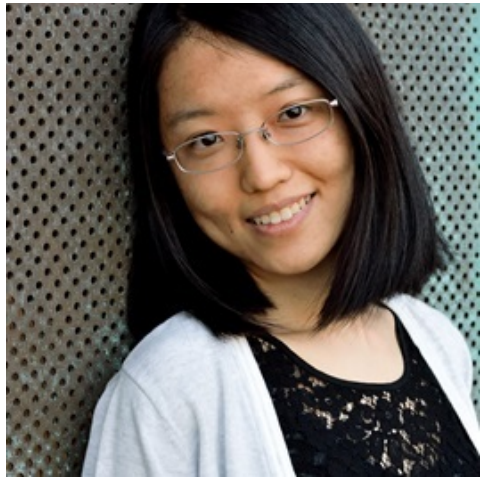
CS224C: **Natural Language Processing for Computational Social Science**

Diyi Yang

Stanford University

Instructor and CAs

Diyi Yang



Jing Huang

Weixin Liang

Course Overview

Website:

http://web.stanford.edu/class/cs224c/

Ed Discussion:

https://edstem.org/us/courses/57892/discussion/

Learning Objectives

Quantitative analysis of social phenomena

Models of network structure

Methods for text analysis

Applications to social science fields, such as political science, sociolinguistics, sociology, and economics

Additional Learning Objectives

- ✦ Reading and understanding contemporary research papers
- ✦ Presenting concise and informative summaries of research
- ✦ Executing computational social science research

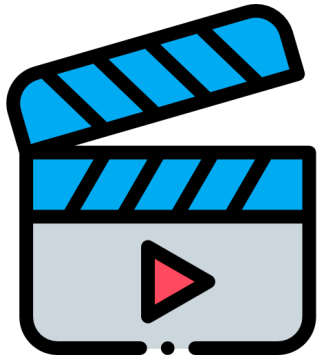
Attributes	CS224C NLP for Computational Social Science	CS224U: Natural Language Understanding	CS224N: Deep Learning for NLP	CS124: From Language to Information
Audiences	Undergrad, Grad, and Non-CS major	Undergrad, Grad	Undergrad, Grad	Undergrad
Suggested Prerequistes	CS106B or equivalent	One of LINGUIST 180/280, CS 124, CS 224N, or CS 224S	Calculus and linear algebra; CS124, CS221, or CS229.	CS106B
Evaluation	Project, Quiz, Reading	Homework, Quiz, Project	Homework, Project	Programming homework, quiz, midterm
Keywords	Applications in NLP Social science	Hands-on NLP Linguistics	Advanced NLP Deep Learning	Introduction to NLP, IR Social Networks
Format	Lectures Discussion	Lectures, Working Sessions, Podcast	Lectures Working Sessions	Flipped Class
Interdisciplinary	*****	***	*	***
Example Topics	NLP basics, cause inference, hypothesis testing, social influence, prosocial behavior, stigma/social movement	Word embedding, BERT, rational speech acts model, analysis methods in NLP, neural IR	Word vectors, language model, neural networks, parsing, pretraining, prompting, QA	Logistic regression, sentiment, IR, neural networks, chatbots, recommender systems, Pagerank and networks

Course Setup

(1) Lectures given by the Instructor

NLP basics

Statistical and casual inference



(2) Discussion led by students

Key techniques and theories in readings will be covered in lectures

Lectures: key topics

1. Computational basics
2. Working with text data
3. Inferring sentiment and affect
4. Topic modeling for the social sciences
5. Word embedding and representation
6. Deep learning for CSS
7. Causal inference
8. Statistical Hypothesis testing

Discussion Led by Students

Focused Areas:

1. **Social Influence:** emotion contagion, weak and strong ties, social comparison
2. **Language and Persuasion:** argumentation, deception, persuasion
3. **Network and Influence:** echo chamber, segregation
4. **Hate Speech, Fake News and Misinformation: rumors, deepfake, prebunking**
5. **Prosocial Behavior:** politeness, positive reframing, social support
6. **Prejudice and Stigma:** microaggression, bias, stigma and social movement

Grading

Project (55%)

- 10 for proposal
- 15 for midway
- 25 for final report
- 2.5 for project pitch, and 2.5 for poster presentation

Presentation (10%)

Reading Responses (13.5%, 1.5 points for each reading response)

Homework (20%, 5 points for each homework)

Class Participation (2%)

Project

Group Project

- 2~3 people per group
- Please discuss your project idea with instructor/TA early in the course

Literature Review + Proposal (10%)

Experiment Protocol or Midway (15%)

Final Paper (20%)

Role-Playing Paper Reading & Discussion

Instructors 👨‍🏫

Peer reviewer 👽

Academic researcher 🤓

Industry practitioner 🤑

Social impact Assessor 🌍

Hacker 👾

https://colinraffel.com/blog/role-playing-seminar.html

Role-Playing Paper Reading & Discussion

Instructors (2) 20 mins

You are the instructor who needs to provide a comprehensive overview of the paper. What did it study? What's the novelty? What's the methods and results?

Peer reviewer (1) 10 mins

The papers have not been published yet and is currently submitted to a top conference where you've been assigned as a peer reviewer. Complete a full review of the paper answering all prompts "strengths, weaknesses, questions"

Academic researcher (1) 10 mins

You're a researcher who is working on a new project in this area. Propose an imaginary follow-up project not just based on the current but only possible due to the existence and success of the current paper.

Industry practitioner (1) 10 mins

You work at a company or organization developing an application or product of your choice (that has not already been suggested in a prior session). Bring a convincing pitch for why you should be paid to implement the method in the paper, and discuss at least one positive and negative impact of this application.

Social impact assessor (1) 10 mins

Identify how this paper self-assesses its (likely positive) impact on the world. Have any additional positive social impacts left out? What are possible negative social impacts that were overlooked or omitted?

Hacker (1*) 10 mins

You're a hacker who needs a demo of this paper ASAP. Implement a small part or simplified version of the paper on a small dataset or toy problem. Prepare to share the core code of the algorithm to the class and demo your implementation. Do not simply download and run an existing implementation – though you are welcome to use (and give credit to) an existing implementation for "backbone" code.

Presentation

The group works together to deliver a presentation

- Work together to well cover the material
- Make easy-to-understand slides
- Be prepared for Q&As
- Please send your draft slides to the instructor/TA **1 day** before the class

Grading: 5 points (group), 5 points (each role)

Presentation: **Dos and Don’ts**

Dos

- Coherent
- Interactive and engaging

Don’ts

- **Simply summarizing the content**
- **No question/interest from the audience**

Sign up for Role-Playing Presentation

https://docs.google.com/spreadsheets/d/1fSb_IOVdiwHP_2nX9PkbNcLGQ2yQmEH4dHC3AFZkDq4/edit?usp=sharing

Reading Responses

Reply to Ed discussion posts about the reading assigned for a particular class

No need to do reading response if you are the discussion leader

You're also welcome to post any other thoughts about the readings

critique certain features of the papers

identify potentially important issues not covered in the papers

suggest new research questions stimulated by the papers

think about new ways to improve the work

Homework

Lightweight Python notebook to help practice using NLP methods

One week to finish the homework once it is released

No collaboration will be permitted

Logistics and Other Information

Course Contacts:

Webpage: materials and announcements

Ed discussion: discussion forum

Other personal issues: email cs224c-staff@lists.stanford.edu **(faster reply)**

Computing Resources:

Experiments can take up to hours, even with efficient computation

Stay tuned for credit emails!

Academic Integrity

This class abides by the Honor Code

We take academic integrity **seriously**

You are encouraged to discuss readings/project with your classmates; however, what you hand in should be your own work

- Okay to use open-source software, however, do acknowledge
- Copying/reusing code is not allowed; strict action will be taken if similarities are found
- Copying content from other published work (without citing it) is considered plagiarism

Late Policy

Reading responses are due the day (23:59pm PT) **before** the class

Presentations need to be sent to the instructor or TAs one day before the class meeting (not required, by strongly encouraged)

6 late days to use in total

Course Materials

Readings are available on the course website.

Readings are subject to change, so always double check

No official text books

Lecture slides will be made available on the course website

Expectation and Prerequisites

Prerequisites

- CS 106B or equivalent is strictly required; Programming background
- Basics in machine learning and data science
- Passion for topics on **Social NLP** 🤩

Expectation

- High-quality course project
- Read research papers from different research fields and venues (e.g., ACL, EMNLP, NAACL, CSCW, SIGCHI, Science, etc.)

Books to Check Out (Optional)

An Introduction to Statistical Learning by James, Witten, Hastie, and Tibshirani

Bit by Bit: Social Research in the Digital Age by Sagalnik

Networks, Crowds, and Markets by Easley and Kleinberg

Six Degrees by Duncan Watts

On Individuality and Social Forms by Georg Simmel

Writing for Social Scientists by Howard Becker

Natural Language Processing with Python by Steven Bird, Ewan Klein, and Edward Lope

Preference Intake Form for CS224C

https://shorturl.at/ako13

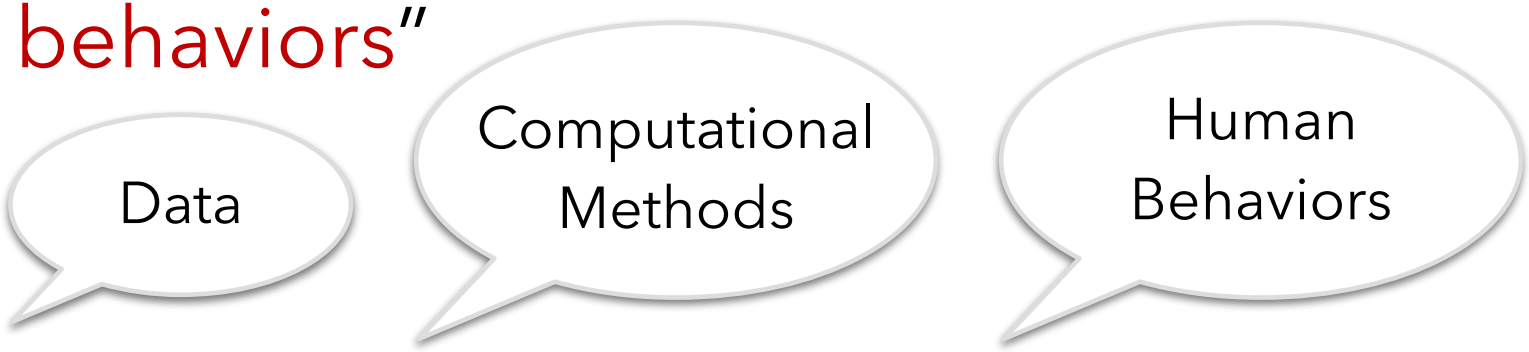
Share us your preferences

by Apr 7th, 2024

Introduction to Computational Social Science

Computational Social Science

"A field is emerging that leverages the capacity to collect and analyze data at a scale that may reveal patterns of individual and group behaviors"



Computational Social Science. Lazer D, Pentland A, Adamic L, Aral S, Barabási AL, Brewer D, Christakis N, Contractor N, Fowler J, Gutmann M, Jebara T

The Cross-Disciplinary Flavor of CSS

Cross-disciplinary research and application field with theoretical and methodological aspects in computational and social sciences.

Related fields:

NLP/ML/CV, Data science

Communication

Human computer interaction

Sociological, psychological, economics

Political science, social science


LinkedIn
foursquare
LIVEJOURNAL
vimeo
YouTube
Insta
facebook
Blogger
twitter
flickr
Like

Online Interaction Generates Big Unstructured Text Data

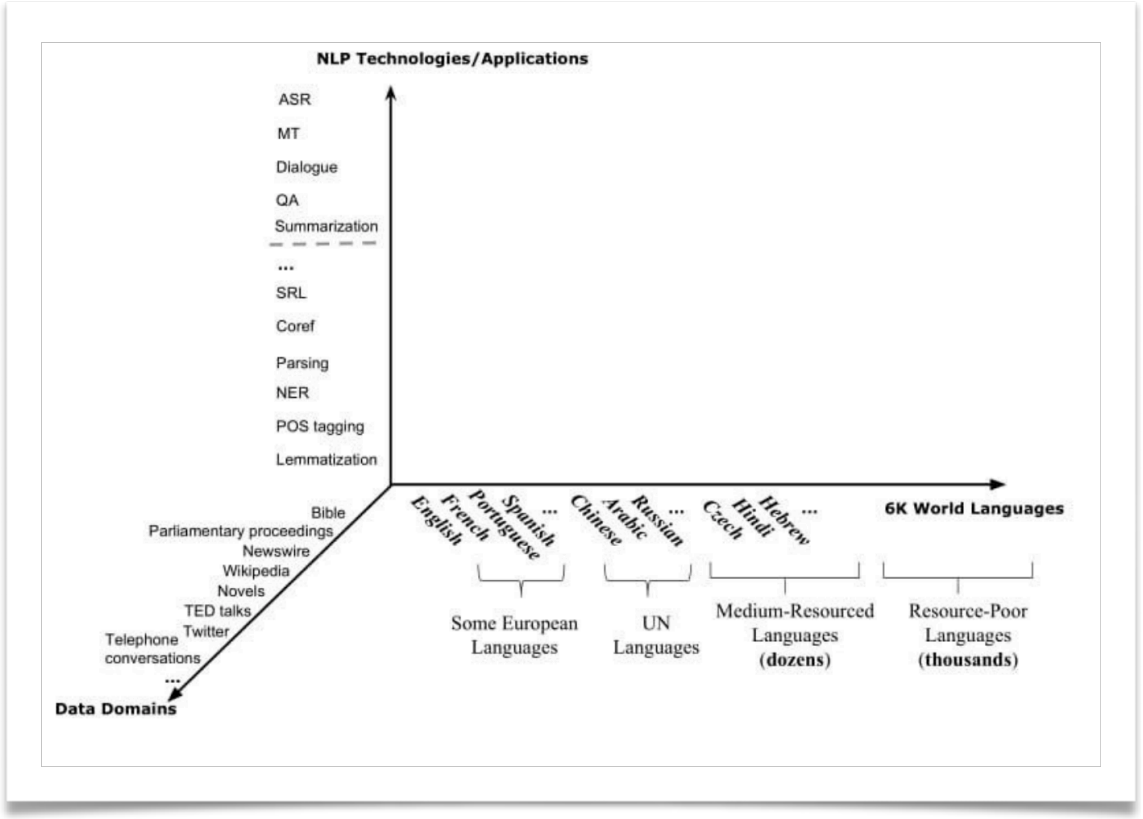
Volume

Velocity

2 Wikipedia revisions per second

Variety

Tweets, articles, slangs, news, etc



Online Interaction in Text Format Grows Exponentially

between human and human

between human and machines
(e.g., ChatGPT)

Opportunities: Data & Social Phenomena

Data

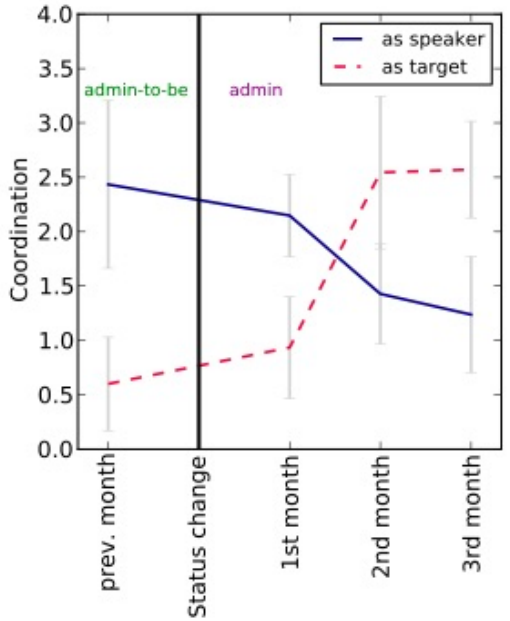
- Speech data is expensive; social media data is a good proxy
- Personal conversations
- Socially grounded data
- Evolution of new words and slang

Social phenomena

- Hate speech, fake news, misinformation, online counseling ..

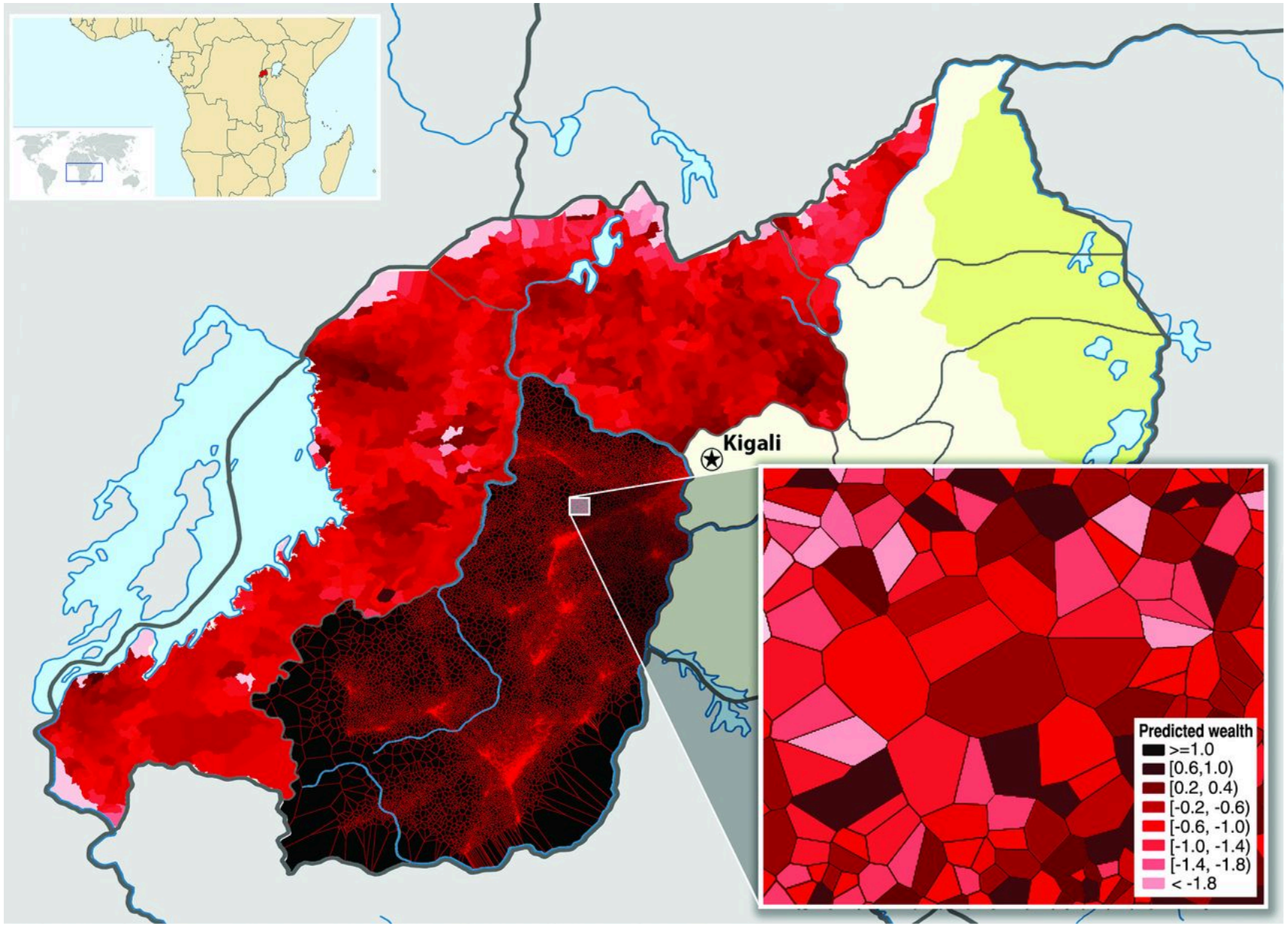
Opportunities and Benefits

1. **Provide information about social relationships (e.g., emails)**
2. **Analyze how group interactions predict individual behaviors**



Coordination of the user (as speaker) and, respectively, towards the user (as target) in the months before and after status change occurs.

Cristian Danescu-Niculescu-Mizil, Lillian Lee, Bo Pang and Jon Kleinberg. Echoes of power: Language effects and power differences in social interaction. Proceedings of WWW, 2012.



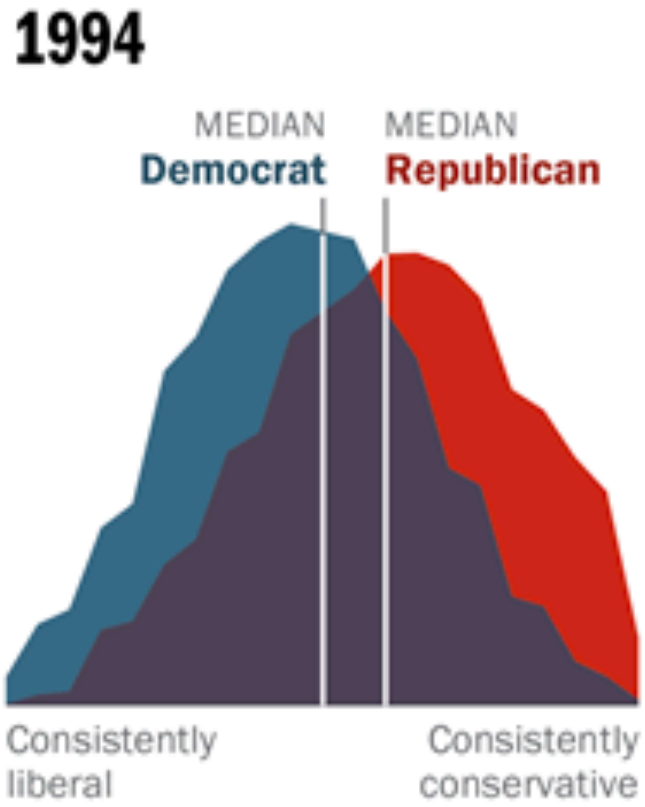
Blumenstock, Joshua, Gabriel Cadamuro, and Robert On. "Predicting poverty and wealth from mobile phone metadata." Science 350, no. 6264 (2015): 1073-1076.

Opportunities and Benefits

1. Provide information about social relationships (e.g., emails)
2. Analyze how group interactions predict individual behaviors
3. **Understand how the structures of society change evolve over time**

Democrats and Republicans More Ideologically Divided than in the Past

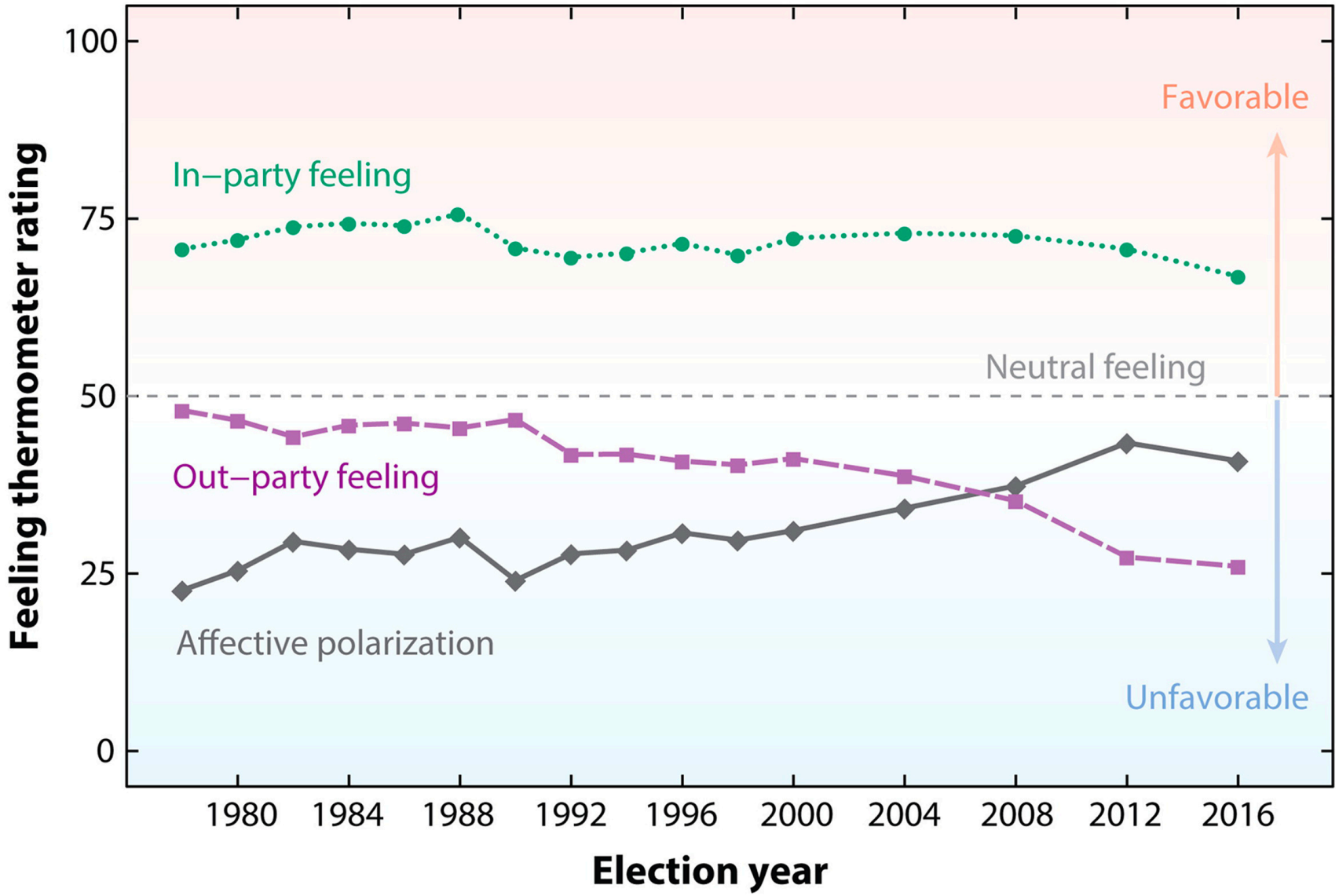
Distribution of Democrats and Republicans on a 10-item scale of political values



Source: 2014 Political Polarization in the American Public
Notes: Ideological consistency based on a scale of 10 political values questions (see Appendix A). The blue area in this chart represents the ideological distribution of Democrats; the red area of Republicans. The overlap of these two distributions is shaded purple. Republicans include Republican-leaning independents; Democrats include Democratic-leaning independents (see Appendix B).

PEW RESEARCH CENTER

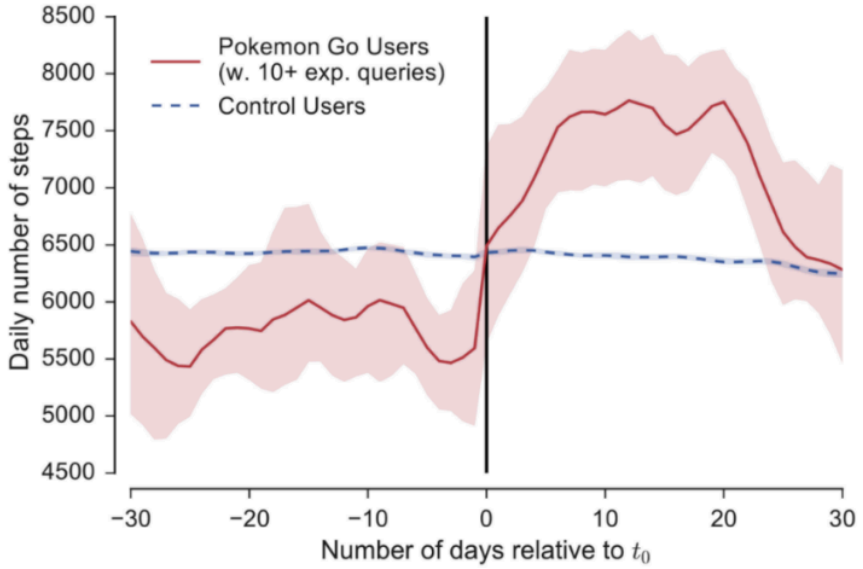
https://www.pewresearch.org/politics/2017/10/05/1-partisan-divides-over-political-values-widen/



Waldrop, M. Mitchell. "Modeling the power of polarization." Proceedings of the National Academy of Sciences 118, no. 37 (2021): e2114484118.
S. Iyengar, Y. Lelkes, M. Levendusky, N. Malhotra, S. J. Westwood, The origins and consequences of affective polarization in the United States. Annu. Rev. Polit. Sci. 22, 129–146 (2021).

Opportunities and Benefits

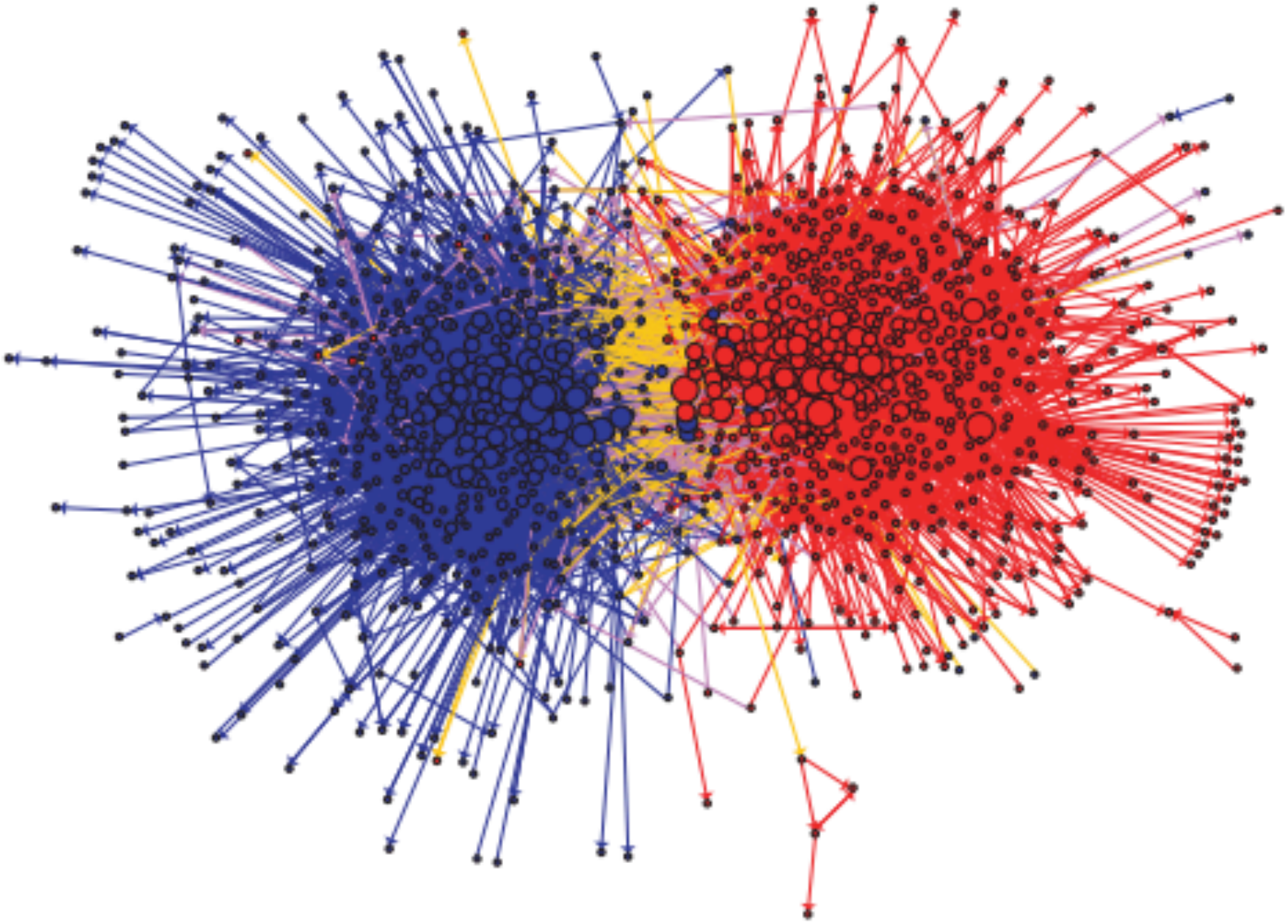
1. Provide information about social relationships (e.g., emails)
2. Analyze how group interactions predict individual behaviors
3. Understand how the structures, network of society change evolve over time
4. **Large-scale tracing of people's movements and physical proximities**



Althoff, Tim, Ryen W. White, and Eric Horvitz. "Influence of Pokémon Go on physical activity: study and implications." Journal of medical Internet research 18, no. 12 (2016): e6759.

Opportunities and Benefits

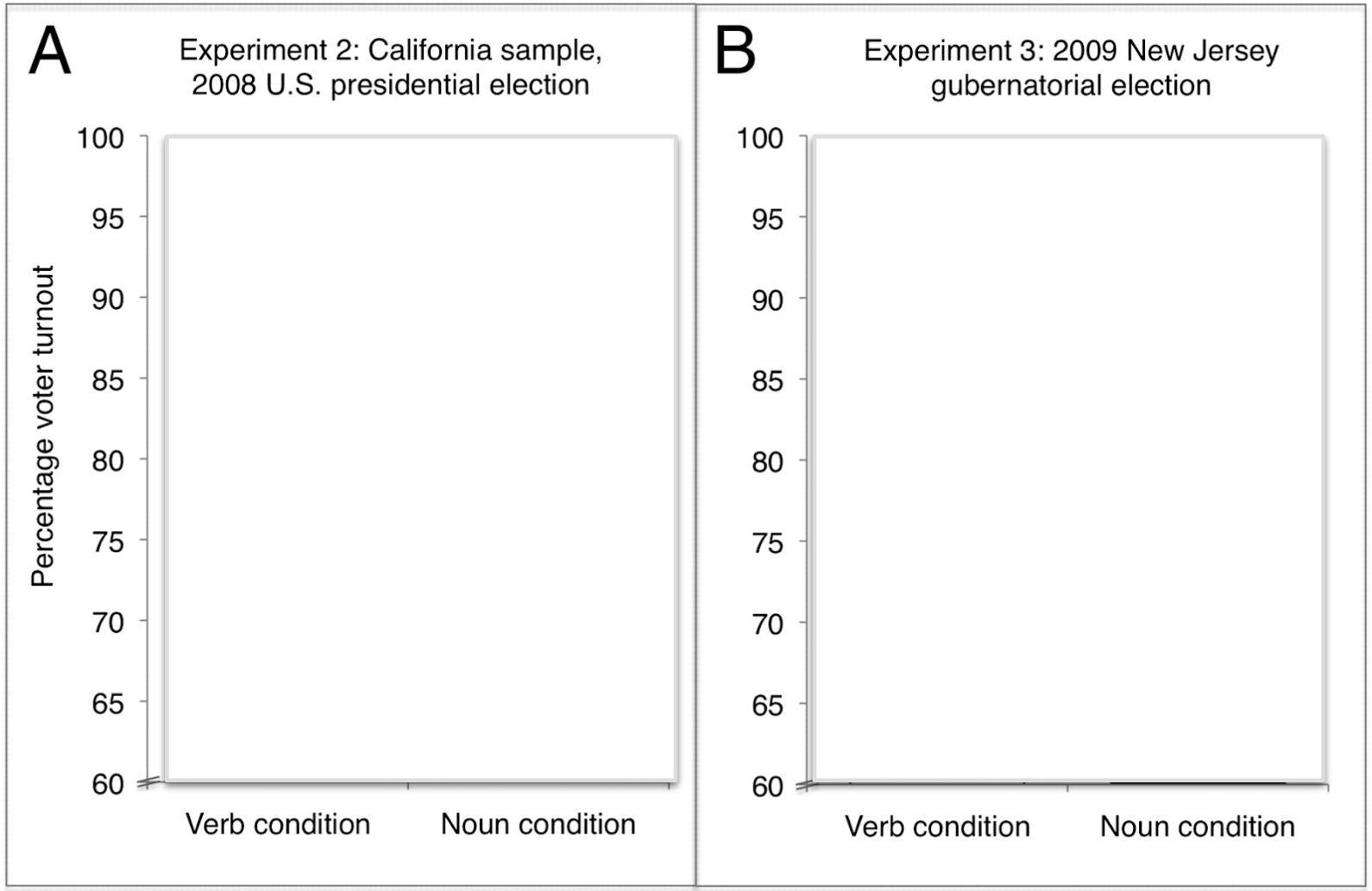
1. Provide information about social relationships (e.g., emails)
2. Analyze how group interactions predict individual behaviors
3. Understand how the structures, network of society change evolve over time
4. Large-scale tracing of people's movements and physical proximities
5. **Offer channels for understanding what people say and how they connect**
6. **Understand the impact of users' digital activities on everything from their moods, political ideology, to their health**



Community structure of political blogs

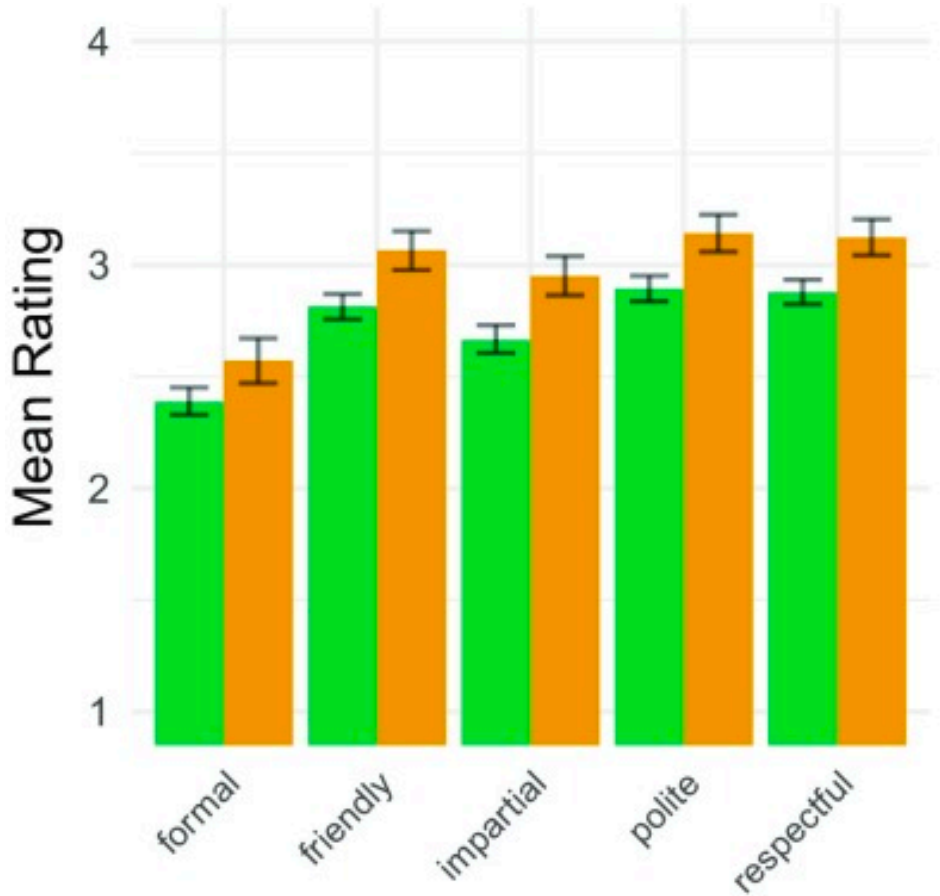
The colors reflect political orientation, red for conservative, and blue for liberal. Orange links go from liberal to conservative, and purple ones from conservative to liberal. The size of each blog reflects the number of other blogs that link to it.

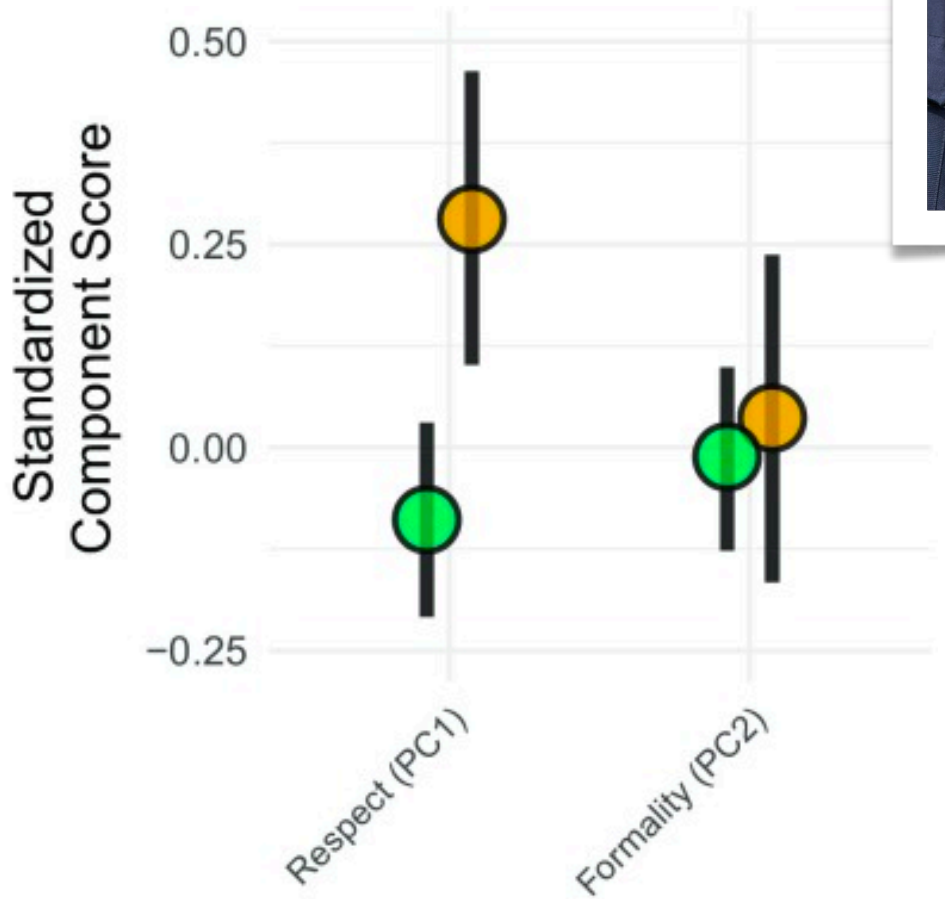
Adamic, Lada A., and Natalie Glance. "The political blogosphere and the 2004 US election: divided they blog." In Proceedings of the 3rd international workshop on Link discovery, pp. 36-43. 2005.



"Being A Voter" Vs "Voting"

(Bryan Et Al., 2011)





- Voigt, Rob, Nicholas P. Camp, Vinodkumar Prabhakaran, William L. Hamilton, Rebecca C. Hetey, Camilla M. Griffiths, David Jurgens, Dan Jurafsky, and Jennifer L. Eberhardt. "Language from police body camera footage shows racial disparities in officer respect." Proceedings of the National Academy of Sciences 114, no. 25 (2017): 6521-6526.
- Image: https://commons.wikimedia.org/wiki/File:Police_body_cam.png

Opportunities and Benefits

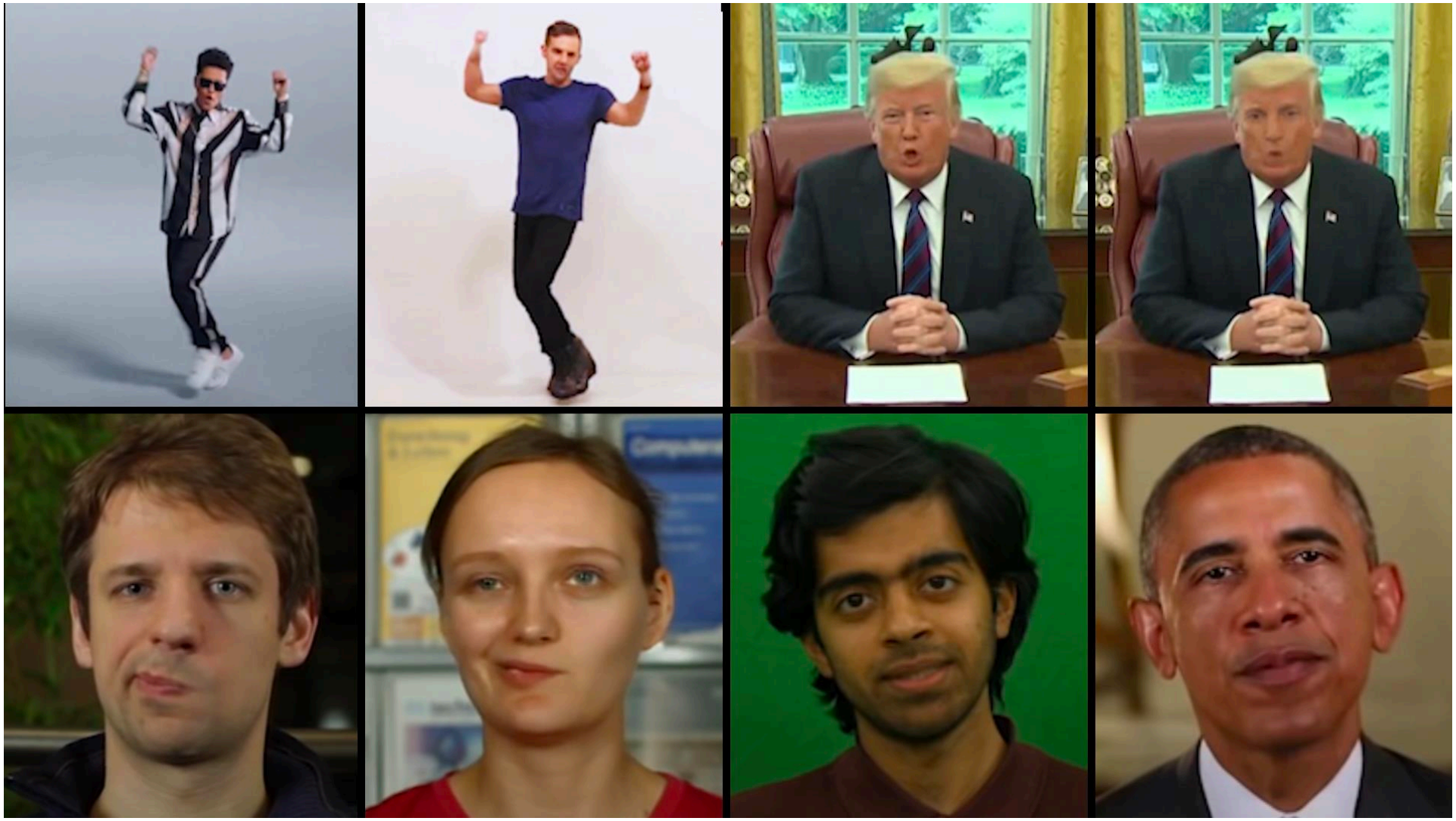
1. Provide information about social relationships (e.g., emails)
2. Analyze how group interactions predict our power and performance
3. Understand how the structures, network of society change evolve over time
4. Large-scale tracing of people's movements and physical proximities
5. Offer channels for understanding what people say and how they connect
6. Understand the impact of users' digital activities on everything from their moods, political ideology, to their health
7. **Analyze how technology affects the society as a whole**

Can we really detect fake news?

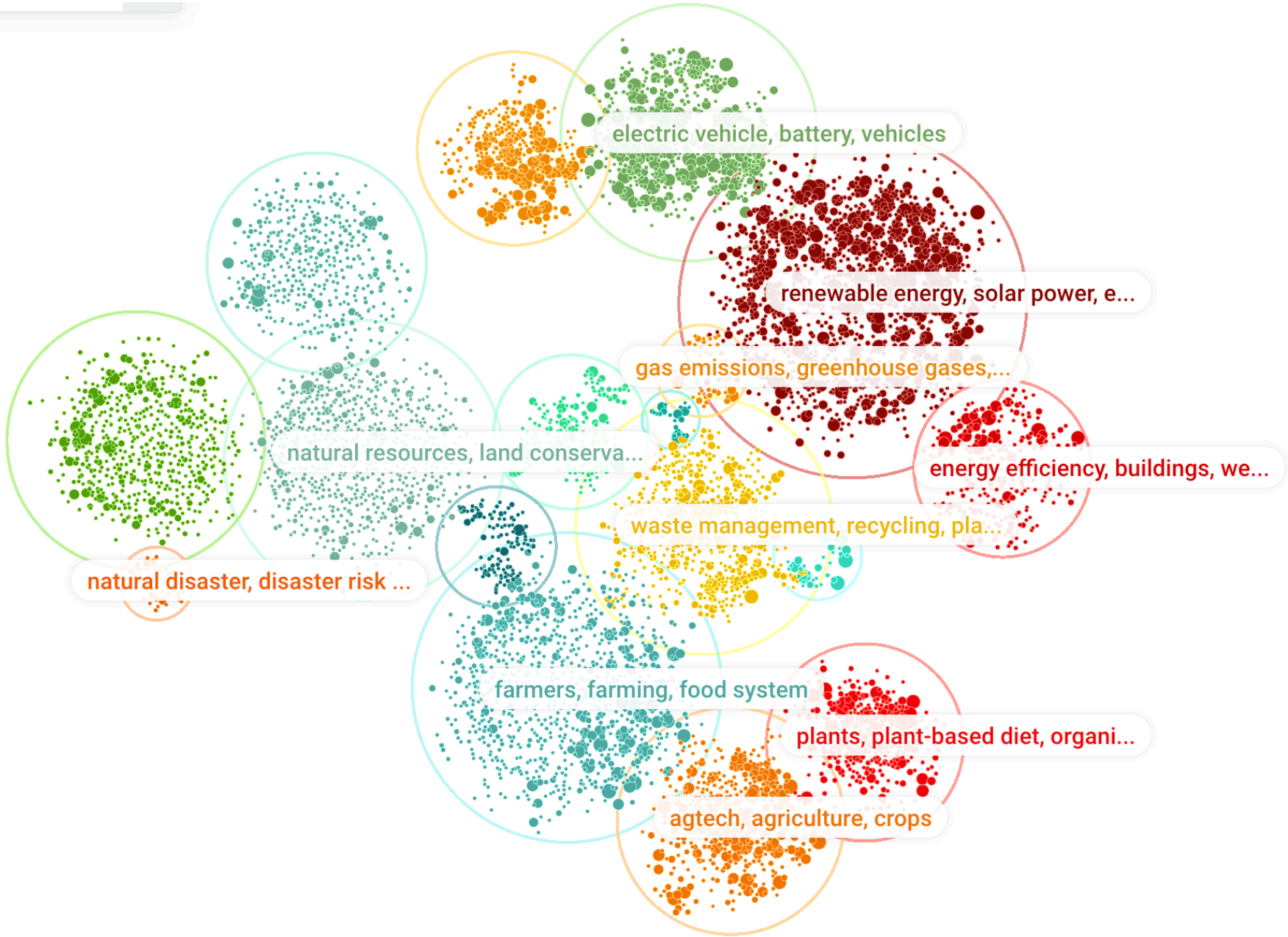
Kim And Kanye Silence Divorce Rumors With Family Photo. Kanye took to Twitter on Tuesday to share a photo of his family, simply writing, "Happy Holidays." In the picture, seemingly taken at Kris Jenner's annual Christmas Eve party, Kim and a newly blond Kanye pose with their children, North, 3, and Saint, 1. After Kanyes hospitalization, reports that there was trouble in paradise with Kim started brewing. But E! News shut down the speculation with a family source denying the rumors and telling the site, "It's been a very hard couple of months."

Kim Kardashian Reportedly Cheating With Marquette King as She Gears up for Divorce From Kanye West. Kim Kardashian is ready to file for divorce from Kanye West but has she REALLY been cheating on him with Oakland Raiders punter Marquette King? The NFL star seemingly took to Twitter to address rumors that they've been getting close amid Kanye's mental breakdown, which were originally started by sports blogger Terez Owens. While he doesn't appear to confirm or deny an affair, her reps said there is "no truth whatsoever" to the reports and labeled the situation "fabricated."

Pérez-Rosas, Verónica, Bennett Kleinberg, Alexandra Lefevre, and Rada Mihalcea. "Automatic detection of fake news." arXiv preprint arXiv:1708.07104 (2017).

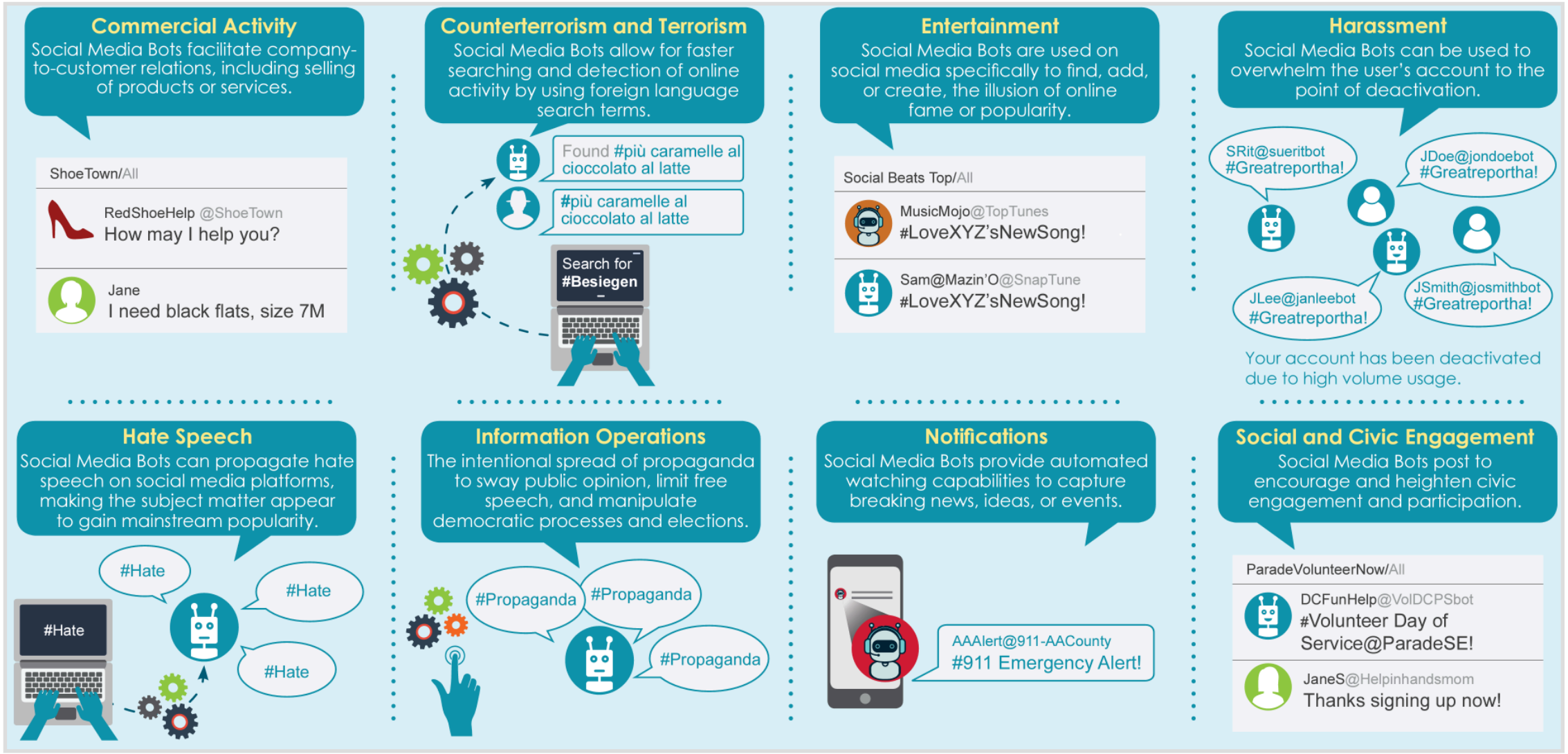


Source: https://www.wsj.com/articles/deepfake-videos-are-ruining-lives-is-democracy-next-1539595787



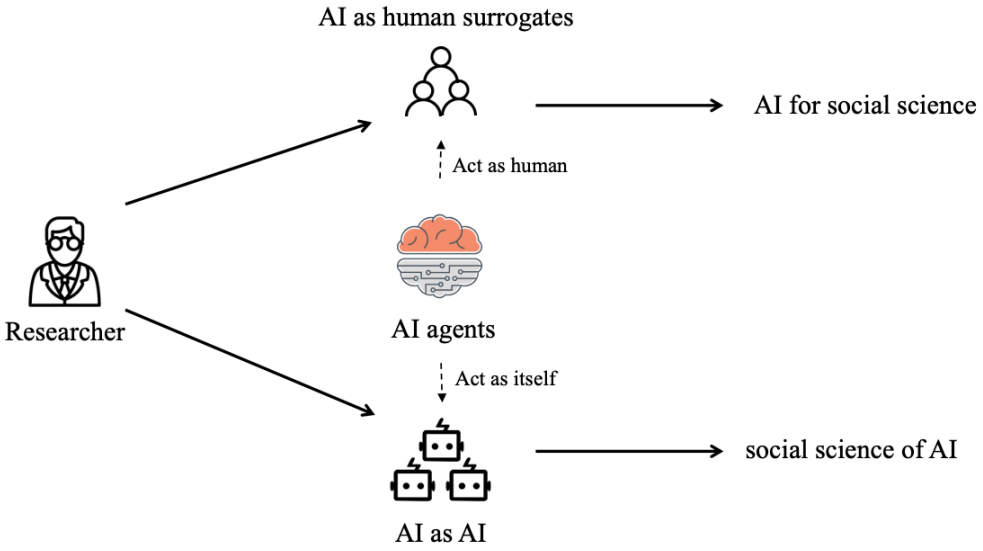
Source: https://primer.ai/business-solutions/primer-partners-with-oneearth-using-ai-to-fight-climate-change/

Bots and Social Media



https://niccs.cisa.gov/sites/default/files/documents/pdf/ncsam_socialmediabotsoverview_508.pdf?trackDocs=ncsam_socialmediabotsoverview_508.pdf

LLMs meet Human Behaviors



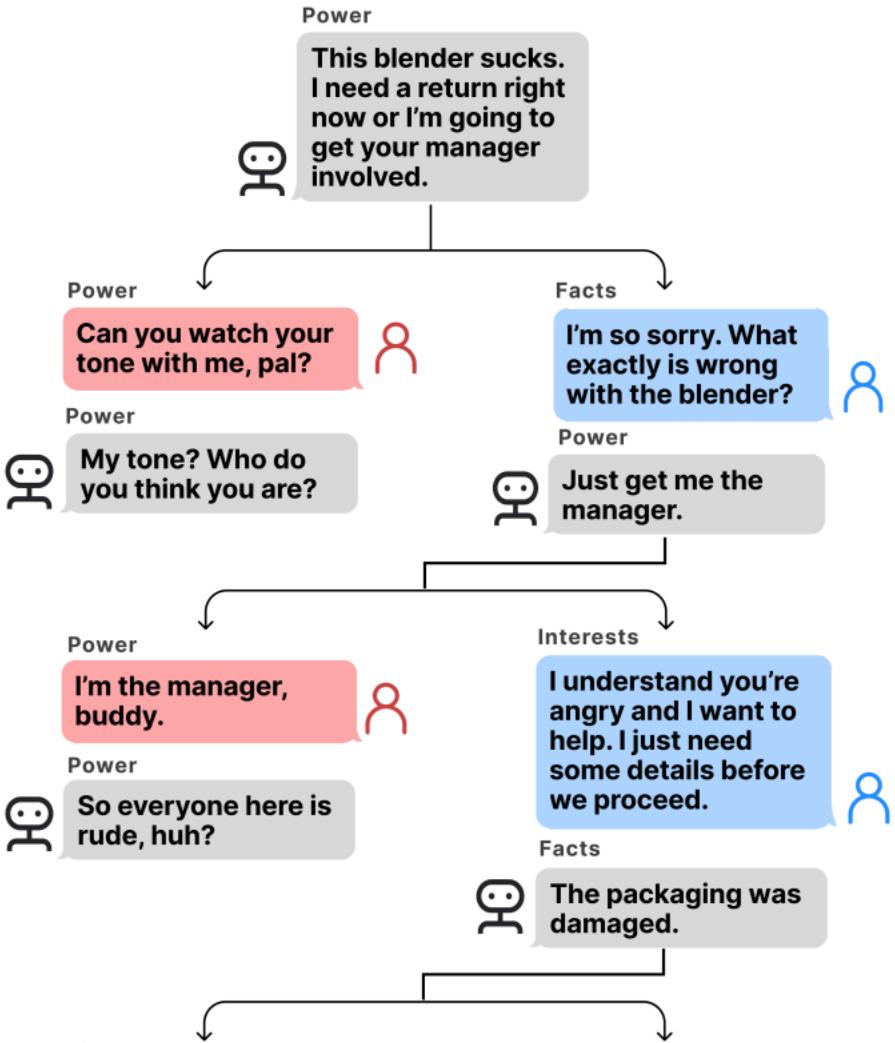
AI for Social Science and Social Science of AI: A Survey
https://arxiv.org/pdf/2401.11839.pdf

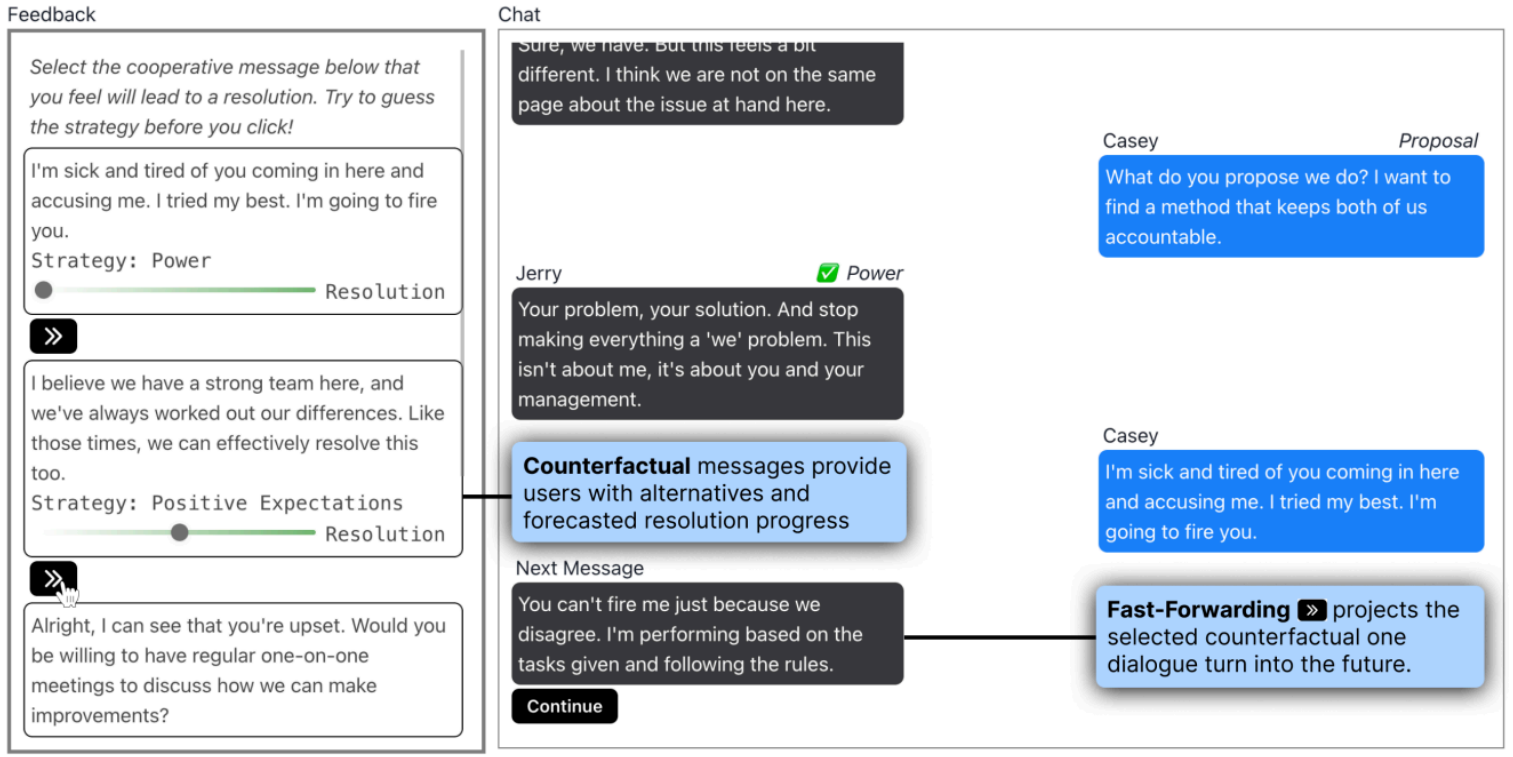
Generative Agents: Interactive Simulacra of Human Behavior
https://arxiv.org/pdf/2304.03442.pdf

Opportunities and Benefits

1. Provide information about social relationships (e.g., emails)
2. Analyze how group interactions predict our power and performance
3. Understand how the structures, network of society change evolve over time
4. Large-scale tracing of people's movements and physical proximities
5. Offer channels for understanding what people say and how they connect
6. Understand the impact of users' digital activities on everything from their moods, political ideology, to their health
7. Analyze how technology affects the society as a whole
8. **Build interventions to facilitate better social interactions**

Simulating Conflict to Teach Conflict Resolution



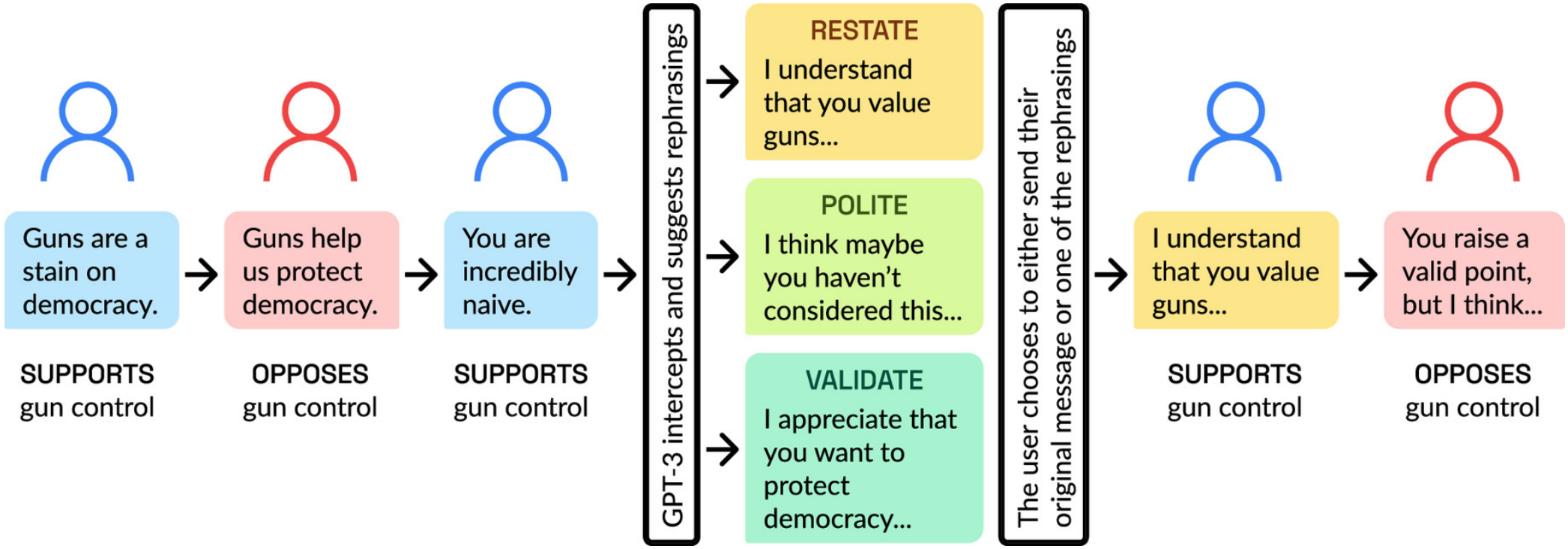


Feedback
Provides contextual information on conflict resolution strategies, and shows counterfactuals at each turn.

Simulation
Shows message history, and allows users to send new messages + view applied strategies during a simulated conversation. Additionally, users can view "fast-forwarded" projections from counterfactuals in the simulation.

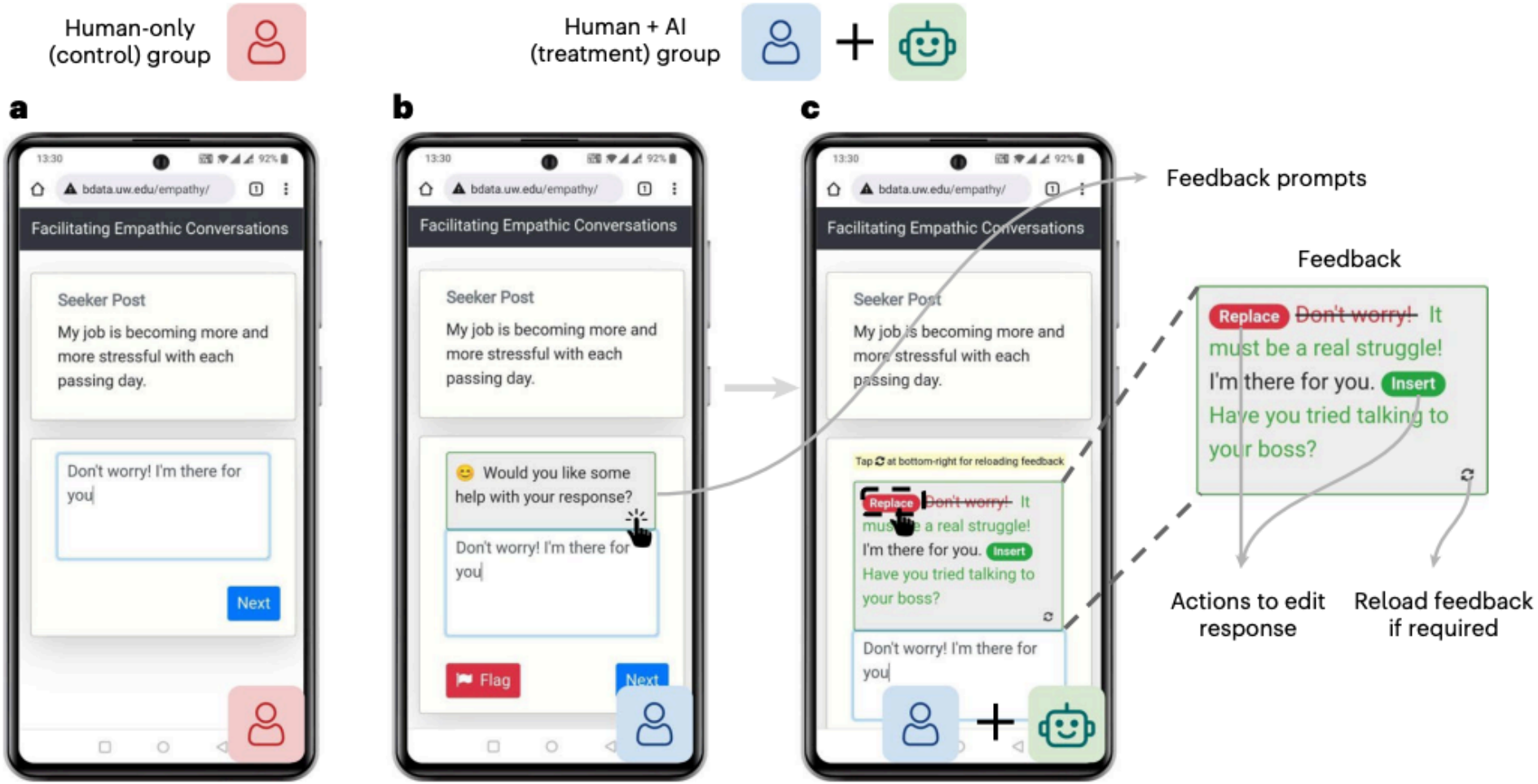
Shaikh, Omar, Valentino Chai, Michele J. Gelfand, Diyi Yang, and Michael S. Bernstein. "Rehearsal: Simulating conflict to teach conflict resolution." arXiv preprint arXiv:2309.12309 (2023).

Chat interventions can improve online political conversations



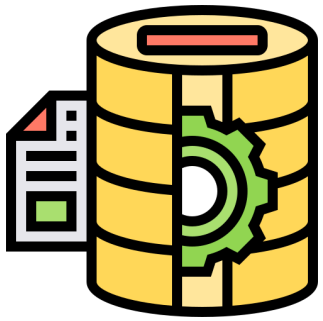
Argyle, Lisa P., Christopher A. Bail, Ethan C. Busby, Joshua R. Gubler, Thomas Howe, Christopher Rytting, Taylor Sorensen, and David Wingate. "Leveraging AI for democratic discourse: Chat interventions can improve online political conversations at scale." Proceedings of the National Academy of Sciences 120, no. 41 (2023)

Human–AI collaboration enables more empathic conversations

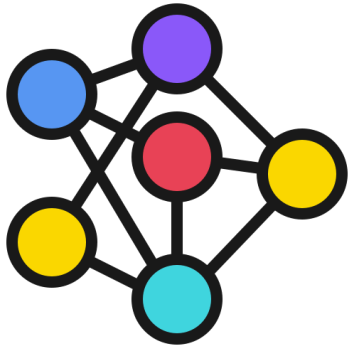


Sharma, Ashish, Inna W. Lin, Adam S. Miner, David C. Atkins, and Tim Althoff. "Human–AI collaboration enables more empathic conversations in text-based peer-to-peer mental health support." Nature Machine Intelligence 5, no. 1 (2023): 46-57.

Computational Social Science in a nutshell

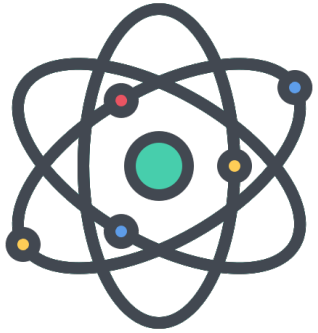


Data



Algorithm

Problem



Theory

Knowledge

Impact

Risks

1. The potential risk to individuals and corporations in the sharing of personal data by private companies
2. Robust models of collaboration and data sharing between industry and academia
3. Potential risks of de-anonymization
4. Ethical concerns & Institutional Review Boards

Lazer, D., Pentland, A., Adamic, L., Aral, S., Barabasi, A.L., Brewer, D., Christakis, N., Contractor, N., Fowler, J., Gutmann, M. and Jebara, T., 2009. Computational social science. Science (New York, NY), 323 (5915), pp.721-723.

Ethics in CSS

IRB is a floor not a ceiling

Put yourself in everyone else's shoes

Think of research ethics as continuous not discrete

Always

- Design ethically thoughtful research
- Explain your decisions to others

Credit to Matthew Salganik @ Princeton

Challenges You See in CSS?

Large amount of noisy data, but limited supervisions

AI-generated content on the rise

Sometimes subjective and hard to obtain “consensus”

    Why do we even optimize “consensus”?

Context is the key, but often missing

“Ad-hoc” phenomena vs. generalizable knowledge

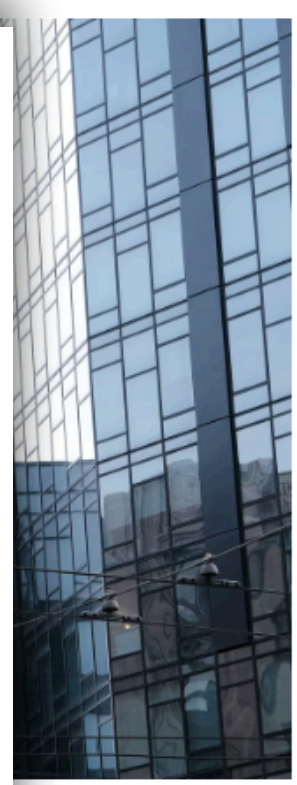
…

Data Access

Twitter's new data access rules will make social media research harder

FEBRUARY 9, 2023 · 7:00 AM ET

By Huo Jingnan



rder to researchers to

Without access to social media platform data, we risk being left in the dark

Significance:

Social media data are essential for studying human behaviour and understanding potential systemic risks. Social media platforms have, however, begun to remove access to these data. In response, other countries and regions have implemented legislation that compels platforms to provide researchers with data access. In South Africa, we have lagged behind the Global North when it comes to using platform data in our research and, given the recent access restrictions, we risk being left behind. In this Commentary, I call attention to this critical issue and initiate a conversation about access to social media data in South Africa.

Challenge Summary

1. The complexity of the theoretical issues confronting social science
2. The difficulty in obtaining the relevant observational data
3. The difficulty of manipulating large scale social organizationals experimentally
4. **The complexity and difficulty in computationally, scientifically and rigorously modeling such problems and data**

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