

# Toward a Science of Policy

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## Introduction

From a biological perspective, all human action is aimed at self-preservation. While there may be differences in the proximate goals of individuals, all their actions (whether of mice or men) can be explained by the pursuit of predictability in the conditions of their existence. The proximate goals appear to be different simply because different individuals calculate the consequences of their actions over different lengths of time, i.e., some calculate further into the future than others. In the context of scarce resources, where desires exceed means, this leads to a contest for them. While technology does extend the means significantly from generation to generation, our desires have also continued to grow as we seek ever more of predictability.

A question naturally arises: does adoption of some simple guidelines to action ensure better chances of survival in the future? Does liberalism, or socialism, or conservatism, or populism guarantee a better future? Do corporate policies, or design guidelines developed by professional associations for engineering guarantee better profits or engineering performance? What is the framework in which such questions can be answered definitively?

For comparison, let us look at a game such as chess or go, extremely simple compared to the contest for resources in complex modern society. Potential successful strategies in these games are exponential in the length of their descriptions. A two player game with  $N$  moves and  $M$  kinds of moves has a strategy that requires  $M^N$  steps to detail so every possible move of the opponent is considered. These games are relatively simple as the moves of the other players and their situation are entirely known unlike human actions in society where each player has little knowledge of the conditions, knowledge, motivations and intentions of other players.

In society, the number of players and moves is obviously large, and in modern networked society, the number of moves available to everyone of them is increasing with the advance of technology. By contrast, in the pre-technological societies in which the ideas of the humanities and social sciences were developed, the number of moves available to individuals was small. Women were severely restricted in their movements, everyone was subject to religious, class and caste constraints, free discussion of ideas often resulted in injury, imprisonment, or death, and besides limited travel and communication for most everyone.

The great danger we face as a society is that most of what is considered education is training in the humanities and social sciences, which are firmly anchored in pre-technological literature even if they have begun to use modern statistical methods. These ideas were developed in pre-technological non-networked societies with severe constraints. Hence we have lawyers, journalists, politicians and academics supplying simplistic solutions to modern problems inspired by pre-industrial guidelines with many still believing them because of ideological affinity and what they have been taught to believe in college. Moreover, most schoolteachers worldwide have a background in the humanities and social sciences, and indeed education credentials and research is grounded in philosophies long invalidated by modern mathematics and physics. However, political and religious beliefs only undergo slight modification

when invalidated by evidence unlike theories in the physical sciences. This is because of the hypothetical rather than empirical basis of the current practice of the humanities, the social sciences and all education.

As society has become more networked, we have increasing failure in the predictive power of the humanities and the social sciences. We have seen in recent times that economists and sophisticated mathematical finance have failed to predict the markets. Similarly, many of the theories of the humanities and social sciences are being disproved by Donald Trump's campaign for President in the United States or Narendra Modi becoming Prime Minister in India in spite of determined opposition from media controlled by established business, and various data-based predictions. The media using political science or the 'science' of policy, or the social sciences or even big data has completely failed to predict the rise of Donald Trump or even to analyze his candidacy [1]. Established business has also failed to destroy his candidacy even though it makes them nervous, in spite of spending millions of dollars. All of this ***calls into question whether we have any science of policy or even social science***. By definition, a science has predictive power, not just the capacity to explain events in hindsight.

### Common Misconceptions Arising from Pre-Technological Society

The following hypotheses, which are accepted without question by different groups of policymakers or the public based on their ideological affiliations are examples of such misconceptions.

1. **The Delusion of Expertise.** In pre-technological society, where universal cause-effect relationships such as Newton's laws of motion were not understood, all human effort was empirical craftsmanship. Because of the constraints on human expression, there was little chance for capable individuals to excel, except perhaps as soldiers in turbulent times. However, this notion that expert advice arising from memorization of various books or crafts can help solve complex problems still persists. An obvious example is the large number of think tanks and expert advisers on all variety of topics in both corporations and government. In practice, expertise from multiple disciplines cannot be integrated by the experts whose knowledge is narrow and contextual, but only by true generalists with depth in all those multiple disciplines.
2. **Free trade is universally beneficial.** Unilateral free trade for a given country is only beneficial when all countries have a commodity based currency. This automatically forces exchanges based on the natural competitive advantages of different regions and groups to the benefit of all parties, as a certain quantity of the commodity has to be exchanged for goods or services. Second, if one side runs out of the commodity such as gold, the exchange cannot continue. Currently, currencies are based on debt and non-market barriers to trade can significantly distort the international division of labor through various kinds of debt purchases.
3. **All professions of religious belief have equal merit.** All religions claim that practice of their principles helps individuals harness more fundamental natural laws in a manner that violates known physical constraints. Of course, if they do claim exceptions to natural laws, they contradict themselves, as our intuition of a consistent existence is the basis of all our actions, and certainly all our interactions and communication, besides being the basis for all scientific endeavor including unified physical theories. Similarly, if a religion is interpreted so as to produce logical contradictions, the interpretation must certainly be invalid, whether or not the religious belief is valid. Indeed, many wars have been fought because of such beliefs. The South fought the North in the United States in part because they believed they were on God's side [2] and therefore

invincible in spite of being completely dominated by the north's industrial infrastructure; the Germans in the First World War had similar beliefs [4]. Many Native Americans fought the vastly superior US Army at Wounded Knee believing themselves to be invulnerable to bullets as did the Sudanese under the Mahdi against the British. Hence, when someone claims to interpret a religion, they should first prove that they have practiced the religion, for example, by walking on water or raising the dead, or moving mountains. Otherwise, their interpretation does not have any greater standing than that of anyone else. Mere memorization of various books in schools does not give anyone standing, as an inanimate computer with can do that far faster, and besides, with modern search engines can give answers from books far faster.

4. **Socialism produces just societies.** Whether it is China or the Soviet Union, we have seen that the central planning of economies produces a concentration of power, and large scale corruption, with little scope for justice. Those pointing to the Scandinavian countries forget that they had relatively unregulated economies, and little war and violence for a long time before they instituted their welfare states. A major reason for the failure of central planning is that there are few individuals with both great intelligence and great integrity that can handle great concentrations of power inherent to socialist systems. It is not generally possible for a group of individuals to solve extremely complex problems in unison as most optimization problems are not obviously distributable. That is, the problem of delegation of responsibility can be almost as difficult as the problem itself.
5. **Markets are inherently efficient.** Most economic analysis does not yet recognize that the value of money today is a random variable, given that we have debt based currencies worldwide, and the value of that debt fluctuates significantly as asset bubbles form and get liquidated. Hence, those who have the earliest information on the creation of money or its liquidation have an informational advantage over those who don't, i.e., an arbitrage opportunity which is not supposed to exist. The efficient markets hypothesis [3] may still be valid when the fluctuation of currency values (eg., its standard deviation) is a factor of 10 less than the average productivity of the economy (GDP growth rate), but this certainly not the case anywhere today.
6. **Immigration is economically beneficial to any country.** (Increases the predictability of the conditions of existence, i.e., maximizing the sum of the gains to both the exchequer and the public in a country.) This only true if there is no welfare state—something true more than a hundred years ago in most countries. Otherwise it is only beneficial to have immigration of individuals who are more productive than the average citizen of the country (GDP/capita), so the country does not become less wealthy.
7. **Social media is more trustworthy and less censored.** While most everything can be explained, coherent explanations are needed for long term trust, and only coherent or consistent explanations can be either validated or invalidated by data. This absence of coherent explanations, and inability to predict actual events has resulted in an erosion of trust in media, and the Balkanization of society into groups sharing similar views or having similar objectives, facilitated by the internet and social media. Many do not trust the media, and their distrust is justifiable, given that media companies are not performing a public service, but trying to maximize profits through getting larger audiences. Social media, with its natural Balkanization into groups sharing similar views is believed by many to be uncensored. However, we know that this is not true as social media companies also look to their bottom line, apply rules of censorship aimed at preserving and maximizing revenues, and even cut deals with authoritarian governments.

8. **There is a tradeoff between efficiency and equality.** Technological progress over the past several decades has greatly increased efficiency, forced governments into far greater transparency and is leveling various power structures. As individuals have greater access to energy and information, concentrations of power are more difficult to maintain. It is only with tremendous government intervention that inequality has been preserved, trillions of dollars in bailouts for large businesses being an obvious example. The notion that there is a trade-off is again pre-technological, when the pace of technological change was at best glacial.
9. **Rules can be followed and we can have a deterministic marketplace.** If the rules are contradictory, or in sufficiently rapid flux, they cannot be followed. If the number of rules is sufficiently large, they will never be followed, leading to comparison of behavior with 'best practice,' as defined by some of the players. This results in permanent fear and paralysis of decision making in those affected by such rules. What we need is a deterministic government or legal system so as to have a functioning marketplace that rations scarce resources appropriately. However, it is not possible to have a deterministic marketplace as the discovery of resources, whether natural or artificial, cannot be predicted.
10. **Games and therefore Economies are computable.** There is plenty of work showing in fact that policy in a complex economy is undecidable under fairly generic assumptions [6,7,8]. Indeed, Max Euwe ( [https://en.wikipedia.org/wiki/Max\\_Euwe](https://en.wikipedia.org/wiki/Max_Euwe)) showed in 1929 that even chess games under the rules of the time could be infinite without repetition of any sequence of moves.
11. **Creativity as simple permutations.** We still consider such things as music, art, drama, writing and the fine arts as being creative while mathematics and engineering are not considered creative in popular perception. However, just as computers can memorize anything and quote anything better than the most learned scholar, they can also produce the best classical music, or painting, or writing. (<http://www.fastcodesign.com/3058708/a-computer-paints-a-rembrandt-and-it-looks-just-like-the-real-thing>, <http://io9.gizmodo.com/5973551/this-classical-music-was-created-by-a-supercomputer-in-less-than-a-second>, <http://www.gizmag.com/creative-artificial-intelligence-computer-algorithmic-music/35764/>) The same holds for anything done with the memory--drama, novels and stories--and the like. They can be easily created by permutations and combinations of existing works, and therefore do not contain anything new. All real creativity consists in using our basic intuition of the consistency of existence in ever more sophisticated ways, i.e., reason mathematically from commonly observable measurements, or as Newton put it, make deductions from phenomena.

### Do we have any solutions?

While it is not in general possible to derive general solutions or strategies to complex games, as even the length of a strategy will be very long, or even design problems of various kinds, it is possible to verify if a solution indeed satisfies various constraints. There are many problems which are difficult to solve but whose solutions are easy to verify. These are known as NP hard problems in computer science [5]. Similarly, we have the notion of probabilistically checkable proofs [5] that find with high probability if a long solution is correct without having to evaluate the entire solution. Thus solutions developed in a narrower context could be scaled up to cover larger geo-political regions. Solutions are more easily developed in smaller problems as they are easier to solve. Moreover, there is a fundamental trade-off between measurement and inference, and solutions that use measurement heavily or feedback solutions to various optimization problems are far less complex than open loop or prescriptive solutions, and also

far more robust to uncertainties in real world conditions. Most of the great inventions of the modern age incorporate these principles besides that of distributed optimization which reduces the complexity of experimentation and therefore the ability required build good designs. From the refinery and automobile, to the airplane and the modern electric grid, to the computer, the cell phone, and the internet, these systems have endured because of extreme robustness indeed resilience to uncertainty in components and operating conditions. However, the questions of finding the correct measurements, and correct distribution of decision making powers, and matching capacity with responsibility are all difficult problems.

Data or Big Data cannot solve these fundamental problems as all data can be distorted unless the decision maker has the ability to fact check all propositions presented before him, and integrate it in a fashion both consistent and correct (consistent with physical laws). Second, the interests of the decision maker have to align with the group she is deciding for or the decision maker has to be someone that puts truth above self-preservation which is highly unlikely as we seldom get angels to govern men. The key to equitable policy in any domain in any sphere is to ensure that decision makers are those with great intelligence and integrity and with interests aligned with the group they are making decisions for. ***The matching of demonstrable decision making ability with responsibility is the great problem of our time if we want to solve all of the fundamental challenges facing mankind such as physical security, water, food and energy availability, besides creating a just society.***

Another thing we note is that human beings and indeed most living organisms have been solving computationally difficult problems for a long time—that of preserving their identity as a sequence of memories of events—this is very much a Boolean constraint satisfaction problem which generally requires an exponential number of steps of computation. Moreover, living organisms solve this problem in real time, so the potential exists that humans could be trained to solve extremely difficult problems.

### Conclusion: There are no shortcuts to salvation or knowledge

The belief that knowledge can be obtained without effort from hypotheses is akin to medieval notions of random victimhood and random salvation. We cannot hope to obtain knowledge from speculative hypotheses, without physical measurements and logical deductions therefrom. The artificial quantification of human preferences or restaurant ratings do not constitute measurements as they are not physically reproducible in any sense of the word. We should not forget that we are also part of nature and biology even if we are the dominant player. Biology engineers for self-preservation or the reduction in unpredictability of conditions of existence. All engineering is necessarily constrained by physical laws. Physics in turn is a tiny subset of our communicable ideas or mathematics which are consistent with physical measurements. All knowledge is mathematical, by definition (mathematics is that which is learned), as nothing self-contradictory can be communicated. All that can be communicated reliably is theorems and proofs, i.e., experiments with physical measurements such as mass, length and time and deductions therefrom.

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