The Most Intolerant Wins: The Dominance of the Stubborn Minority

Why you don't have to smoke in the smoking section — Your food choices on the fall of the Saudi king –How to prevent a friend from working too hard –Omar Sharif's conversion — How to make a market collapse

The best example I know that gives insights into the functioning of a complex system is with the following situation. It suffices for an intransigent minority – a certain type of intransigent minorities –to reach a minutely small level, say three or four percent of the total population, for the entire population to have to submit to their preferences. Further, an optical illusion comes with the dominance of the minority: a naive observer would be under the impression that the choices and preferences are those of the majority. If it seems absurd, it is because our scientific intuitions aren't calibrated for that (fughedabout scientific and academic intuitions and snap judgments; they don't work and your standard intellectualization fails with complex systems, though not your grandmothers' wisdom).

The main idea behind complex systems is that the ensemble behaves in way not predicted by the components. The interactions matter more than the nature of the units. Studying individual ants will *never* (one can safely say never for most such situations), never give us an idea on how the ant colony operates. For that, one needs to understand an ant colony as an ant colony, no less, no more, not a collection of ants. This is called an "emergent" property of the whole, by which *parts* and *whole* differ because what matters is the interactions between such parts. And interactions can obey very simple rules. The rule we discuss in this chapter is the *minority* rule.

Figure 4 The lemonade container with the circled U indicating it is (literally) Kosher.

The minority rule will show us how it all it takes is a small number of intolerant virtuous people with skin in the game, in the form of courage, for society to function properly.

This example of complexity hit me, ironically, as I was attending the New England Complex Systems institute summer barbecue. As the hosts were setting up the table and unpacking the drinks, a friend who was observant and only ate Kosher dropped by to say hello. I offered him a glass of that type of yellow sugared water with citric acid people sometimes call lemonade, almost certain that he would reject it owing to dietary laws. He didn't. He drank the liquid called lemonade, and a Kosher person commented: "liquids around here are

Kosher". We looked at the carton container. It carried a symbol, a *U* inside a circle, indicating that it was Kosher. The symbol will be detected by those who need to know and look for the fine print. As to others, like myself, I had been speaking prose all these years without knowing, drinking Kosher liquids without knowing they were Kosher liquids.

Criminals With Peanut Allergies

A strange idea hit me. The Kosher population represents less than three tenth of a percent of the residents of the United States. Yet, it appears that almost all drinks are Kosher. Why? Simply because going full Kosher allows the producer, grocer, restaurant, to not have to distinguish between Kosher and nonkosher for liquids, with special markers, separate aisles, separate inventories, different stocking sub-facilities. And the simple rule that changes the total is as follows:

> *A Kosher (or halal) eater will never eat nonkosher (or nonhalal) food , but a nonkosher eater isn't banned from eating kosher.*

Or, rephrased in another domain:

> *A disabled person will not use the regular bathroom but a nondisabled person will use the bathroom for disabled people.*

Granted, sometimes, in practice, we hesitate to use the bathroom with the disabled sign on it owing to some confusion –mistaking the rule for the one for parking cars, under the belief that the bathroom is reserved for exclusive use by the handicapped.

> *Someone with a peanut allergy will not eat products that touch peanuts but a person without such allergy can eat items without peanut traces in them.*

Which explains why it is so hard to find peanuts on airplanes and why schools are peanut-free (which, in a way, increases the number of persons with peanut allergies as reduced exposure is one of the causes behind such allergies).

Let us apply the rule to domains where it can get entertaining:

> *An honest person will never commit criminal acts but a criminal will readily engage in legal acts.*

Let us call such minority an *intransigent* group, and the majority a *flexible* one. And the rule is an asymmetry in choices.

I once pulled a prank on a friend. Years ago when Big Tobacco were hiding and repressing the evidence of harm from secondary smoking, New York had smoking and nonsmoking sections in restaurants (even airplanes had, absurdly, a smoking section). I once went to lunch with a friend visiting from Europe: the restaurant had tables available only in the smoking sections. I convinced the friend that we needed to buy cigarettes as we *had to* smoke in the smoking section. He complied.

Two more things. First, the geography of the terrain, that is, the spatial structure, matters a bit; it makes a big difference whether the intransigents are in their own district or are mixed with the rest of the population. If the people following the minority rule lived in Ghettos, with their separate small economy, then the minority rule would not apply. But, when a population has an even spatial distribution, say the ratio of such a minority in a neighborhood is the same as that in the village, that in the village is the same as in the county, that in the county is the same as that in state, and that in the sate is the same as nationwide, then the (flexible) majority will have to submit to the minority rule. Second, the cost structure matters quite a bit. It happens in our first example that making lemonade compliant with Kosher laws doesn't change the price by much, not enough to justify inventories. But if the manufacturing of Kosher lemonade cost substantially more, then the rule will be weakened in some nonlinear proportion to the difference in costs. If it cost ten times as much to make Kosher food, then the minority rule will not apply, except perhaps in some very rich neighborhoods.

Muslims have Kosher laws so to speak, but these are much narrower and apply only to meat. For Muslim and Jews have near-identical slaughter rules (all Kosher is halal for most Sunni Muslims, or was so in past centuries, but the reverse is not true). Note that these slaughter rules are skin-in-the-game driven, inherited from the ancient Eastern Mediterranean [discussed in Chapter] Greek and Semitic practice to only worship the gods if one has skin in the game, sacrifice meat to the divinity, and eat what's left. The Gods do not like cheap signaling.

Now consider this manifestation of the dictatorship of the minority. In the United Kingdom, where the (practicing) Muslim population is only three to four percent, a very high number of the meat we find is halal. Close to seventy percent of lamb imports from New Zealand are halal. Close to ten percent of the chain Subway carry halal-only stores (meaning no pork), in spite of the high costs from the loss of business of nonpork stores. The same holds in South Africa where, with the same proportion of Muslims, a disproportionately higher number of chicken is Halal certified. But in the U.K. and other Christian countries, halal is not neutral enough to reach a high level, as people may use other people's religious norms. For instance, the 7th Century Christian Arab poet Al-Akhtal made a point to never eat halal meat, in his famous defiant poem boasting his Christianity: "I do not eat sacrificial flesh"

ولست بآكل لحم الأضاحي

One can expect the same rejection of religious norms to take place in the West as the Muslim populations in Europe grows.

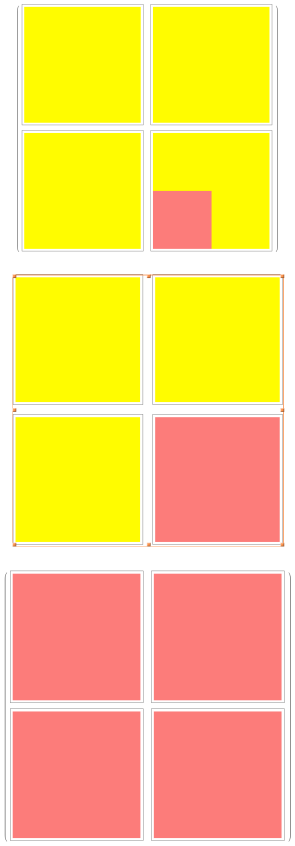

Figure 5 Renormalization group: steps one through three (start from the top): Four boxes containing four boxes, with one of the boxes pink at step one, with successive applications of the minority rule.

So the minority rule may produce a larger share of halal food in the stores than warranted by the proportion of halal eaters in the population, but with a headwind somewhere because some people may have a taboo against Moslem

food. But with some non-religious Kashrut rules, so to speak, the share can be expected converge to closer to a hundred percent (or some high number). In the U.S. and Europe, "organic" food companies are selling more and more products precisely because of the minority rule and because ordinary and unlabeled food may be seen by some to contain pesticides, herbicides, and transgenic genetically modified organisms, "GMOs" with, according to them, unknown risks. (What we call GMOs in this context means transgenic food, entailing the transfer of genes from a foreign organism or species). Or it could be for some existential reasons, cautious behavior, or Burkean conservatism –some may not want to venture too far too fast from what their grandparents ate. Labeling something "organic" is a way to say that it contains no transgenic GMOs.

In promoting genetically modified food via all manner of lobbying, purchasing of congressmen, and overt scientific propaganda (with smear campaigns against such persons as yours truly), the big agricultural companies foolishly believed that all they needed was to win the majority. No, you idiots. As I said, your snap "scientific" judgment is too naive in these type of decisions. Consider that transgenic-GMO eaters will eat nonGMOs, but not the reverse. So it may suffice to have a tiny, say no more than five percent of evenly spatially distributed population of non-genetically modified eaters for the *entire* population to have to eat non-GMO food. How? Say you have a corporate event, a wedding, or a lavish party to celebrate the fall of the Saudi Arabian regime, the bankruptcy of the rent-seeking investment bank Goldman Sachs, or the public reviling of Ray Kotcher, chairman of Ketchum the public relation firm that smears scientists and scientific whistleblowers on behalf of big corporations. Do you need to send a questionnaire asking people if they eat or don't eat transgenic GMOs and reserve special meals accordingly? No. You just select everything non-GMO, provided the price difference is not consequential. And the price difference appears to be small enough to be negligible as (perishable) food costs in America are largely, about up to eighty or ninety percent, determined by distribution and storage, not the cost at the agricultural level. And as organic food (and designations such as "natural") is in higher demand, from the minority rule, distribution costs decrease and the minority rule ends up accelerating in its effect.

Big Ag (the large agricultural firms) did not realize that this is the equivalent of entering a game in which one needed to not just win more points than the adversary, but win ninety-seven percent of the total points just to be safe. It is strange, once again, to see Big Ag who spent hundreds of millions of dollars on research cum smear campaigns, with hundreds of these scientists who think of themselves as more intelligent than the rest of the population, miss such an elementary point about asymmetric choices.

Another example: do not think that the spread of automatic shifting cars is necessarily due to the majority of drivers initially preferring automatic; it can just be because those who can drive manual shifts can always drive automatic, but the reciprocal is not true [I thank Amir-Reza Amini].

The method of analysis employed here is called renormalization group, a powerful apparatus in mathematical physics that allows us to see how things scale up (or down). Let us examine it next –without mathematics.

RENORMALIZATION GROUP

Figure 2 shows four boxes exhibiting what is called fractal self-similarity. Each box contains four smaller boxes. Each one of the four boxes will contain four boxes, and so all the way down, and all the way up until we reach a certain level. There are two colors: yellow for the majority choice, and pink for the minority one.

Assume the smaller unit contains four people, a family of four. One of them is in the intransigent minority and eats only nonGMO food (which includes organic). The color of the box is pink and the others yellow . We "renormalize once" as we move up: the stubborn daughter manages to impose her rule on the four and the unit is now all pink, i.e. will opt for nonGMO. Now, step three, you have the family going to a barbecue party attended by three other families. As they are known to only eat nonGMO, the guests will cook only organic. The local

grocery store realizing the neighborhood is only nonGMO switches to nonGMO to simplify life, which impacts the local wholesaler, and the stories continues and "renormalizes".

By some coincidence, the day before the Boston barbecue, I was flaneuring in New York, and I dropped by the office of a friend I wanted to prevent from working, that is, engage in an activity that when abused, causes the loss of mental clarity, in addition to bad posture and loss of definition in the facial features. The French physicist Serge Galam happened to be visiting and chose the friend's office to kill time. Galam was first to apply these renormalization techniques to social matters and political science; his name was familiar as he is the author of the main book on the subject, which had then been sitting for months in an unopened Amazon box in my basement. He introduced me to his research and showed me a computer model of elections by which it suffices that some minority exceeds a certain level for its choices to prevail.

So the same illusion exists in political discussions, spread by the political "scientists": you think that because some extreme right or left wing party has, say, the support of ten percent of the population that their candidate would get ten percent of the votes. No: these baseline voters should be classified as "inflexible" and will always vote for their faction. But some of the flexible voters *can* also vote for that extreme faction, just as nonKosher people can eat Kosher, and these people are the ones to watch out for as they may swell the numbers of votes for the extreme party. Galam's models produced a bevy of counterintuitive effects in political science –and his predictions turned out to be way closer to real outcomes than the naive consensus.

The Veto

The fact we saw from the renormalization group the "veto" effect as a person in a group can steer choices. Rory Sutherland suggested that this explains why some fast-food chains, such as McDonald thrive, not because they offer a great product, but because they are not vetoed in a certain socio-economic group –and by a small proportions of people in that group at that. To put it in technical terms, it was a best worse-case divergence from expectations: a lower variance and lower mean.

When there are few choices, McDonald's appears to be a safe bet. It is also a safe bet in shady places with few regulars where the food variance from expectation can be consequential –I am writing these lines in Milan train station and it as offensive as it can be to a visitor from far away, McDonald's is one of the few restaurants there. Shockingly, one sees Italians there seeking refuge from a risky meal.

Pizza is the same story: it is commonly accepted food and outside a fancy party nobody will be blamed for ordering it.

Rory wrote to me about the asymmetry beer-wine and the choices made for parties: "Once you have ten percent or more women at a party, you cannot serve only beer. But most men will drink wine. So you only need one set of glasses if you serve only wine - the universal donor, to use the language of blood groups."

Lingua Franca

If a meeting is taking place in Germany in the Teutonic-looking conference room of a corporation that is sufficiently international or European, and one of the persons in the room doesn't speak German, the entire meeting will be run in... English, the brand of inelegant English used in corporations across the world. That way they can equally offend their Teuronic ancestors and the English language. [Thank Arnie Schwarzvogel] It all started with the asymmetric rule that those who are nonnative in English know (bad) English, but the reverse (English speakers knowing other languages) is less likely. French was supposed to be the language of diplomacy as civil servants coming from aristocratic background used it –while their more vulgar compatriots involved in commerce relied on English. In the rivalry between the two languages, English won as commerce grew to dominate modern life; the victory it has nothing to do with the prestige of France or the efforts of their civil servants in promoting their

more or less beautiful Latinized and logically spelled language over the orthographically confusing one of trans-Channel meat-pie eaters.

We can thus get some intuition on how the emergence of *lingua franca* languages can come from minority rules–and that is a point that is not visible to linguists. Aramaic is a Semitic language which succeeded Canaanite (that is, Phoenician-Hebrew) in the Levant and resembles Arabic; it was the language Jesus Christ spoke. The reason it came to dominate the Levant and Egypt isn't because of any particular imperial Semitic power. It was the Persians –who speak an Indo-European language –who spread Aramaic, the language of Syria. Persians taught Egyptians a language that was not their own. Simply, when the Persians invaded Babylon they found an administration with scribes who could only use Aramaic and didn't know Persian, so Aramaic became the state language. If your secretary can only take dictation in Aramaic, Aramaic is what you will use. This led to the oddity of Aramaic being used in Mongolia, as records were maintained in the Syriac alphabet (Syriac is the Eastern dialect of Aramaic). And centuries later, the story would repeat itself in reverse, with the Arabs using Greek in their early administration in the seventh and eighth's centuries. For during the Hellenistic era, Greek replaced Aramaic as the *lingua franca* in the Levant, and the scribes of Damascus maintained their records in Greek. But it was not the Greeks who spread Greek around the Mediterranean – Alexander (himself not Greek but Macedonian and spoke Greek as second language) did not lead to an immediate deep cultural Hellenization. It was the Romans who accelerated the spreading of Greek, as they used it in their administration across the Eastern empire.

A French Canadian friend from Montreal, Jean-Louis Rheault, commented as follows, bemoaning the loss of language of French Canadians outside narrowly provincial areas. He said: "In Canada, when we say bilingual, it is English speaking and when we say "French speaking" it becomes bilingual."

THE ONE-WAY STREET OF RELIGIONS

In the same manner, the spread of Islam in the Near East where Christianity was heavily entrenched (it was born there) can be attributed to two simple asymmetries. The original Islamic rulers weren't particularly interested in converting Christians as these provided them with tax revenues –the proselytism of Islam did not address those called "people of the book", i.e. individuals of Abrahamic faith. In fact, my ancestors who survived thirteen centuries under Muslim rule saw advantages in not being Muslim: mostly in the avoidance of military conscription.

The two asymmetric rules were are as follows. First, if a non Muslim man under the rule of Islam marries a Muslim woman, he or she needs to convert to Islam –and if *either* parents of a child happens to be Muslim, the child will be Muslim[21]. Second, becoming Muslim is irreversible, as apostasy is the heaviest crime under the religion, sanctioned by the death penalty. The famous Egyptian actor Omar Sharif, born Mikhael Demetri Shalhoub, was of Lebanese Christian origins. He converted to Islam to marry a famous Egyptian actress and had to change his name to an Arabic one. He later divorced, but did not revert to the faith of his ancestors.

Under these two asymmetric rules, one can do simple simulations and see how a small Islamic group occupying Christian (Coptic) Egypt can lead, over the centuries, to the Copts becoming a tiny minority. All one needs is a small rate of interfaith marriages. Likewise, one can see how Judaism doesn't spread and tends to stay in the minority, as the religion has opposite rules: the mother is required to be Jewish, causing interfaith marriages to leave the community. An even stronger asymmetry than that of Judaism explains the depletion in the Near East of three Gnostic faiths: the Druze, the Ezidi, and the Mandeans (Gnostic religions are those with *mysteries* and *knowledge* that is typically accessible to only a minority of elders, with the rest of the members in the dark

[21] Note some minor variations across regions and Islamic sects. The original rule is that if a Muslim woman marries a Non Muslim man, he needs to convert. In practice, in many countries, both need to do so.

about the details of the faith). Unlike Islam that requires either parents to be Muslim, and Judaism that asks for at least the mother to have the faith, these three religions require *both* parents to be of the faith, otherwise the person leaves the community.

Egypt has a flat terrain. The distribution of the population present homogeneous mixtures there, which permits renormalization (i.e. allows the asymmetric rule to prevail) –we saw earlier in the chapter that for Kosher rules to work, one needed Jews to be somewhat spread out across the country. But in places such as Lebanon, Galilee, and Northern Syria, with mountainous terrain, Christians and other Non Sunni Muslims remained concentrated. Christians not being exposed to Muslims, experienced no intermarriage.

All Islam did was out-stubborn Christianity, which won thanks to its stubbornness. For, before Islam, the original spread of Christianity in the Roman empire can be largely seen due to... the blinding intolerance of Christians, their unconditional, aggressive and proselyting recalcitrance. Roman pagans were initially tolerant of Christians, as the tradition was to share gods with other members of the empire. But they wondered why these Nazarenes didn't want to give and take gods and offer that Jesus fellow to the Roman pantheon in exchange for some other gods. What, our gods aren't good enough for them? But Christians were intolerant of Roman paganism. The "persecutions" of the Christians had vastly more to do with the intolerance of the Christians for the pantheon and local gods, than the reverse. What we read is history written by the Christian side, not the Greco-Roman one.

We know too little about the Roman side during the rise of Christianity, as hagiographies have dominated the discourse: we have for instance the narrative of the martyr Saint Catherine, who kept converting her jailors until she was beheaded, except that... she may have never existed. There are endless histories of Christian martyrs and saints –but very little about the other side, Pagan heroes. All we have is the bit we know about the reversion to Christianity during the emperor Julian's apostasy and the writings of his entourage of Syrian-Greek pagans such as Libanius Antiochus. Julian had tried to go back to Ancient Paganism in vain: it was like trying to keep a balloon under water. And it was not because the majority was pagan: it was because the Christian side was too unyielding. Christianity had great minds such as Gregorius of Nazianzen and Basil of Caesaria, but nothing to match the great orator Libanius, not even close.

In fact we can observe in the history of Mediterranean "religions" or, rather, rituals and systems of behavior and belief, a drift dictated by the intolerant, actually bringing the system closer to what we can call a religion. Judaism might have almost lost because of the mother-rule and the confinement to a tribal base, but Christianity ruled, and for the very same reasons, Islam did. Islam? there have been many *Islams*, the final accretion quite different from the earlier ones. For Islam itself is ending up being taken over (in the Sunni branch) by the purists because these were more intolerant than the rest: the Wahhabis, founders of Saudi Arabia, were the ones who destroyed the shrines, and to impose the maximally intolerant rule, in a manner that was later imitated by "ISIS" (the Islamic State of Iraq and Syria/the Levant). Every single accretion of Sunni Islam seems to be there to accommodate the most intolerant of its branches.

[The worrisome aspect of the distribution of devout Sunni Salafi Islam around the globe]

Imposing Virtue on Others

This idea can help us debunk a few more misconceptions. How do books get banned? Certainly not because they offend the average person –most persons are passive and don't really care, or don't care enough to request the banning. It looks like, from past episodes, that all it takes is a few (motivated) activists for the banning of some books, or the black-listing of some people. The great philosopher and logician Bertrand Russell lost his job at the City University of New York owing to a letter by an angry –and stubborn –mother who did not

wish to have her daughter in the same room as the fellow with dissolute lifestyle and unruly ideas. [22]

The same seems to apply to prohibitions –at least the prohibition of alcohol in the United States which led to interesting Mafia stories. [Expand]

Let us conjecture that the formation of moral values in society doesn't come from the evolution of the consensus. No, it is the most intolerant person who imposes virtue on others precisely because of that intolerance. The same can apply to civil rights.

An insight as to how the mechanisms of religion and transmission of morals obey the same renormalization dynamics as dietary laws –and how we can show that morality is more likely to be something enforced by a minority. We saw earlier the asymmetry between obeying and breaking rules: a law-abiding (or rule abiding) fellow always followed the rules, but that a felon or someone with looser principle will not *always* break the rules. We also discussed the asymmetric effects of the *halal* dietary laws. Let us merge the two. It turns out that, in classical Arabic, the term *halal* has one opposite: *haram*. Violating legal and moral rules –any rule— is called *haram*. It is the exact same interdict that governs food intake and *all* other human behaviors, like sleeping with the wife of the neighbor, lending with interest (without partaking of downside of the borrower) or killing one's landlord for pleasure. *Haram* is *haram* and is asymmetric.

From that we can see that once a moral rule is established, it would suffice to have a small intransigent minority of geographically distributed followers to dictate the norm in society. The sad news, as we will see in the next chapter, is that one person looking at mankind as an aggregate may mistakenly believe that humans are spontaneously getting more moral, better, more gentle, have better breath, when only a small proportion is doing so.

[22] "Never doubt that a small group of thoughtful citizens can change the world. Indeed, it is the only thing that ever has." - Margaret Mead

Popper's Paradox

As I am writing these lines, people are disputing whether the freedom of the West can be undermined by the intrusive policies that would be needed to fight Salafi fundamentalists.

Clearly can democracy –by definition the majority –tolerate enemies? The question is as follows: " Would you agree to deny the freedom of speech to every political party that has in its charter the banning the freedom of speech?"

One step further, "Should a society that has elected to be tolerant be intolerant about intolerance?"

This is in fact the incoherence that Kurt Gödel (the grandmaster of logical rigor) detected in the constitution while taking the naturalization exam. Legend has it that Gödel started arguing with the judge and Einstein his witness during the process saved him.

I wrote about people with logical flaws asking me if one should be "skeptical about skepticism"; I used a similar answer as Popper was asked if " one could falsify falsification".

We can answer these points using the minority rule. Yes, an intolerant minority can control and destroy democracy.

The Irreverence of Markets and Science

Now consider markets. We can say that markets aren't the sum of market participants, but price changes reflect the activities of the most motivated buyer and seller. Indeed this is something that only traders seem to understand: why a price can drop by ten percent because of a single seller. All you need is a stubborn seller. Markets react in a way that is disproportional to the impetus. The overall stock markets represent currently more than thirty trillions dollars but a single order in 2008, only fifty billion, that is less than two tenth of a percent of the total, caused them to drop by close to ten percent, causing losses of around three trillion. It was an order activated by the Parisian Bank Société

Générale who discovered a hidden acquisition by a rogue trader and wanted to reverse the purchase. Why did the market react so disproportionately? Because the order was one-way –stubborn— there was desire to sell but no way to change one's mind. My personal adage is:

The market is like a large movie theatre with a small door.

And the best way to detect a sucker (say the usual finance journalist) is to see if his focus is on the size of the door or on that of the theater. Stampedes happen in cinemas, say when someone shouts "fire", because those who want to be out do not want to stay in, exactly the same unconditionality we saw with Kosher observance.

Science acts similarly. We will return later with a discussion of how the minority rule is behind Karl Popper's approach to science. But let us for now discuss the more entertaining Feynman. *What do You Care What Other People Think?* is the title of a book of anecdotes by the great Richard Feynman, the most irreverent and playful scientist of his day. As reflected in the title of the book, Feynman conveys in it the idea of the fundamental irreverence of science, acting through a similar mechanism as the Kosher asymmetry. How? Science isn't the sum of what scientists think, but exactly as with markets, a procedure that is highly skewed. Once you debunk something, it is now wrong (that is how science operates but let's ignore disciplines such as economics and political science that are more like pompous entertainment). Had science operated by majority consensus we would be still stuck in the Middle Ages and Einstein would have ended as he started, a patent clerk with fruitless side hobbies.

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Alexander said that it was preferable to have an army of sheep led by a lion to an army of lions led by a sheep. Alexander (or no doubt he who produced this probably apocryphal saying) understood the value of the active, intolerant, and courageous minority. Hannibal terrorized Rome for a decade and a half with a tiny army of mercenaries, winning twenty-two battles against the Romans, battles in which he was outnumbered each time. He was inspired by a version of this maxim. At the battle of Cannae, he remarked to Gisco who complained that the Carthaginians were outnumbered by the Romans: "There is one thing that's more wonderful than their numbers … in all that vast number there is not one man called Gisgo."[23]

This large payoff from stubborn courage is not just in the military. The entire growth of society, whether economic or moral, comes from a small number of people. So we close this chapter with a remark about the role of skin in the game in the condition of society. Society doesn't evolve by consensus, voting, majority, committees, verbose meeting, academic conferences, and polling; only a few people suffice to disproportionately move the needle. All one needs is an asymmetric rule somewhere. And asymmetry is present in about everything.

[23] https://books.google.com/books?id=VzMGAAAAQAAJ&pg=PA269&lpg=PA269&dq=gisco+battle+of+cannae&source=bl&ots=2ybmCD6EaT&sig=lqU71NF46YOpnOSXDfZUsQco2O0&hl=en&sa=X&ved=0CC4Q6AEwAmoVChMI7vnU8-2tyAIVRjw-Ch3DhQkM#v=onepage&q=gisco%20battle%20of%20cannae&f=false

On Things that Do Not Average or the Mean Field Problem

–Not the same way – A liter a day – C elegans deserves its name –the selfish Richard Dawkins

Let us take the idea of the last chapter [the intransigent minority's disproportional influence] one step further, get a bit more technical, and generalize. It will debunk some of the fallacies we hear in psychology, "evolutionary theory", game theory, behavioral economics, neuroscience, and similar fields not subjected to proper logical (and mathematical) rigor, in spite of the occasional complicated equations.

Consider the following as a rule. Whenever you have nonlinearity, the average doesn't matter anymore. Hence:

> *The more nonlinearity in the response, the less informational the average.*

For instance, your benefit from drinking water would be linear if ten glasses of water were ten times as good as one single glass. If that is not the case, then *necessarily* the average water consumption matters less than something else that we will call "unevenness", or volatility, or inequality in consumption. Say your average daily consumption needs to be one liter a day and I gave you ten liters one day and none for the remaining nine days, for an average of one liter a day. Odds are you won't survive. You want your quantity of water to be as evenly distributed as possible. Within the day, you do not need to consume the same amount water every minute, but at the scale of the day, you want maximal evenness.

The effect of the nonlinearity in the response on the average –and the informational value of such an average –is something I've explained in some depth in *Antifragile*, so I will just assume a summary here is sufficient. From an informational standpoint, someone who tells you "I drank one liter of water liter day *on average*" is not conveying much information at all; there needs to be a second dimension, the variations around such an average.

Note that an average and a sum are mathematically the same thing up to a simple division by a constant, so the fallacy of the average translate into the fallacy of summing, or aggregating, or looking at collective that has many components from the properties of a single unit.

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As we saw, complex systems are characterized by the interactions between their components, and the resulting properties of the ensemble not seen from the parts.

There is a rich apparatus to study interactions originating from what is called the Ising problem, after the physicist Ernst Ising, originally in the ferromagnetic domain, but that has been adapted to many other areas. The model consists of discrete variables that represent atoms that can be in one of two states called "spins" but are in fact representing whether the state is what is nicknamed "up" or "down" (or can be dealt with using +1 or –1). The atoms are arranged in a lattice, allowing each unit to interact with its neighbors. In low dimensions, that is that for every atom you look at an interaction on a line (one dimensional) between two neighbors one to its left and one to its right, on a grid (two dimensional), the Ising model is simple and lend itself to simple solutions. But when we move to higher dimensions things get rapidly complicated. Just imagine the acceleration: if you have forty dimensions you end up having a billion possible combinations of interactions in a single neighborhood. [Add a bit more here. Because of LLN higher dimensions average better than lower ones.]

One method in such situations called "mean field" is to generalize from the *average* interaction and apply to the ensemble. This is possible if and only if there is no dependence between one interaction and another –the procedure appears to be the opposite of renormalization from the last chapter. And, of course, this type of averaging is not possible if there are nonlinearities in the effect of the interactions.

More generally, the Übererror is to apply the "mean field" technique, by looking at the average and applying a function to it, instead of averaging the functions –a violation of Jensen's inequality. Distortions from mean field techniques will necessarily occur in the presence of nonlinearities. But dimensionality compounds the effect of nonlinearity: something may seem fine in low dimensions, then explode in higher ones.

What I am saying may appear to be complicated here –but it was not so with the story of the average water consumption. So let us produce equivalent simplifications across things that do not average.

From the last chapter,

> *The* average *dietary preferences of the population will not allow us to understand the dietary preferences of the whole.*

or

> *The* average *behavior of the market participant will not allow us to understand the general behavior of the market.*

These points appear clear thanks to our discussion about renormalization. They may cancel some stuff you know. But to show how under complexity the entire field of social science may fall apart, take one step further,

> *The psychological experiments on individuals showing "biases" do not allow us to understand aggregates or collective behavior, nor do they enlighten us on the behavior of groups.*

Human nature is not defined outside of transactions involving other humans. Remember that we do not live alone, but in packs and almost nothing of relevance concerns a person in isolation –which is what is typically done in laboratory-style work.

What I just said explains the failure of the so-called field of behavioral economics to give us any more information than orthodox economics (itself rather poor) on how to play the market or understand the economy, or generate policy.

But, going further, there is this thing called, or as Fat Tony would say, *this ting called* game theory that hasn't done much for us other than produce loads of BS. Why?

> *The average interaction as studied in game theory insofar as it reveals individual behavior does not allow us to generalize across preferences and behavior of groups.*

[Explain with maximal simplicity how the ultimatum game between two individuals fails under renormalization...]

And it is a fact that groups are units on their own. There are qualitative differences between a group of ten and a group of, say 395,435. Each is a different animal, in the literal sense, as different as a book is from an office building. When we focus on commonalities, we get confused, but, at a certain scale, things become different. Mathematically different. The higher the dimension, in other words the number of possible interactions, the more difficult to understand the macro from the micro, the general from the units.

Or, in spite of the huge excitement about our ability to see into the brain using the so-called field of neuroscience:

> *Understanding how the subparts of the brain (say, neurons) work will never allow us to understand how the brain works.*

So far we have no *f***g* idea how the brain of the worm *C elegans* works, which has around three hundred neurons. C elegans was the first living unit to have its gene sequenced. Now consider that the human brain has about one hundred billion neurons. and that going from 300 to 301 neurons may double the complexity [I have actually found situations that comes a point when it may more than double the complexity, going from a 1000 to 1001 may cause complexity to be multiplied by a billion times.] So use of *never* here is appropriate. And if you also want to understand why, in spite of the trumpeted "advances" in sequencing the DNA, we are largely unable to get information except in small isolated pockets of some diseases.

> *Understanding the genetic make-up of a unit will never allow us to understand the behavior of the unit itself.*

A reminder that what I am writing here isn't an opinion. It is a straightforward mathematical property.

I cannot resist this:

> *Much of the local research in experimental biology, in spite of its seemingly "scientific" and evidentiary attributes fail a simple test of mathematical rigor.*

This means we need to be careful of what conclusions we can and cannot make about what we see, no matter how locally robust it seems. It is impossible, because of the curse of dimensionality, to produce information about a complex system from the reduction of conventional experimental methods in science. Impossible.

My colleague Bar Yam has applied the failure of mean-field to evolutionary theory of the *selfish-gene* narrative trumpeted by such aggressive journalists as Richard Dawkins and other naive big egos with more mastery of English than probability theory. [Explain Bar Yam's problem of absence of spatial averaging and connect to nonlinearities.]