Laws
○○○○○○○○○○○○○○○

Causation
○○○○○○○○○○○○

Mechanism
○○○○○○○○

Causality in the Social Sciences I

Renjie Yang

COMPHI LAB for Data Science

June 2020

Laws
○○○○○○○○○○○○○○○

Causation
○○○○○○○○○○○○

Mechanism
○○○○○○○○○

Causality in the Social Sciences

- Science seems capable of understanding the hidden causes of nature.
  - Newton: fundamental causes of real motion
  - Higgs field is responsible for mass
  - DNA molecules replicate to preserve traits
- Our social systems seem to be at once the products of free human action and causal mechanisms that run behind our backs.
  - I am free to act as I choose.
  - Companies can't deliver their goods: social reorganization would cause a different result.

Outline

1. Social Scientific Laws
2. Conceptualizing Causation
3. Models and Mechanisms
4. Statistical Inference for Causal Effects: Framework
5. Statistical Inference for Causal Effects: Methods
6. Experimentation

The Democratic Peace Hypothesis

- Immanuel Kant: democracies are more peaceful.
- Rational people would not vote "to bring down the miseries of war upon their country". (Kant 1903 [1795], 122)
- Dean Babst (1964) used World Wars I and II as test cases.

Laws
○○●○○○○○○○○○○○○○

Causation
○○○○○○○○○○○

Mechanism
○○○○○○○○

The Democratic Peace Hypothesis

How should we define "democracy" and "war"?

- Babst defined democracies as having legislation controlled by an elected body, a separately elected executive, and "some" freedom of the press.

- One commonly used body of data about wars comes from the *Correlates of War* project. This dataset defines war as requiring 1,000 battle deaths per year of conflict (among other criteria), and its current version lists 95 inter-state wars between 1816 and 2007.

- https://cow.dss.ucdavis.edu/data-sets/COW-war

Laws
○○○●○○○○○○○○○○○○

Causation
○○○○○○○○○○○○

Mechanism
○○○○○○○○

The Democratic Peace Hypothesis

- By Babst's count, 33 independent nations were at war in World War I. Of the countries who went to war, 10 had elective governments.

- There are 528 possible conflicts between pairs of nations that went to war in World War I. 72 of them actual happened.

- Out of the 45 different possible conflicts among the 10 democracies involved in World War I, none went to war with each other.

- In World Wars II, democracies did not go to war against each other. All declarations of war involved at least one non-democratic nation.

Conditional Probability

The probability that a normal die will roll a two is $1/6$.

- $\Pr(\text{Two}) = 1/6$
- $\Pr(\text{Even}) = 1/2$
- $\Pr(\text{Two given Even}) = \Pr(\text{Two} \mid \text{Even}) = 1/3$

Laws
ooooo●oooooooooo

Causation
oooooooooooo

Mechanism
oooooooo

Correlation

In Babst's study, the variables were whether or not a pair of
countries went to war (W) and whether both members of the pair
were democracies (D).

- $Pr(Y \mid X) > Pr(Y \mid \neg X)$, positive correlation between Y and X
- $Pr(Y \mid X) < Pr(Y \mid \neg X)$, negative correlation between Y and X
- $Pr(Y \mid X) = Pr(Y \mid \neg X)$ No correlation between Y and X
- $Pr(W \mid D)$ ¡ $Pr(W \mid \neg D)$

Laws
○○○○○○○●○○○○○○○

Causation
○○○○○○○○○○○○

Mechanism
○○○○○○○○

The Democratic Peace Hypothesis

- Babst analyzed data only from World Wars I and II, but his conclusion is general: Pairs of democracies are less likely to go to war with each other than are other mixes of government type.

- The next step, then, is to see whether the correlation holds up in a larger dataset.

- Using datasets like the Correlates of War, scholars have found that the negative correlation between democratic conflict and war holds.

- Can we draw any causal conclusion from this correlative study: democratic institutions reduce the risk of war with another democracy?

Laws
○○○○○○○●○○○○○○○

Causation
○○○○○○○○○○○

Mechanism
○○○○○○○○

Are There Social Scientific Laws?

- The correlation between democracy and peace is very strong. In this way, it seems similar to the laws discovered in the natural sciences.

- Should we regard the democratic peace hypothesis, if true, as a law?

- This question strikes to the heart of what it means to be a social science.

- Depending on one's perspective on this debate, the apparent lack of laws in the social sciences can be either treated as an indication of their failure to be genuine sciences, or as a mark of their distinctive character.

Laws
○○○○○○○○○●○○○○○○

Causation
○○○○○○○○○○○○

Mechanism
○○○○○○○○

Characteristics of Natural Laws

Two conditions are generally agreed upon which distinguish laws from mere correlations.

1 Laws must be general, making no reference to particular objects, times, or places.

2 Laws must support counterfactual statements.

Laws
○○○○○○○○○○●○○○○○

Causation
○○○○○○○○○○○○

Mechanism
○○○○○○○○

Newton's Laws of Motion

1 In an inertial frame of reference, an object either remains at rest or continues to move at a constant velocity, unless acted upon by a force.

2 In an inertial frame of reference, the vector sum of the forces F on an object is equal to the mass m of that object multiplied by the acceleration a of the object: $F = ma$. (It is assumed here that the mass m is constant.)

3 When one body exerts a force on a second body, the second body simultaneously exerts a force equal in magnitude and opposite in direction on the first body.

Laws
000000000000000

Causation
000000000000

Mechanism
00000000

The Law of Supply and Demand

- If the supply of a commodity increases (decreases) while the demand for it stays the same, the price decreases (increases); if the demand for a commodity increases (decreases) while the supply remains the same, the price increases (decreases).
- There are numerous kinds of cases in which it will be false:
    - the government imposes price controls
    - either vendors or consumers are ignorant about changes in supply or demand
    - humanitarian feelings on the part of many vendors motivate them not to raise prices on goods
- The law holds *ceteris paribus*, or all things being equal.

Laws
00000000000●000

Causation
00000000000

Mechanism
00000000

Creativity

- The unpredictability of human behavior seems incompatible with the existence of social scientific laws.

- Since a law must be general, it is true of events past, present, and future. This means that where there is a genuine law, there must be predictability.

- People can be creative, and the very nature of creativity precludes prediction.

- If human behavior is unpredictable, then there are no laws of the social world.

Laws
○○○○○○○○○○○○○●○○

Causation
○○○○○○○○○○○○

Mechanism
○○○○○○○○

Creativity

- One might argue that creativity is not merely difficult to anticipate; it is logically impossible (to predict an innovation).

- Humphrey Lyttelton: "If I knew where jazz was going I'd be there already"

- Alasdair MacIntyre makes two refinements on innovations (MacIntyre 1981, 94):
    1. the innovations have to be "radically new" in the sense that they are not simply new assemblages of existing materials.
    2. the predictions need to be based on principle, not simply imagined possibilities.

- When one looks at the fine details of conceptual, technological, or social invention, the changes are often incremental. "Radically new" innovations are rare.

Laws
○○○○○○○○○○○○○●○

Causation
○○○○○○○○○○○○

Mechanism
○○○○○○○○

Complexity

- The powerful generalizations of the natural sciences can be identified because it is possible to exclude external influences from our experiments, thereby isolating simple systems and repeatable phenomena.

- In the social sciences, we are interested in phenomena that cannot be isolated or described in simple terms. "simple laws will very rarely be found" (Scriven 1956, 335).

- Examples: prisoner's dilemmas vs. wars; controlled experiments vs. real interactions; diplomatic conversations

- In response to this argument, Lee McIntyre has pointed out that it privileges our existing descriptions of social phenomena (McIntyre 1993)

Laws
○○○○○○○○○○○○○○●

Causation
○○○○○○○○○○○○

Mechanism
○○○○○○○○

Summary

- None of the above arguments succeeds in showing that laws in the social world are impossible.

- At best, they show that there may be limits to what can be described and explained by social laws.

- The arguments also suggest that it might be helpful to separate the notion of law from the notion of predictability.

- There are alternative approaches to study causal relations in social phenomenon scientifically other than resorting to laws.

Laws
○○○○○○○○○○○○○○○○

Causation
●○○○○○○○○○○○

Mechanism
○○○○○○○○

Outline

1 Social Scientific Laws

2 **Conceptualizing Causation**

3 Models and Mechanisms

4 Statistical Inference for Causal Effects: Framework

5 Statistical Inference for Causal Effects: Methods

6 Experimentation

Laws
○○○○○○○○○○○○○○○○

Causation
○●○○○○○○○○○○○

Mechanism
○○○○○○○○

Constant Conjunction

> *an object followed by another, and where all the objects,*
> *similar to the first, are followed by objects similar to the*
> *second. Or, in other words, where, if the first object had*
> *not been, the second never had existed.*
>
> *(Hume 1955 [1777], 87)*

Causal Regularities

- When we explain an event by reference to its cause, we are implicitly invoking a causal law.

- The notorious problem with a regularity conception of causation is that regularities are too easy to find.

- The dominant approach in the social sciences has been to represent the regularities in terms of probabilities.

- It is very tempting to identify causes and correlations: X causes Y if and only if $\Pr(Y \text{ given } X) \neq \Pr(Y \text{ given } X)$

Laws
000000000000000

Causation
000●00000000

Mechanism
00000000

Interventionism

- An alternative to Hume's regularity conception of causality, is to think of causes in terms of manipulation, intervention, and experiment.

- X causes Y if and only if a person can bring about changes in Y by changing X.

- If causality depends on the possibility of intervention, we cannot make causal claims about history. Since it is impossible to travel back in time.

Laws
00000000000000

Causation
00000●00000

Mechanism
00000000

The Content of A Causal Claim

A necessary and sufficient condition for X to be a direct cause of Y with respect to some variable set V is that there be a possible intervention on X that will change Y (or the probability distribution of Y) when all other variables in V besides X and Y are held fixed at some value by interventions.

(Woodward 2003, 55)

Interventionism

- Modularity assumption: it is possible to isolate X and "surgically" intervene on it.

- There can be direct causes at different levels of analysis. So the analysis should be relative to a set of causal variables V.

- On Woodward's version of an interventionist account of causality, it is possible to have causal relationships at the social level.

- If we succeed at generating powerful causal theories which make no reference to individual-level properties, then an anti-reductionist position will be supported.

Advantages of Interventionism

- On an interventionist account, causal explanations can be given in the absence of laws.

- The notion of an intervention can be recruited to characterize the distinction between genuine laws and spurious correlations.

- A further, practical virtue of the interventionist analysis is that it helps disambiguate causal claims. "Being female causes one to receive a lower salary."

Laws
000000000000000

Causation
0000000●0000

Mechanism
00000000

Genuine Laws and Spurious Correlations

> *A generalization G (relating, say, changes in the value of X to changes in the value of Y) is invariant if G would continue to hold under some intervention that changes the value of X in such a way that, according to G, the value of Y would change - "continue to hold" in the sense that G correctly describes how the value of Y would change under this intervention.*
>
> *(Woodward 2003, 15)*

Laws
0000000000000000

Causation
00000000●000

Mechanism
00000000

Social Capacities

- Both the Humean and the interventionist accounts of causality tend to agree that a correlation is a necessary, but not sufficient, condition of causality: If X causes Y then Pr(Y given X) ≠ Pr(Y given X)

- By contrast, the capacity views of causality reject correlations as a necessary condition of causes.

- On the capacity view, the correlations we observe arise from underlying causal relationships. Those causal powers exist even if the causes cancel each other out or are masked by other causal forces.

Capacities

- Both the Humean and the interventionist accounts of causality tend to agree that a correlation is a necessary, but not sufficient, condition of causality: If X causes Y then Pr(Y given X) ≠ Pr(Y given X)

- By contrast, the capacity views of causality reject correlations as a necessary condition of causes.

- On the capacity view, the correlations we observe arise from underlying causal relationships. Those causal powers exist even if the causes cancel each other out or are masked by other causal forces.

Capacities

- Do social properties have causal powers? Social entities or individual agency.

- Whether or not there are irreducible social capacities, capacity theorists agree that most social phenomena gain their causal efficacy from the fact that they are parts of, or rely on, larger causal systems.

- Nancy Cartwright's "nomological engines": automobile

- The fact that causal relationships often depend on larger causal systems (nomological engines) also explains why *ceteris paribus* clauses are necessary in many causal generalizations.

Laws
○○○○○○○○○○○○○○○○

Causation
○○○○○○○○○○○●

Mechanism
○○○○○○○○

Capacities: Pros and Cons

- Modularity: both the regularity and the interventionist conceptions of causality tend to view causes as independent and isolatable.

- Nancy Cartwright has argued, to the contrary, that "[m]odularity is not a universal feature of deterministic causal systems" (Cartwright 2007, 96).

- The interventionist may respond that the interventionist conception of cause explicitly does not require that humans be actually able to make the interventions that define causes.

- One objection to a capacity view of causation is that the concept of capacity is mysterious.

Outline

1 Social Scientific Laws

2 Conceptualizing Causation

3 **Models and Mechanisms**

4 Statistical Inference for Causal Effects: Framework

5 Statistical Inference for Causal Effects: Methods

6 Experimentation

Laws
○○○○○○○○○○○○○○○

Causation
○○○○○○○○○○○

Mechanism
○●○○○○○○

Secret Springs and Principles

- "The historian traces the series of actions according to their natural order, remounts to their secret springs and principles, and delineates their most remote consequences" (Hume 1955 [1777]

- Many social scientists have become dissatisfied with the kind of correlational research that results from the search for laws. They have called for an approach that unwinds the secret springs and principles of social phenomena.

- We want to understand why democracy is correlated with peace, and for that we need to understand the underlying mechanism. The cause must lie deeper.

Laws
○○○○○○○○○○○○○○

Causation
○○○○○○○○○○○

Mechanism
○○●○○○○○

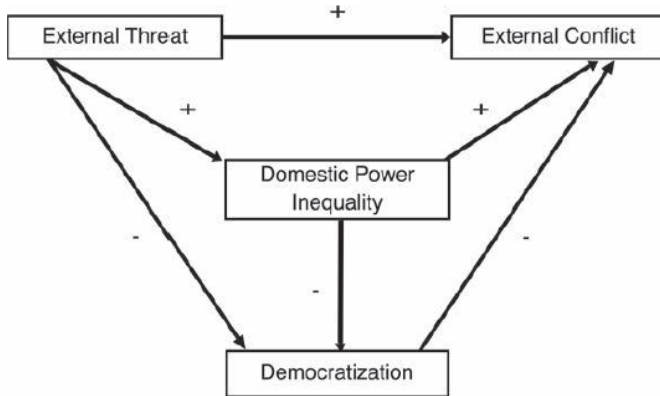## The "Process Argument": Eliminate the Macro Level

> *Theories of voting behavior, for instance, have identified both an underdog mechanism and a bandwagon mechanism ... Those subject to the former tend to vote for the candidate who is behind in preelection polls, whereas those subject to the latter vote for the front-runner. With many voting for the underdog, the frontrunner might lose, and vice versa. If the two types are more evenly mixed, there might be no noticeable net effect, so that the polls would be good predictors of the actual vote. Th e lack of influence of polls on voting in the aggregate does not show, however, that individuals are unaffected by the polls. Th e neutral aggregate could mask a homogenous population of neutral individuals-or a heterogeneous population of individuals who are all strongly affected but in opposite directions.*

(Elster 1998, 70–1)

Regularity and Uniqueness

- The underdog and bandwagon effects are themselves causal relationships that hold across a wide range of social contexts.

- From a regularity standpoint, mechanistic explanation is nothing more than explanation by laws governing the micro-level phenomena.

- For the interventionist, appeal to causal laws is replaced by appeal to invariant generalizations. These will be dependent on the particular causal systems under study.

- For the capacity theorists, while mechanistic explanations will require some generalizations, their gambit may not reach very far beyond the particular systems under investigation.

Laws
○○○○○○○○○○○○○○○

Causation
○○○○○○○○○○○○

Mechanism
○○○○○●○○○

Rasler and Thompson Model of Democratic Peace

Laws
○○○○○○○○○○○○○○○

Causation
○○○○○○○○○○○○

Mechanism
○○○○○●○○

Rasler and Thompson Model of Democratic Peace

$$
\begin{aligned}
log(Dispute)_t = {} & \alpha + \beta_1(Threat) + \beta_2(Democracy)_t \\
& + \beta_3(PeaceYears)_t + \beta_4(War)_t \\
& + \beta_5(Disputes)_t - 1 + error_t
\end{aligned}
$$

(Rasler and Thompson 2004, 897)

Rasler and Thompson's Model

- If we think of the perception of external threat by citizens of a
  nation and the distribution of political power within that
  nation as the "micro" variables, this explanation includes both
  micro-and macro-level causes.

- Schelling's model of neighborhood segregation is routinely
  cited as an example of mechanistic explanation and causal
  modeling. But it is not explaining a higher level association
  between two macro variables.

- This kind of causal modeling treats models as replacing the
  interest in higher-level generalizations entirely.

- Can we combine micro-level ABM and higher-level causal
  models systematically?

Laws
○○○○○○○○○○○○○○○

Causation
○○○○○○○○○○○○

Mechanism
○○○○○○○●

Reference

- Mark Risjord (2014) *Philosophy of Social Science: A Contemporary Introduction*, Routledge.