

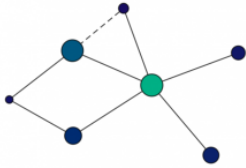
# Main Page

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## Project Overview

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This is an open science project that explores a computational model of international relations, called **quantitative realism**. The international system is represented as an abstract power structure, like this:



Larger nodes are more powerful, solid lines represent cooperation, and dashed lines represent conflict.

The major questions are:

1. How do power structures evolve in time?
2. Does the abstract model say anything meaningful about actual historical power struggles?
3. What is the nature of the current world power structure?

The project uses the Wolfram Language and C++ to investigate these questions. The code lives in [this Github repository](https://github.com/mpoulshock/QuantitativeRealism/) (<https://github.com/mpoulshock/QuantitativeRealism/>).

## Content Summary

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The material in this wiki is organized more or less like a long scientific article. It can be read in a linear way, like a book, using the "Next" links at the bottom of each page.

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# Abstract

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Political realism aims to describe the interaction of agents involved in struggles for political power. This project attempts to formulate realism in terms of quantitative postulates that depict political power as a fluid-like substance flowing through a network of agents. Agent preferences within this framework resemble those of nation states competing for power. By combining these preferences with game-playing techniques such as Monte Carlo tree search, we can simulate balance of power dynamics in the international system.

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# Preface

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What happens when a big country and a small country interact with each other? If they were at war, how would that reduce their levels of capital? And if they were to cooperate, how much would each grow? If their relationship was friendly, or positive, how would they enlarge? If the relationship was negative, at what rates would they shrink?

And if you added other countries to the situation, how would that change things? With a system composed of many states, a country would have to take into consideration its relationships not just with its allies and enemies, but with their allies and enemies as well. It would also have to figure out how to allocate its power among the various states in the system. For instance, it might want to expend a bit of its positive energy interacting with one country, but focus most of its destructive power on fighting with a rival. States would have to figure out what to do at each moment, but they'd also have to anticipate what the other states were going to do, in a kind of never-ending, multiplayer chess game. And after each round of moves, the power levels of the countries would change. Some would come to dominate; others might be destroyed.

The conceptual model just sketched has only one variable, something vaguely corresponding to the notion of capital or political power. Is there a way to formulate it mathematically, to be able to say the degree to which power levels change as a result of the agents' interactions? And is there some optimal way that the agents should behave in order to survive?

This simple model provides a template applicable to a wide range of situations in the social world, not just among countries but also to political networks more generally. In any venue where there are agents struggling for power, this conceptualization seems to capture something essential about the situation.

The purpose of this wiki is to provide **a technical introduction to a computational model of power** and to explore how it may be applicable to problems of world order: that is, to the understanding of empires, international relations, and historical change. This is an ongoing science project. It is presented in its current state in the spirit of discovery, acknowledging that it is incomplete and in some respects likely incorrect. Consider this your invitation to participate.

The world is rife with injustice, real and perceived, and power is at the root of it. There is much to be angry about, and political anger is sometimes a constructive force. But it can also be beneficial to temporarily set aside both the moral repulsion and undeniable attraction that we feel towards power, and instead to try to gather our observations into a logical framework — abstract, austere, universal — that has no larger political purpose other than as an attempt at scientific understanding.

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# A Few Quotes

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A few quotes to set the mood...

[I]f it is possible to attain an internal knowledge of history...we shall be able to see in all historic phenomena the expression of a moulding force behind the play of circumstance.

— Christopher Dawson, *The Dynamics of World History*

As subjects become more understood, they become more mathematical.

— John Ball, *The Oxford Guide to Mathematics*

The concepts and conclusions of arithmetic, which generalize an enormous amount of experience, reflect in abstract form those relationships in the actual world that are met with constantly and everywhere. It is possible to count the objects in a room, the stars, people, atoms, and so forth. Arithmetic considers certain of their general properties, in abstraction from everything particular and concrete, and it is precisely because it considers only these general properties that its conclusions are applicable to so many cases. The possibility of wide application is guaranteed by the very abstractness of arithmetic, although it is important here that this abstraction is not an empty one but is derived from long practical experience. The same is true for all mathematics, and for any abstract concept or theory...At the same time every abstract concept...is limited in its significance as a result of its very abstractness.

— Aleksandrov, Kolmogorov, and Lavrent'ev, *Mathematics: Its Content, Methods, and Meaning, Vol. 1*

The object of power is power.

— George Orwell, *1984*

But also bearing in mind that...

Many a man has cherished for years as his hobby some vague shadow of an idea, too meaningless to be positively false.

— Charles Sanders Peirce, *Chance, Love, and Logic: Philosophical Essays*

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# Power and World Order

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When we look back over the history of humanity, regardless of the time period, place, or culture that we examine, we find people engaged in power struggles. We can see these struggles in the rising and falling of civilizations and empires. We see them in acts of war, genocide, and revolution, and in the games nations play in the international arena. We see these struggles as politicians attempt to gain control of the levers of government, as citizens strive to win rights and benefits, as ideological movements coalesce and dissipate, and as interest groups try to reshape society in their own image. We see power struggles among corporate titans, within civic institutions, and between street gangs. We experience them firsthand in our workplaces, in our neighborhoods, in the organizations where we volunteer, and sometimes at the hands of our friends and family. At all of these levels, across all of history, the existence of power struggles is a constant.

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## Power and History

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Power provides a unifying interpretive framework for understanding the primary forces that drive historical processes forward. When we reflect upon history, we tend to focus on the operation of power and about things that were shaped by power. Our curiosity about the past gravitates naturally towards leaders, presidents, empires, dominant civilizations, and the conflicts and wars that have had a formative effect on the events that followed. We want to know what powerful people did, how they became powerful, how they were vanquished, and what happened when they clashed with others in power. We are intrigued by individuals and institutions which have agglomerated authority or capital, and which influenced the events of their day. We are entranced by conflict, and the bigger and more destructive it is, the more it commands our attention.

In contrast, we are less interested in the powerless, such as ordinary ancient Sumerians, nameless toilers who built the Great Wall, or basket weavers of the pre-Columbian Amazon. This is not to say that no one cares about them (scholars certainly do), or that their lives had any less worth than our own. It is instead to say that they are not the focal points of our collective awareness of the past. To the extent that we consider them at all, it's more about them as a class, or about what their lives reveal about the power structures that controlled and dominated them. Even social history, a discipline which was invented to contextualize the experiences of ordinary people and demonstrate their historical agency, frames such groups in the context of the struggle for power.

The struggle for power is a driver of events, unlike other determinants of history to which we are primarily reactive or which we control only obliquely. Humankind has little command over many of the phenomena that affect the course of events. Our fate is fairly sensitive to natural climatic changes, ice ages, earthquakes, tsunamis, volcanoes, drought, severe storms, floods, and asteroid impacts. Events like these have shaped the rise and fall of civilizations since time immemorial. We can be more or less prepared for these events, marshalling our surpluses with foresight, or not, but we are otherwise at their mercy. Similarly, we can prepare for epidemics and plagues, but they are basically calamities that fall upon us and which we do our best to survive. Sometimes they manage to destabilize societies, but they are not the primary plot line of the human story, thankfully.

Technological innovation and advances in knowledge are other factors that can result in enormous rearrangements of social and political power, and history at its most dramatic scale is the story of humankind's capacity to create its own change. But even if such advances could magically be halted, the struggle for power would go on, as it did in the places and centuries where few innovations were introduced. Conversely, it is extremely difficult to imagine the opposite situation: a world in which technology continued to advance but humans' struggle for power ceased.



Common terms from 50 random history articles in Wikipedia

Likewise, it cannot be denied that personality plays a role in history. One can see many branch points where events almost certainly would have been different if not for the influence of particular individuals. But were we to make personality the locus of our understanding of historical processes, we would be lost in a forest of detail without much substance to unite the mass of historical facts in front of us. Because power is a general phenomenon based upon human agency, it has explanatory potential that these other phenomena do not, or do to a much lesser degree.

Moreover, power tends to underlie other sociological forces that propel history, such as religion and ideology. Ideological and religious movements can be interpreted, fairly plausibly, as contenders for power and attempts to reshape the topology of power in their respective societies. For political ideologies, this is almost self-evident. Communism, socialism, conservatism, liberalism, anarchism, nationalism, and racism, for instance, set forth explicit visions of how power should be allocated and used. Ideologies advocate for power to be channeled towards certain individuals, groups, and institutions, and away from others. Their objectives are to alter existing power structures, reshaping them towards

their respective ideals, or conversely to defend those structures against attack. And it's not only in the abstract that political ideologies are fundamentally about power. They invariably entail networks of individuals and organizations mobilizing to shift, constrain, or preserve social and political power, typically in an assertive fashion. Ideologies are integral to the course of history and our understanding of it, and this is largely because of their effects on the operation of power in society.

That religion is deeply involved in the power dynamics of human societies is a slightly more difficult premise to accept. It's not always easy to see religion objectively due to its emotional and nostalgic hold over us. Obviously, religion fulfills many people's needs for existential meaning, moral guidance, and a sense of community. So it's not purely about power. Yet its political dimension cannot be denied. In the earliest civilizations, religious and political authority were closely intertwined, often as a singular form of order and control. Religious and political structures have coevolved for thousands of years and even today they remain fairly entangled. Religions have historically provided political and military leaders with the justifications for violence that they often require, and they have benefitted from the resulting victories by having had more opportunities to proliferate. Religious orders are concentrations of capital in their own right, some large, like the Catholic Church, and many small, and these loci tend to compel loyalty, deference, and obedience. Religious organizations also tend to encourage adherents to advance their agendas in the political arena. And they typically engage in communal self-help to provide social assistance and cooperation among their members, a low-level form of mutual support. Much more could be said on this topic, but the point is that religious behavior often has a political dimension resembling tribalism that results in self-interested changes to the way that power is distributed. To the extent that religion has relevance as a causative force in history, it is largely along this dimension.

## The Ubiquity of Power

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Power operates at many scales in the social world. It is coveted and contested by civilizations, nations, peoples, organizations, families, and individuals. It's difficult to think of social contexts in which power has no relevance at all, and in those it's often just that the machinations of power are drowned out by other competing psychological and sociological phenomena. Power is therefore a useful common thread for grasping the logic of human events.

Because it is relevant at so many levels of analysis, the desire for it is a plausible motivation of many historical actors. If individuals and organizations of various kinds all tend to have a lust for control, dominance, and influence, we can gain insight into historical processes at various scales of social organization by understanding the logic of power struggles. Put differently, one way to start understanding a particular historical situation is to look at the power relations among the various agents involved and ask what each is trying to achieve. More likely than not, they are motivated by the pursuit of power in some form or another. Obviously, not every individual or institution is power hungry. However, those who are tend to be much more likely to influence events, and thus more relevant to the overall story.

Power is also closely related to the notion of scarcity and how we respond to it. Presumably, in a world of infinite supply, where everyone's desires could always be fulfilled, there would be no need for conflict. That is not the world we inhabit. Our capacity for desire is fathomless, and its objects therefore necessarily scarce. When things are scarce, people fight over them. Sometimes the market resolves problems of scarcity through the operation of supply and demand, allocating

scarce items to those with the greatest capacity to pay for them. But often people resort to using whatever power is at their disposal to compel others to relinquish their claims over contested resources. In extreme cases, they use physical violence. More frequently, they find ways of imposing some kind of negative consequences upon their competitors. Typically, contestants over scarce resources form alliances in order to use their collective power to win control over the resource, meaning that scarcity also helps forge cooperation.

It is not the case that all human interaction is about power, or that if you understood power you'd understand everything about society and history. The social world is obviously extremely complex and numerous forces exert determinative effects upon it. However, the struggle for power is central to a coherent interpretation of events.

It's not always easy for us to see this. Certain things conspire against that perception. Usually the history that we're interested in is what's relevant to the present, and specifically to our present. We're vested in the interpretation and meaning of that history, because it helps define us and legitimize our place in the world. If those historical processes were fundamentally about power, it might suggest that any privileges we derived from them were unfairly obtained. So it's hard to get a sense of moral proportion about any part of the past from which we see ourselves emerging, as doing so has the potential to undermine our political identities.

In contrast, when looking at the remote past, remote in the sense of time, place, or culture, we're more likely to view events as the power struggles that they actually were. Ancient kingdoms fought with each other not over any great principles, certainly none relevant to us, but in order to conquer or resist being conquered. We can see these processes fairly objectively. The meanings of these distant events are open to debate and they have multiple plausible interpretations. Nonetheless, our ability to identify raw power and its pursuit in these remote contexts is not compromised by what the interpretation of these events implies about us now.

The same challenge applies to appreciating the role of power in the present. If power is one of the central concepts for understanding history, then it must play the same role in illuminating the present, since the present is feverishly generating tomorrow's history, being propelled by the same impetus. When we benefit from a power structure, we're disinclined to view our privileges as deriving from it (although those who are less privileged may have fewer illusions about this). The present is difficult to see clearly because we consume media diets of spin, deception, and ideology, and are taught fictionalized narratives of history from an early age. Moreover, the significance of events that occur in our lifetimes is not always fully clear, as it can take generations for the historical record to be sufficiently developed, for long-held secrets to be unearthed, and for causal patterns to be identified and given their appropriate weight. So while we may be able to recognize the past as primarily a struggle for power, we're likely to mistakenly believe that the present is primarily a struggle for principle.

## **The Dynamic Nature of Power**

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So what is power, this curious, ubiquitous thing that everyone keeps fighting over? Where does it come from? How do you get it? Why is it so ephemeral?

The existence of power has been recognized since time immemorial, but its nature remains a mystery. The concept is intuitively known to all of us, perceptible even by young children, a kind of animal instinct. It has been pondered for centuries, generating a literature so vast that it's tiresome merely to list all of the academic disciplines that have grappled with the subject: political science, international relations, sociology, psychology, geography, economics, law, military science, postcolonial studies, and philosophy. Yet despite all of this research, there are still gaps in our understanding of how power operates. Most social scientists define power as the ability to influence or control someone, or to compel probable obedience, or something along those lines. But how is that ability acquired? How is it lost? Why do some people seem to have so much of it, and others virtually none? And why are some power structures and organizational forms so stable and resistant to disturbance, while others are rickety and weak?

What we lack is an understanding of the dynamic nature of power. Power is both a stock, a quantity that can be possessed, and a flow, a quantity in motion. It spends much of its time on the move, circulating around human networks like a fluid. Though its course may shift rapidly, often quite surprisingly, it doesn't come out of nowhere. It is a substance created, nurtured, transferred, and destroyed by people. We can use it to make others more powerful or, conversely, to diminish their power, and in choosing how to deploy it, we alter the course of its movement. Power shifts as a consequence of the way that agents interact. And if power moves around, then there must be patterns that describe it. Its flow can't be entirely random. Too much is at stake. Power is simply too valuable for its conduct to be haphazard. There must be some explanation for its behavior, some logic to the way it's transmitted through social networks.



Power struggles at every level of the social world are generated by a single underlying process, regardless of whether the scale is that of world history or the office water cooler, and regardless of whether the struggle occurs over the course of centuries or during an elementary school recess. If we conceive of power at the proper level of abstraction, as a substance that oozes through human networks, we can gain insight into a wide range of social and historical phenomena, because it turns out that this diversity of situations is actually governed by the same core principles.

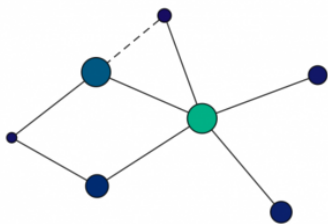
We know that power is desired, that people want to attract and possess it. They tend to want as much of it as they can reasonably get, and they'd prefer that competitors have as little of it as possible. To accumulate it, they rearrange and restructure their relationships: forming alliances, defending themselves, and coordinating aggression. Ultimately, people tend to use what power they have at their disposal to accumulate more of it. This is the essence of a power struggle: the use of power to obtain even more power, in competition with others who are trying to do exactly the same thing. Power is both the means and the object.

## The Abstraction of Quantitative Realism

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Turning rough ideas like these into clearly defined axioms, we can devise a model describing the dynamic nature of power. We call this model quantitative realism, because it's an outgrowth of political realism, discussed later on. It attempts to capture quantitatively what political realism describes qualitatively.

Quantitative realism seeks to answer the following question: If we had a set of agents and knew how powerful each one was, as well as their alliance structure, such as in the figure below, how would that network tend to evolve in time? Who would grow stronger, and who would weaken? From that minimal amount of data — the relative strengths of the agents and their network topology — can we predict how a particular power struggle is likely to unfold?



A random abstract **power structure**. Solid lines represent cooperation and dashed lines indicate conflict. The larger the node, the more powerful that agent is.

Quantitative realism is abstract, a deliberate over-simplification. It leaves out numerous features of the real world that determine the course of human events. It says nothing about institutions, technology, culture, ideology, religion, the environment, climate, race, justice, economics, personality, and disease. It ignores these and other factors, focusing its attention exclusively on the behavior of a single variable: power.

Though it's counterintuitive, often the simpler a model is, the more useful it becomes. Simple models winnow away things that are irrelevant or that have trivial effects. They help feeble human minds comprehend complex phenomena. And they yield approximations that make computation practicable. In contrast, complex models are generally too complex to be useful. Even if a complex model were able to make sufficiently accurate predictions about a phenomenon, it would not provide much insight into why it worked, as one would have to disentangle the many variables generating the behavior in order to understand what was going on. This minimalistic approach is referred to as parsimony, the belief that a scientific theory should be based on as few concepts and assumptions as possible.

The abstract nature of a simple model is what helps makes it applicable to many situations. Because quantitative realism is independent of institutions, technology, and the like, it allows us to say something about the ways of power regardless of whether we're talking about ancient tribal violence, city council politics, or the Israeli-Palestinian conflict. The abstraction lets us tease out pure patterns, and the fact that these patterns may not exist perfectly in the real world is about as unimportant as the fact that perfect spheres don't exist in the real world. Despite their nonexistence, mathematical spheres are useful idealizations of real world shapes, and we can use their properties to infer information that we wouldn't otherwise know, such as the approximate surface area of the Earth.

The abstraction of quantitative realism can help us unearth patterns in human conflict. If the pattern is hard to recognize, it is perhaps because we're so deeply embedded in it that it's hidden in plain sight. Power struggles are a ubiquitous feature of the social world and, regardless of who's engaging in them or the means by which they're carried out, they all share similar dynamic tendencies. By studying these fluid dynamics as abstractions, we can come to understand how political power moves, how that movement forges networks, and how those networks shape world order.

