Fall 2022
PS0700 Research Method in Political Science

Aggregate Analysis, Content Analysis and "Big Data"

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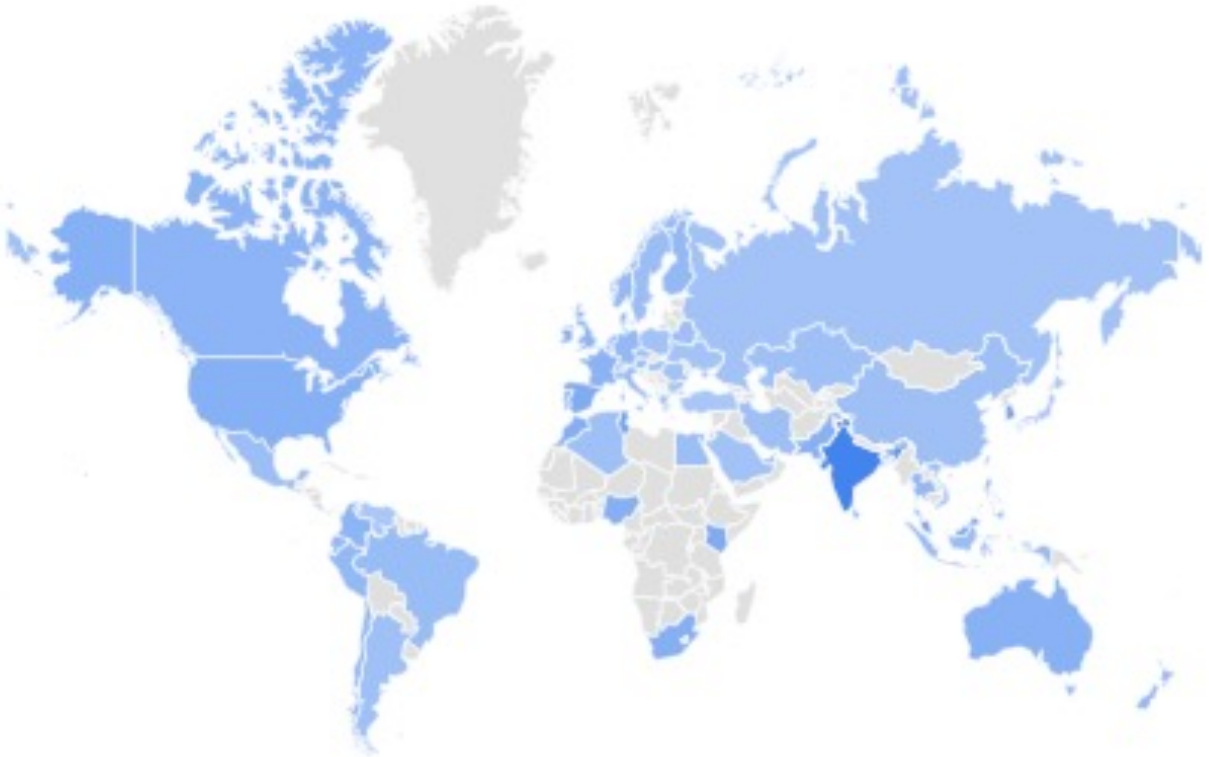
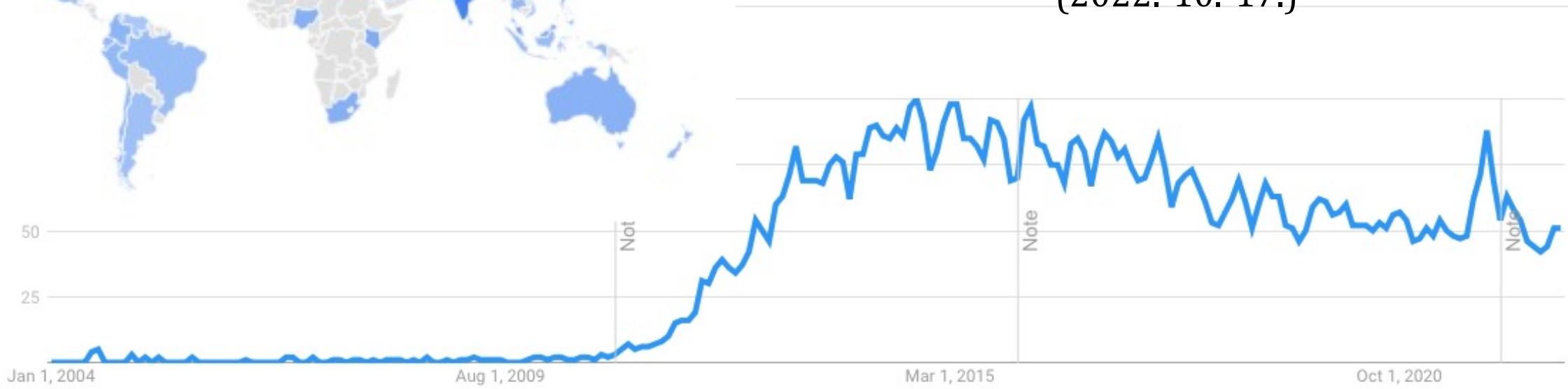
Prevalent usage of “Big Data”



Google Trend “Big Data”
(2022. 10. 17.)



The Outline of Today's Lecture

- What is "Big Data"?
- Opportunities of Big Data in Political Science
- Limitations of Big Data in Political Science

Part 1.

What is “Big Data”?

What is “Data” ?

- *Data is “Information, especially facts or numbers, collected to be examined and considered and used to help decision-making” Cambridge Dictionary*

- *Types of Data:*

1) *Purpose: Is data designed to fulfill a specific purpose?*
   - *“Designed/Made” vs. “Organic/Found”*

2) *Structure: Is the format of data organized and structured?*
   - *“Structured ” vs. “Unstructured”*

Data Type (1): *"Designed/Made" vs. "Organic/Found"*

- *"Designed/Made" D*ata
  - Data created for research purposes or designed to answer specific questions
  - More directly relevant to research questions or concepts
  - Measurement validity is usually higher
  - e.g. Survey Data; Interviews; Experiment Data

- *"Organic/Found" D*ata
  - Data created a by-product of another process of activity
  - Less relevant originally to research questions or concepts
  - Measurement validity needs to be assessed
  - e.g. Friends lists on social media; Online browsing and purchasing history

Data Type (1): *Example of "Designed/Made" Data*

WVS 2017-2021: WAVE 7

2017 -2021 WORLD VALUES SURVEY WAVE 7

MASTER SURVEY QUESTIONNAIRE

ANES 2020 Time Series Study

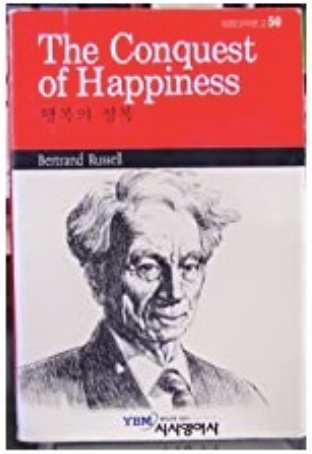
Pre-Election and Post-Election Survey Questionnaires

July 19, 2021

Data Type (1): *Example of "Organic/Found" Data*

Your Items

Saved for later (41 items) Buy it again



The Conquest of Happiness (In English and Korean)

Currently unavailable.

Delete

Add to list

DreamWorks Girls' Spirit Riding Free Top & Leggings...

$16.05

Only 5 left in stock - order soon.

prime & FREE Returns

Size: 5

Move to cart

Delete

Horse Girl Temporary Tattoos Birthday Party Supplies Dec...

$8.99

In Stock

prime & FREE Returns

Move to cart

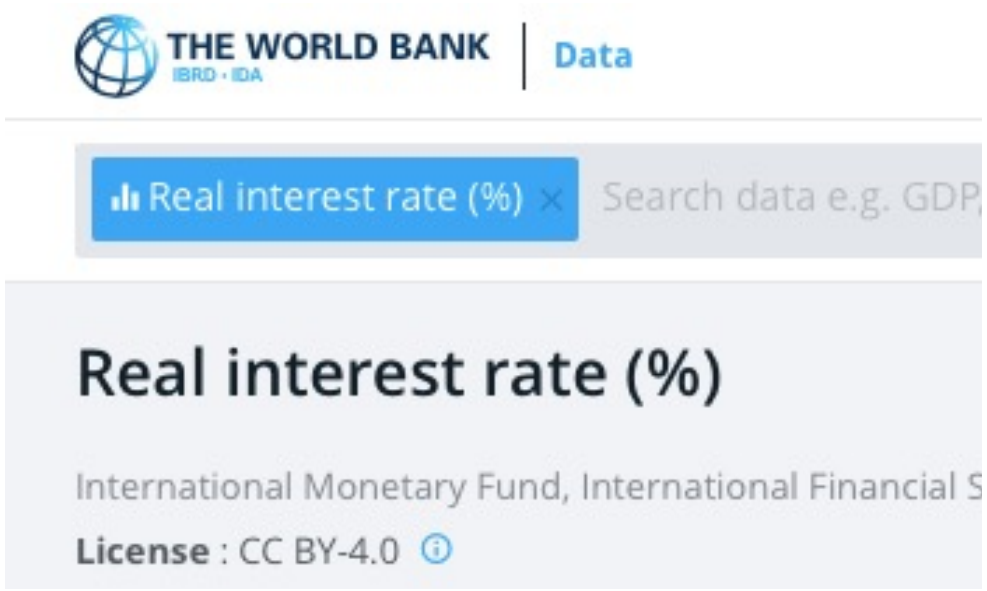
Delete

Add to list

Data Type (2): "*Structured" vs. "Unstructured"*

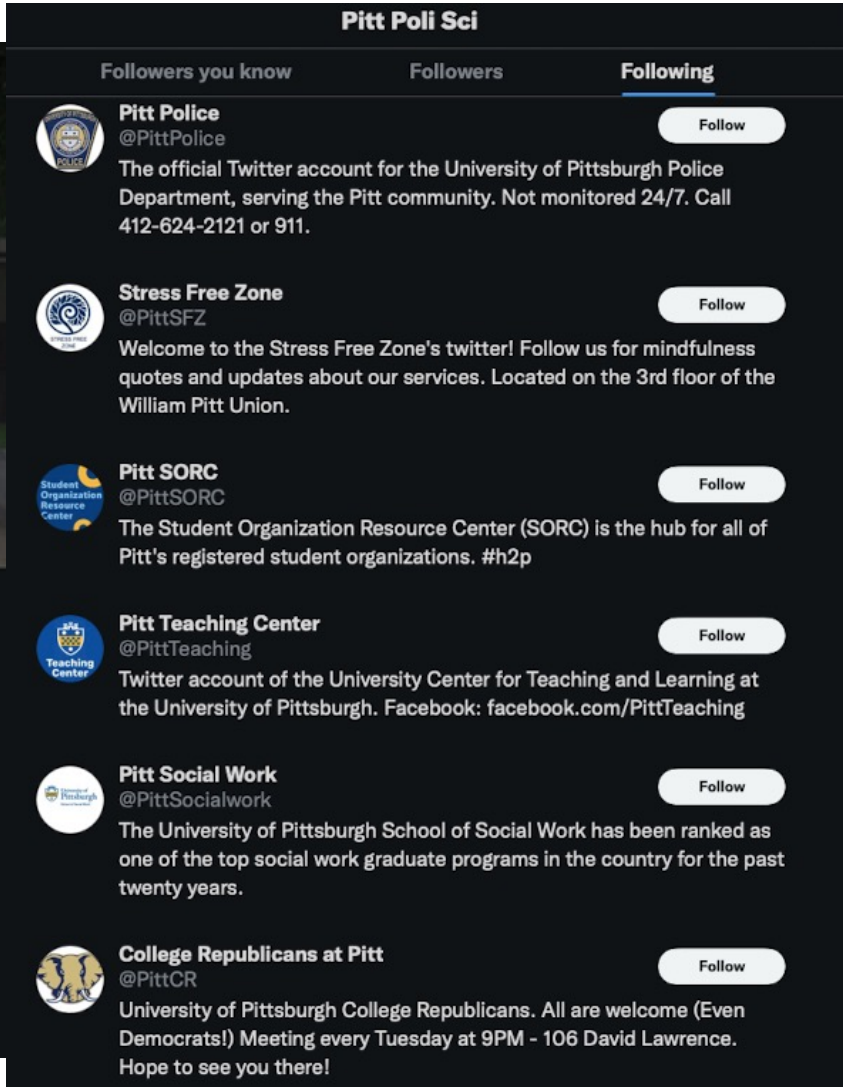
- *"Structured" Data*
  - Information is stored neatly in rows (observations) and columns (variables)
- *"Unstructured" Data*
  - Information is stored "free-form" in texts, images, or audio-visual format etc.
  - Rich in information, BUT needs lots of processing to extract the information out before usable for analysis
  - In social and political science, unstructured textual data is commonly used
    - E.g. Different linguistic styles between political leaders (Jordan et al., 2019; Schoonvelde et al., 2019); Predict violence onset from newspaper texts (Mueller and Rauh, 2017)

Data Type (2): Example of "*Structured* " *Data*



Data Source	World Development Indicators						
Last Updated Date	2022-09-16						
Country Name	Country Code	Indicator Name	2010	2011	2012	2013	2014
Aruba	ABW	Real interest rate (%)	11.658484092447	4.79578773803402	8.21727796856164	10.6993243243243	4.85160128102481
Africa Eastern and Southern	AFE	Real interest rate (%)					
Afghanistan	AFG	Real interest rate (%)	11.3640937400601	-1.24150600219686	7.17438724378044	9.78449593802676	14.3516893399556
Africa Western and Central	AFW	Real interest rate (%)					
Angola	AGO	Real interest rate (%)	-6.94413460977478	-9.87814512128374	8.76259485211296	12.6058526338601	12.3777859689274
Albania	ALB	Real interest rate (%)	7.97103659621924	9.88846223555399	9.73611207346728	9.51039749125922	6.32455753333484
Andorra	AND	Real interest rate (%)					
Arab World	ARB	Real interest rate (%)					
United Arab Emirates	ARE	Real interest rate (%)					
Argentina	ARG	Real interest rate (%)	-8.56602872006595	-7.77340523607891	-6.74819555440488	-5.48583918237899	-11.6006987702161
Armenia	ARM	Real interest rate (%)	10.6076357898925	12.9197578932998	11.2811932906832	12.2168430436348	13.7812486601176
American Samoa	ASM	Real interest rate (%)					
Antigua and Barbuda	ATG	Real interest rate (%)	9.3876761408781	9.79953139854016	7.95945311994109	11.0030464701126	8.0072745506121
Australia	AUS	Real interest rate (%)	6.04335497000121	1.44126323003352	5.09471889327147	6.34143469956045	4.44409935543742
Austria	AUT	Real interest rate (%)					
Azerbaijan	AZE	Real interest rate (%)	6.30070170030242	-2.88597938752249	15.0296068894244	17.6862204009871	19.3916777101463
Burundi	BDI	Real interest rate (%)	3.55415181609771	4.49248695285009	0.0226856189418669	6.6643715965697	9.84057048451342
Belgium	BEL	Real interest rate (%)					
Benin	BEN	Real interest rate (%)	4.19549019095698	1.46803081679031	-2.46960852040217	3.83659295370063	5.5999917955037
Burkina Faso	BFA	Real interest rate (%)	1.28514116887426	-1.3885289905265	-0.741639727368065	7.57802019961703	5.99591815146962
Bangladesh	BGD	Real interest rate (%)	4.7361235719975	5.06419768357502	5.34333265724941	5.98869390785248	6.88586627498441
Bulgaria	BGR	Real interest rate (%)	10.3014064810926	4.25629214173815	8.50745697999523	8.96499492994047	6.83032456491182
Bahrain	BHR	Real interest rate (%)	-0.180215875919306	-2.68453373074554	2.93184586033418	5.52961851204117	7.66732842513014
Bahamas, The	BHS	Real interest rate (%)	5.91550048070293	5.97260932490227	1.43580032378823	3.26981245370623	0.830597823616353

Data Type (2): Example of "*Unstructured*" *Data*



Data

that is TOO BIG to design or structure (?)

What is Big Data? (cont.)

- Francis Diebold (2000), "'Big Data' Dynamic Factor Models for Macroeconomic Measurement and Forecasting"

  "*Recently, much good science, whether physical, biological, or social, has been forced to confront—and has often benefited from—the "Big Data" phenomenon.* ***Big Data refers to the explosion in the quantity (and sometimes, quality) of available and potentially relevant data****, largely the result of recent and unprecedented advancements in data recording and storage technology*."

- O'Reilly (2005), "What is Web 2.0?"

"Big Data refers to ***a large set of data*** *that is almost impossible to manage and process using traditional business intelligence tools."*

What is Big Data? (cont.)

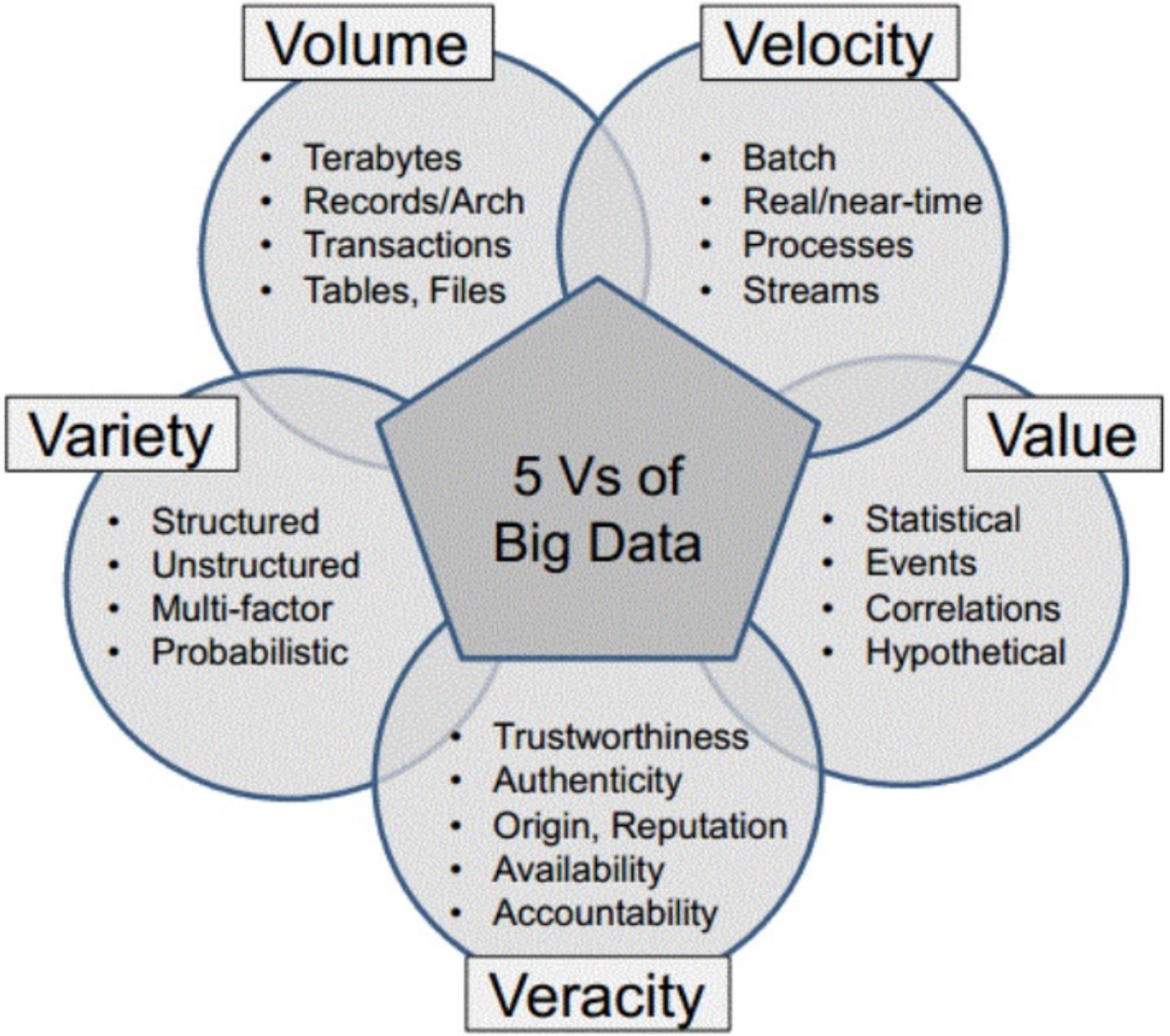
- Laney (2001), "3D Data Management: Controlling Data Volume, Velocity, and Variety."

  *"**High-volume, high-velocity and/or high-variety information assets** that demand cost-effective, innovative forms of information processing that enable enhanced insight, decision making, and process automation."*

- **Size, complexity, and technological challenges** provide one definition of big data (National Research Council 2013, Ward & Barker 2013), but they do not seem a sufficient basis for heralding a sea-change in our data environment.

- Beyond the sheer amount of data, the truly distinguishing features of the big-data revolution are the **new technologies for recording, connecting, networking, and creating information** (Brady, 2019).

"Five V" Characteristics of Big Data (*Hadi et al. 2015*)



- ***Volume***: *quantity of data collected*
- ***Velocity***: *speed of data collection*
- ***Variety***: *source, type, and context of data collected*
- ***Value***: *spectrum of modeling and prediction*
- ***Veracity***: *data quality and accuracy*

- *Variability, Volatility, and Visibility etc.*

Part 2.

Opportunities of “Big Data” in Political Science

Big Data in Political Science Research

- Promising area where big data can be used (examples)
  - Collective action and social movements
  - Political campaigns, mobilizations, and participations
  - Communication and information flow
  - State-citizen interactions

- ***How to use big data as a source of information to analyze political phenomenon?***
  (1) Individual behaviors and attitudes
  (2) Elite or state behaviors
  (3) Network Analysis

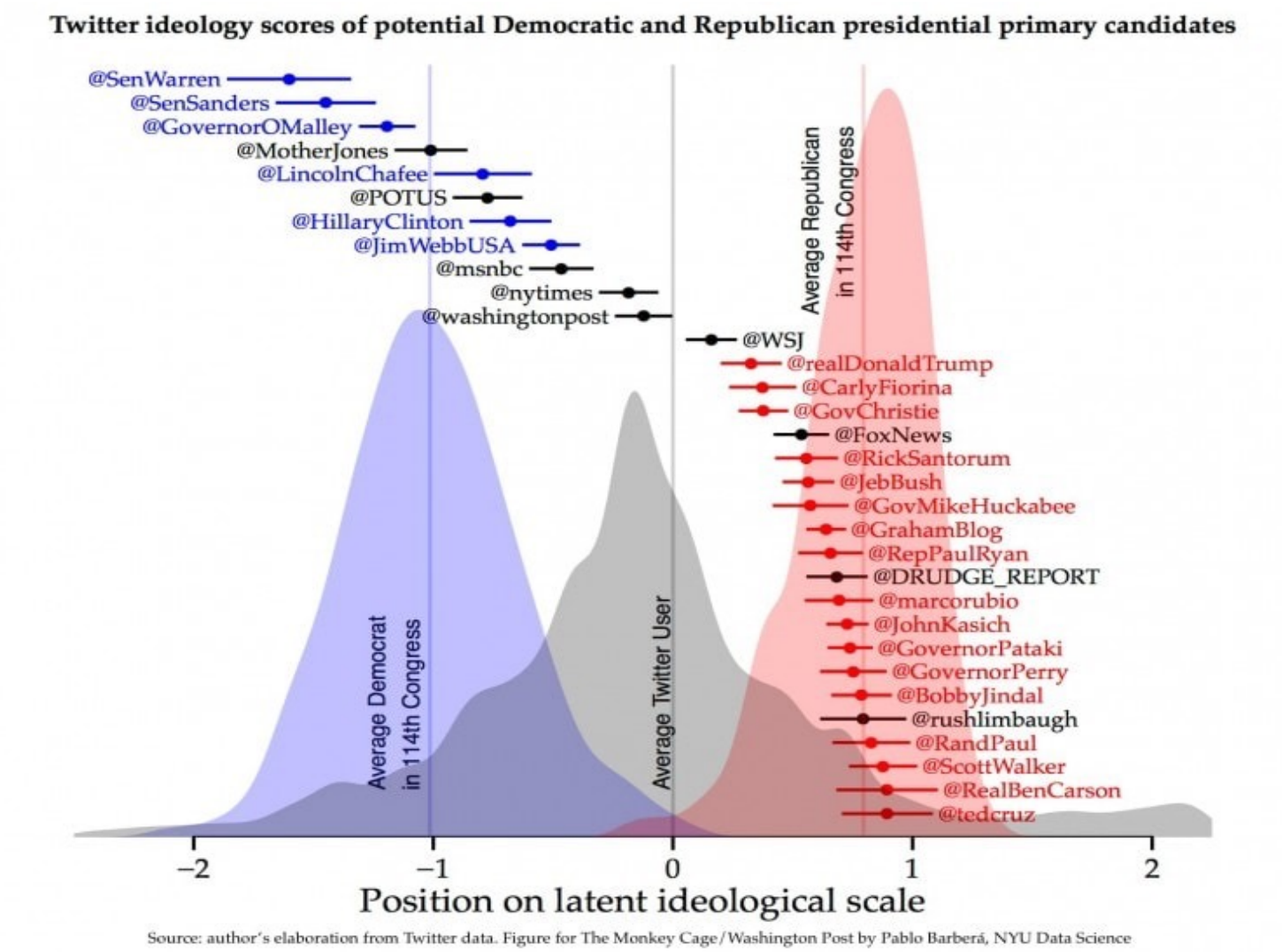
Big Data in PS 1: Infer Individual Attitudes and Behaviors

- Survey data is collected using direct questioning, and its data quality typically rely on:
  - Accurate introspection when asking about latent traits such as ideology and personal traits
  - Accurate reporting when asking about socially undesirable behaviors

- Big data provides *non-intrusive measurement* of behavior and public opinion (Nagler and Tucker, 2015)
  - Revealed preferences circumvents the problems associated with self-reporting

- Examples
  - Using Facebook likes to infer sexual orientation, personality etc. (Kosinski et. al 2013)
  - Using Twitter follow as networks to infer ideology (Barberá 2015)
  - Using Google searches to infer racial animosity (Stephens-Davidowitz 2014)

Big Data in PS 1: Infer Individual Attitudes and Behaviors



Barberá et al. (2015), Tweeting From Left to Right: Is Online Political Communication More Than an Echo Chamber?

Big Data in PS 2: Infer Elite or State Behaviors

- Elite or state behaviors are traditionally difficult to observe
  - Difficult to survey
  - Direct observation (e.g. interviews) are susceptible to misrepresentation
  - Many behaviors by nature are hidden (unobservable)

- Example:
  - Using social media posts to examine government censorship in China (King et al., 2013)
  - Observe how congressional members interact with constituents on Facebook (Pew Research Center, 2018)

Big Data in PS 2: Infer Elite or State Behaviors (Example)

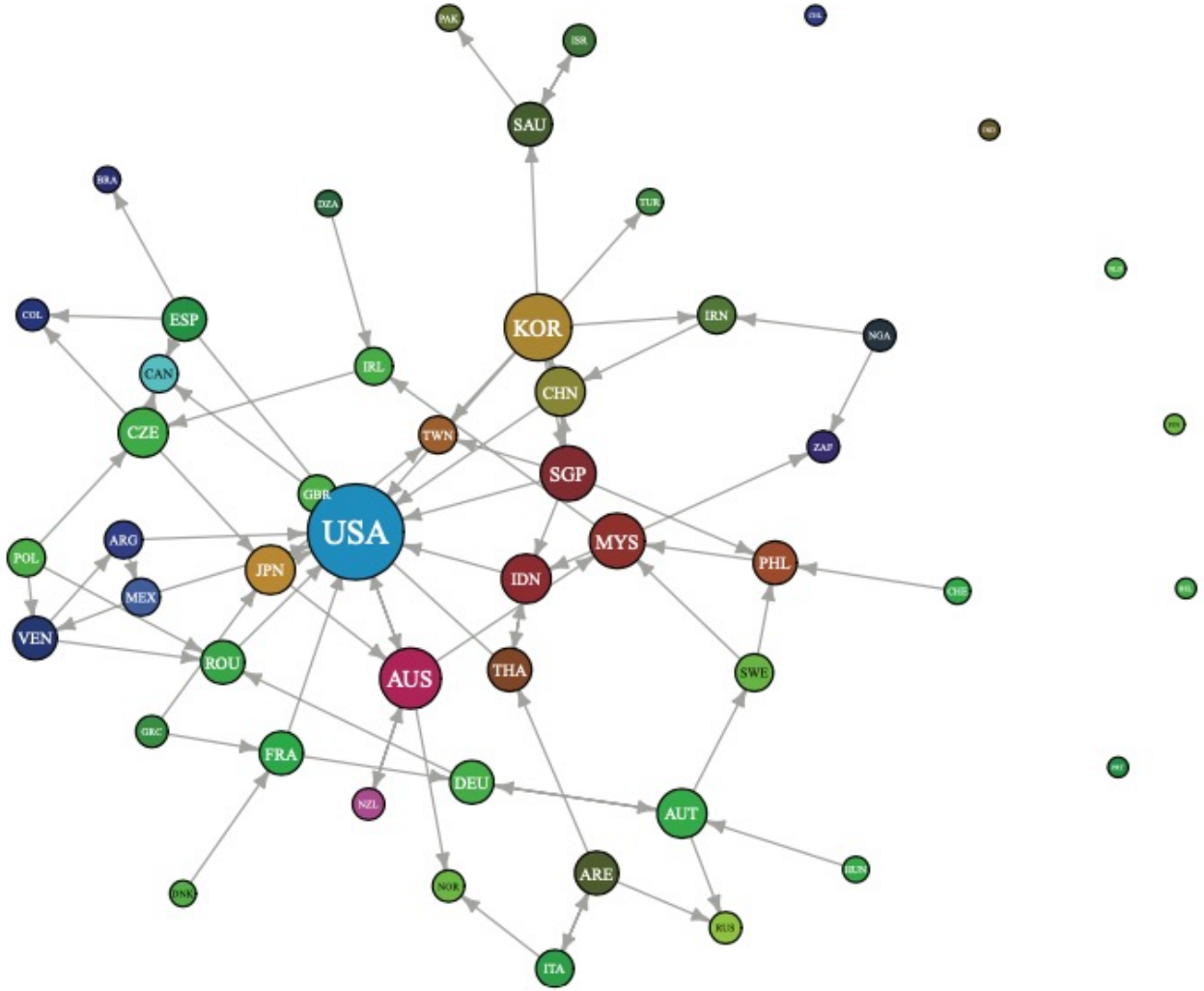
How Censorship in China Allows Government Criticism but Silences Collective Expression (King et al., 2013)

Big Data in PS 3: Network Analysis

- Network structures are difficult to measure by using survey data
- Social networks and online database provide an easy way to map network structure and density

- Examples
  - Using sharing and linking on Twitter to measure network pattern and influence of media outlets (Faris et al. 2017)
  - Analyzing international conflicts and cooperation by using a corpus of about 30 million media reports from about 275 local and global news sources (Minhas et al. 2016)

Big Data in PS 3: Network Analysis (Example)



Minhas et al. (2016), A new approach to analyzing coevolving longitudinal networks in international relations

Part 3.

Limitations of Big Data in Political Science

Main Limitations of Big Data in Political Science

(1) Non-representativeness

(2) Interpretation

(3) Measurement Validity

(4) Causal Inference

(5) Data quality

Limitation 1: Non-representativeness (1)

- Different big data sources have different user base
  - Different socio-demographic characteristics are correlated with usage and membership on different platforms and services
  - Non-random sample poses problems of generalizability (Nagler and Tucker 2015)

- Sample representativeness and its impact on external validity is always assessed in relevance to the target population we are trying to generalize to
  - Target population is not always “the population” (everyone on the Earth)
  - Sample from big data or social media is not always problematic
  - Depends on the research goal and question

Limitation 1: Non-representativeness (2)

- Platforms structure behavior patterns, not just recording them
  - Networks on Twitter is directional (one-sided follow)
  - Networks on Facebook is bidirectional (two-sided follow)

- Platforms encourage certain behaviors, potentially distorting the “true” pattern
  - Google auto-complete searches
  - Twitter suggests people for you to follow
  - YouTube recommends videos to watch

Limitation 1: Non-representativeness (3)

- Behaviors recorded in big data = behaviors in real life?
  - Some are records of offline behaviors or behaviors with offline analogous
    (e.g. voting records, purchase pattern, media exposure and consumption)
  - But, many are behaviors that only exists online, or specific to platforms, that do not have an offline analogous
    (e.g. retweets, likes)

- Are online behaviors representative and generalizable? (Jungherr & Yannis 2017)
  - Is a specific type of online behaviors a good indicator for the concept of interest?
    (e.g. Retweet = Political Participation ?)
  - Do online behaviors reflect offline behavior?
    (e.g. Civility in Online = Civility in Offline ?)

Limitation 2: Measurement Validity

- Is the indicator capturing the concept that we are interested in?

- Which indicator is a valid measure of a user's "influence" on Twitter?
  - Number of followers? Number of retweets? Centrality in network?

- Which indicator is a valid measure of "new consumption" on Facebook?
  - Headline on Timeline? Shared? Clicked?

Limitation 3: Interpretation

- What's in the text?
  - Sincere or sarcastic?
- What's in a retweet?
  - Endorsing? Mocking? Hate-retweeting?
- What's in a search query?
  - If we observe increase in Google search trend for "impeach president", what does it mean?
  - Increase in interest or salience of the issue (information seeking)?
  - Or, increase in support for impeaching the president (expressing preference)?
- Generally, it is difficult to infer attitudes from behavior based on observations alone
  - Behaviors are often overdetermined: different causes led to same observed behavior
  - This is a broad problem we often face beyond the big data context

Limitation 4: Causal Inference

- Finding interesting patterns (covariation) is itself a daunting task, because a hallmark of Big Data is the fact that it vastly exceeds human comprehension (Shiffrin, 2016).

- Additionally, there are enormous difficulties facing researchers trying to draw causal inference from or about some pattern found in Big Data.
  - There are almost always a large number of additional and mostly uncontrolled confounders and covariates (Z) with correlations among them
  - This is particularly the case given that most Big Data are formed as a nonrandom sample taken from the infinitely complex real world.

Limitation 5: Data Quality

- Researchers do not control how the data is generated and data quality
- (In)Consistency over time
  - Data is consistently produced but algorithms that generate the data could be changed time to time (e.g. updating system and adjusting platforms and services)
- (Lack of) Veracity
  - Much of information from the internet is fake
  - Algorithms can be gamed: astroturfing