

# Elements of quantitative research

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# Roadmap

Theories and research questions

Concepts and operationalization

Measurement

Description

Example: Wartime civilian deaths

Paper discussion

# Research and RQs

- Research = answering questions
- Re-cap on research types
  1. **Normative** vs. **positive** research
  2. Positive: **theoretical** vs. **empirical**
  3. Empirical: **Descriptive, explanatory**

# Research and RQs

- Research = answering questions
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  1. **Normative** vs. **positive** research
  2. Positive: **theoretical** vs. **empirical**
  3. Empirical: **Descriptive, explanatory**  
And **predictive?**

# Example on types of questions and evidence

- Imagine you are doing the analytics previous to creating a campaign for Mahou
- Think of questions that are:
  - Quantitative and descriptive
  - Quantitative and explanatory
  - Qualitative and descriptive
  - Qualitative and explanatory



# What is a research question?

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- **Even though** this ‘argument’ can be something anecdotal that we later develop into a proper, abstract theoretical argument
  - And it would actually look into something like this:
  - Previous > ‘Anecdotal argument’ > RQ > (Proper) Theory > Hs

# Good RQs, in brief

## 1. Empirically **answerable**

→ i.e. you can answer it with data

## 2. Theoretically **relevant**

→ i.e. it helps you learn something about your theory/argument

# Good RQs, more in detail

1. Consider potential results of the analyses
  - if you found X, does that answer the question? causally?
  - example: are kids who play videogames often more aggressive?
  - does that inform a theory on the aggressiveness effect of VGs?
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  - do you have the data? is it possible to do it? (e.g. re-offenders)
  - also: is there any design or strategy to answer it?

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  - also: is there any design or strategy to answer it?
3. Keeping it simple and narrow
  - what are the causes of economic underdevelopment? vs. does exposure to natural disasters hinder economic development?

## Example on generating RQs

- Couple things to remember:
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- Couple things to remember:
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  - So they already suggest which variation to look at
- Imagine you have the following argument:

How good students do at school depends more on the peers they are surrounded by than on the quality of the teaching they receive
- Which RQ could let us test this?

## Stories, RQs, and theories

- There're no exclusive definitions of 'stories' and theories
- It's just about getting to a sufficient level of abstraction
- Often, you start with a story or example, and then you move up the ladder for both theory and RQs until you get to a general theory tested with a RQ

# Generating theories

- No recipe for this, everyone generates theories *all the time*
- Usually it refers to an analytical argument that explains something
  - It could also be a descriptive or predictive theory, but even in those cases there's probably an explanation underneath
- Developed inductively, from descriptive data to general explanations
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- **Q:** How to identify a **good theory**?

# Evaluating theories

## 1. Simple

# Evaluating theories

1. Simple
2. Internally coherent and able to explain variation

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1. Simple
2. Internally coherent and able to explain variation
3. Testable

# Example (of the whole process)



## Example

- That's some descriptive evidence that could inspire an anecdote
- The **anecdotal argument** (think of a story)
- The **research question**
- The 'proper' **theory**
- The **hypotheses?**

# Example

- That's some descriptive evidence that could inspire an anecdote
- The **anecdotal argument** (think of a story)
  - My friend John who went on Erasmus has more money than my other friend who couldn't go, and also, John managed to get a job because his father is partner at a local firm
- The **research question**
  - Is there a causal effect of Erasmus on labor market early success? Is the effect mediated by household income?
- The 'proper' **theory**
  - Going on Erasmus does not have any causal effect on getting a first job, the relationship is explained by the confounding effect of income
  - Or: Positive effect among high-income students because they have access to informal networks where this experience is valued
- The **hypotheses?**

# Hypotheses

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  - Which essentially means being able to say what you expect to see given a theory  
And ideally, knowing what you need to see in order to discredit the theory
- Imagine that I have the theory that my knee hurts when I do sports on cold days
  - Simplifying it, we have a 2x2 situation:

Hypotheses: what would you expect to observe?

	<i>Cold day</i>	<i>Hot day</i>
<i>Run</i>		
<i>Didn't run</i>		

Hypotheses: what would you expect to observe?

	<i>Cold day</i>	<i>Hot day</i>
<i>Run</i>	Pain	Not pain
<i>Didn't run</i>	Not pain	Not pain

## What if you observe this?

	<i>Cold day</i>	<i>Hot day</i>
<i>Run</i>	Pain	Not pain
<i>Didn't run</i>	Pain	Pain

- New theory?
- How would you test it?

# Why bother about theory?

- Why start with questions and arguments?

Why not just exploit data? (Especially if we have big data)

# Why bother about theory?

## Teen Arrested in Samurai Killing

April 3, 2000



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MADRID, Spain (AP) — Police in southeastern Spain arrested a 16-year-old martial arts fan Monday for killing his parents and little sister with a samurai sword.

Police arrested the teen in a train station in Alicante as he and a friend were preparing to travel to Barcelona, said Jose Luis Rico, spokesman for the Alicante police.

# Why bother about theory?

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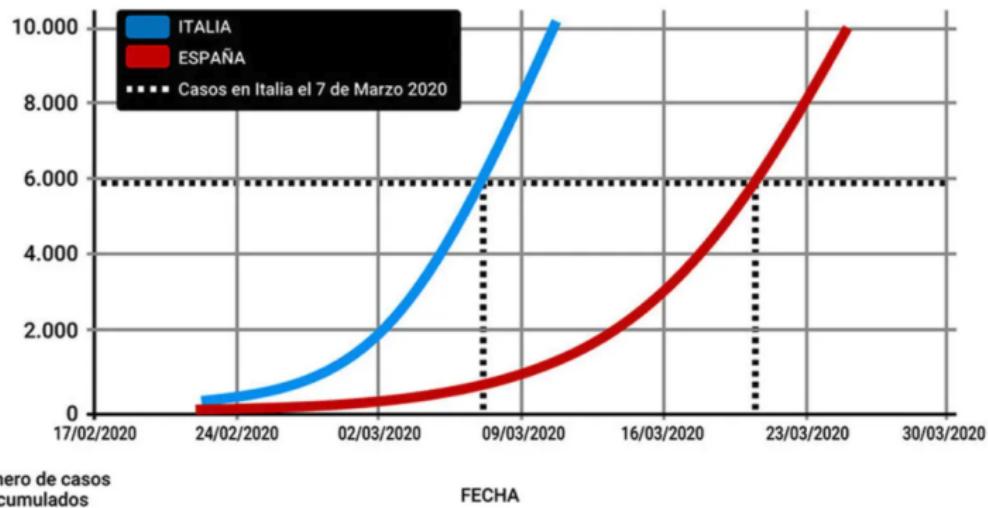
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# Computational methods and theory

- Limitations of *data mining*
- Focus on the what rather than on the why
- Problems with machine learning
  - Example of predicting ice cream sales

Why bother about theory?

CIVIL UNREST

# Predicting Civil Conflict: What Machine Learning Can Tell Us

Computer programs can be used as early warning systems, allowing the global community to act before violence erupts.

## Mechanisms briefly

- A **mechanism** is basically the **how** (or why) of a relationship
- e.g., we know that the flu gives us fever
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# Mechanisms briefly

- A **mechanism** is basically the **how** (or why) of a relationship
- e.g., we know that the flu gives us fever
  - flu > fever
- What's the mechanism?
  - flu > *immune system detects infection* >  $\Delta$  body temp > fever
- Good thing about mechanisms is that we can try to test them

## Testing mechanisms ( $\approx$ sub-research questions)

- Let's go back to the Erasmus example
- If our theory is that the effect of going on Eramus is higher for high-income students due to their access to social networks,  
**what's the mechanism?**
- And how could we try to **test it?**  
→ (Think about the sub-RQs)

# Recap

- Questions on theory, RQ, or mechanisms?

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# Concepts

- What are **concepts**?
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  - *Household* income? What's considered a household?
  - More problematic: Ideology? Democracy?

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- Some times they are a no brainer (income), but in many cases we have to think about them
  - *Household* income? What's considered a household?
  - More problematic: Ideology? Democracy?
- Also minor point: *concept*  $\neq$  *term*
  - Think about the labels we use to refer to some particular concept, e.g. authoritarian regime (i.e. dictatorship), rationality, etc

# Concepts types

- No fixed categories, but some people talk of:
  1. **Rule-based** (definition)
    - e.g. what are the rules we could use to define a household?
  2. **Ideal types** (or family resemblance?)
    - How do household look like? Can we intuitively identify them?
- Rather than two exclusive types of concepts, they are two ways to think about them which are usually useful in improving concepts

# Operationalization

- To translate abstract concepts into concrete stuff we can observe and potentially measure
- Operationalize  $\neq$  measure
  - The fact that you can think of a concept in concrete terms does not mean you can always measure it easily
  - Remember the algorithm that models rate of re-offenders
  - Ideology of Twitter users? easy to op, hard to measure (\*)

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  - Ideology of Twitter users? easy to op, hard to measure (\*)
- More like thinking of real-world attributes that map the conceptual dimensions we think about
  - *concept*: war intensity; *operationalization*: number of battle deaths
- the **Botswana example** on defining/operationalizing democracies

# Importance

- Might seem like something too abstract to care about (especially for computational social science), but it is actually not
- A **huge** part of good quantitative work relies on improving current concepts and their operationalization (which often leads to new ways of measuring them)
- Classic examples with theoretical importance (e.g. Putnam's *social capital*), but also today's paper ('Roads to rule') is a good example of this

# Example

- Say we have a question about some  $x$  cause of civil war outbreak
- That's two concepts we are actually talking about:
  1. **Civil war**
  2. **Outbreak**
- How could we define them? And operationalize them?

## Another example of a contentious concept

- What is **populism**? How can we operationalize it?  
→ e.g. how could we code a list of *populist* political parties? or leaders?

(re: moving concepts up and down different levels of analysis)

# Roadmap

Theories and research questions

Concepts and operationalization

**Measurement**

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# Measurement issues

1. Measuring what you really want to measure
  - Careful with the use of proxies
2. Keep in mind what units you're not observing
  - Missing data, sampling bias
3. Choosing the right unit of analysis
  - Depends on the theory

# Measurement issue #1

Measuring the right stuff

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- Not a lot to say here, other than to **pay attention**
- We normally look at one variable superficially without thinking about how it was created
- How was it exactly measured?
  - Survey wordings
  - Coding issues (e.g. level of democracy)
  - Type of raw data used
- And more importantly, are there **biases related to our question?**

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- **Expert surveys**
  - You send questionnaires to experts who then reply, aggregate using average or similar
- **Coding written texts**
  - Manifesto project, but also others based on NLP
- **Observing roll call voting**
  - Voteview project
- All these point to slightly different concepts or operationalizations
- We'll see a different strategy based on *latent variables* in a moment

## Measuring the right stuff: Example

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- You find a dataset that lists all minorities in a given country and gives them a yearly score of discrimination from 0 to 10
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- You also learn that the dataset was coded through **expert surveys**, sending a questionnaire to 2–3 researchers from each country
- **What do you think?**

## Measuring the right stuff: Example

- Now imagine you use the same dataset to analyze whether more extreme forms of discrimination make violence against minorities more likely
  - You take the violence data from another dataset that e.g. codes actual violence events from newspapers
- You find a *positive relationship* in the results
- Thoughts?

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- Thoughts?
- (Go back to previous definition)
- Another issue: difference depending on whether you do *within vs between comparisons*

## Measuring the right stuff: Another example

- Recent debate on **democratic backsliding**
- Problem: how do we measure democracy?
- Available data: many international datasets on democracy rely on subjective **expert judgement**

# Measuring Democratic Backsliding

Andrew T. Little, *University of California, Berkeley, USA*

Anne Meng, *University of Virginia, USA*

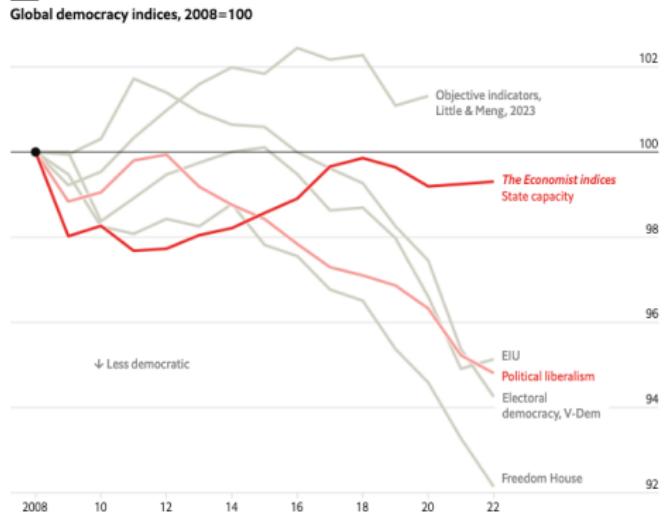
**ABSTRACT** Despite the general narrative that the world is in a period of democratic decline, there have been surprisingly few empirical studies that assess whether this is systematically true. Most existing studies of global backsliding are based largely if not entirely on subjective indicators that rely on expert coder judgment. Our study surveys objective indicators of democracy (e.g., incumbent performance in elections) and finds little evidence of global democratic decline during the past decade. To explain the discrepancy in trends between expert-coded and objective indicators, we consider the role of coder bias and leaders strategically using more subtle undemocratic action. Although we cannot rule out the possibility that the world is becoming less democratic exclusively in ways that require subjective judgment to detect, this claim is not justified by existing evidence.

[Graphic detail](#) | Measure for measure

# Global democratic backsliding seems real, even if it is hard to measure

Our analysis highlights two measures of governance that have diverged in recent years

Sep 12th 2023



# EPR example? (<https://icr.ethz.ch/data/epr/>)

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ETH Zurich > D-GESS > CIS > ICR > Data > Ethnic Power Relations (EPR) Dataset Family

## Ethnic Power Relations (EPR) Dataset Family 2021

The EPR Dataset Family provides data on ethnic groups' access to state power, their settlement patterns, links to rebel organizations, transborder ethnic kin relations, and intraethnic cleavages. The 2014 version has been introduced in [Vogt, Bormann, Rüegger, Cederman, Hunziker, Girardin \(2015\)](#) and has been updated in 2021 in a series of data sets on ethnicity that have stimulated civil war research in the past decade. It features a comprehensive system of tightly integrated data sets:



**EPR Core**  
Politically relevant ethnic groups

The EPR Core dataset identifies all politically relevant ethnic



**GeoEPR**  
Polygons describing ethnic groups

The GeoEPR dataset provides geo-spatial information about



**ACD2EPR**  
Conflicts between ethnic groups

The ACD2EPR docking dataset links conflicts inventoried in

## EPR definitions

- **We define ethnicity** as a subjectively experienced sense of commonality based on a belief in common ancestry and shared culture. Different markers may be used to indicate such shared ancestry and culture: common language, similar phenotypical features, adherence to the same faith, and so on. **Our definition of ethnicity thus includes ethnolinguistic, ethnoreligious, and ethnosomatic (or “racial”) groups**, but not tribes and clans that conceive of ancestry in genealogical terms, nor regions that do not define commonality on the basis of shared ancestry.
- **An ethnic group is politically relevant if** either at least one significant political actor claims to represent the interests of that group in the national political arena or if group members are systematically and intentionally discriminated against in the domain of public politics.

# EPR definitions

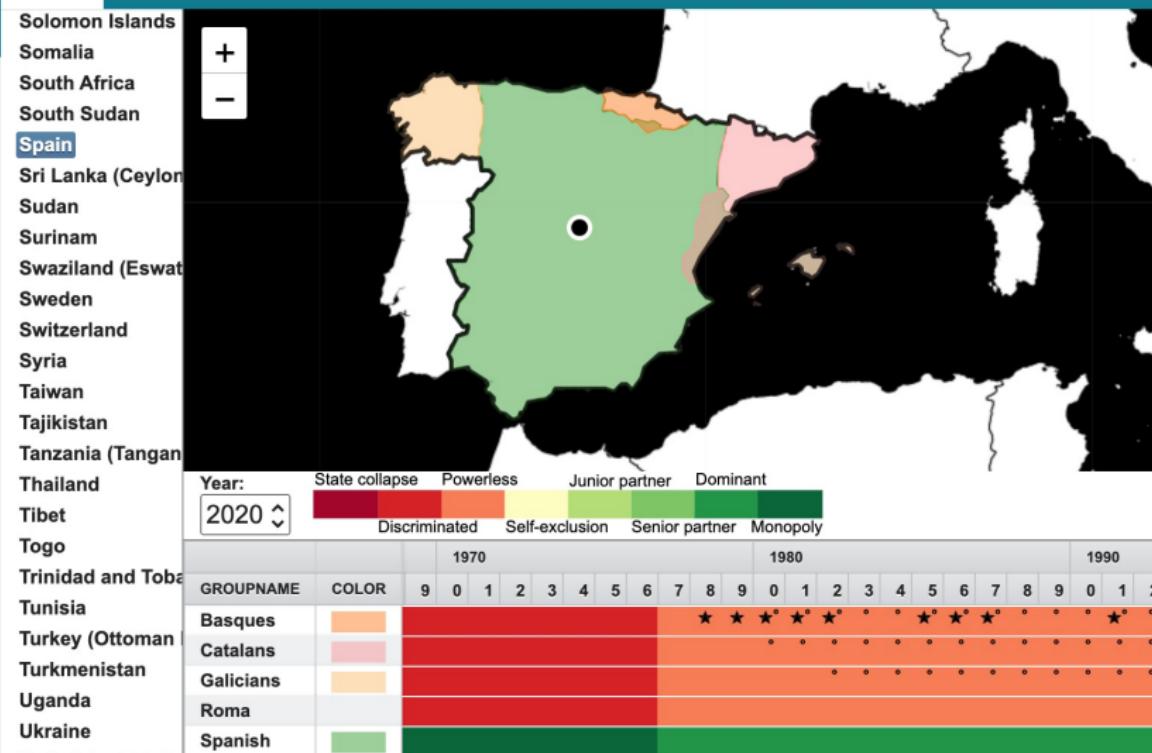
- **Monopoly:** Elite members hold monopoly power in the executive to the exclusion of members of all other ethnic groups.
- **Dominance:** ... dominant power in the executive but ... some limited inclusion of "token" members of other groups
- **Senior Partner:** Representatives of the group participate as senior partners in a formal or informal power-sharing arrangement ... (any arrangement that divides executive power among leaders who claim to represent particular ethnic groups and who have real influence on political decision making)
- **Junior Partner:** ... as junior partners in government.
- **Powerless:** Elite representatives hold no political power (or do not have influence on decision making) at the national level of executive power - although without being explicitly discriminated against.
- **Discrimination:** Group members are subjected to active, intentional, and targeted discrimination (formal or informal) by the state, with the intent of excluding them from political power (but not from socio-economic sphere).
- **Self-exclusion:** groups that have excluded themselves from central state power, in the sense that they control a particular territory of the state which they have declared independent

# EPR in Spain?

- How would you code Spain? (Or your own country, in case it's multi-ethnic)
- Two main things?
  1. How many *politically relevant* ethnic groups?
  2. Political status by period?

**GROW<sup>up</sup> - Geographical Research On War, Unified Platform**

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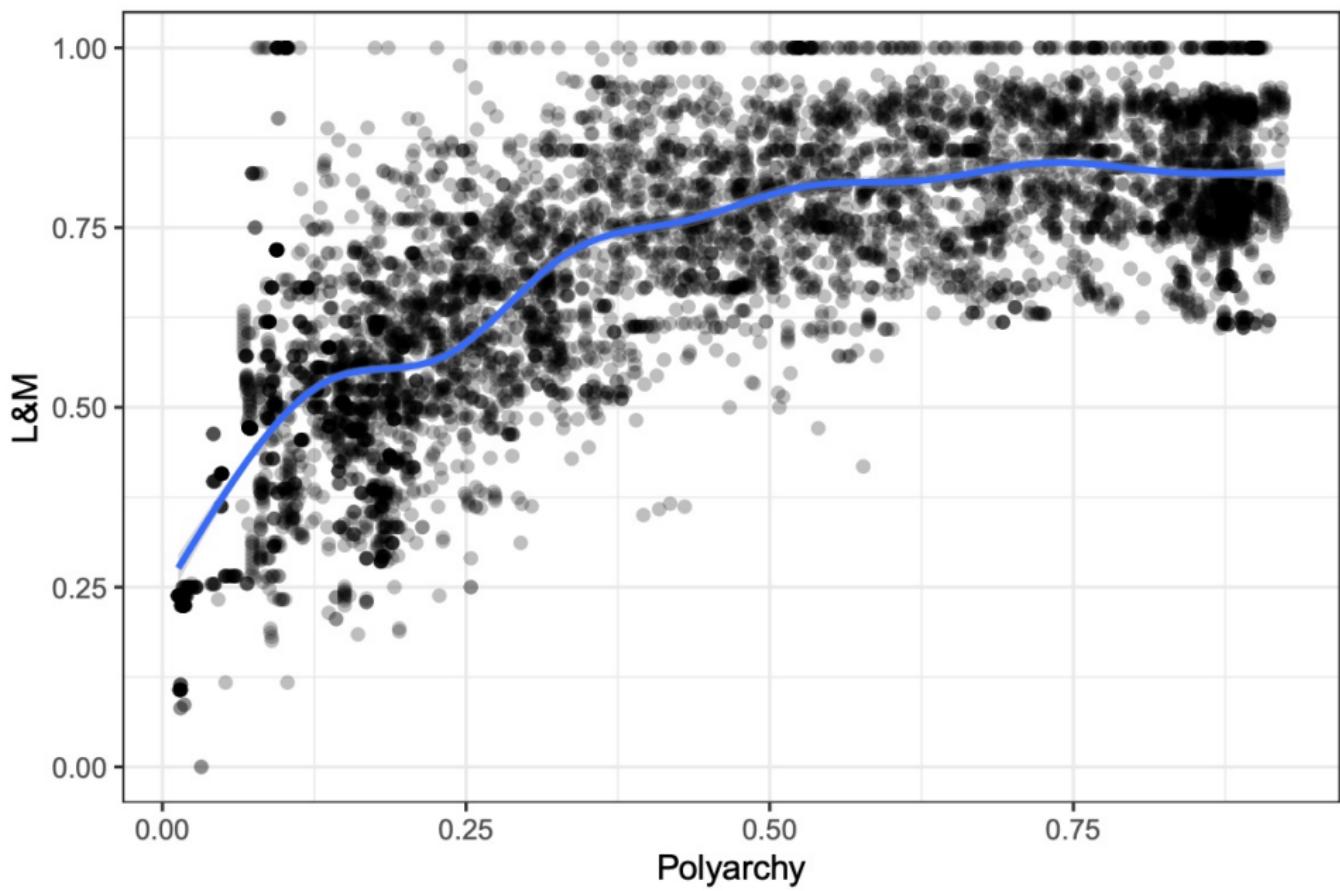


# Democratic backsliding

- 'Objective' and 'subjective' operationalization & measurement
- 'Objective' measures usually rely on a *minimalist* conceptualization of democracy
  - e.g. celebration of contested elections
- 'Subjective' measures tap into *maximalist* definitions of democracy that incorporate more dimensions
  - regular, contested elections; but also rule of law, participation, media, etc
- Problem: Autocrats are usually pretty creative

## The case for objective measures

- One example from the ACLP (Alvarez, Cheibub, Limongi, Przeworski) Democracy and Dictatorship Dataset
- Coding democracy based on four objective, observable rules:
  1. The chief executive must be chosen by popular election or by a body that was itself popularly elected.
  2. The legislature must be popularly elected.
  3. There must be more than one party competing in the elections.
  4. An alternation in power under electoral rules identical to the ones that brought the incumbent to office must have taken place.



## One view on this (by V-Dem people)

- Even if using expert surveys, you can take some measures
  - Aim for *replicability*
  - Incorporate measures of uncertainty
  - Build it differently: e.g. incorporate different dimensions, use an ordinal scale, aggregate differently, etc
- 'Objective measures' are not that objective
  - Botswana example, and systematic downward bias against young democracies with economic growth
  - e.g. how do you detect fraud? election forensics methods (based on distribution) can be incorporated by autocrats in later elections
- To know more: Knutsen *et al.* 'Conceptual and Measurement Issues in Assessing Democratic Backsliding.' V-Dem Working Paper, May 2023.
  - [v-dem.net/media/publications/wp\\_140.pdf](https://v-dem.net/media/publications/wp_140.pdf)

# Proxies

- A **proxy variable** is a variable that we use to substitute another variable we cannot observe or measure
- This is a matter of creativity, but the important thing is to think about **potential biases**
- A real example:
  - Trying to know if leftist/Basque nationalist priests during Francoist Spain had an effect on later terrorism
  - First problem (among many): how do you measure the ideology of these people?
  - Using the 1963 letter to the Vatican

# Latent variables

- Some concepts are just not directly observable  
→ (or very expensive / unfeasible to do so)
- Another option is to create the variable out of other observables
- This is sometimes called **latent variables**

# Latent variables

- Let's look at one example: imagine you want to do research on whether left-wing or right-wing people tweet differently (or some other outcome, e.g. echo chambers idea)
- It's easy to get data on the outcome variable (Tweet content, frequency, ...)
  - if you don't know how now, you'll learn in the spring
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  - Of even some others have linked survey data to Twitter activity, asking for consent (problem of cost, non-response)

# Birds of the Same Feather Tweet Together: Bayesian Ideal Point Estimation Using Twitter Data

Pablo Barberá

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New York, NY 10012.  
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Edited by R. Michael Alvarez

Politicians and citizens increasingly engage in political conversations on social media outlets such as Twitter. In this article, I show that the structure of the social networks in which they are embedded can be a source of information about their ideological positions. Under the assumption that social networks are homophilic, I develop a Bayesian Spatial Following model that considers ideology as a latent variable, whose value can be inferred by examining which politics actors each user is following. This method allows us to estimate ideology for more actors than any existing alternative, at any point in time and across many polities. I apply this method to estimate ideal points for a large sample of both elite and mass public Twitter users in the United States and five European countries. The estimated positions of legislators and political parties replicate conventional measures of ideology. The method is also able to successfully classify individuals who state their political preferences publicly and a sample of users matched with their party registration records. To illustrate the potential contribution of these estimates, I examine the extent to which online behavior during the 2012 US presidential election campaign is clustered along ideological lines.

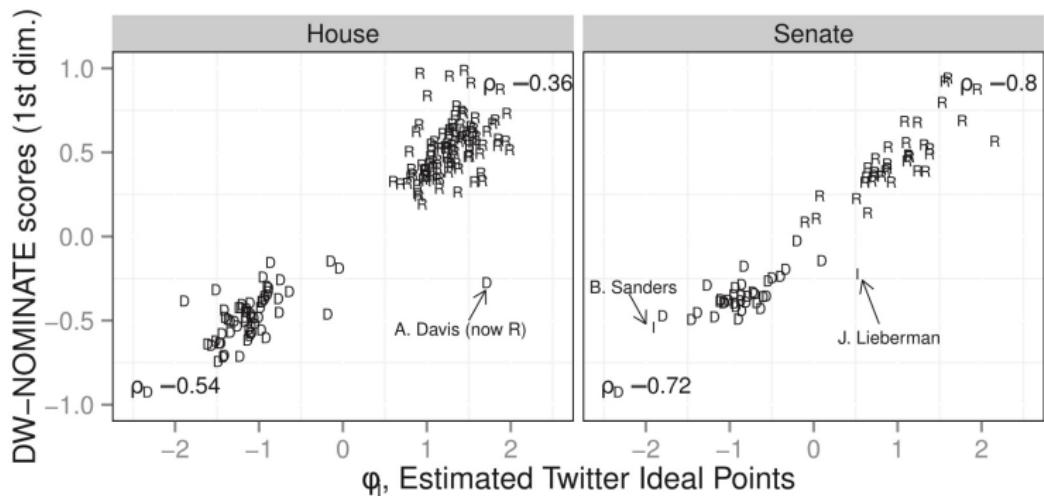
## **2 Ideal Point Estimation Using Twitter Data**

### **2.1 Assumptions**

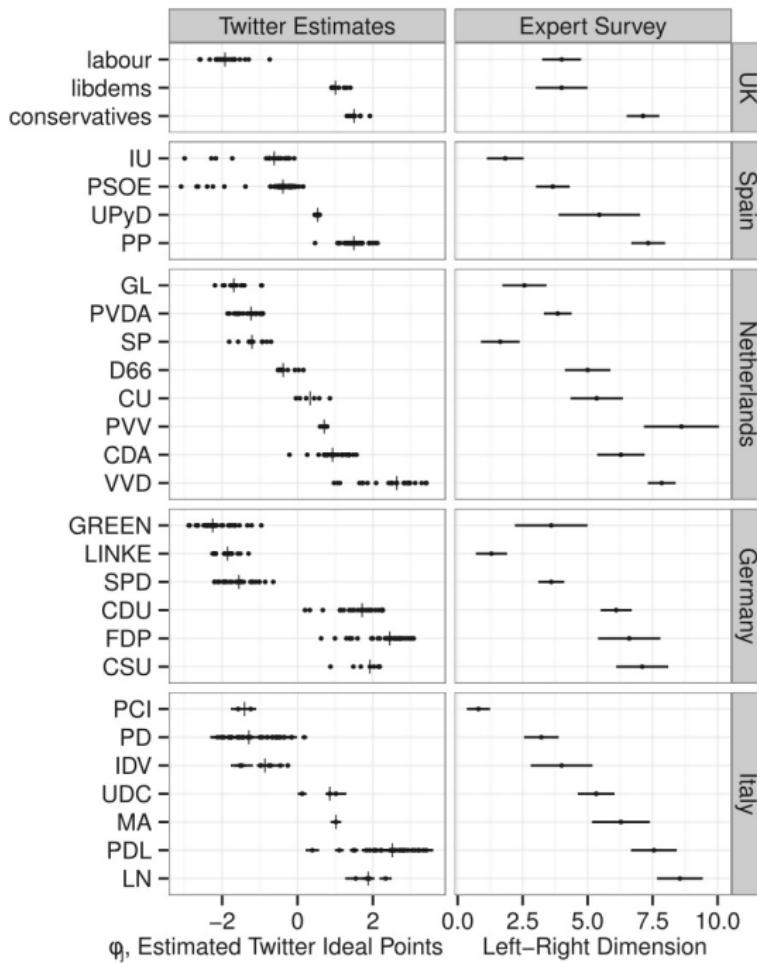
In this article, I demonstrate that valid ideal point estimates of individual Twitter users and political actors with a Twitter account can be derived from the structure of the “following” links between these two sets of users. In order to do so, I develop a Bayesian spatial model of Twitter users’ following behavior.

The key assumption of this model is that Twitter users prefer to follow politicians whose positions on the latent ideological dimension are similar to theirs. This assumption is equivalent to that of spatial voting models (see, e.g., Enelow and Hinich 1984). I consider following decisions to be costly signals about users’ perceptions of both their ideological location and that of political accounts. Such cost can take two forms. If the content of the messages users are exposed to as a

# Validating measure



**Fig. 1** Ideal point estimates for members of US Congress.



**Fig. 3** Ideological location of parties in five European countries.

# Tweeting From Left to Right: Is Online Political Communication More Than an Echo Chamber?

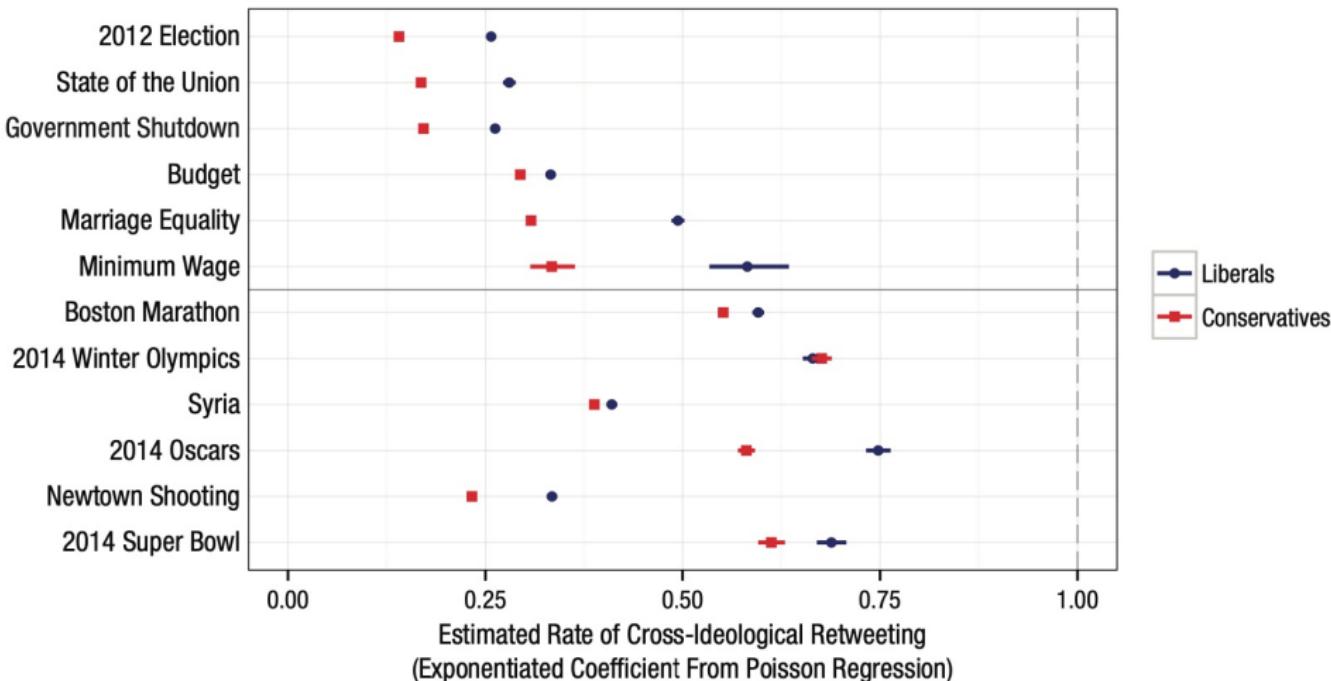


**Pablo Barberá<sup>1</sup>, John T. Jost<sup>1,2,3</sup>, Jonathan Nagler<sup>3</sup>,  
Joshua A. Tucker<sup>3</sup>, and Richard Bonneau<sup>4</sup>**

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## Abstract

We estimated ideological preferences of 3.8 million Twitter users and, using a data set of nearly 150 million tweets concerning 12 political and nonpolitical issues, explored whether online communication resembles an “echo chamber” (as a result of selective exposure and ideological segregation) or a “national conversation.” We observed that information was exchanged primarily among individuals with similar ideological preferences in the case of political issues (e.g., 2012 presidential election, 2013 government shutdown) but not many other current events (e.g., 2013 Boston Marathon bombing, 2014 Super Bowl). Discussion of the Newtown shootings in 2012 reflected a dynamic process, beginning as a national conversation before transforming into a polarized exchange. With respect to both political and nonpolitical issues, liberals were more likely than conservatives to engage in cross-ideological dissemination; this is an important asymmetry with respect to the structure of communication that is consistent with psychological theory and research bearing on ideological differences in epistemic, existential, and relational motivation. Overall, we conclude that previous work may have overestimated the degree of ideological segregation in social-media usage.



**Fig. 4.** Liberal-conservative asymmetries in cross-ideological retweeting. The graph shows the estimated rate of cross-ideological retweeting for each tweet collection and for each ideological group after adjusting for each group's propensity to retweet and be retweeted; each point corresponds to an exponentiated coefficient of a Poisson regression for the indicated topic and ideological group. The error bars indicate 99.9% confidence intervals (not visible in some cases because of their small size). An exponentiated coefficient of 1 (highlighted by the dashed vertical line) would indicate identical retweeting rates for individuals of the same and different ideological orientations—that is, a rate of cross-ideological retweeting that is equal to the rate of within-group retweeting.

## Measurement issue #2

What units are you **not** measuring?

## Beyond our observations: missing data

- **Missing data** is when we don't have data for some observations
  - often more important than it looks, important to understand if it's biasing our analyses

Three types:

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## 2. Missing **at random**

- One variable explains whether obs are missing or not, but it's not related to our question

## 3. Missing **not at random**

- The variable that explains 'missingness' is key to our question

- Example: smoking status missing, gender (MAR), emergency (MNAR)

## Beyond our observations: sampling bias

- **Sampling bias** could be thought of as missing data or, rather, as a controlling variable we'll indirectly include
- Easy case: we're dealing with a pre-designed sample that might have some biases
  - Online survey and +65

## Beyond our observations: sampling bias

- **Sampling bias** could be thought of as missing data or, rather, as a controlling variable we'll indirectly include
- Easy case: we're dealing with a pre-designed sample that might have some biases
  - Online survey and +65
- More easy to miss: there is an 'invisible variable' determining which observations we have or not
  - e.g. when using Twitter data,
- We'll talk more about how this affects inference
  - Collider bias example?

## Measurement issue #3

At which level should we measure?

# Unit of analyses

- Level at which we have our observations
- Deeply related to the variables we have
  - Even though not all variables have to/can be measured at the same level

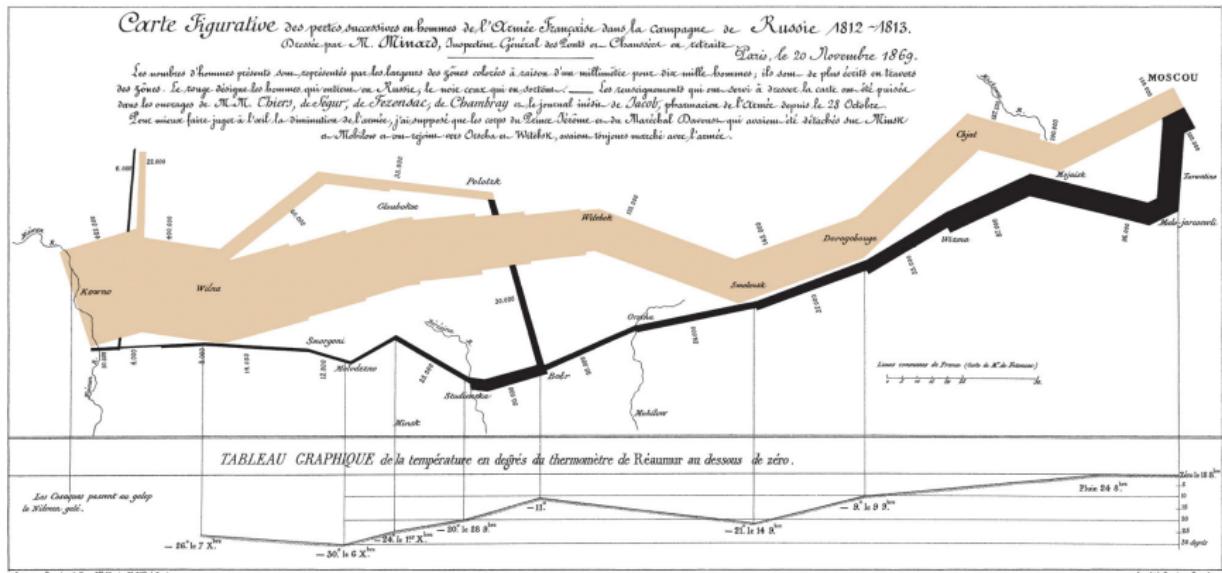
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- Level at which we have our observations
- Deeply related to the variables we have
  - Even though not all variables have to/can be measured at the same level
  - e.g. individual-level data and household income
- Most important thing: we need to **choose the right unit of analyses** depending on the theory (and mechanism) we are testing
  - Getting the variation that matters (example of online bookings?)

## A more difficult example



- How many variables and what's the unit of observation?

**Extra:** What's the causal argument being told here?

Could we test it with the data we have?

## Theories, hypotheses, and measurement

- Let's say I want to explain the effect of school choice on future salaries
- My argument is: going to private schools leads to higher salaries in the future because increased resources lead to better educational attainment through lower teacher/pupil ratio, which signals individuals as more skillful in the labour market, explaining higher salaries

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- Hypotheses?
- Testing the relationship and the mechanism?  
And alternative explanations?

# Another example



## Percentage of years in which the 'Great Powers' fought one another, 1500–2015 – by Max Roser

Between 1500 and today there were more than 50 wars between 'Great Powers'.

Data are aggregated over 25-year periods.

### The Great Powers:

Entire period – France and England/Great Britain/U.K.

Since 1949 – China

Since 1898 – USA

Since 1740 – Germany/Prussia

Since 1721 – Russia/USSR

1905 to 1945 – Japan

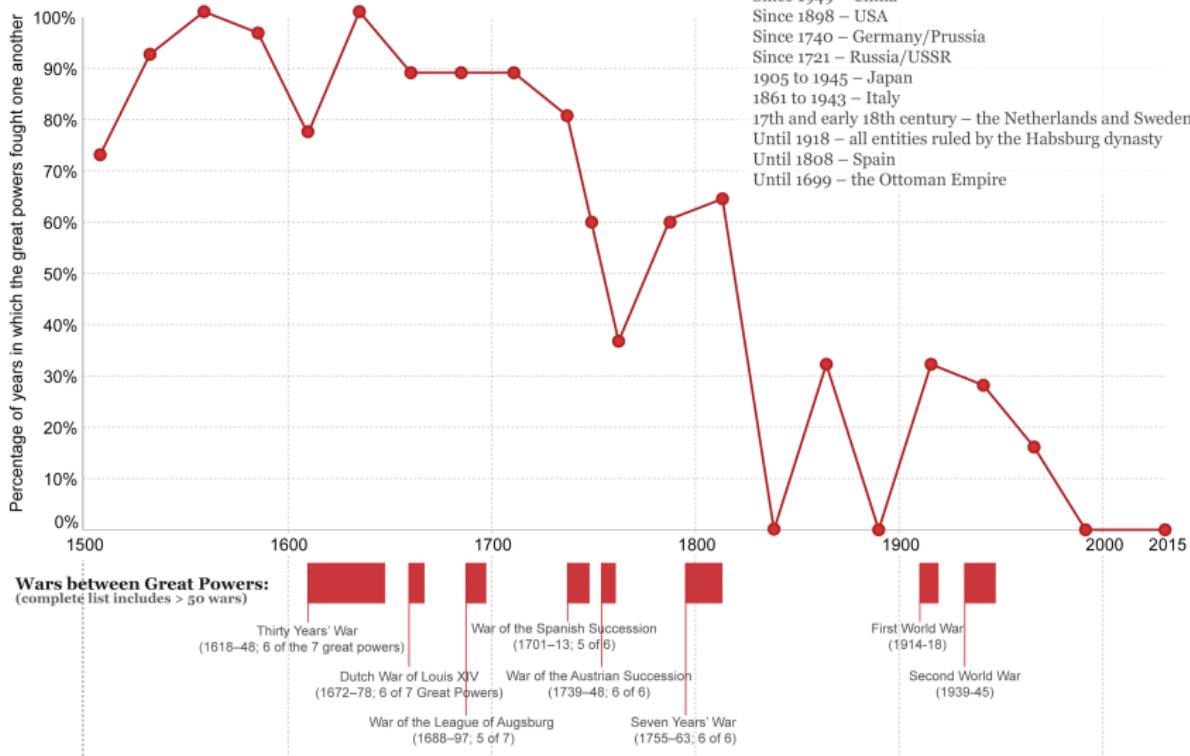
1861 to 1943 – Italy

17th and early 18th century – the Netherlands and Sweden

Until 1918 – all entities ruled by the Habsburg dynasty

Until 1808 – Spain

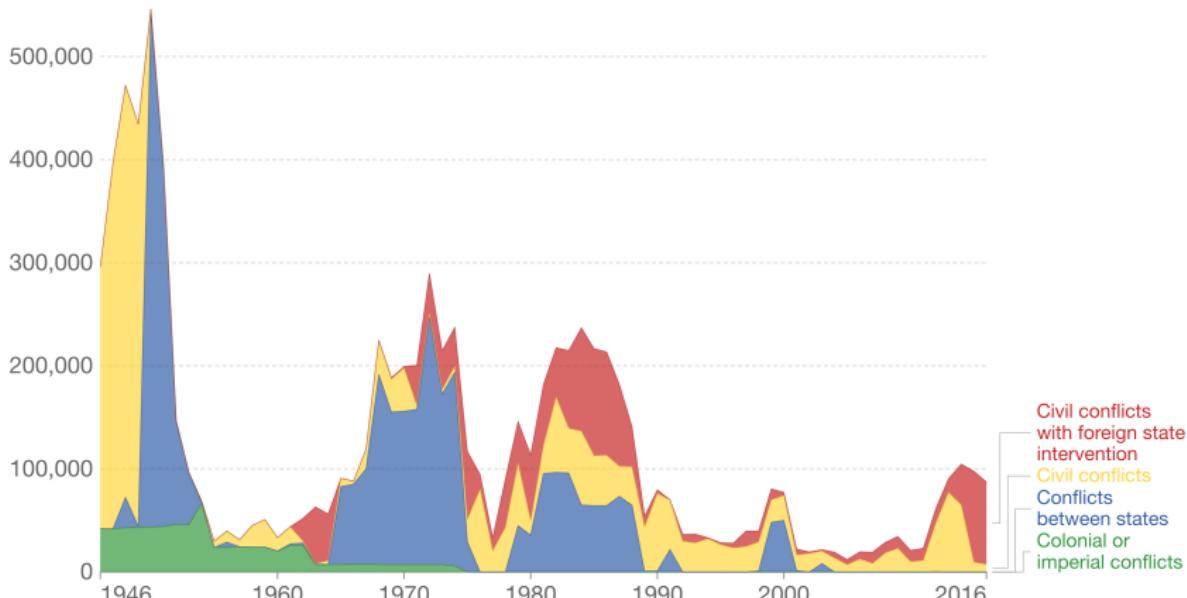
Until 1699 – the Ottoman Empire



# Another example

## Battle-related deaths in state-based conflicts since 1946, 1946 to 2016

Only conflicts in which at least one party was the government of a state and which generated more than 25 battle-related deaths are included. The data refer to direct violent deaths. Deaths due to disease or famine caused by conflict are excluded. Extra-judicial killings in custody are also excluded.



Source: UCDP/PRIO

Note: The war categories paraphrase UCDP/PRIO's technical definitions of 'Extrasystemic', 'Internal', 'Internationalised internal' and 'Interstate' respectively. In a small number of cases where wars were ascribed more than one type, deaths have been apportioned evenly to each type.

CC BY

## Another example

- Now, let's say my theory is that inter-state war has declined because democratic countries are less likely to go to war because they face higher domestic costs for waging wars
- Hypotheses? Testing the mechanism? Unit of analyses?  
Measurement? Alternative explanations?

## Another example

- What if I say that it is because democracies do not fight *each other*, as they have shared interests in the international system and shared conflict resolution mechanisms?
- And if I say that democratic countries face higher costs when fighting another democracy, but not otherwise?
- What should I observe in each case? At different levels? How to measure?

# Complexity of the social world and micro/macro



- Why do mass protests emerge?

# Levels of explanation

Can you think of...?

- Macro-level mechanisms
- Micro-level mechanisms

# Levels of explanation

Can you think of...?

- Macro-level mechanisms
- Micro-level mechanisms
- What's the point of macro-level explanations, actually?

# Roadmap

Theories and research questions

Concepts and operationalization

Measurement

Description

Example: Wartime civilian deaths

Paper discussion

# Describing variables

- What is a **variable**?
- Types?

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- What is a **variable**?
- Types?
  - Continuous
  - Count
  - Ordinal
  - Categorical (binary)
  - Qualitative (\* are really a variable?)
- Why does it matter?
- Conceptual meaning vs statistical meaning

# Describing variables

- Main idea: you are describing the variable distribution (i.e. how the frequency of values looks like)
- You probably know this from basic statistics
  - In practice, the measures of distribution do not matter so much
- But one important thing: we are talking about **real-world observations**, so before you do anything (analyses, etc), do look at them
  - At least, **plot the main variables**
  - Is it coherent with the **theoretical** or **expected distribution?**

# Describing variables

- Also, sometimes the distribution is important to think about actual effect sizes, so it's good to summarize variables (mean, SD, IQR...)
  - Maybe this makes sense if you've learned logistic regression?
  - We'll talk more tomorrow about the concept of average effect in causality
- In a normal distribution, there's probably not much to say
- But what if a key independent variable has a bimodal distribution?  
What does this say about the **causal mechanism**?
  - e.g. think about the effect of income on X in two societies: one is extremely unequal and the other is normally distributed

# Describing relationships

- What is a **relationship**?
- Essentially that as you know about the values of one variable, you learn about the values of the other variables
  - e.g. a *negative* relationship means that you know that higher values in  $x$  imply lower values in  $y$

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Imagine you have a small car, and a friend of yours is coming and is bringing along his two kids. Concerned about space, you ask '*how old are they?*' And the answer is: '*They're 6 and 2.*'

→ What do you imagine about size?

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Imagine you have a small car, and a friend of yours is coming and is bringing along his two kids. Concerned about space, you ask '*how old are they?*' And the answer is: '*They're 6 and 2.*'

- What do you imagine about size?
- Now imagine you ask '*are they blonde, red-haired, or brown-haired?*'

# Statistical relationship $\neq$ causal relationships

- Last example: Is there a causal relationship  $age \rightarrow size$ ?

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- What if the variable you want to guess is **the time of the day**, and someone tells you that she just heard the rooster crow? Causal?

# Statistical relationship $\neq$ causal relationships

- Last example: Is there a causal relationship  $age \rightarrow size$ ?
- What if the variable you want to guess is **the time of the day**, and someone tells you that she just heard the rooster crow? Causal?
- Why are non-causal descriptive relationships **useful**?

## Univariate description

**Facebook says there are only 3.57 degrees of separation**

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*By James Titcomb*

4 February 2016 • 10:06am

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# Univariate description

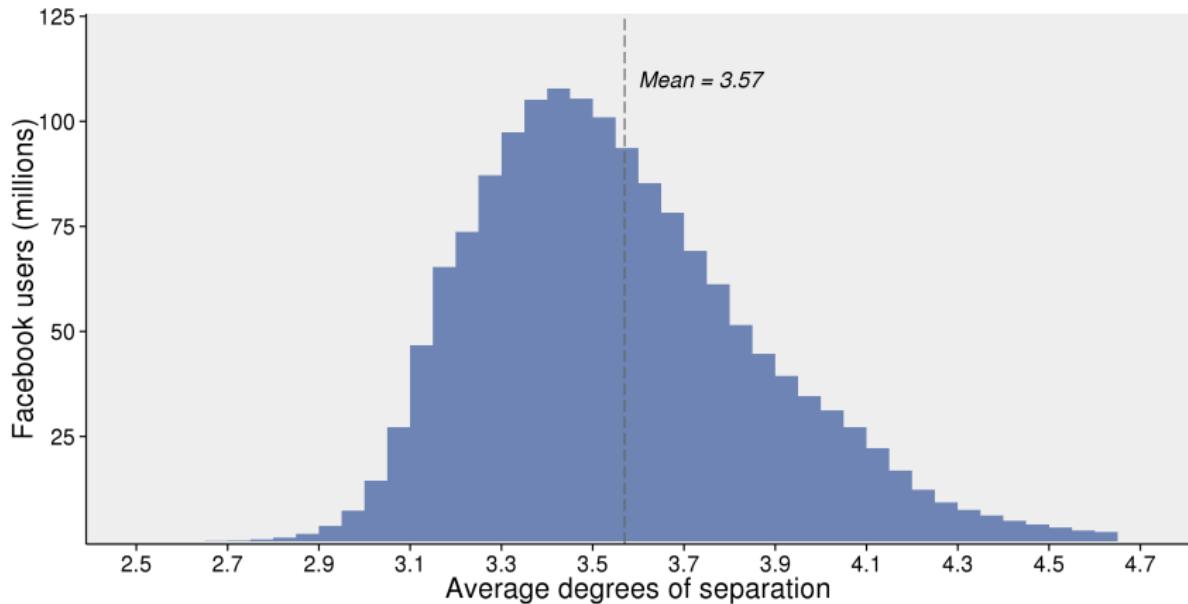


Fig 1. Estimated average degrees of separation between all people on FB.

(<https://research.facebook.com/blog/2016/2/three-and-a-half-degrees-of-separation/>)

## The original 'theory'

*I read somewhere that everybody on this planet is separated by only six other people. Six degrees of separation. Between us and everybody else on this planet. The president of the United States. A gondolier in Venice. fill in the names.*

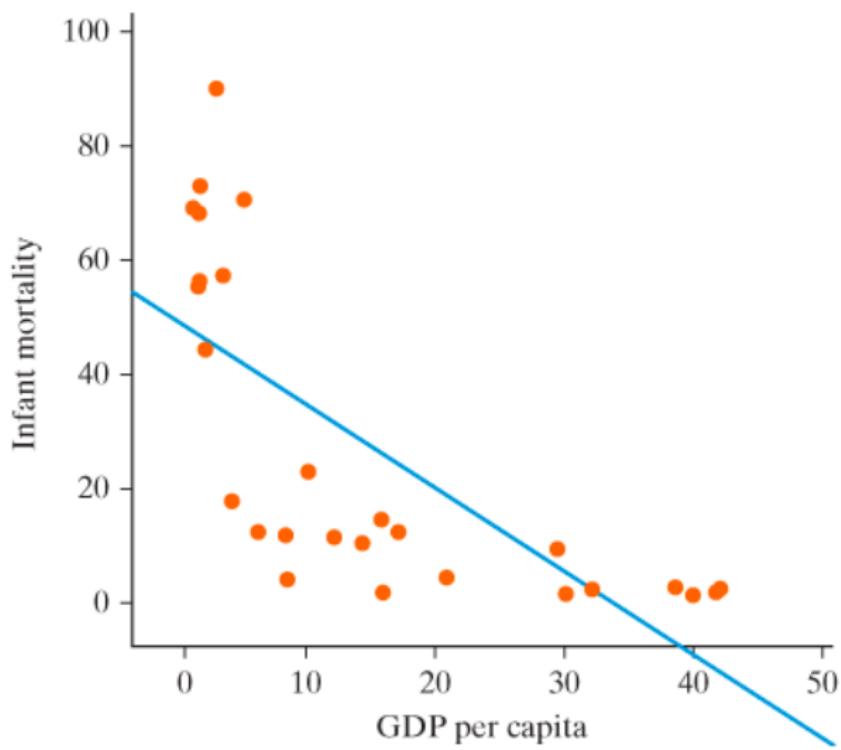
Six Degrees of Separation, John Guare

- Do we have an answer?

# Bivariate relationships

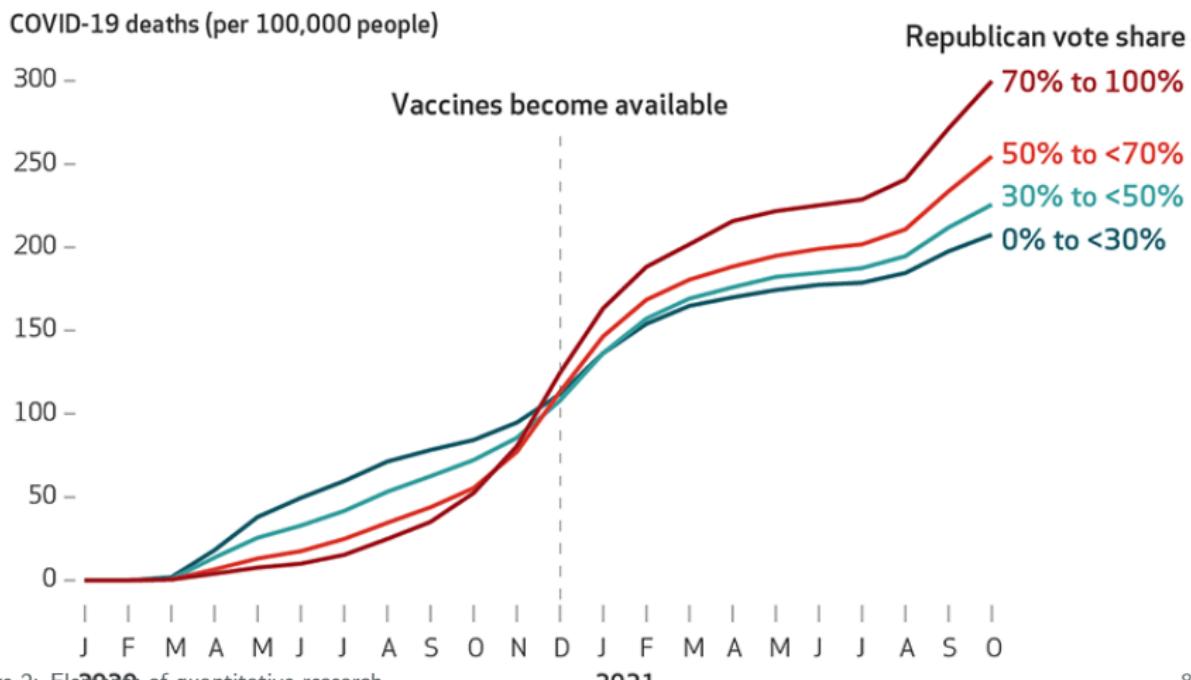
- Examples?

## Bivariate relationship



# How many variables? Unit?

Cumulative COVID-19 deaths per 100,000 people, by county proportion of Republican presidential popular vote in the 2020 election, January 1, 2020–October 31, 2021

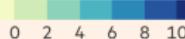
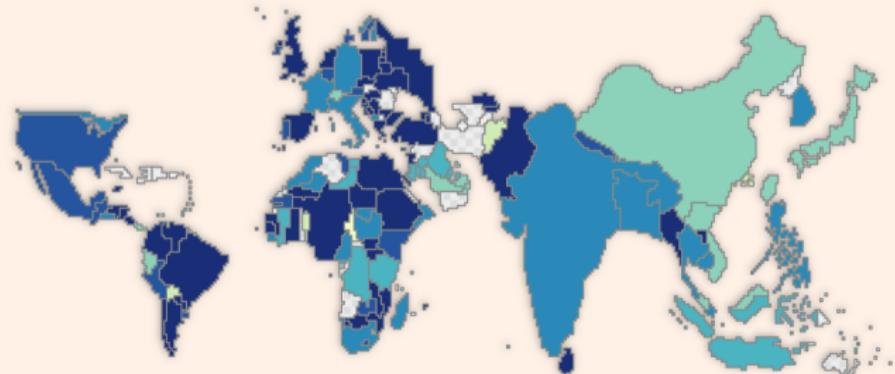


# How many variables? Unit?

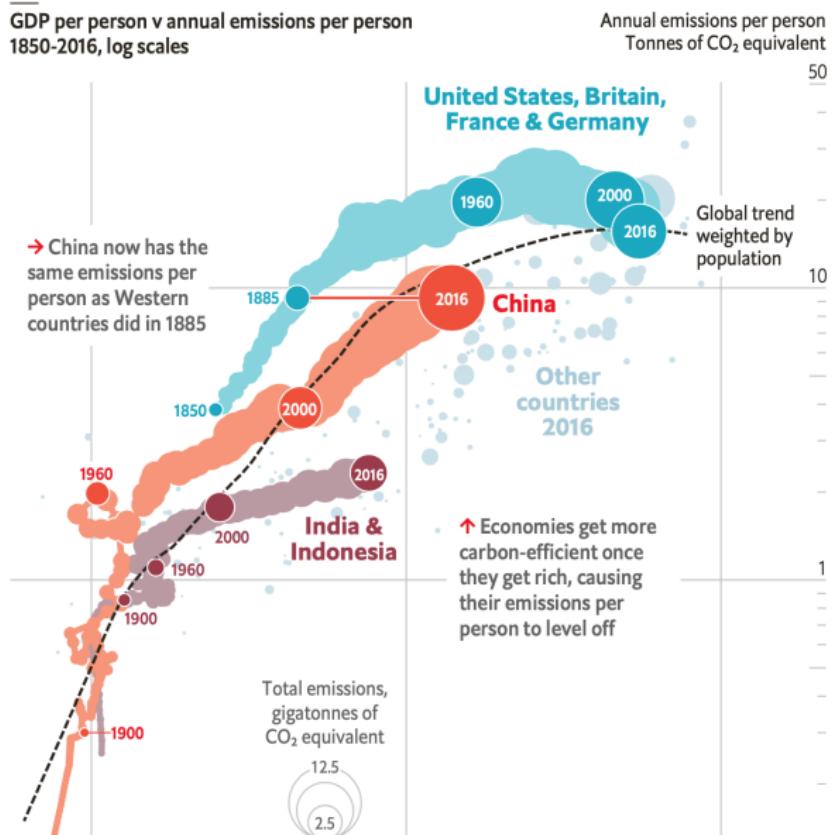
A population-adjusted snapshot of global inflation

Annual % change in consumer price indices, latest figures available (select a country for details).

Each country on the map is sized according to total population in 2018

 Search..

# How many variables? Unit?



# Bivariate relationships

- What do we use this for?

## Bivariate relationships

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- Essentially, we are trying to detect whether two variables are dependent
  - In other words, it's about conditional values:  $E(Y|X)$
- Example graph about infant mortality:  
 $E(IM|GDPpc = 1000)?$   
 $E(IM|GDPpc = 30000)?$

# Bivariate relationships

- This is what statistics is about, and only this

# Bivariate relationships

- This is what statistics is about, and only this
- Even if it can get complicated: non-linear relationships, multivariate dependencies, etc

# Bivariate relationships

[nature](#) > [nature communications](#) > [articles](#) > [article](#)

Article | [Open Access](#) | Published: 20 August 2018

## Sequences of purchases in credit card data reveal lifestyles in urban populations

[Riccardo Di Clemente](#), [Miguel Luengo-Oroz](#), [Matias Travizano](#), [Sharon Xu](#), [Bapu Vaitla](#) & [Marta C. González](#) 

[Nature Communications](#) **9**, Article number: 3330 (2018) | [Cite this article](#)

14k Accesses | 31 Citations | 268 Altmetric | [Metrics](#)

 This article has been [updated](#)

### Abstract

Zipf-like distributions characterize a wide set of phenomena in physics, biology, economics, and social sciences. In human activities, Zipf's law describes, for example, the frequency of appearance of words in a text or the purchase types in shopping patterns. In the latter, the uneven distribution of transaction types is bound with the temporal sequences of purchases of individual choices. In this work, we define a framework using a text compression technique

# Bivariate relationships

RESEARCH ARTICLE

## Faces in the crowd: Twitter as alternative to protest surveys

Christopher Barrie<sup>1</sup>\*, Arun Frey<sup>2,3</sup>\*

<sup>1</sup> School of Social & Political Science, University of Edinburgh, Scotland, United Kingdom, <sup>2</sup> Department of Sociology, University of Oxford, England, United Kingdom, <sup>3</sup> Leverhulme Centre for Demographic Science, Oxford, England, United Kingdom

\* All these authors contributed equally to this work and are listed in alphabetical order.

\* [christopher.barrie@ed.ac.uk](mailto:christopher.barrie@ed.ac.uk)

### Abstract

Who goes to protests? To answer this question, existing research has relied either on retrospective surveys of populations or in-protest surveys of participants. Both techniques are prohibitively costly and face logistical and methodological constraints. In this article, we investigate the possibility of surveying protests using Twitter. We propose two techniques for sampling protestors on the ground from digital traces and estimate the demographic and ideological composition of ten protestor crowds using multidimensional scaling and machine-learning techniques. We test the accuracy of our estimates by comparing to two in-protest surveys from the 2017 Women's March in Washington, D.C. Results show that our Twitter sampling techniques are superior to hashtag sampling alone. They also approximate the ideology and gender distributions derived from on-the-ground surveys, albeit with some bias, but fail to retrieve accurate age group estimates. We conclude that online samples are

# Describing relationships

- When we find a conditional relationship, we often say that  $X$  *explains*  $Y$
- But these statistical relationships do *not* tell us anything about cause and effect, only about conditional means (or  $E(Y|X)$ , or conditional conditional means if we also control for  $Z$ )
- We need another strategy to understand *why*

# Roadmap

Theories and research questions

Concepts and operationalization

Measurement

Description

**Example: Wartime civilian deaths**

Paper discussion

## Practical example

- You want to test an argument about **wartime civilian deaths**:
  - The intuition you have is that civilians will be more likely to be treated well (and not killed) by rebel groups during civil wars when they need their resources (e.g. labor) to survive
- Clean up the theory, decide on the main concepts
- Develop different RQ at different levels
- How can we measure the main concepts? Variables?
- What answers could we get from the data?
  - Are we learning something about our theory?

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# Roads to Rule, Roads to Rebel: Relational State Capacity and Conflict in Africa

Journal of Conflict Resolution

2021, Vol. 65(2-3) 563-590

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Carl Müller-Crepion<sup>1</sup> ID, Philipp Hunziker<sup>2</sup>,  
and Lars-Erik Cederman<sup>3</sup>

## Abstract

Weak state capacity is one of the most important explanations of civil conflict. Yet, current conceptualizations of state capacity typically focus only on the state while ignoring the relational nature of armed conflict. We argue that opportunities for conflict arise where relational state capacity is low, that is, where the state has less control over its subjects than its potential challengers. This occurs in ethnic groups that are poorly accessible from the state capital, but are internally highly interconnected. To test this argument, we digitize detailed African road maps and convert them into a road atlas akin to Google Maps. We measure the accessibility and internal connectedness of groups via travel times obtained from this atlas and simulate road networks for an instrumental variable design. Our findings suggest that low relational state capacity increases the risk of armed conflict in Africa.