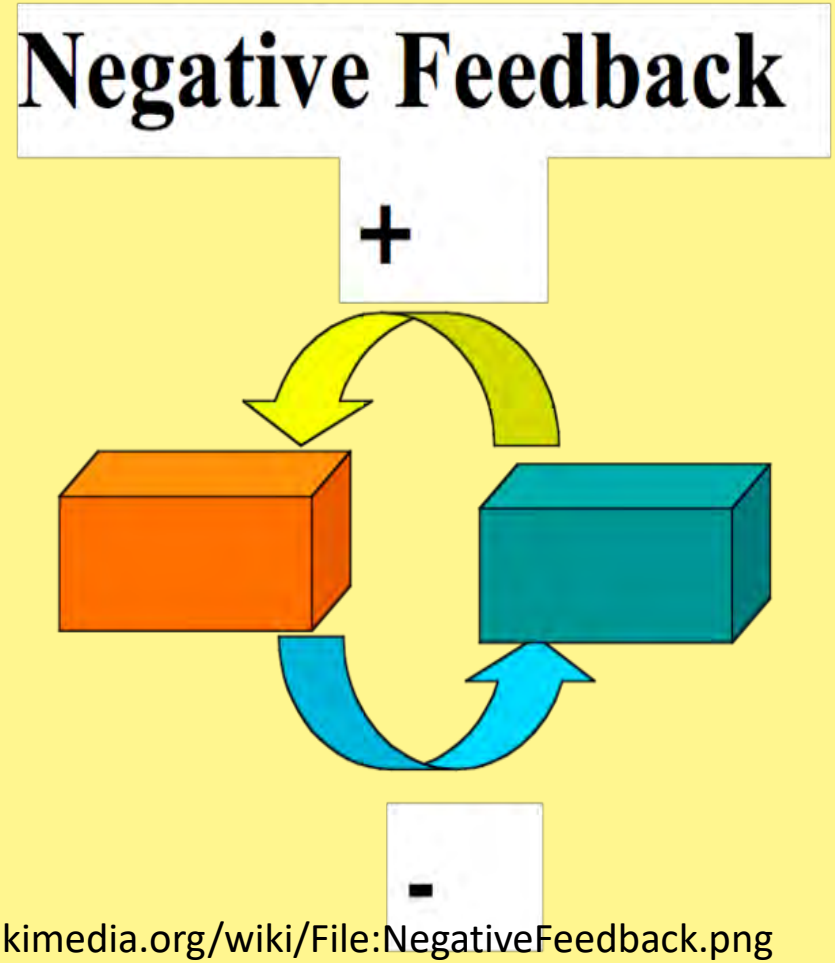
We can learn a great deal from Nature about how to respond to extreme events

- What leads to robustness/resilience in natural systems?
- What mechanisms have emerged from natural selection and self-organization?

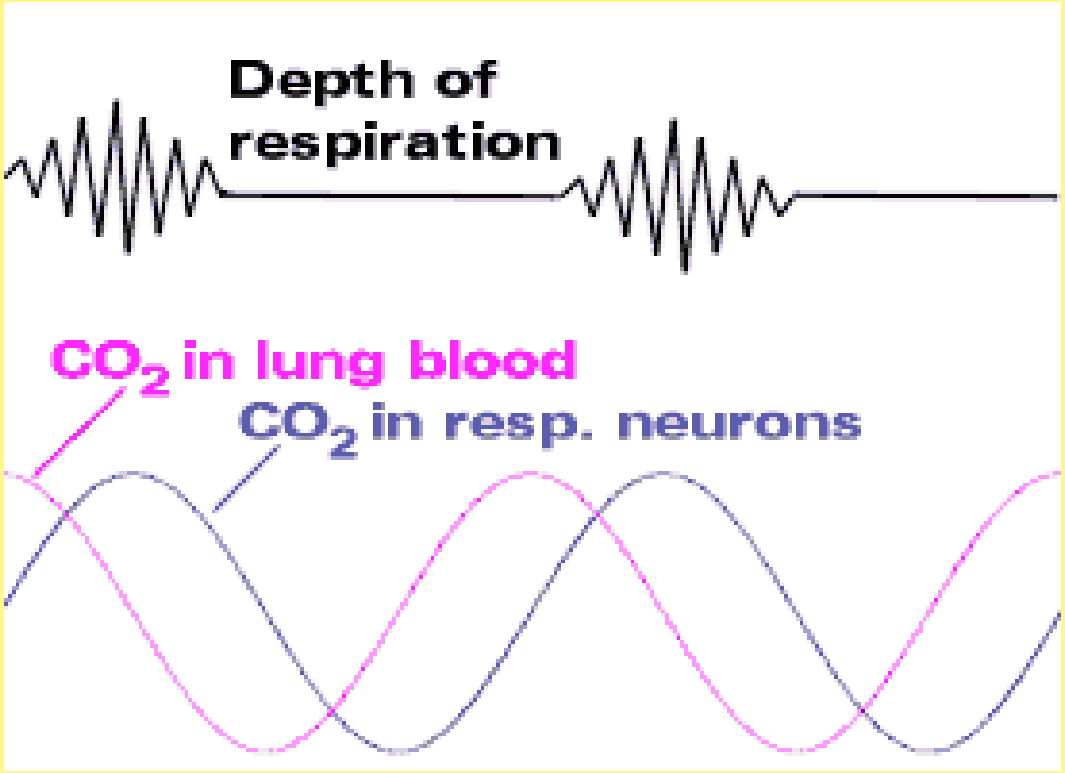
Robust regulation depends on feedbacks..on the right scale



http://commons.wikimedia.org/wiki/File:NegativeFeedback.png

Cheyne-Stokes breathing:

Medullary respiratory center loses sensitivity to pCO_2 fluctuations



https://primumn0nn0cere.wordpress.com/2010/07/01/cheyne-stokes-respirations/

Regulatory mismatches

Opinion: A new approach to financial regulation

Simon A. Levin[a,1] **and Andrew W. Lo**[b]

[a]*Department of Ecology and Evolutionary Biology and Center for BioComplexity, Princeton Environmental Institute, Princeton University, Princeton, NJ 08544-1003; and* [b]*Laboratory for Financial Engineering, Massachusetts Institute of Technology Sloan School of Management, Cambridge, MA 02142*

It has been five years since the US Congress enacted the landmark Dodd–Frank Wall Street Reform and Consumer Protection Act; and despite the fact that about 20% of the Act has yet to be implemented (1), several legislative initiatives are now attempting to soften or roll back key provisions. This pattern of regulatory action and reaction is not new. The financial excesses of one period often lead to asset bubbles that burst, ushering in a new period of much greater regulation. This, in turn, is systematically weakened over time as markets recover and we forget the reasons why we imposed such stringent regulations in the first place. Even before Dodd–Frank, the financial industry was among the most highly regulated of industries in the world. However, the many layers of regulation and multiple regulatory agencies were insufficient to prevent financial crisis. Why?

We propose that the financial system has crossed a threshold of complexity where the system is evolving faster than regulators and regulations can keep pace. For example, the system is now truly globally connected, but coordination across sovereign jurisdictions is difficult to achieve. This new situation calls for a new perspective, one based on a different paradigm than the ones on which financial regulation is currently based, such as efficient markets, rational expectations, and models patterned after the physical sciences.

The challenge of complexity is not unique to finance but applies as well to other human endeavors, including the management of environmental systems, international relations, cyberterrorism, and bioterrorism. In some cases, this challenge has been met successfully by implementing perspectives and methods from evolutionary biology, game theory, and complex systems theory, in partnership with domain experts in each field of application.

These ideas have generally not been applied to financial regulation, despite a National Research Council report on systemic risk that was cosponsored by the Federal Reserve Bank of New York and the National Academy of Sciences to encourage such partnerships (2), and sympathetic perspectives by prominent regulatory insiders (3, 4). Evolutionary principles have, of course, been applied to many economic contexts, but they have had little impact to date on financial regulation. Here, we advocate changing the regulatory ecosystem by proposing collaboration among experts in various disciplines and professions.

Biological systems have faced a range of challenges throughout evolutionary history, and this has led to solutions that are adaptive, hierarchical, modular, and with sufficient redundancy to minimize the chances of collapse. We can learn a great deal from biological systems in designing new regulatory frameworks for financial systems, which face similar challenges. We do not

Our financial system is arguably on shaky ground. Could principles from biology and ecology inspire better ways to maintain stability? Image courtesy of Dave Cutler.

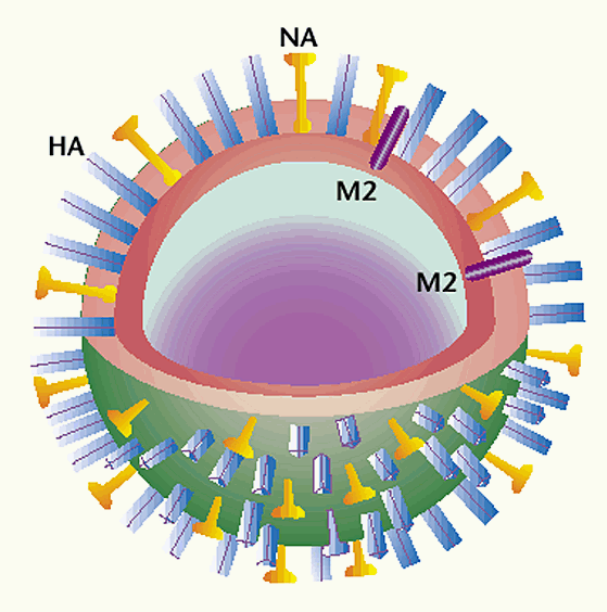
Author contributions: S.A.L. and A.W.L. wrote the paper.

[1]To whom correspondence should be addressed. Email: slevin@princeton.edu.

In evolution, unpredictability is both challenge and opportunity

More generally, unpredictability is the most predictable feature of future environments.

- Societies must be adaptive



Nature Medicine **5**, 1119 - 1120 (1999)
doi:10.1038/13436 **What are the prospects for a universal influenza vaccine?**
Edwin D. Kilbourne

Achieving robustness in CAS: multiple pathways

- Rigid design and robust components

Achieving robustness in CAS: multiple pathways

- Rigid design and robust components
- Flexible design or replaceable components

Tradeoffs in achieving robustness/resilience

- Rigid design may work best over short time scales, or in relatively constant environments

Tradeoffs in achieving robustness/resilience

- Rigid design may work best over short time scales, or in relatively constant environments

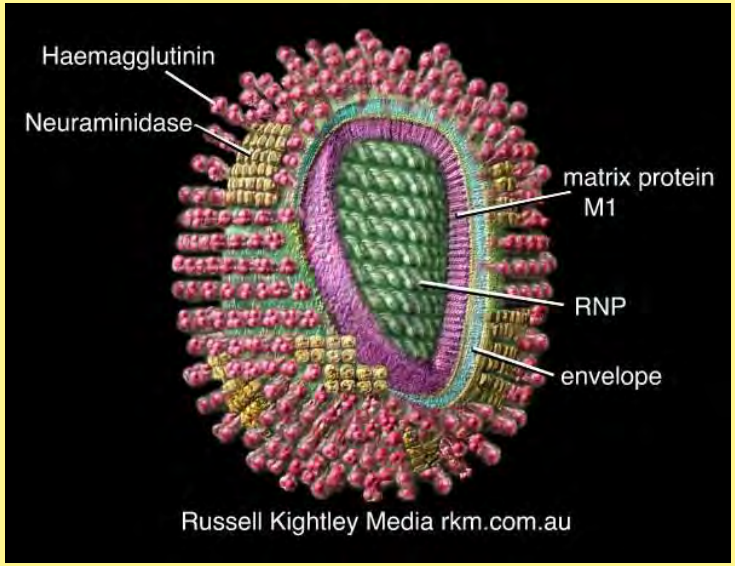
- Flexible design may work best over long time scales, or in fluctuating environments

In changing environments: Must keep running just to stay in place

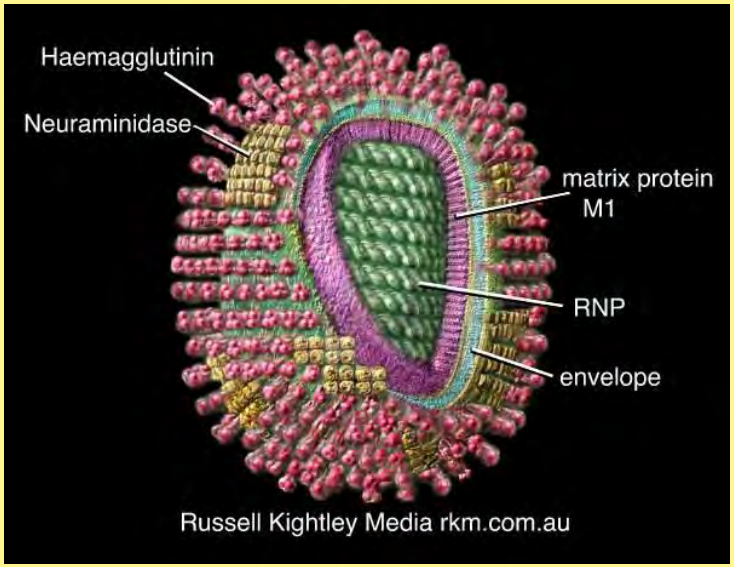
myweb.tiscali.co.uk/greavesandthomas

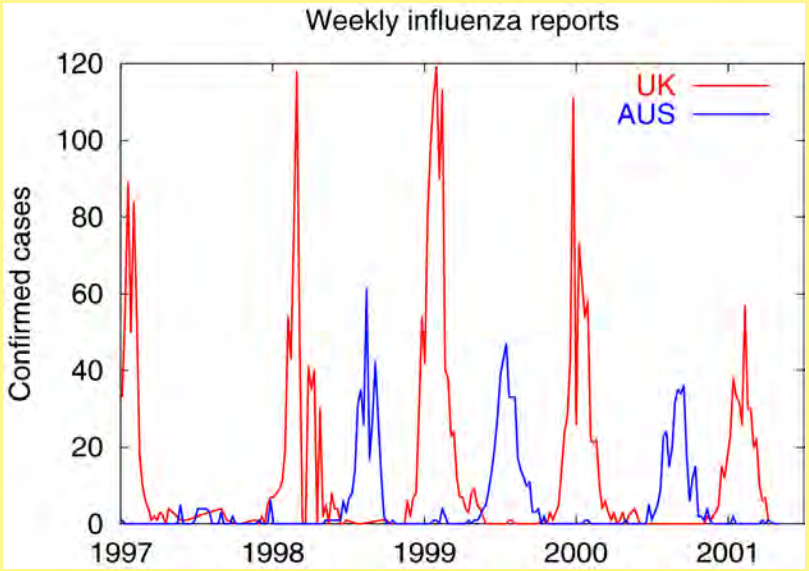
Hence

- Achieving robustness at one level may require overcoming robustness at another level



Influenza A is robust because the individual strains replace one another





Key Features of Robustness

Diversity and Heterogeneity

provide adaptive capacity

seedworld.com

Redundancy and pandemic

- Stockpiles of materials
- Multiple measures (quarantine, antivirals, vaccines, testing, contact tracing)
- Multiple producers and modes of distribution

theengineer.co.uk

Key Features of Robustness

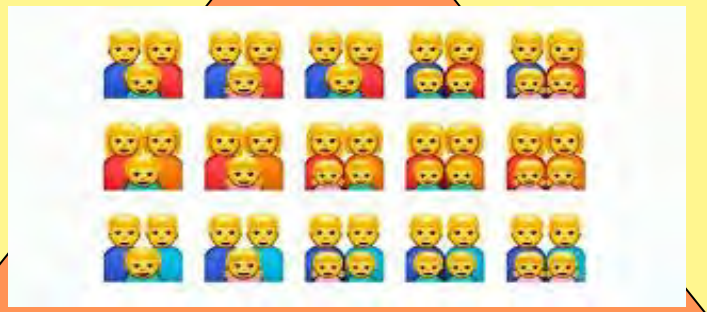
Diversity and Heterogeneity

Redundancy and Degeneracy

www.cbc.ca

Key Features of Robustness

Diversity and Heterogeneity



blogs.brighton.ac.uk

Redundancy and Degeneracy

Modularity

(*Compartmentalization /Social distancing*)

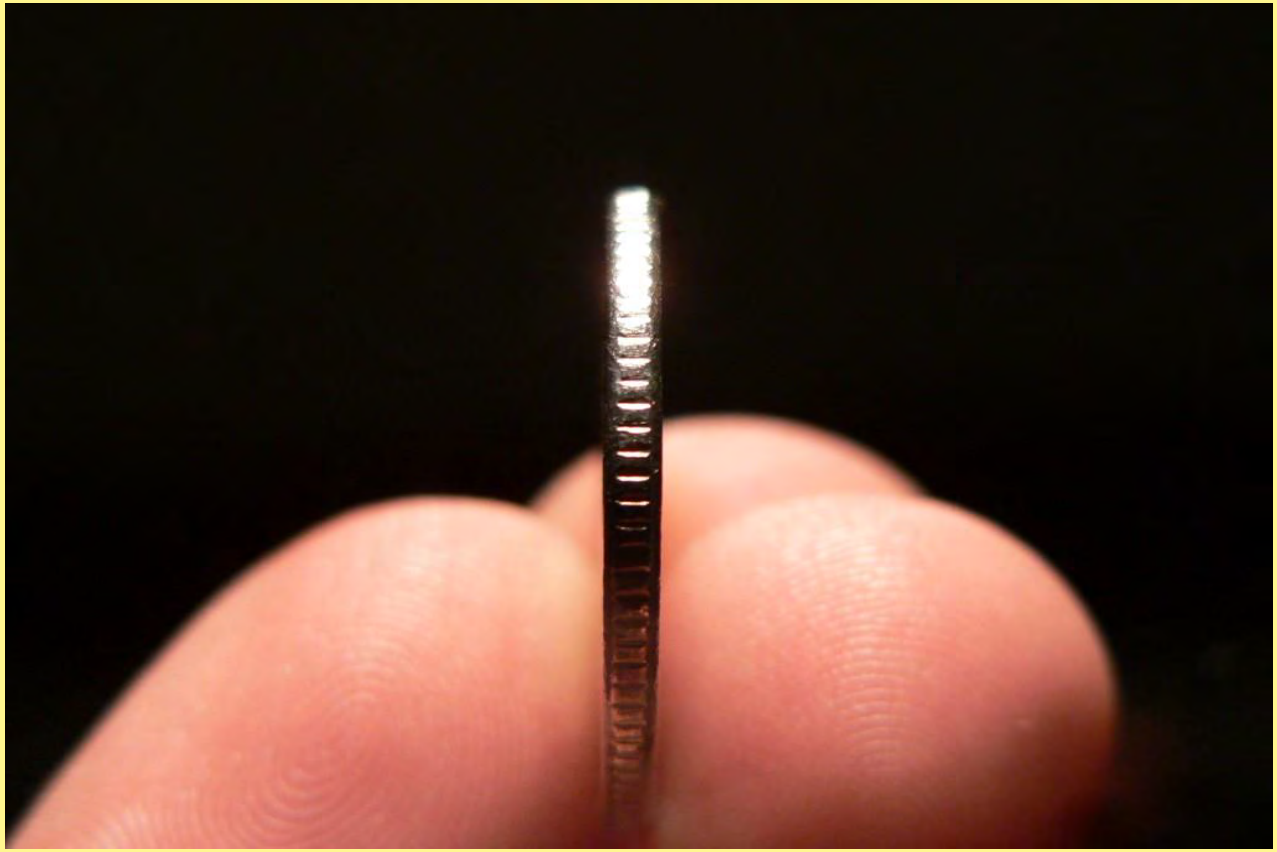
Ecosystems and the Biosphere are Complex Adaptive Systems

Heterogeneous collections of individual units (agents) that interact locally, and evolve based on the outcomes of those interactions.

NOAA

So too are socio-economic systems

Indeed, ecology and economics are two sides of the same coin



http://ecoopportunity.net/2013/07/sustainability-and-innovation-two-sides-of-the-same-coin/

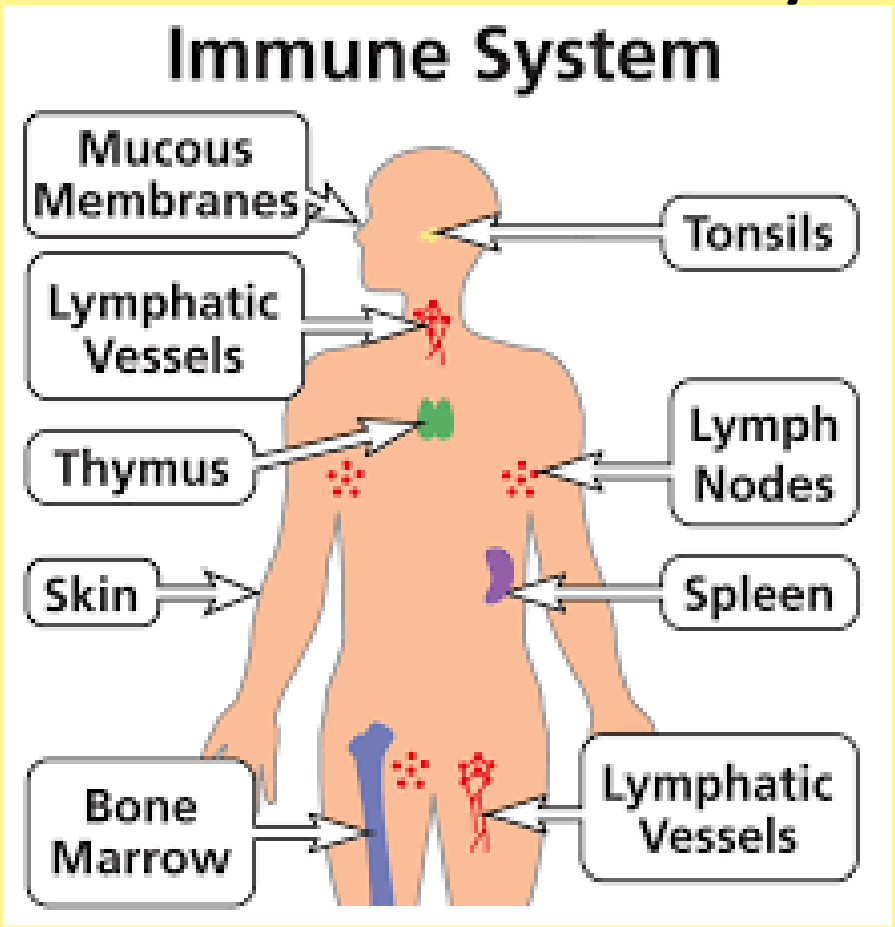
From microbial systems to socioeconomic systems, macroscopic patterns *emerge* from microscopic interactions

Claudo Carere
StarFLAG EU FP6 project

Features of CAS

- Multiple spatial, temporal and organizational scales
- Self-organization, and consequent unpredictability
- Multiple stable states, path dependence, hysteresis
- Contagious spread and systemic risk
- Potential for destabilization and regime shifts through slow-time-scale evolution

To deal with unpredictable extreme events, vertebrates have evolved a hierarchical immune system



Aidsinfo.nih.gov

Vertebrate immune system

- Threats: Viruses, bacteria
- Recognition: Innate immune system, cytokines
- Generalized rapid response: Macrophages, physical barriers, inflammation, interferons
- Specialized adaptive response: Lymphocytes (T cells, B cells), Antibodies
- Memory: Memory B-cells, Antibodies

Immune systems for financial systems and societies

Ω ηατ χαν Μοτηερ Νατυρε τεαχη υσ αβουτ μ ανα γινγ φ ννχι αλ σψστεμσ ?

What can Mother Nature teach us about managing nancial systems?

Like ecosystems, nancial markets are complex evolving systems from which unexpected bubbles, crashes, and other surprising behaviors can emerge. Building resilient nancial systems may require policymakers to take cues from biology.

Santa Fe Institute Follow
Apr 5, 2018 · 9 min read

By Simon Levin, Princeton University and Santa Fe Institute Andrew Lo, Massachusetts Institute of Technology

Originally appeared in Christian Science Monitor, August 22, 2016 as part of a continuing series about complexity science by the Santa Fe Institute and The Christian Science Monitor, generously supported by Arizona State University.

Like ecosystems, financial markets are complex evolving systems from which unexpected bubbles, crashes, and other surprising behaviors can

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Christian Science Monitor

5/16/2020 What can Mother Nature teach us about managing financial systems?

https://medium.com/@sfiscience/what-can-mother-nature-teach-us-about-managing-financial-systems-7b5f1fa6a35 1/14

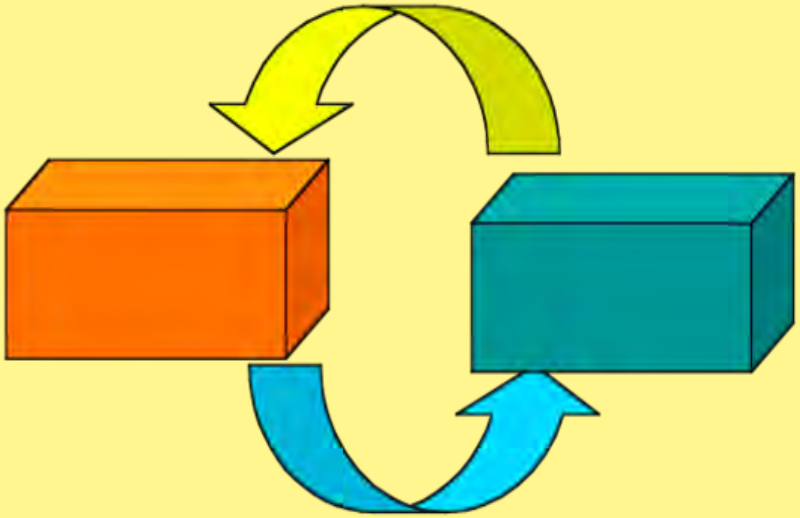
We need an immune system for dealing with pandemics and other challenges

- Preparedness
- Early generalized responses (quarantine) that buy time
- Development of antigen-specific responses (vaccines)
- Attention to over-response (cytokine storms)
  - Adequate planning for reopening
- Collective action

Dealing with global problems, like the pandemic

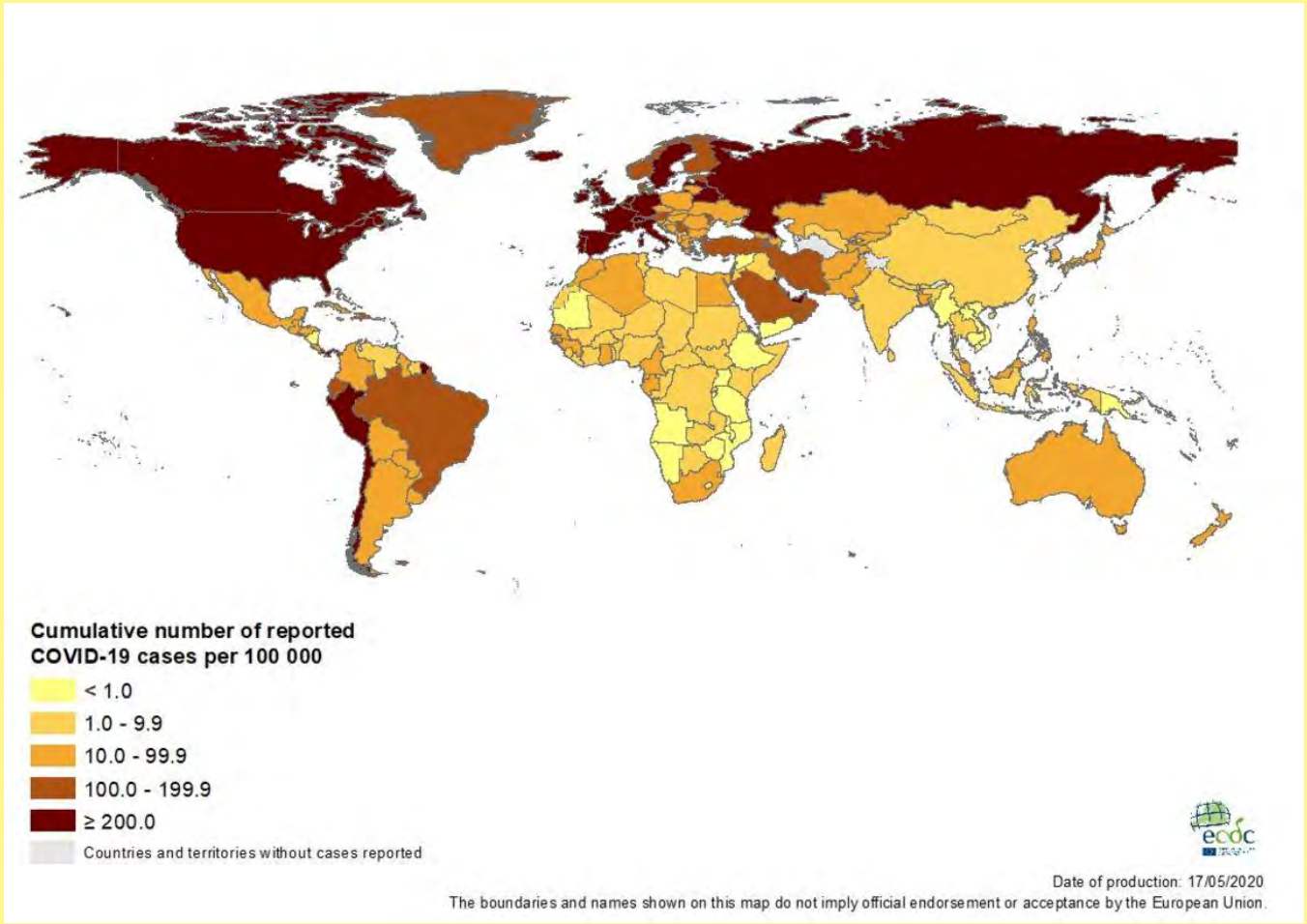
- Measures for robustness must be invoked at multiple levels of organization
  - Individuals
  - Societies
  - Globe

Local measures, like testing and contact tracing will be essential, providing feedback



http://commons.wikimedia.org/wiki/File:NegativeFeedback.png

So too will be collective action

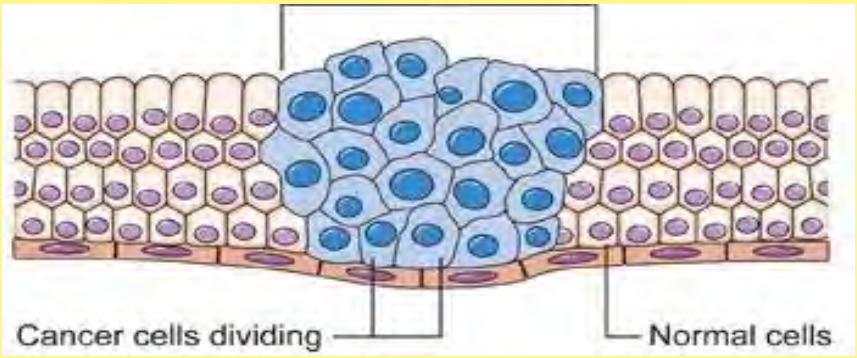


https://www.ecdc.europa.eu/en/geographical-distribution-2019-ncov-cases

May 17, 2020

Public goods problems demand cooperative solutions

Patrick Semansky/AP



http://www.cancerresearchuk.org/

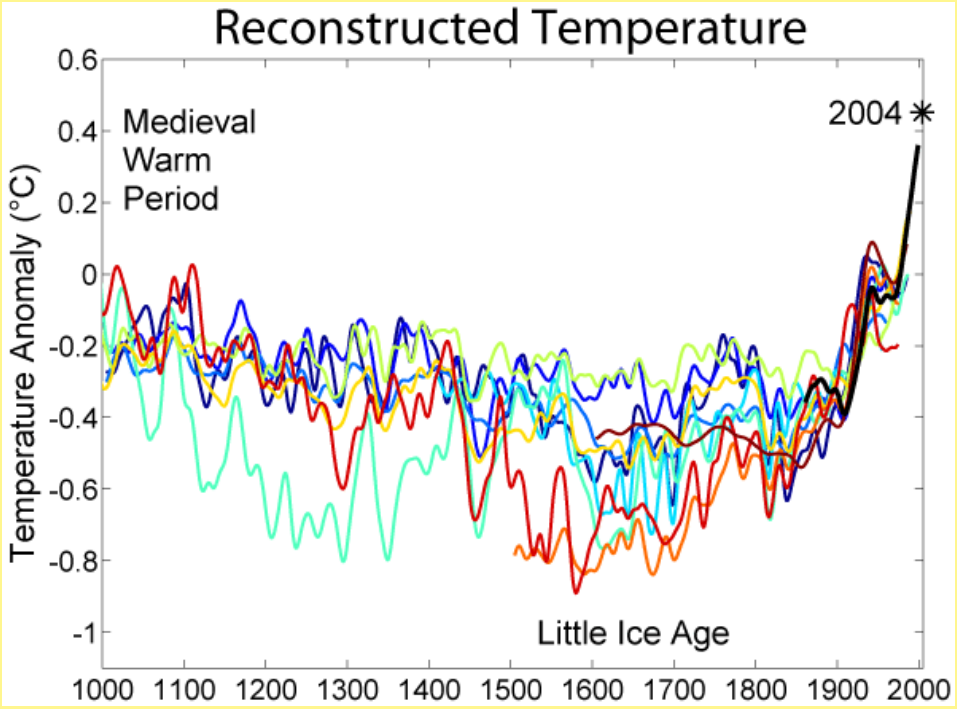
The Commons solution (Hardin, Ostrom)

"Mutual coercion, mutually agreed upon"

http://www.physics.ohio-state.edu/~wilkins

http://www.guardian.co.uk

Scientific consensus is strong regarding climate change



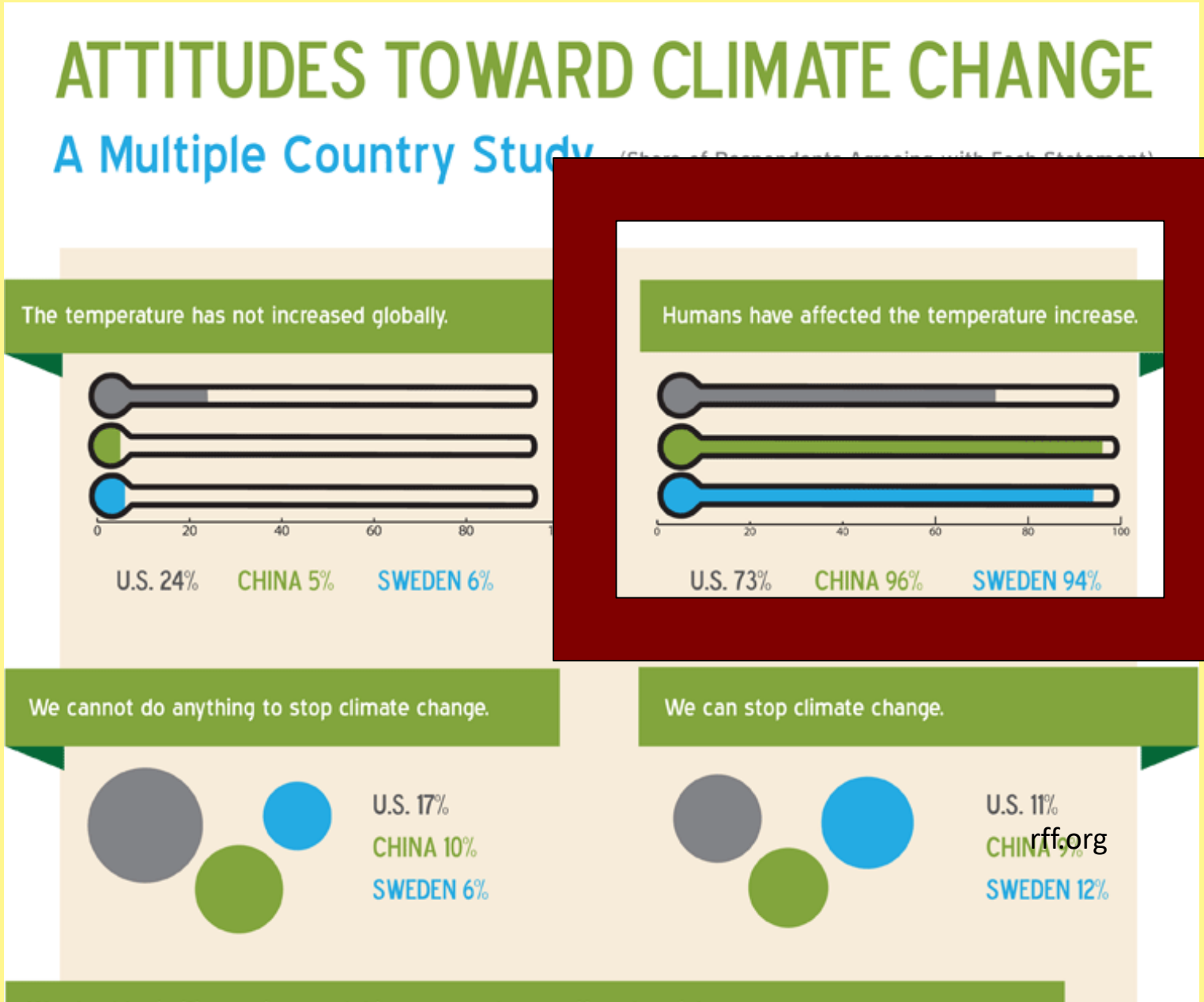
Robert Rohde, for Global Warming Art

But adequate action to address them has been lacking

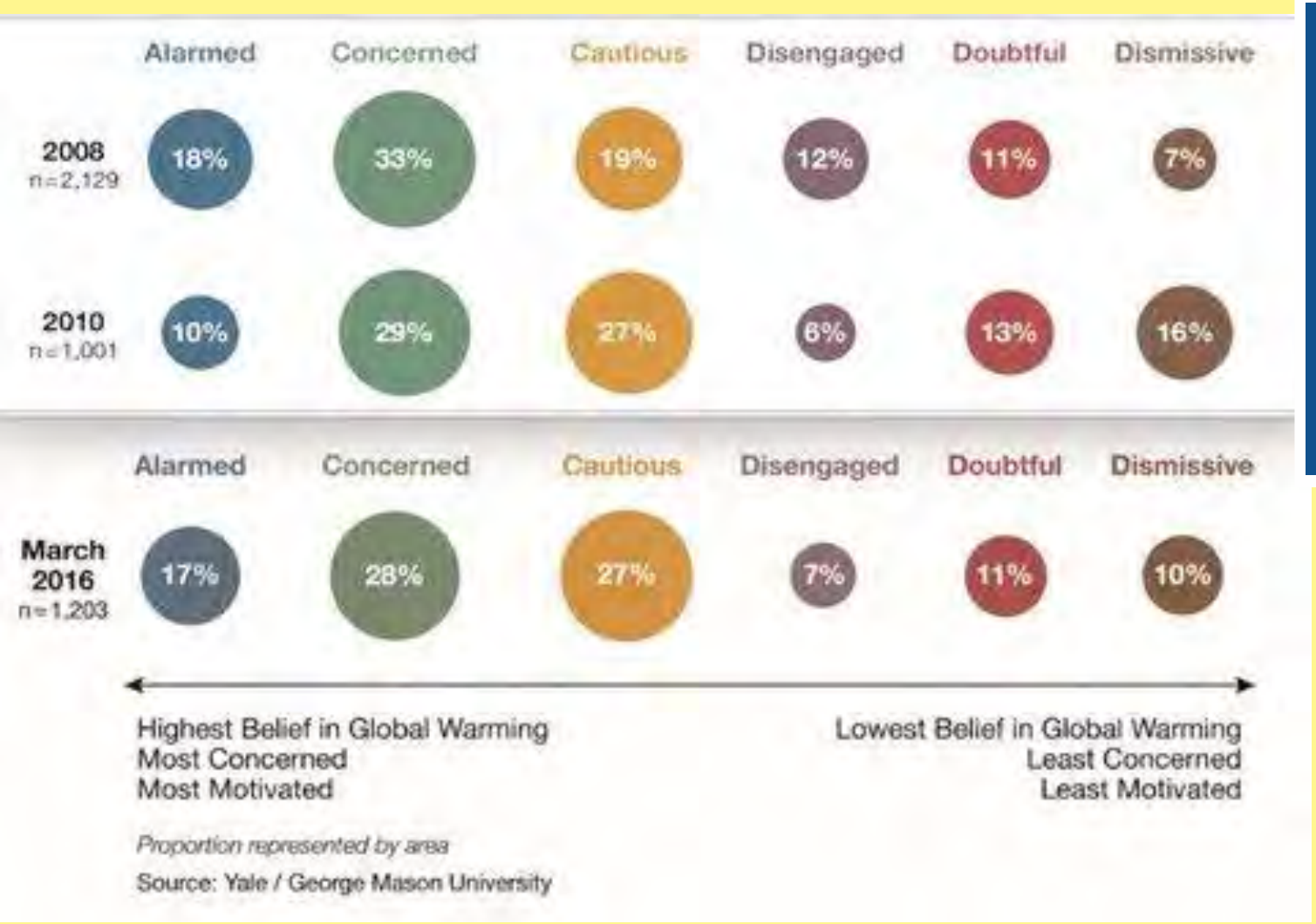
- Primary limitations to solutions not scientific knowledge, but rather
- Willingness of people and governments to commit to the common good
- And to cooperate in finding solutions that benefit all

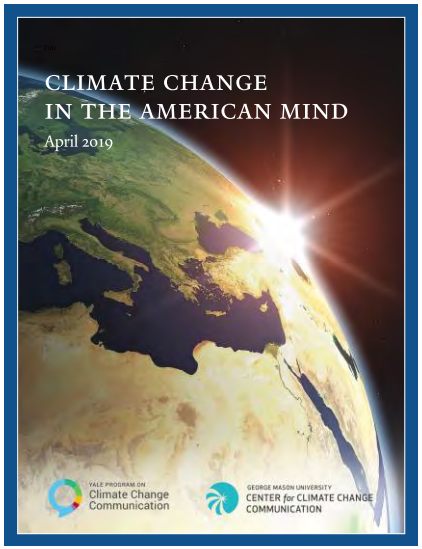
www.edie.net

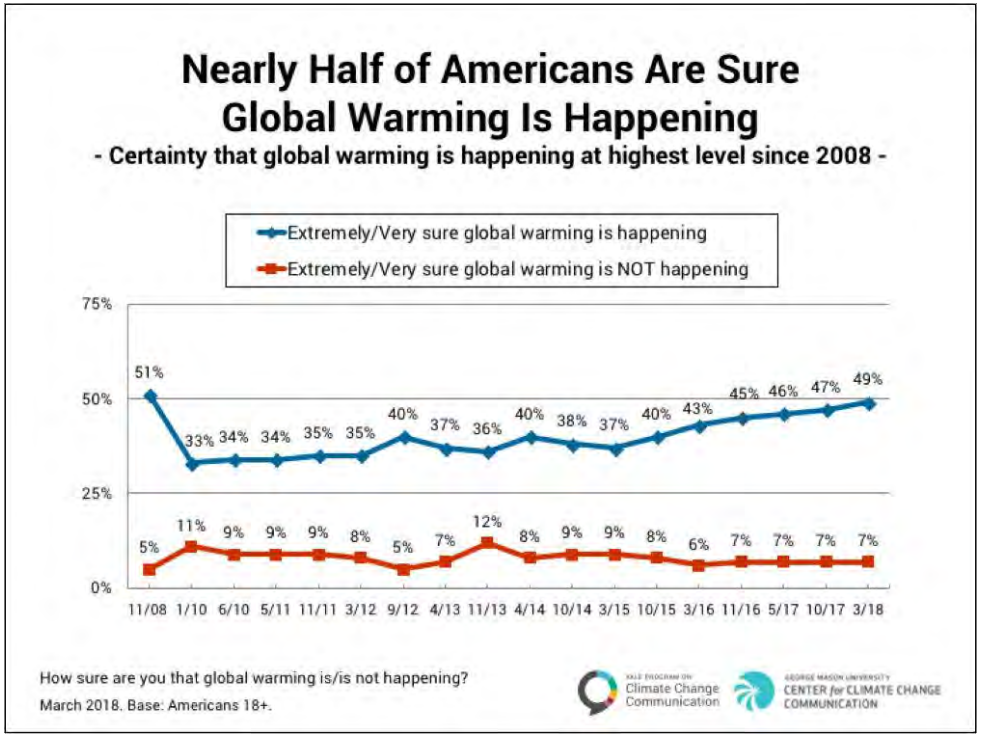
RFF


ATTITUDES TOWARD CLIMATE CHANGE
A Multiple Country Study
The temperature has not increased globally.
0
20
40
60
80
U.S. 24%
CHINA 5%
SWEDEN 6%
Humans have affected the temperature increase.
0
20
40
60
80
100
U.S. 73%
CHINA 96%
SWEDEN 94%
We cannot do anything to stop climate change.
U.S. 17%
CHINA 10%
SWEDEN 6%
We can stop climate change.
U.S. 11%
CHINA 9%
SWEDEN 12%

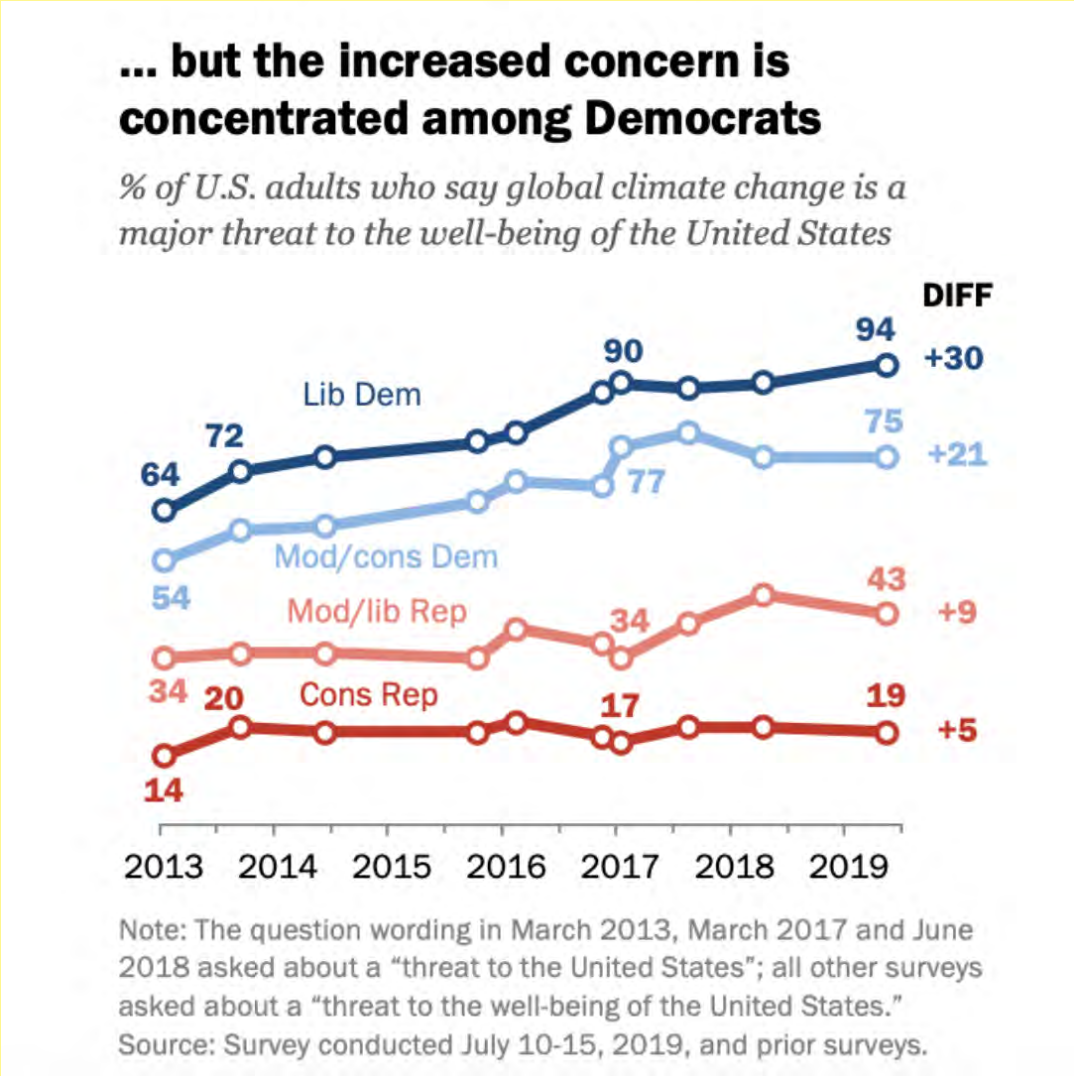
rff.org


Alarmed
Concerned
Cautious
Disengaged
Doubtful
Dismissive
2008
n=2,129
18%
33%
19%
12%
11%
7%
2010
n=1,001
10%
29%
27%
6%
13%
16%
Alarmed
Concerned
Cautious
Disengaged
Doubtful
Dismissive
March
2016
n=1,203
17%
28%
27%
7%
11%
10%
Highest Belief in Global Warming
Most Concerned
Most Motivated
Lowest Belief in Global Warming
Least Concerned
Least Motivated
Proportion represented by area
Source: Yale / George Mason University


CLIMATE CHANGE
IN THE AMERICAN MIND
April 2019
Climate Change Communication
CENTER for CLIMATE CHANGE COMMUNICATION


Nearly Half of Americans Are Sure Global Warming Is Happening
- Certainty that global warming is happening at highest level since 2008 -
Extremely/Very sure global warming is happening
Extremely/Very sure global warming is NOT happening
75%
50%
25%
0%
51% 33% 34% 34% 35% 35% 40% 37% 36% 40% 38% 37% 40% 43% 45% 46% 47% 49%
5% 11% 9% 9% 9% 8% 5% 7% 12% 8% 9% 9% 8% 6% 7% 7% 7% 7%
11/08 1/10 6/10 5/11 11/11 3/12 9/12 4/13 11/13 4/14 10/14 3/15 10/15 3/16 11/16 5/17 10/17 3/18
How sure are you that global warming is/is not happening?
March 2018. Base: Americans 18+.
Climate Change Communication
CENTER for CLIMATE CHANGE COMMUNICATION

July 2019



https://www.pewresearch.org/fact-tank/2019/08/28/u-s-concern-about-climate-change-is-rising-but-mainly-among-democrats/ Courtesy, Steve Pacala

Public Health Challenges raise a suite of public goods problems

- Antibiotic use

SURGICAL PERSPECTIVE

Antibiotic Overuse: The Influence of Social Norms

The McDonnell Norms Group

Since the introduction of penicillin in the 1940s, antibiotics ("antibiotics" refers to antibacterial and antifungal drugs) have become ubiquitous. Many infectious diseases that used to pose immediate threats to human life are now readily treated.

This widespread use of antibiotics has led to at least two undesirable consequences. One consequence includes unpleasant and occasionally lethal side effects resulting from changes in the normal microbial flora. For example, many women experience vaginal yeast overgrowth consequent to treatment of respiratory and urinary infections with conventional antibiotics. A more serious problem is the recent epidemic of antibiotic-associated intestinal infections caused by *Clostridium difficile*, which are becoming progressively more difficult to treat, can sometimes require surgical removal of the colon, and in some cases, lead to death.[1] This previously rare toxin-producing organism, now the most frequent enteric pathogen in the developed world, is able to proliferate to clinically problematic levels as a result of the disturbance of the ecological balance of the microbes of the colon.

An undesirable consequence often reported on in news stories and much discussed in health care policy forums is the emergence of bacterial resistance: the evolution and spread of pathogenic strains that have lost susceptibility to the treating drugs. With the introduction of each new antibiotic, the biologic forces of random mutation and natural selection have led to the appearance of resistant strains that are sustained by continued use of the drugs. New strains of bacteria resistant to multiple classes of antibiotics have increased the risks of morbidity and mortality from hospital-acquired infections, resulting in correspondingly longer hospitals stays and higher treatment costs.[2] The appearance and persistence of resistant organisms has led to an arms race between medicinal chemistry and evolution: a never-ending need to develop and bring to market costlier new antibiotics to treat progressively more resistant infections.[3]

In the past, the problem of resistance was thought to be largely confined to hospitals and nursing homes. Recently, the proportion of community-acquired infections with bacteria resistant to conventional antibiotics has steadily increased.[4] In addition, longer life expectancies and the expansion of chronic care facilities have resulted in a new group of patients at risk of health care-associated infection, with rates between those of the community and of the hospital. The cost of treating these resistant infections has also increased, both in hospital and outpatient settings.[5]

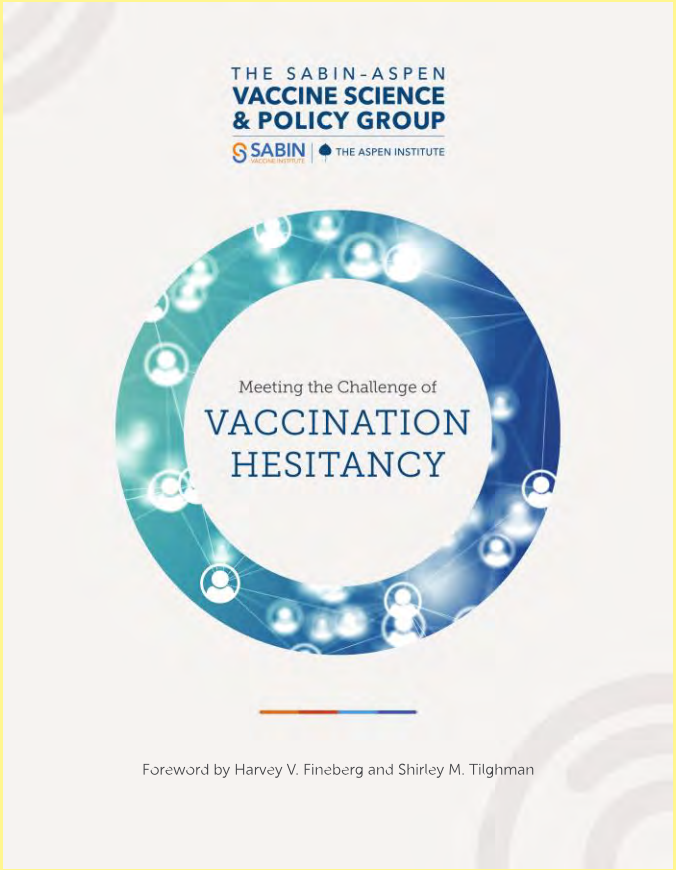
Two perspectives

Public health officers and epidemiologists recognize that the phenomenon of resistance is ecologic, so it is affected by behaviors and events remote in time and in distance.[6,7] For example, when antibiotics are administered to farm animals, the antibiotics themselves and the resistant bacteria for which they select may enter the food webs.[8] This entry may be direct, through milk and meat, or indirect, through runoff that contaminates the water supply. Resistant bacteria evolving in farm animals can spread to humans, and resistant genes can spread to bacteria responsible for human disease. In clinical settings, aggressive use of broad-spectrum antibiotics can favor the rapid emergence of resistant organisms that can spread within and between health care organizations. Although the use of antibiotics in each of these settings is well intentioned, at least some of the antibiotic use comes about as a response to choices made concerning farm management (animal overcrowding) and inconsistencies in health care hygiene (failure to properly hand wash).

Local practices can quickly create regional challenges. Modern transportation systems convey asymptomatic carriers of resistant organisms. They travel in confined spaces that favor transmission. Livestock transport by truck and

Public Health Challenges raise a suite of public goods problems

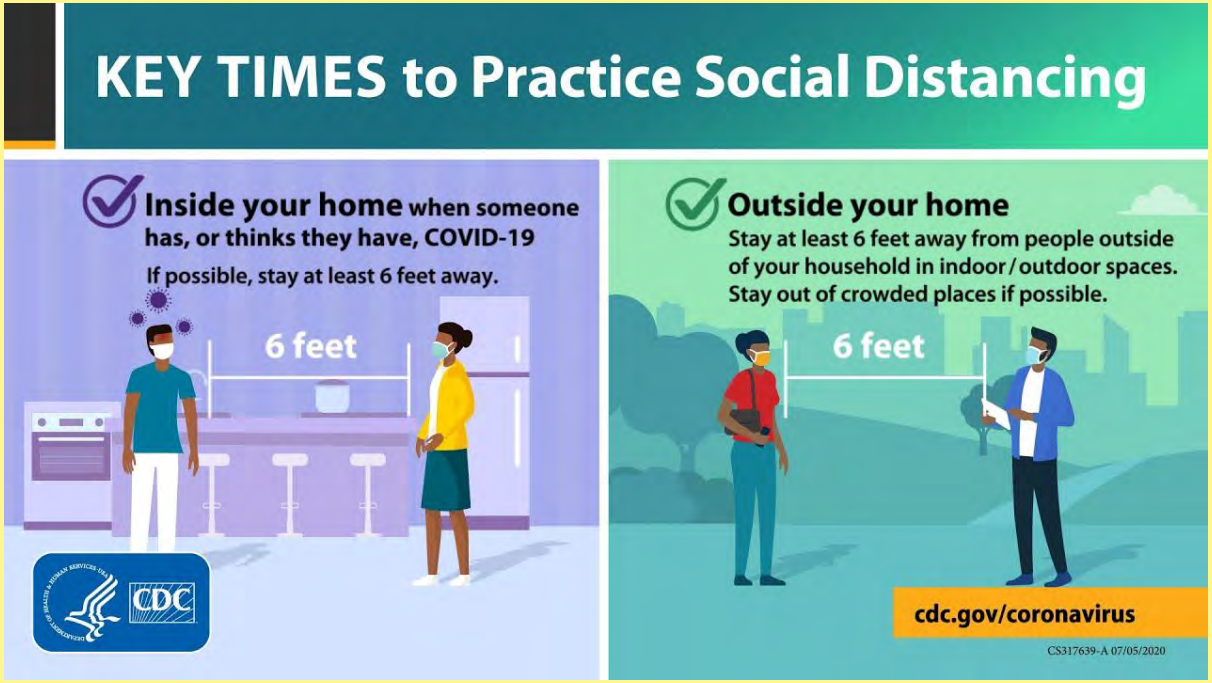
- Antibiotic use
- Vaccine hesitancy



www.nursingworld.org

Public Health Challenges raise a suite of public goods problems

- Antibiotic use
- Vaccine hesitancy
- Social Distancing

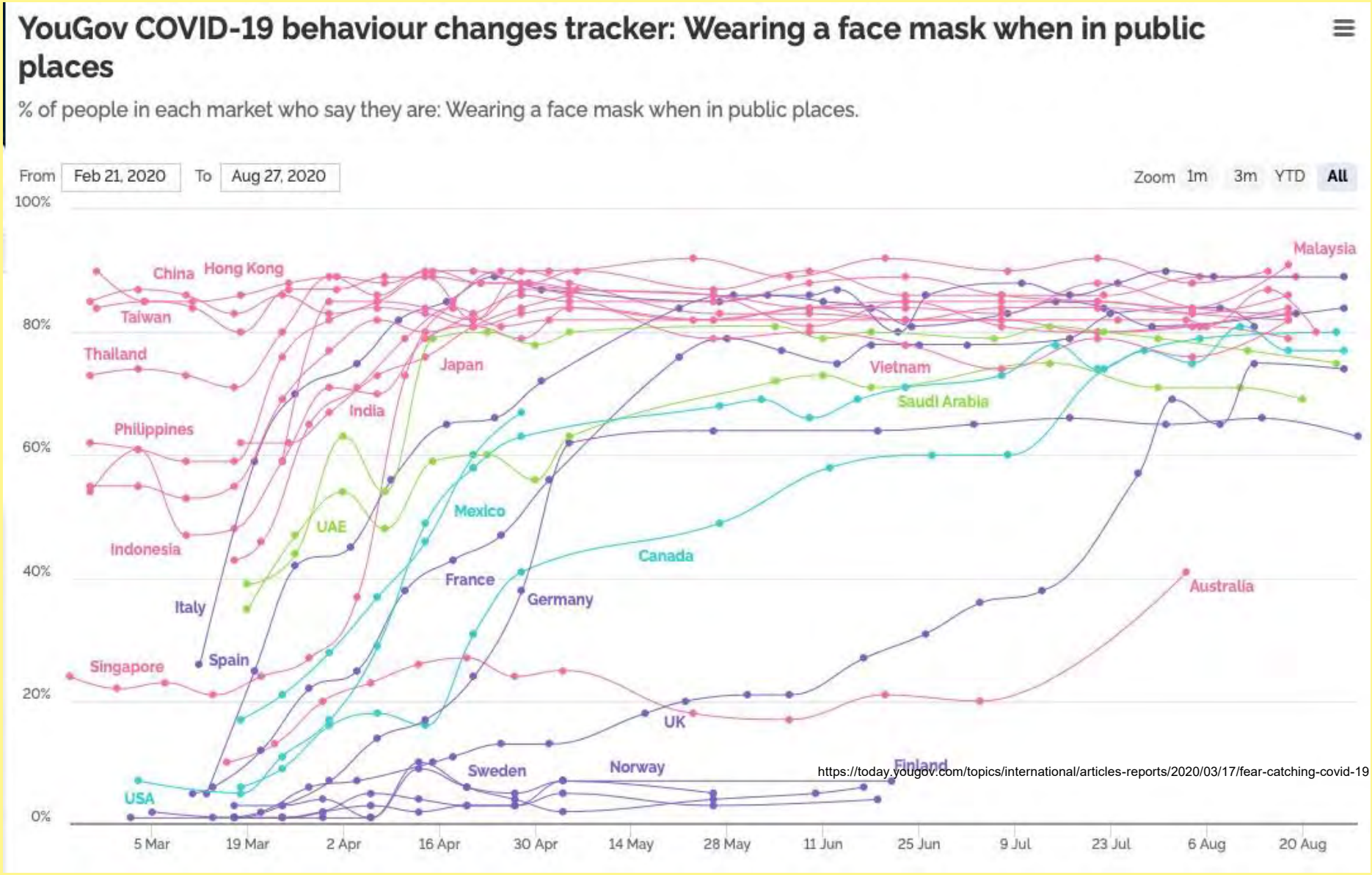


Public Health Challenges raise a suite of public goods problems

- Antibiotic use
- Vaccine hesitancy
- Social Distancing
- Mask wearing
- Mask donations

Businessinsider.com.

Cultural and Political Influences are Crucial



Social norms can change rapidly

- Attitudes towards
  - Smoking in public places
  - Racial equality
  - Gender equality
  - Climate change
  - Pandemic?

Foot-binding in China

theatlantic.com

COLLECTIVE ACTION

Social norms as solutions

Policies may influence large-scale behavioral tipping

By **Karine Nyborg, John M. Anderies, Astrid Dannenberg, Therese Lindahl, Caroline Schill, Maja Schlüter, W. Neil Adger, Kenneth J. Arrow, Scott Barrett, Stephen Carpenter, F. Stuart Chapin III, Anne-Sophie Crépin, Gretchen Daily, Paul Ehrlich, Carl Folke, Wander Jager, Nils Kautsky, Simon A. Levin, Ole Jacob Madsen, Stephen Polasky, Marten Scheffer, Brian Walker, Elke U. Weber, James Wilen, Anastasios Xepapadeas, Aart de Zeeuw**

Climate change, biodiversity loss, antibiotic resistance, and other global challenges pose major collective action problems: A group benefits from a certain action, but no individual has sufficient incentive to act alone. Formal institutions, e.g., laws and treaties, have helped address issues like ozone depletion, lead pollution, and acid rain. However, cooperation (*1*). Solutions can be specific to context (e.g., small-scale irrigated rice paddies in Nepal) and local in nature. Yet social norms can affect behavior on larger scales, e.g., cessation of smoking in public places (*2*, *3*), abandonment of foot-binding in China (*4*), and changed fertility norms (*4*)—all striking large-scale transformations of social (dis)approval and behavior.

to understanding social norm changes (*6*). Here, we try to integrate these views.

IS THERE A TIPPING POINT?

For vicious and virtuous behavioral cycles to arise, people must be more willing to choose a behavior the more widespread it is. The tipping point is where a vicious cycle turns into a virtuous one, or vice versa. Social, economic, and technical factors often invoke a need for people to coordinate their behavior. Striking cases are provided by network externalities, in which a good's value to the individual increases with the frequency of others consuming that same type of good. For example, if few own electric cars, charging stations are rare and few will buy electric cars; if most cars are electric, gas stations are rare, and few buy gas-fueled cars.

Similar coordination benefits occur in social life. Diet variation across countries cannot be fully explained by prices, incomes, and nutrition content (*7*); it appears that other forces, like norms, are involved. Differing diets make cooking shared meals cumbersome. If people tend to prefer the foods they are used to, sticking to the most common diet is convenient. The availability and quality of particular foods in stores and restaurants may increase with demand. Hence, if a less meat-intensive diet became the norm, individuals might conform partly owing to social pressure or a wish to be environmentally friendly; but a primary motive may simply be to enjoy pleasant and convenient joint meals.

When behavior is easily observable (e.g., smoking), social sanctioning can create tipping points. If norm followers sanction norm violators, the social sanctioning of violators increases as the share of followers grows (*2*). Other mechanisms inducing people to act like others include conditional cooperation—an often observed willingness to cooperate more when others cooperate

Globally, we will increasingly be challenged to deal with extreme events in the decades to come

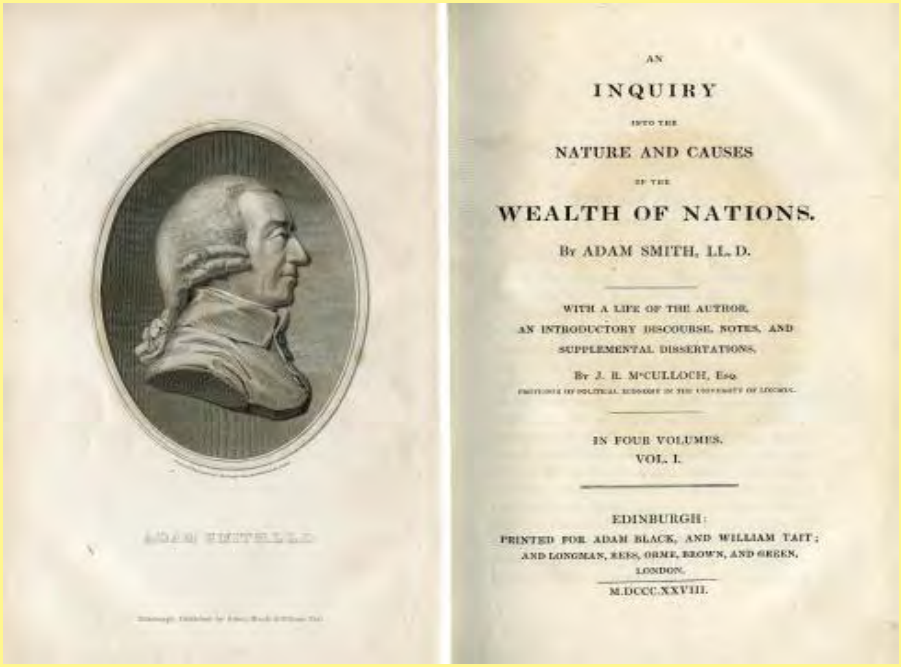
- Climatic
- Economic
- Cultural
- And others

Cooperation and collective action lead to robustness in complex societies

doyourownpestcontrol.com

Claudo Carere
StarFLAG EU FP6 project

More generally, evolutionary perspectives can inform understanding how we might respond to challenges



AN

INQUIRY

INTO THE

NATURE AND CAUSES

OF THE

WEALTH OF NATIONS.

By ADAM SMITH, LL.D.

WITH A LIFE OF THE AUTHOR,
AN INTRODUCTORY DISCOURSE, NOTES, AND
SUPPLEMENTAL DISSERTATIONS,

By J. R. M'CULLOCH, Esq.

IN FOUR VOLUMES.
VOL. I.

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AND LONGMAN, REES, ORME, BROWN, AND GREEN,
LONDON.
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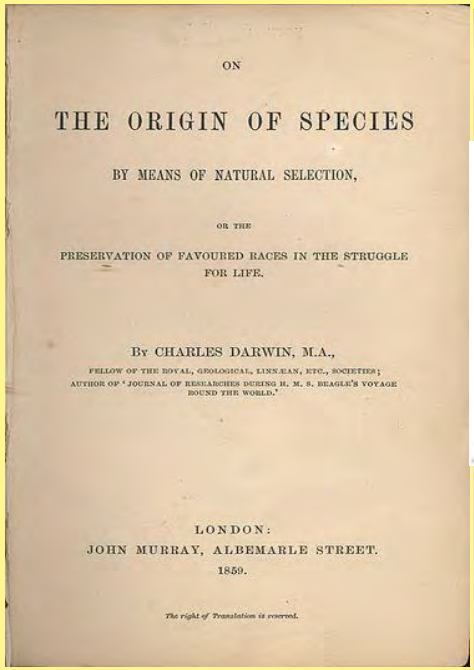

ON

THE ORIGIN OF SPECIES

BY MEANS OF NATURAL SELECTION,

OR THE

PRESERVATION OF FAVOURED RACES IN THE STRUGGLE
FOR LIFE.

By CHARLES DARWIN, M.A.,

LONDON:
JOHN MURRAY, ALBEMARLE STREET.
1859.

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www.neoformix.com

GREATER PHILADELPHIA

FUTURES GROUP

DIALOGUE. COLLABORATION. KNOWLEDGE-SHARING.

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

Futures Group Workshop Analysis

On Friday September 4, 2020, Connect the Dots joined DVRPC's Futures Group to collect data from participants that will inform planning for future meetings that contribute to long range planning.

Overview

After a discussion on complex systems in biology and economics by Dr. Simon Levin, participants were split into breakout groups of 5-7 people for a concentrated discussion. Due to a technical error, several of these groups were not able to complete the first portion of the exercises, but still had time to offer recommendations for DVRPC's consideration.

Exercise 1 focused on a discussion of Dr. Levin's lecture, and thoughts about what the future might look like in terms of solving some problems that face our region today. Participants were prompted with the following questions: How did we develop a process of inclusion? How did we tackle issues collectively? What did the discussion make you think about in terms of urban/regional systems? How did we adapt inclusively?

Exercise 2 asked participants to dig deeper and make direct recommendations for WHOM should be included in future conversations and WHAT topics should be addressed, as well as HOW to go about addressing some pressing issues that face our region.

Worksheets and Recommendations

Themes from Exercise 1:

People are equal parts optimistic and pessimistic. Groups wrestled with questions of power, reach, jurisdiction, and responsibility, and made suggestions for future divisions of power and planning that might be more appropriate and equipped for problem solving. Ideas about biology, evolution, and the course of nature were explored. One group focused on the idea of planners as LISTENERS, and on the importance of placing more value on listening and less on doing or inventing as planners. Connect the Dots was pleased to see an emphasis on the importance of

engagement, and recommendations to budget for more robust and inclusive engagement in more processes. One group remarked on increased efficiencies of government due to remote work, and the potential of more flexible hours in many fields.

Direct Recommendations from Exercise 2:

1. ***People to include***
    - Young People
    - Aging communities
    - Essential Workers
    - Rural Voices
    - Historians
    - Climate scientists
    - Anthropologists
    - Folks who recognize synergies between systems
    - People outside of politics
    - High level leaders
    - Highly Diverse panels
    - Mayor's commission on African American men
    - CDCs
    - Arts and Cultural orgs
    - Mural Arts
    - Urban Consulate
    - David Saunders
    - Business leaders that drive the region
    - More diverse audience: race and socioeconomics
    - Community ambassadors, paid (like PPTF)

2. ***Topics to cover***
    - Health Equity
    - Small Business formation
    - Impacts of decisions about underserved populations
    - Creating economic value for other elements
    - Gas Tax and surrounding issues
    - Impact of Distance Learning
    - Understanding location identity and impact of settlement/moving
    - Transportation Demand Modeling
    - How does a city budget work?
    - Reframing diversity: biological benefits of heterogeneity
    - More short term scenarios to feed long term
    - Link between health care and employment
    - New and challenging ways of thinking
    - Chaos, and thinking "big picture"
    - How to be transparent and responsible (not everything can be said) in government
    - Internet as a public entity
    - Digital Divide: what is it, who does it impact?

Recommendations

The workshop was an excellent opportunity for people to experience small group facilitated conversations and to dig into some complex topics. We recommend this format whenever possible, ideally with a bit more time to cover the material and dig deeply into ideas. Take some time to look over the Mural worksheets to see some of the conversations that happened within the groups.

Unsurprisingly, diversity was the topic on everyone's minds, specifically when it came to representation of voices. Whenever possible, we recommend seeking out representatives of those affected by a topic or issue and letting them speak or partake in the discussion.

Finally, we recommend a follow-up survey or a pre-event survey for the next event that collects information on the best way for the attendees to feel engaged, heard, and educated. You may want to include a question about people's familiarity with different video meeting platforms, willingness to partake in a workshop or lecture, and suggestions for fielding questions and comments. There's always something new to be learned from the wisdom of the people!

Connect the Dots designs stakeholder engagement for impact. We develop tailored strategies and expert insights to help build cities, regions, and entities focused on the health and happiness of all citizens. All Connect the Dots work is informed by diverse perspectives, bringing a unique set of insights and learnings to any project we work on.

Mission: To build better cities, towns, and neighborhoods through inclusive, insight-driven stakeholder engagement. We help community, private and public sector partners to develop creative solutions that move projects and cities forward

Vision: To bring individuals and organizations together to co-design the future of our cities

Connect the Dots is based in both Dublin, Ireland and Philadelphia, USA.

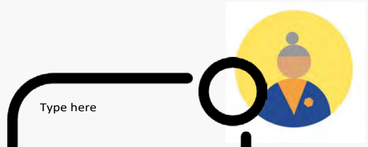
We work with public and private sector entities to co-design with their stakeholders and enable inclusive, insight-driven decisions that drive equitable and robust solutions.

Learn more at www.connectthedotsinsights.com

Put yourself in the future mindset, looking back omnipotently and confidently on 2020

1

General Discussion: Reflections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Reflect on the Discussion: How did we develop a process of inclusion? How did we tackle issues collectively? What did the discussion make you think about in terms of urban/regional systems? How did we adapt inclusively?

Sticky Note Bank

Still in a future mindset, "reflect"* on who we brought to our lectures, what we learned, how we worked together: what were some essential voices and lessons that helped us to recover?

** if the future mindset is too complicated, let people speak freely and don't worry too much about it.

2

Honing in: Who, What, and How?

Whom did we talk to (what new voices were invited to the table and how)?

every discussion panel was diverse in age, race, background

Local municipalities have a big say as to what happens in their jurisdictions - we could bring more people from the communities into the discussion from the outset

north carolina in partcular there were major challenges in services delivery etc.

technology could assist in capturing those voices, man power or representatives from those harder to reach groups were also ways we got to hear from everyone

Broader regional groups do not have as many local officials as their should be

Greater funding resources to include locals from the outset in the planning process

this might be due to them being volunteers or from a small burrow, deal with the limited capacity to plan - need o

What did we learn?

break down in communication - it was very hard to get in touch with Gov. about unemployment etc.

smaller entities managing smaller communities

food or employment should come from townsnot federal government

need resources at a federal level in order to be able to facilitate this

What knowledge gaps did we fill?

How did we understand and respond to competing forces?

What did we do differently from the last round of meetings?

What systemic assumptionsand/or bad habits did we address?

Connect the Dots

Put yourself in the future mindset, looking back omnipotently and confidently on 2020

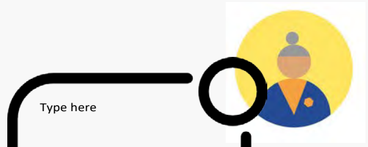
What problems existed in 2020 that were solved in looking back from a future year (2050)

Still in a future mindset, "reflect"* on who we brought to our lectures, what we learned, how we worked together: what were some essential voices and lessons that helped us to recover?

** if the future mindset is too complicated, let people speak freely and don't worry too much about it.

1

General Discussion: Reflections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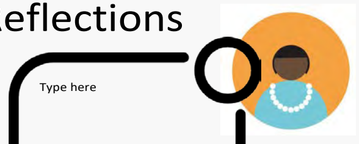
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Reflect on the Discussion: How did we develop a process of inclusion? How did we tackle issues collectively? What did the discussion make you think about in terms of urban/regional systems? How did we adapt inclusively?

Sticky Note Bank

2

Honing in: Who, What, and How?

Whom did we talk to (what new voices were invited to the table and how)?

Rank and file first responders

More diverse groups - ie mayors committee on african am men

what are they encountering, how functioning?

What's already there - what other groups to talk to

Reaching out to community development groups

Arts & culture groups (have had to pivot)

Have thought about ways to do this to support mental health

Art for wider mission - attuned to what people need

What

BLM

Urban Consulate - partner with them to gather diverse, interesting speakers

Someone from Mural Arts

What did we learn?

People's location choices - understanding of barriers to choices

Where our money was going

Digital divide

how well distance learning worked

explored sustainable transportatio funding

how city budget works

What to do to fix things after; what works and what doesn't

gas tax won be generatin what propos to do

how hit some things that feel like higher priorities now

Need more than pilots by then

How funding can move around; ie don't need to resave as often goes to chromebooks

What knowledge gaps did we fill?

state of entrepreneurship and business poor - why is it - what did we learn to make a better foundation

How did we understand and respond to competing forces?

What did we do differently from the last round of meetings?

What systemic assumptionsand/or bad habits did we address?

Connect the Dots

Put yourself in the future mindset, looking back omnipotently and confidently on 2020

1

General Discussion: Reflections

Biking / micromobility is taking off as a result of the pandemic - can build in these as bigger modes for getting around in the future

45 parklets in Jersey City were built in 45 days to increase pedestrian spaces

This is a title

Reset button where people are taking health more seriously -- can help us to take disease risks into consideration in our behavior.

Reflect on the Discussion: How did we develop a process of inclusion? How did we tackle issues collectively? What did the discussion make you think about in terms of urban/regional systems? How did we adapt inclusively?

Remote working has increased involvement in a lot of other activities -- no need to factor in travel time. Post-pandemic may not be able to do as much.

The internet is really becoming a public utility, and needs to regulated as such and made available to everyone.

TMAs and others have been pushing telecommuting for years, but it took a shock to the system to make this happen. Can have major implications for land use decisions and public health.

If we don't make changes now, we'll have to learn this lesson again.

The new normal will be very different -- more people will be able to telework even after the pandemic. But then we need to figure out what to do with all this space?

The pandemic has highlighted the vast racial descrepencies in our communities in terms of access to health, technology, and safe and healthy communities.

Sticky Note Bank

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2

Honing in: Who, What, and How?

Whom did we talk to (what new voices were invited to the table and how)?

Community ambassadors within the community and paying them for participation.

Bringing in a more diverse audience in terms of race and socioeconomics.

What did we learn?

What knowledge gaps did we fill?

How did we understand and respond to competing forces?

A better understanding of who is impacted negatively by the digital divide. How do we make the business case.

What did we do differently from the last round of meetings?

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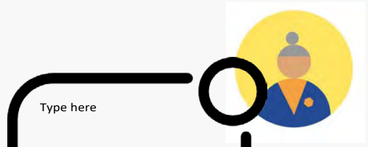
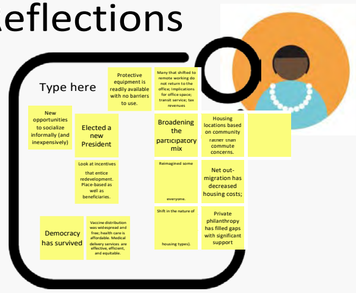
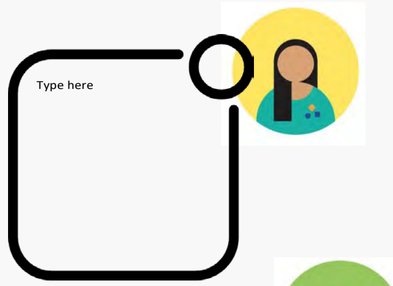
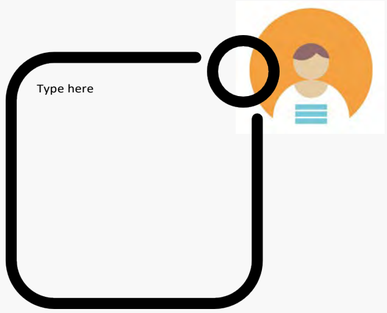
1

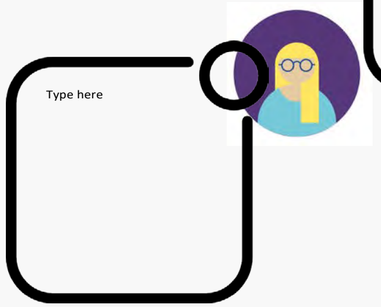
General Discussion: Reflections











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2

Honing in: Who, What, and How?

Whom did we talk to (what new voices were invited to the table and how)?

Reach out to philanthropic organizations

What did we learn?

That we can't predict everything

Keep an open space for unpredictable events

Capture and learn from this experience.

What knowledge gaps did we fill?

How did we understand and respond to competing forces?

Invite more technologists and futurists to participate.

How technolo gy can improve our lives.

What did we do differently from the last round of meetings?

Expand DVRPC's role as a convener or organizer of conversations among implementing agencies on policy issues that have hard questions.

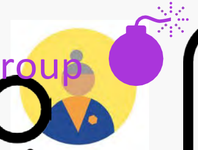
What systemic assumptionsand/or bad habits did we address?

Connect the Dots

Put yourself in the future mindset, looking back omnipotently and confidently on 2020

1 General Discussion: Reflections

This was the Government Group



From the infrastructure set up by government jumping into telework technologies, government got more efficient jumping to meetings in different places all in one day.

More flexible hours in government

Hybrid of remote and in person created more opportunities for inclusion and communication with groups. Sensitivity to digital divides were considered.

Reflect on the Discussion: How did we develop a process of inclusion? How did we tackle issues collectively? What did the discussion make you think about in terms of urban/regional systems? How did we adapt inclusively?

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BLM opened eyes and allowed terms like systemic racism to be accepted and drive conversations forward.

Funding and money spread (ex. grant programs) that considered equity in scoring criteria proliferated.

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2 Honing in: Who, What, and How?

Whom did we talk to (what new voices were invited to the table and how)?

Aging communities, hard to reach, essential workers, rural voices included

What did we learn?

When all we had left was communication, we learned how important it was

People are more flexible than we thought. When people were forced to do something, it worked

What knowledge gaps did we fill?

Figured out how to do hybrid meetings where some people were in person and some virtual

How did we understand and respond to competing forces?

Being more transparent about how decisions are being made so people better understand competing/contradicting forces

What did we do differently from the last round of meetings?

What systemic assumptionsand/or bad habits did we address?

Taking more risks and questioning choices we're making. Worrying less about people's comfort level

Started thinking more "big picture" and generally accepting that the world is pretty chaotic

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the Dots

Put yourself in the future mindset, looking back omnipotently and confidently on 2020

1

General Discussion: Reflections

Planners are facing the risk of all their decisions and projects/trends breaking apart

techniques for involving many voices, not usual suspects

Internet has been a useful tool for inclusion

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general public found fewer barriers to entry

Increased opportunity for public

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Planner's greatest role is to LISTEN: how do we RESPOND to public developing a process of inclusion

How we listen: is it changing?

More diverse in ways we accept information: all populations

Reflect on the Discussion: How did we develop a process of inclusion? How did we tackle issues collectively? What did the discussion make you think about in terms of urban/regional systems? How did we adapt inclusively?

"the science of planning": where did it come from? consider the roots

Reduce intimidation factor for being experts

Complexity in data, inputs, loud voices: must acknowledge them

Process of inclusion: using a stage and a searing chart (tied to physical room): change to listening, communal

Planners should not be gatekeepers: public informs everyone at once, all in the same room: eliminate the chain of command

change mentality: Planners are here to listen and take in information: Polycentric

rising cynicism for gov and planning

Techniques? empowerment

humility!

differing focuses: competing? What does public want to solve first when presented with two major issues?

Sticky Note Bank

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2

Honing in: Who, What, and How?

Whom did we talk to (what new voices were invited to the table and how)?

Someone to talk about health equity work that is being done around COVID-19? Dr. Levine or David Saunders from the PA DOH. I bet NJ is doing a similar effort.

Speakers who address why Philadelphia city and region small business formation is so low compared to other cities and metros (see recent Pew report)

What did we learn?

experimental planning: incrementalism-- smaller more local levels, feel permission to experiment from government

changing and adaptable work styles

reality of problems and solutions is 10-15 years: opt for shorter time frames with more implementation

What knowledge gaps did we fill?

Include ideas about international issues

Transportation Demand Models are broken, gov requires us to use them for funding

Planners can make an argument for changing these systems

How did we understand and respond to competing forces?

DVRPC should have short term scenarios feeding into long term. policy can change or stay the same or get worse. Plan should be nimble enough to respond

What did we do differently from the last round of meetings?

opportunity to change range of outcomes, not a sharply defined path

eliminate more of the underlying assumptions going in: we have an opportunity to do a lot of things differently

What systemic assumptionsand/or bad habits did we address?

Building as broad of a concensus as possible: don't aim towards average or middle

This is a shake up: don't carry on as usual

Ability to dignify everyone in the room by accounting for diversity: do not assume that you know what is good for them

Assumption of a 9-5 workschedule and excluding voices based on schedules: opportunity for more inclusivity

Can't always be talking (assumes one language and one time): how can we add on outreach methods?

linkage between health care and employment

Connect the Dots