NEEDED: SYSTEMS THINKING IN PUBLIC AFFAIRS

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Introduction

What is systems thinking? The answer depends on whom you ask. Here are two common perspectives from which you will get two different answers.

Engineering. Here, systems thinking is what you need to build a system whose requirements go beyond current practice. Example: all stages in a plan to evolve into a national energy distribution system for low-emission transportation.

Metapolitics (a neologism analogous to *metamathematics*). Here, systems thinking is what you need (1)to understand the ***ambient social systems*** in which we all have unconsciously long been embedded, and (2)to use that understanding to attempt to bring these systems into alignment with current needs, given some disruptive change such as new technology or increased scale. Example: modifying the global economy in response to climate change.

This essay is based on the Metapolitics perspective. In two Examples I explore perverse behavior patterns of two ambient social systems, a new one and an older one:

1. mass radicalization, disinformation, and other perverse social consequences secondary to new technologies that facilitate intensive everyone-to-everyone communication (for example, “social networking”), and
2. environmental destruction secondary to a compulsion to grow arising from the financing structures of public corporations.

Analysis of both of these behavior patterns reveals a common element:

> Emergent behaviors, not anticipated in classical thinking, of highly intraconnected or coupled networks.

This failure of classical thought leads to the major lesson I wish to communicate in this essay:

THINK NETWORKS FIRST, ACTORS SECOND.

The importance of this lesson is that effective interventions will occur from altering interactions within networks. You cannot even see these interactions unless you focus on the network.

This essay offers two examples that contradict the conventional understanding of Network Effects. We are living inside something we don’t understand.

As a first step, we must make a major upgrade to the language of public discourse. Once-important theory-building words, such as “democracy”, “capitalism”, and “freedom”, have been degraded to trigger-word status with no constructive use. (I use “constructive” advisedly, to mean “for building something”.)

The way I suggest here is to adopt the approach that science has given us: we must bring precision into our language by synthesizing it with specific formal elements for description and prediction. I will model this in the remainder of this essay.

> Permit me to illustrate using my own experience. Ray Nelson, my dissertation advisor, was a philosopher and mathematician. He taught me that if you’re going to build productive theoretical structures that don’t self-destruct you need to argue more formally than using just pure natural language (i.e., the class of languages all humans speak).
>
> A prototypical example of the unreliability of pure natural language for theory-building is this simplest of paradoxes: “This sentence is false”. This example might seem like an artificiality, but once you’re trained to look for this stuff you realize that it’s pretty typical; the mess is everywhere. <u>Aware or not, we inhabit a linguistic garbage pile.</u>

Yet all sciences begin simply with naming and classification. Whole careers have been built from inventing a new term for a distinction and then exploring its implications. We do this, and then we overshoot and start generating nonsense, and we have to figure out how to clean up the mess. Often this requires major surgery. Then, after a generation, we see progress. This is the nature of development, and our task is to move it along.

Pure natural language is good for persuasion but not for prediction. Many disciplines, particularly The Law, seem to thrive on persuasion alone, but that's not true for the sciences. **The currency of Science is testable prediction, not persuasion.** Physics, for example, has learned to make only testable predictions by restricting and formalizing its language. It limits itself to talking about measurements that can be expressed in numeric variables subject to the formalisms of mathematics. Given that restriction, Physics can create new abstractions such as energy, and theorems such as Newton's Laws, to which it can apply the whole of mathematical reasoning.

Public affairs requires a more formal way of penetrating currently intractable problems than language-based persuasion, which is all we have now. This essay is intended to be a concrete model of what some of that might look like.

But it turns out that, in the subject domain of public affairs, incorporation of the formal tools we are used to in science is currently impractical, because we, as an intellectual community, don't have the necessary preparation.

The Western higher education system can be seen as a mass people-processor that transforms a largely undifferentiated input population into two barely-overlapping output subpopulations. It does this by repetitive mental drill over multiple years. The result was observed by C. P. Snow over a half century ago. Each people-processing division of the system has its own distinct production facilities, called "colleges", with its own production methods.

The name I've given to the two output subpopulations of educated people is based on their method of indoctrination:

- "The reading-list folks" and
- "The problem-set folks".

Snow bemoaned the fact that the reading-list folks and the problem-set folks not only can't work together; they rarely talk to each other. The Wikipedia article on Snow cited above suggests that much of the criticism by others of his "Two Cultures" thesis says that this schism is merely an extension of long-standing culture wars.

That culture-war suggestion might have had some validity a half century ago. ***But solutions to many intractable problems of public affairs today will require the reading-list folks and the problem-set folks to work together intimately.*** (You will see two such problems in the two following Examples.) We don't yet have this collaborative habit, we don't have the necessary connective institutions, and the incentives built into today's academic system do not reward such sustained collaboration.

You will see in the discussion of Emergence below that the medicine/biology system of education and practice has undergone the necessary transformation. Elsewhere, wherever public-affairs problems requiring knowledge from many disciplines are discussed, such sustained multi-disciplinary collaboration is unworkable.

You will see from the two extended Examples to follow that without such multi-disciplinary collaboration whole classes of interventions to mitigate antisocial outcomes will simply not present themselves. Team problem-solving is a design activity, and [Conway's Law] applies.

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I. Intraconnected Networks

A. New and Dangerous: Ubiquitous Connectivity

(1)The Internet has enabled, and (2)the widespread adoption of smartphone social-networking applications has put into practice, high-intensity peer-to-peer connectivity. (I'll be calling it "Ubiquitous Connectivity" here.) This is a new, qualitatively distinct social phenomenon that is changing the ways we are organizing ourselves.

The general population, including its political leadership, either doesn't see or doesn't understand the causal relationship between Ubiquitous Connectivity and the many destructive social outcomes arising from the exploitation of Ubiquitous Connectivity by interested parties such as political adversaries. These adverse outcomes include mass disinformation, declines in teen mental health, and increases in mass radicalization, online conspiracy theories, and domestic terrorism.

We can see evidence of such leadership misunderstanding in the current agitation for "regulation" of the dominant social-networking platforms, simply by making analogies to previous experiences in regulation, without any realization that this is a structurally distinct phenomenon.

Indeed, we do not understand the processes through which Ubiquitous Connectivity is reorganizing us. This essay is offered as a contribution to such understanding.

In addition (and this is a common observation I have about content experts in fields affected by mass disinformation, in particular climate change and public health), finding and exposing the antisocial forces behind mass disinformation amplified by Ubiquitous Connectivity is indeed necessary, but it is not sufficient. Also required is understanding how to intervene effectively in order to improve public outcomes. The science behind such understanding is a discipline unto itself, and at present that discipline is an orphan.

I am finding little enthusiasm among content experts for adding to their task of revealing the sources of social disruption, the task of devising interventions into these sources of disruption. Devising interventions requires systems thinking, which (given the structure of today's education system) is outside each field's content expertise.

We are confronted with a new socially disruptive phenomenon, and we are frozen in response because the old approaches aren't working. An effective response will require interdisciplinary collaborations that don't exist, and that are not encouraged or supported by the ways our intellectual institutions are organized.

I will be outlining a general approach to intervention in connection with the Emergence model to follow.

B. Emergence is Everywhere

The disruptive social effects of Ubiquitous Connectivity in a societal network are emergent phenomena that arise from interactions in that network. What are emergent phenomena?

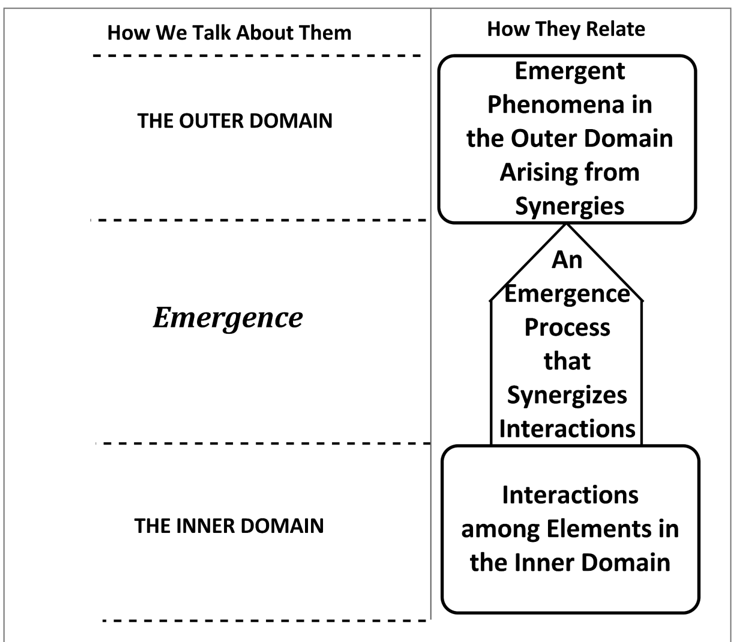
Let's introduce the idea of emergence with an analogy from the history of medicine. Two centuries ago the field of medicine produced the germ theory of disease. Before that, practitioners of medicine were dealing with causal agents of disease like The Vapours and demonic possession, and they were treating disease with bleeding and exorcism. There was an awareness of external pathogens but not of the natures of such pathogens or of such pathogens' interactions with the patient, and how those interactions manifested as disease.

The availability of microscopes changed that.

From this mathematician's perspective, what the microscope did was force the process of thinking about disease to operate in two places concurrently. You have to think about disease as having parts that reside in two separate descriptive domains, by reasoning concurrently about two distinct categories of phenomena: phenomena in the descriptive domain of the microscopic pathogen (the bacterium, say–I'll call that the "inner domain"), and phenomena in the descriptive domain of the macroscopic patient (the fever, say–I'll call that the "outer domain"). The manifestation we commonly call "disease" shows up as phenomena in the outer domain that are consequences of activities in the distinct inner domain. The scientists' challenge then becomes finding and describing the processes that connect the activities in the inner domain to the resultant manifestations in the outer domain.

Those processes that connect activity in one domain to phenomena in another domain that manifest such activity are called emergence processes. (See the accompanying graphic.) This conception of emergence is much broader than, but consistent with, approaches taken by some others.

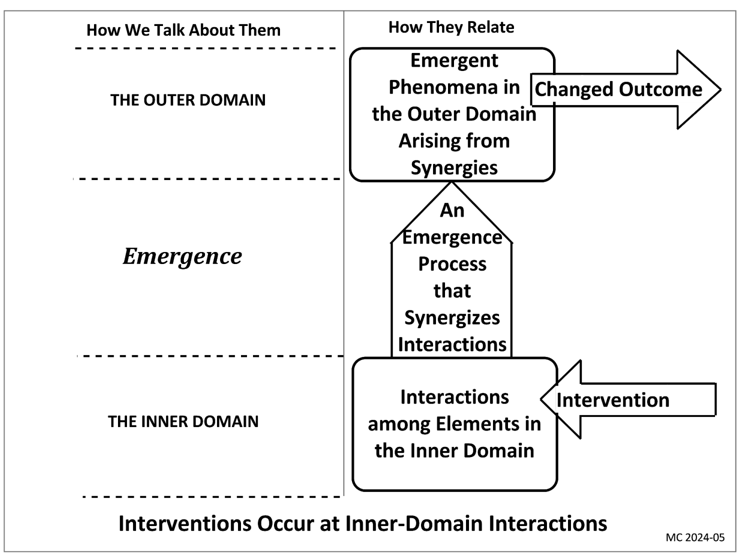
The common view of emergence is that it is esoteric and rare. Be prepared to discover that emergence is ordinary and pervasive.



The Emergence Model Has Three Parts

This three-part Emergence model for framing problems can be useful both theoretically and practically. In practice, once you can describe an emergence process that connects phenomena in two distinct domains you can look for new interventions in the inner domain that can change outcomes in the outer domain. In the case of the germ theory, first came hygiene, then came microbiology and the creation of a pharmaceutical industry.

Drone photographer Lior Patel gives us a jumping-off point to think about intervention into emergent phenomena. Watch **this video** as the drone pilot, who is thinking about the shape-shifting blobs below him. Now watch it as one of the sheep dogs on the ground (you can find a few), who is thinking about what to push. When you can shift back and forth effortlessly, you will be on the way to comfort with the three-part emergence model and this intervention model derived from it.



To think theoretically about intervention we will need to understand better the internal dynamics of emergence, because that's where the action will be.

But we're not there yet. We are at the stage, typical of all new sciences, of collecting and classifying examples. I imagine that we will eventually develop a coherent system of abstractions that will conceptually unify our experience at all levels of description; the next section below offers a first step. But for now, our understanding is sparse. At this point what we need are examples that give us insight. Through examples we will observe how interactions in an inner domain can lead to emergent outer-domain phenomena, and we will teach ourselves to walk and chew gum cognitively.

> The motivating vision behind the research reported here sees a future descendant of germ theory that will do for social science what its ancestor has done for medical science. This theory will contain a model of emergence that will connect the descriptive domains of the behaviors of individual people to the descriptive domains of social phenomena.

C. Classifying Emergence Processes

We need a pattern language for emergence. This is a small prototype of a first step in building such a pattern language. The approach is based on lessons learned from the Smalltalk abstract Collection class and software design patterns.

> I'm coming to the view (whose defense is well beyond the scope of this essay) that emergence is a phenomenon, not of observed Nature, but of observers' processes that help them respond usefully to their experiences. Classifying the emergence phenomenon is as much a project in philosophy as it is in science, and the work needs to be heavily interdisciplinary. The sections following this one will explore, by means of a thought experiment, an emergence process that appears from an abstraction of Ubiquitous Connectivity with Nudging. Even this little thought experiment seems to me to be an order-of-magnitude more difficult phenomenon than the few simple concrete examples I present immediately below. But we have to start somewhere.

1. <u>Threshold avoidance</u>. In this pair of examples, all neighboring individuals adhere to each other, combining into a whole qualitatively stronger than any individual, and conferring a new characteristic of integrity to the whole. An applied external force on one individual is distributed across multiple neighbors, reducing the forces experienced by the bonds connecting the individuals to a level below those bonds' breaking thresholds. Examples include the armor wall of the Greek Hoplite phalanx and the iceberg that sank the Titanic. (Other examples exist that are not physical; for example, contracts that define organizational entities such as corporations.)

a. The armor wall of the Greek Hoplite phalanx.

From [Wikipedia](): "The revolutionary part of the shield was the grip." The two-part grip (upper forearm and hand) permitted a tight mechanical coupling between each shield and its immediate neighbors. The force of a blow to a shield was distributed to neighbors on both sides, reducing the force on the infantryman whose shield received the blow to a level below his breaking point. The armor wall became an unbreakable whole.

b. The iceberg that sank the Titanic.

Each H_2O molecule experiences two kinds of forces from its neighbors.

1. Since the temperature is above absolute zero, the molecules are in motion. When they collide, each molecule experiences the force of the collision.
2. Also, there are tiny electrostatic forces between neighboring molecules. It's these forces that, when the temperature is low enough ("below freezing") so that the collision forces are small, cause the neighboring molecules to arrange themselves into crystalline structures: ice.

Above freezing temperature, the molecules slide around their neighbors and the stuff acts like a liquid. Put enough of the stuff in a container and you can put a ship in it, the water will conform to the shape of the ship, and the ship will float.

But below freezing temperature, the molecules orient themselves and stick to each other in ways determined by molecular geometry, and the stuff acts rigid. Get enough ice together in one piece and run a ship into it, and the iceberg will tear open the steel hull of the ship and sink it.

2. Mosaic. In this class of examples the whole structure is composed of multiple "tiles", each tile comprising a small number of immediately neighboring individuals and having a boundary. All individuals follow the same rules for sticking together within the respective individuals' tile. Immediately adjacent tiles share individuals in their common boundary; this sharing binds all the tiles into a larger entity. The common examples in Nature are schools of fish and murmurations of starlings.

We might speculate that clumping in animal behavior (including people and the sheep photographed by Patel) generally falls into the Mosaic model, and that sheep dogs and politicians have knowledge about how to move mosaics. We need to understand this better.

D. Example 1: Ubiquitous Connectivity With Nudging

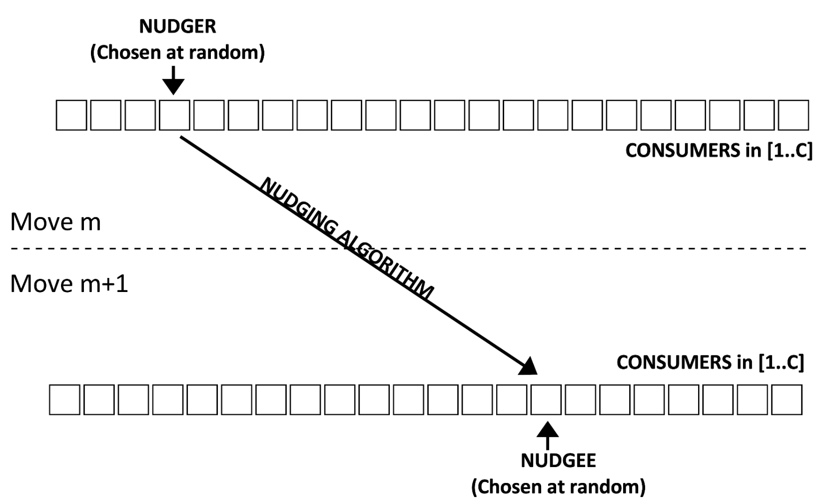
The numerous adverse social outcomes associated with Ubiquitous Connectivity cited near the top of this essay show us how an ensemble of seemingly minor low-level interactions can lead to a high-level effect. To gain insight into this new phenomenon I built the following Monte Carlo simulation of a minimal abstraction of “Ubiquitous Connectivity with Nudging”.

Imagine a marketplace with a small and manageable number P of distinct products (P=6 in this simulation) and an order-of-magnitude larger number C of consumers for these products (C=72 in this simulation). Each consumer is an object with two variables:

1. An “Adoptee” variable: a designator of exactly one of the P products. In every move every consumer is adopting exactly one product. In each move of the simulation exactly zero or one consumer changes its Adoptee.
2. A binary “Committed” state variable. If its value is Uncommitted, this consumer’s Adoptee can be changed. If the value is Committed, the consumer’s Adoptee cannot be changed.

Initially, the consumers’ adoption of products is uniformly distributed; each of the six products is adopted by 12 consumers.

The simulation is a sequence of moves. In each move, two consumers are chosen, both at random; they are called the Nudger and the Nudgee. The purpose of the move is for the Nudger to change (or not change, according to the Nudging Algorithm) the Nudgee's Adoptee to be the same as the Nudger's Adoptee. This graphic describes each move.



One Move in the Monte Carlo Simulation

At the start of the simulation (move m=0) all consumers are Uncommitted, and the adoptees are uniformly distributed. Each move chooses a Nudger R and a Nudgee E, both at random; the move plays out an attempt by R to persuade E to adopt R's adoptee as its own, according to this "nudging algorithm":

1. If R and E are the same consumer, do nothing; exit.
2. If E is Committed, do nothing; exit. (This represents that E has already been irrevocably committed, aka, "radicalized".)
3. If both R and E have the same Adoptee, make E Committed; exit. (If E was previously Uncommitted, this is the moment of E's commitment. If E was already Committed, nothing happens.)
4. Otherwise, assign the value of R's Adoptee to E's Adoptee. (This represents that R has persuaded E to adopt R's Adoptee. E is not yet committed, though; commitment requires two contiguous persuasions to the same Adoptee.)

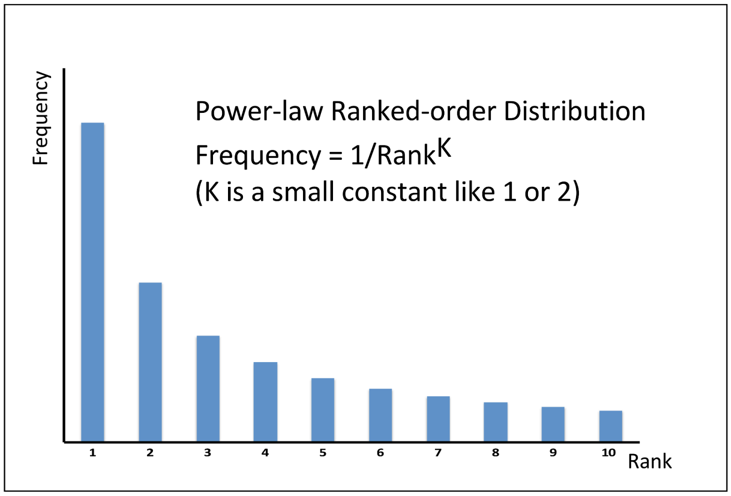
I built this simulation in Excel using its built-in random-number function, and have run a couple of simulations of 250 moves each. (Each move is: (click, copy, click, paste)x2 plus a possible observation-based simple action.) The results of the two runs were strikingly similar, enough to suggest that some principle was being revealed. I'm adopting the name "Zipf Effect" for this principle, named after George Zipf. What I'm calling the Zipf Effect here is a generalization of lessons in engineering lore named, for example, the "Pareto Principle" and the "80/20 Rule".

> George Zipf was a linguist who, among other things, studied the distributions of word frequencies. From the [Wikipedia article](): "...given some corpus of natural language utterances, the frequency of any word is inversely proportional to its rank in the frequency table."
>
> That empirical observation means that when you sort the words in a corpus by frequency of occurrence with the most common word first, you will find a close mathematical relationship between each word's rank (order number) and the number of times it occurs in the corpus.

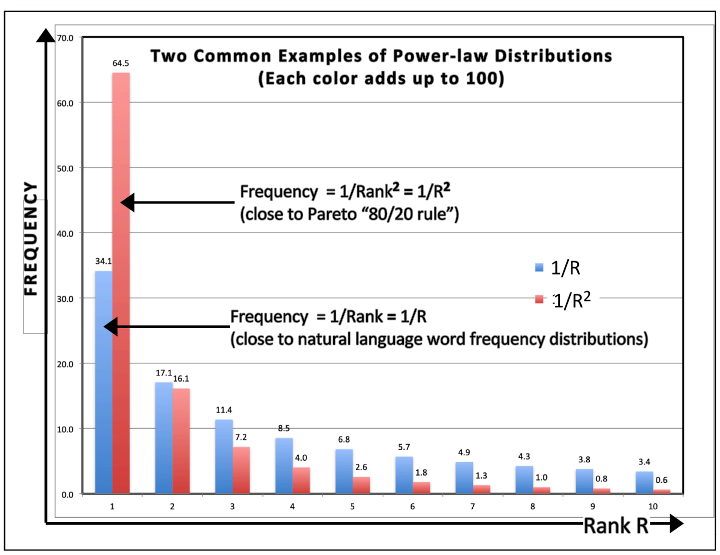
Zipf-effect phenomena can be presented as "Ranked-order Distributions". Ranked-order distributions are vertical bar charts that have different horizontal axes from frequency distributions in statistics.

In a ranked-order distribution the horizontal axis is not a measurement but a sequence of object identifiers. You sort all the separate frequency of occurrence measurements and present them in descending order of frequency on the horizontal axis, with the number of occurrences often shown as the height of a vertical bar.

Ideally, the outcome of the Zipf Effect is described using a “Power-law Ranked-order Distribution”. (The term “power” refers to the exponent K in the formula in the accompanying graphic.)



Here are two common examples of power-law ranked-order distributions.



E. Lessons of Example 1

The question addressed by this simulation of a minimal abstraction of Ubiquitous Connectivity with Nudging:

> Does the behavior of a network with Ubiquitous Connectivity with Nudging converge to a predictable end-state? If so, what can we say about that end-state?

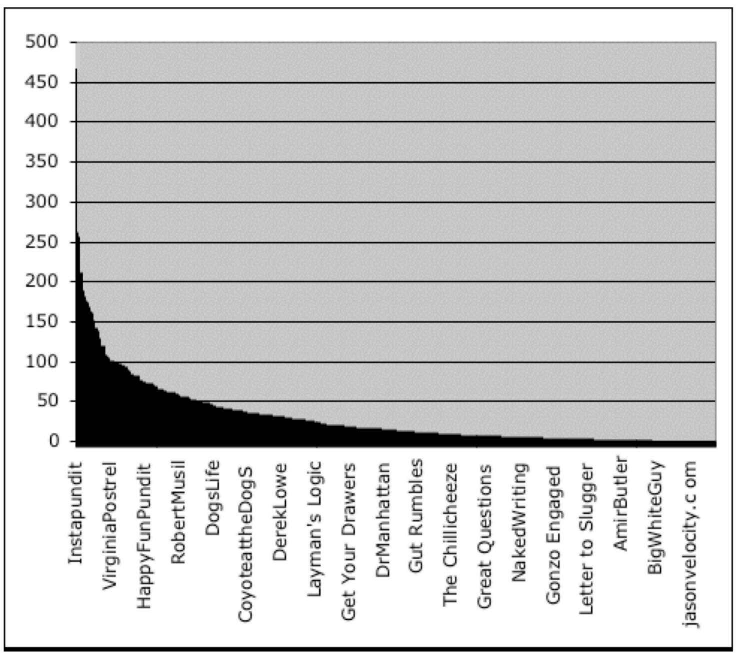
The answer strongly suggested by this simulation:

> In a network with Ubiquitous Connectivity with Nudging, uniformity of distribution is not sustainable. (Compare to the popular interpretation of the "invisible hand") Rather, there is convergence across the network to an end-state power-law distribution.

I first learned about this effect from this [2003 paper by Clay Shirky](#):
“Power Laws, Weblogs, and Inequality”. Here is a page from the article:

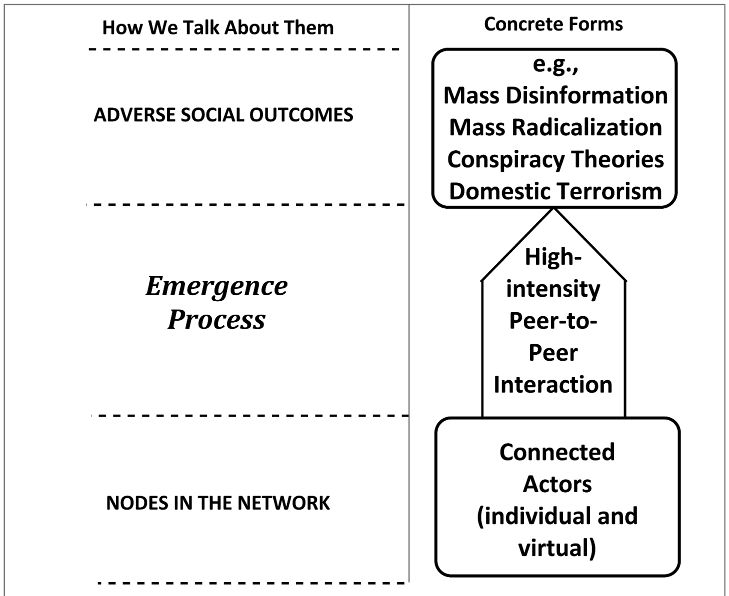
We are all so used to bell curve distributions that power law distributions can seem odd. The shape of Figure 1, several hundred blogs ranked by number of inbound links, is roughly a power law distribution. Of the 433 listed blogs, the top two sites accounted for fully 5 percent of the inbound links between them. (They were InstaPundit and Andrew Sullivan, unsurprisingly.) The top dozen (less than three percent of the total) accounted for 20 percent of the

Figure 1: 433 weblogs arranged in rank order by number of inbound links[1]



[1] The data is drawn from N.Z Bear's 2002 work on the blogosphere ecosystem. The current version of this project can now be found at http://www.myelin.co.nz/ecosystem/.

Uniform networks inherently become lumpy. Absent intervention, Ubiquitous Connectivity with Nudging leads to winners and losers. (And, in the real world of our experience, nudging is inevitably present.) Some of the manifestations of this unfairness are listed as "adverse social outcomes" cited near the top of this essay and in the graphic.

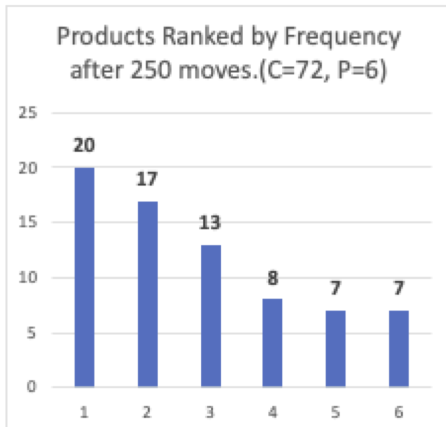


Manifestations of Emergence with Ubiquitous Connectivity

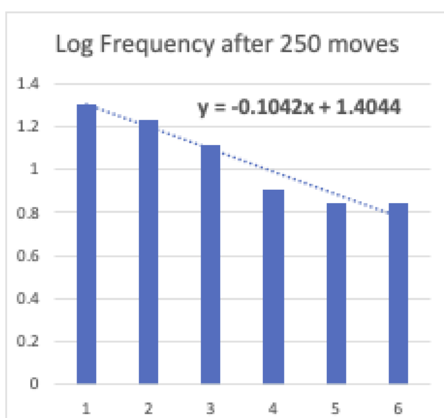
Later in this essay you will see Ubiquitous Connectivity with Nudging in two coupled components of a larger emergent process (widely viewed as economically desirable) containing a positive feedback loop that is helping to drive global warming: a growth imperative structurally inherent to leading publicly-financed corporations.

Here is the actual result of my second 250-move simulation run. After 250 moves, 26 of the 72 consumers, or 31%, had reached a Committed state.

This chart was produced by Excel.



To help suggest that this is a close approximation to a power law, I had Excel take the logarithm of the frequencies and add a trend line. A linear trend line that adheres to the logarithms indicates a power law.



The simulation was designed to be independent of initial conditions and external influences, the unavoidable exception being the random-number generator. The determination of the set of winners and losers in the transition of the ranked-order distribution over 250 moves from uniformity to a power law was highly sensitive to any unavoidable (and uncontrollable) presentation-sequence biases in the random-number generator.

The end state of the emergence process that inevitably converts uniformity into lumpiness in this simulation is dependent on the random-number-generator-determined sequence of choices of nudger and nudgee (see "first-mover advantage"), and the downstream consequences of those sequence dependencies, amplified by the memory inherent to commitment.

The resemblance to processes called "chaotic" is unavoidable. This is not your benign invisible hand. It is a noisy, sensitive process.

My observation from two simulations I also made without the Committed state variable (and the commitment process it enabled) made it clear that the power-law effect was due to persistence of consumer Adoptee memory enabled by the Committed variable. Without commitment the loss of uniformity over the sequence of moves still occurs, but the lumpiness is less pronounced and the behavior over many moves is not convergence to a power law but is roughly cyclical.

The inevitability of winners and losers revealed in this simulation doesn't even take into account the distortions that can come from external interests through agents such as bots, “algorithms”, and propaganda. Such agents can, at least in part, be expressed as variations in initial conditions, the random number generator, and the Nudging Algorithm. I can imagine benefitting from insights gained from research into such variations.

What the simulation does show is the model’s great sensitivity to external influences.

Now we can begin to see the connection between Ubiquitous Connectivity with Nudging and its adverse social consequences. The public speculation about “regulating” popular social networks, without any understanding of the internal dynamics of models such as this, is bound to be futile.

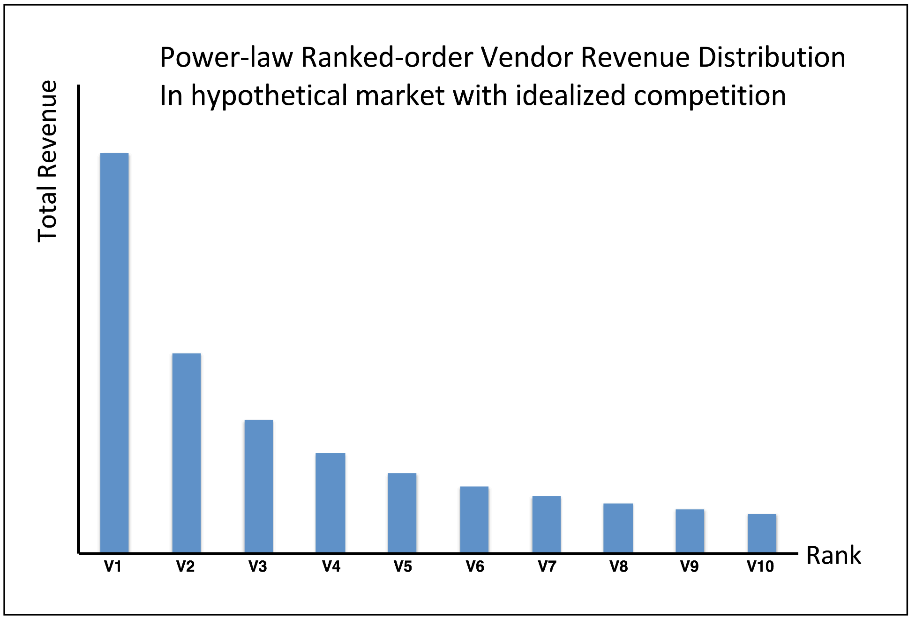
II. Coupled Networks

A. Zipf-like Effects in the Economy

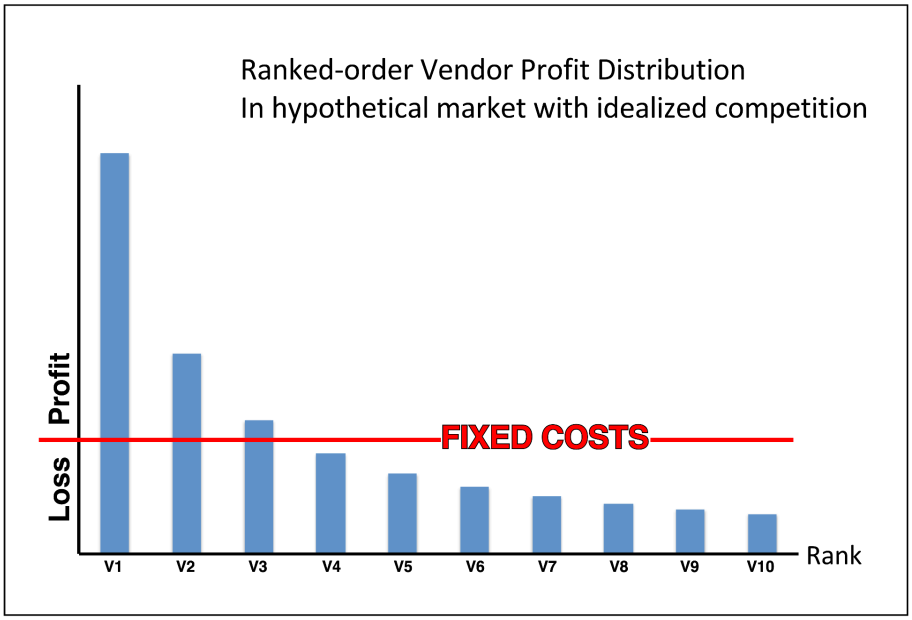
The next three graphics support an idealized argument that the preceding thought experiment, Ubiquitous Connectivity With Nudging, resembles a market with idealized competition if you replace one word, “Product”, with “Vendor”. This is shown in the following graphic. We will soon thereafter return to observable effects.

Ubiquitous Connectivity with Nudging	Market with Idealized Competition
Products in [1..P] (P ~ Miller’s number.) Associated with each product is the current count of the number of consumers who are currently **adopt**ing this product. These values are the heights of the respective ranked-order **adoption count** bars.	**Vendors** in [1..V] (V ~ Miller’s number.) Associated with each vendor is the current sum of the revenues from all consumers who are currently **adopt**ing this vendor. These values are the heights of the respective ranked-order **adoption revenue** bars.
Consumers in [1..C] C>>P. Each consumer is an object with 2 members: Adoptee: a designator of exactly 1 product. A binary: Persuadable/Unpersuadable; Unpersuadable means value of Adoptee cannot subsequently be changed	**Consumers** [1..C] C>>V. Each consumer is an object with 2 members: Adoptee: a designator of exactly 1 vendor. A binary: Persuadable/Unpersuadable; Unpersuadable means value of Adoptee cannot subsequently be changed.
Effect of Adoption: Respective product’s adoption count contains one unit attributable to this consumer. (Note: Total adoption count across all products = C.)	Effect of Adoption: Respective vendor’s adoption revenue contains one unit attributable to this consumer. (Note: Total adoption revenue across all vendors = C.)
The simulation: a sequence of moves m>0. Each m: a. Randomly choose a consumer for role NudgeR b. Randomly choose a consumer for role NudgeE c. Apply Nudging Algorithm	The simulation: same
Nudging Algorithm: see text	Nudging Algorithm: same
Zipf Effect: Power-law ranked-order distribution of **adoption count** for each product.	Zipf Effect: Power-law ranked-order distribution of **adoption revenue** for each vendor.

This would result in a power-law revenue distribution among the vendors, shown here.



But businesses have “fixed” costs (costs that don’t vary with revenue), and below a certain revenue level they are unprofitable. So in this idealized scenario, only the top businesses in such a market can survive.



This effect has been observed. In the 1970s, Boston Consulting Group (BCG) observed a principle for "stable competitive markets" they called "The Rule of Three and Four". Here is their summary of the rule.

> A stable competitive market never has more than three significant competitors, the largest of which has no more than four times the market share of the smallest.
>
> The conditions which create this rule are:
>
> - A ratio of 2 to 1 in market share between any two competitors seems to be the equilibrium point at which it is neither practical nor advantageous for either competitor to increase or decrease share. This is an empirical observation.
> - Any competitor with less than one quarter the share of the largest competitor cannot be an effective competitor. This too is empirical but is predictable from experience curve relationships.

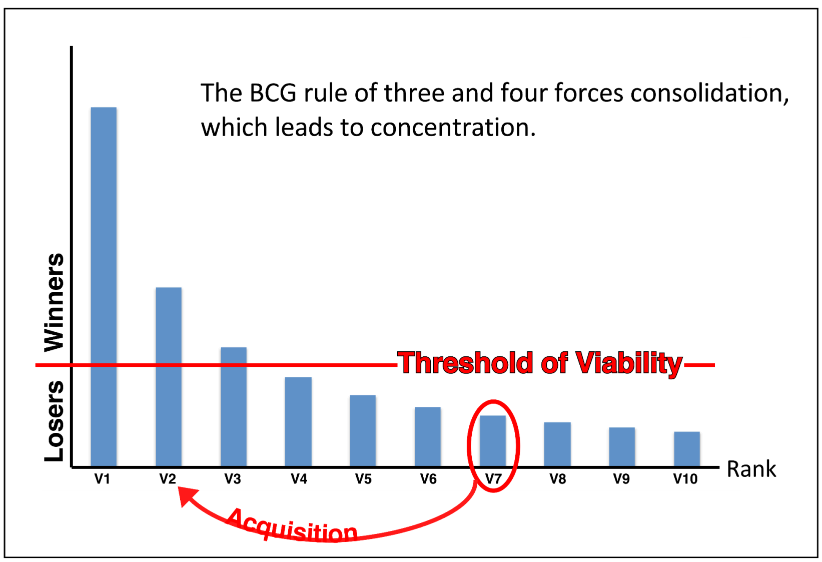
There are more details and conditions at https://www.bcg.com/publications/1976/business-unit-strategy-growth-rule-three-four .

The immediately following text says:

> "Characteristically, this should eventually lead to a market share ranking of each competitor one half that of the next larger competitor with the smallest no less than one quarter the largest. Mathematically, it is impossible to meet both conditions with more than three competitors."

When I read this in the 1980's my immediate takeaway was, "You don't want to be number three". (Note that during the early 1980s Jack Welch, CEO of GE, demanded that GE business units be No. 1 or 2 in their industry or be sold.) I see this rule of thumb in practice in business sector consolidations under pressure, currently evident, it seems, in healthcare.

This pressure toward consolidation, and the resultant concentration, is shown here.



B. Example 2: The Growth Imperative

Let's continue the example above in which Vendor 2 acquires Vendor 7, and Vendor 2 is a public-stock corporation. What currency does Vendor 2 want to use to make that purchase?

Cheap stock.

What do we mean by "cheap". To the management of Vendor 2, "cheap" stock is cheap to existing Vendor 2 shareholders (that is, spending it will minimally dilute their portfolios) but valuable to the shareholders of the company being acquired. In other words, Vendor 2 stock has already appreciated in the stock market.

So the incentive system for assuring Vendor 2's survival (stay number 2 or better) drives Vendor 2 Management to keep growing its stock price. (Note that the Vendor 2 Board of Directors has probably realized this incentive by compensating senior management with stock.)

How does Vendor 2's Management grow its stock price? By growing the business.

Investors are constantly evaluating the relationship between Vendor 2's share price and its business fundamentals, and comparing Vendor 2 with other investment opportunities in the equities market.

Vendor 2 might run out of direct competitors to acquire, but it will continue to be compelled to grow its share price. Its Board is incentivizing senior Management with stock, and the equities market will punish the corporation (and Management) if the share value falls.

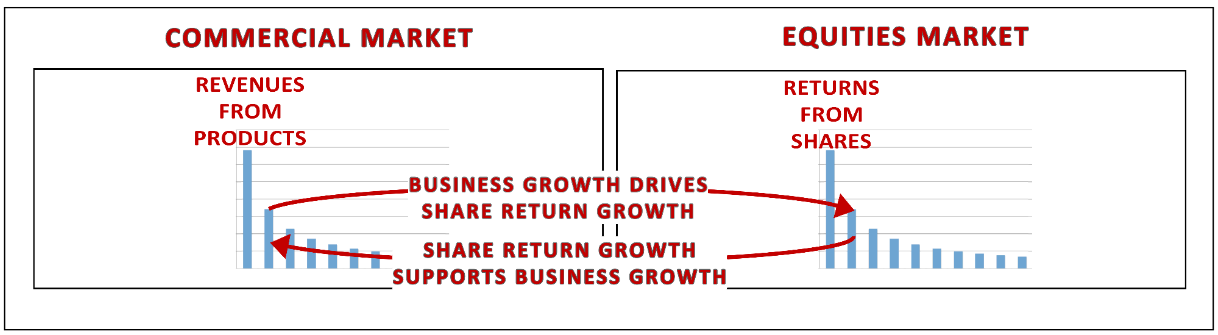
This logic follows from multiple concurrent sources.

1. Shareholding corporate insiders are incentivized to grow their personal wealth.
2. Corporate boards almost always signal to Management its duty to grow the share price.
3. This signal often follows from wide acceptance of the "Friedman Doctrine": the only duty of the corporation is to enrich its shareholders.
4. Many institutional investors, such as pension funds, in fact have a fiduciary duty to grow their clients' money.

These sources of belief add up to a "Grow or Die" imperative driving Vendor 2's behavior.

Here is the logic driving Grow or Die. It turns out that Vendor 2 has a presence, and is represented by two different proxies, in two different (but coupled) markets: the commercial market in which it sells its products, and the equities market in which it sells its shares.

Vendor 2's proxies in these two markets are coupled by the positive feedback loop shown in this graphic. Shrinking the corporation would be Management suicide.



C. Case Study: Exxon

This positive feedback loop is a growth ratchet that is no mere theoretical scenario. It reveals a crucial dilemma within the current public struggle to reduce greenhouse gas emissions and thereby control currently dangerous global-warming trends.

In 2021 the CalPERS pension fund, which has a $1B stake in Exxon, submitted a proposal to "reduce direct emissions and set a target for lowering emissions at suppliers and customers."

Exxon sued CALPERS, which then withdrew the proposal, but Exxon persisted with its suit (as of May 20, 2024). An Exxon spokesperson said the company had engaged with the pension fund and did “not understand how they can make such a poor fiduciary decision,” pointing to the board’s role in creating “industry-leading shareholder value.” (Quotes are correct; emphasis is mine.)

D. Lessons of Example 2

The statement above by the Exxon spokesperson directly reveals the legal necessity to act on the basis of financial outcomes driving the Exxon Board of Directors. There is no statement regarding the "Public Interest" (specifically the consequences of failing to reduce emissions) and, I suspect, no such advice came from Exxon's lawyers.

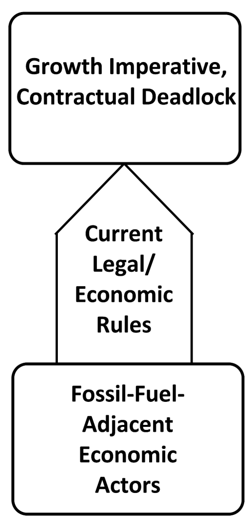
As far as I can see, any conflict between Exxon's fiduciary imperatives and the Public's general interest exists only in our minds, but not in the law. We might be forgiven for having arrived at this situation, however, since the positive feedback growth ratchet shown above has not yet been publicly discovered. The consensus in the public conversation, even among the most seriously concerned economists, is that growth has been, and remains, a choice. This consensus appears to be an error.

Example 2 applies only to public-stock corporations, but investment capital that is free to move moves around (albeit with friction) to find increasing return. Therefore Example 2 applies, more or less, to all corporations.

Lesson 1 of Example 2: **Macroeconomic growth is not a choice but is a consequence of our legal/economic regime**.

Consider the application of Lesson 1 to the global warming crisis. What would it take to de-grow the fossil-fuel-adjacent portion of the economy? The set of mutual dependencies implied in the Rule of Three and Four suggests that degrowth would require a coordinated, cooperative downsizing of all participants. This seems politically unworkable and is probably also legally unfeasible.

Lesson 2 of Example 2: **The global fossil-fuel-adjacent sub-economy is in contractual deadlock**. Downsizing it is not simply a matter of good intentions at scale. Options might be available, but finding them would require studying and understanding the internal dynamics of emergence in this graphic. This would require a heavy dose of Systems Thinking, and I'm seeing no sign of that.



Emergence In the Fossil-Fuel-Adjacent Sub-economy