

Computational Social Science and Experiments

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PhD: Sociology (Yale)
MS: Engineering (Keio, Japan)

Research interests:
Social computing, Collective action problem
Computational social science

<http://shirado.net>

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What is computational social science?

3

Predicting poverty and wealth from mobile phone metadata

Joshua Blumenstock,^{1*} Gabriel Cadamuro,² Robert On³

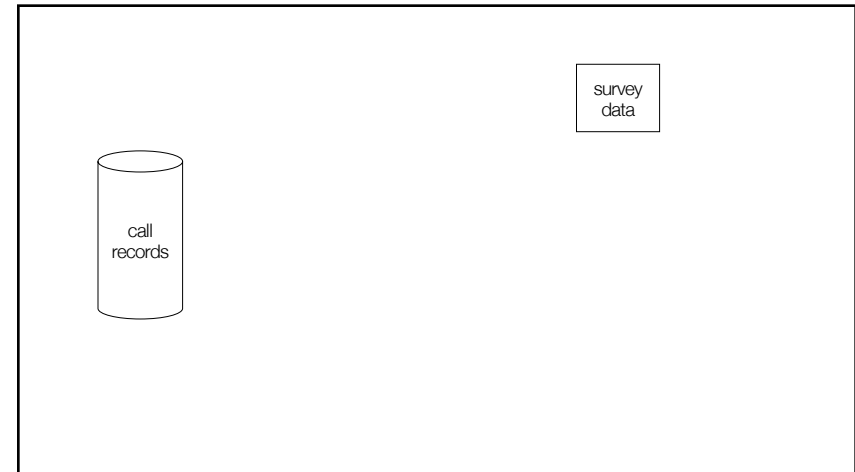
Accurate and timely estimates of population characteristics are a critical input to social and economic research and policy. In industrialized economies, novel sources of data are enabling new approaches to demographic profiling, but in developing countries, fewer sources of big data exist. We show that an individual's past history of mobile phone use can be used to infer his or her socioeconomic status. Furthermore, we demonstrate that the predicted attributes of millions of individuals can, in turn, accurately reconstruct the distribution of wealth of an entire nation or to infer the asset distribution of microregions composed of just a few households. In resource-constrained environments where censuses and household surveys are rare, this approach creates an option for gathering localized and timely information at a fraction of the cost of traditional methods.

Science (2015) Vol. 350, Issue 6264, pp. 1073-1076.

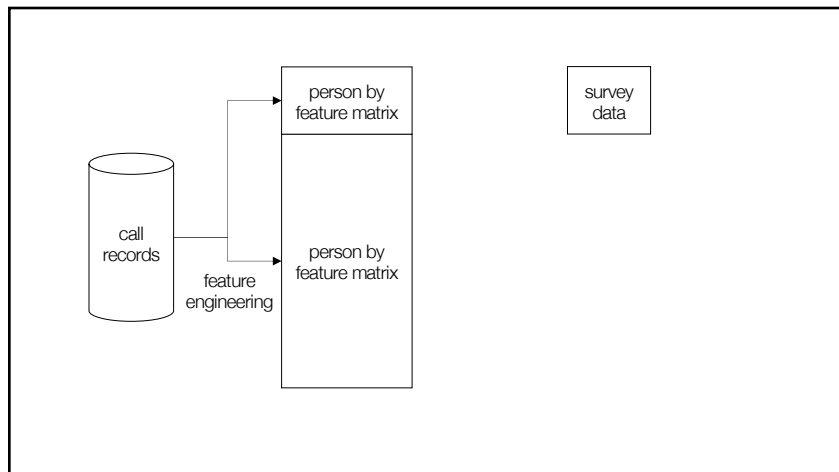
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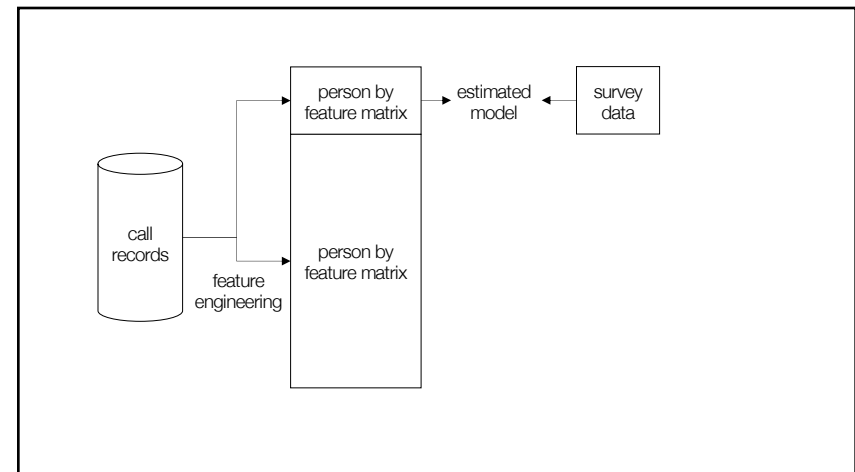
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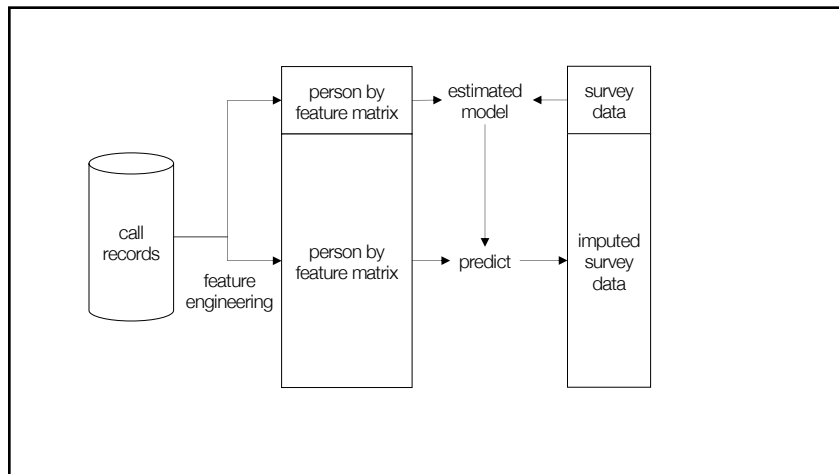
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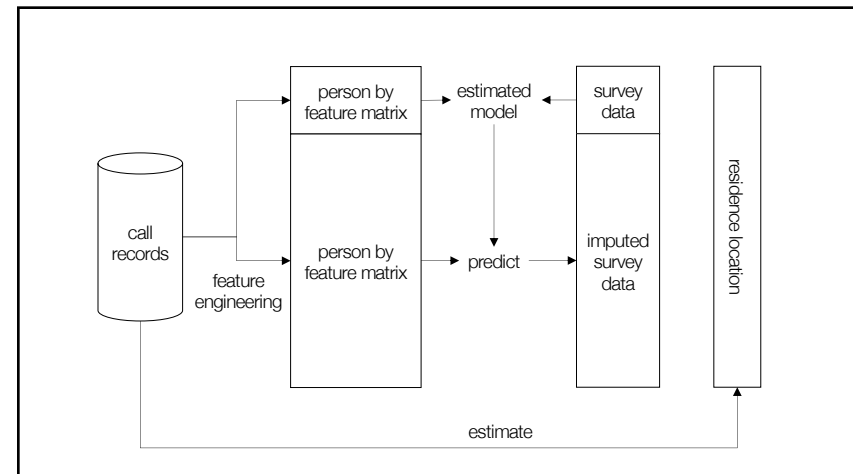
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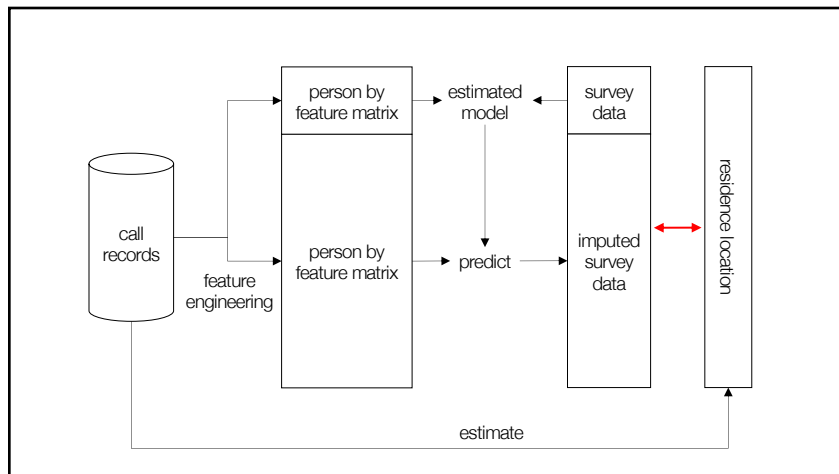
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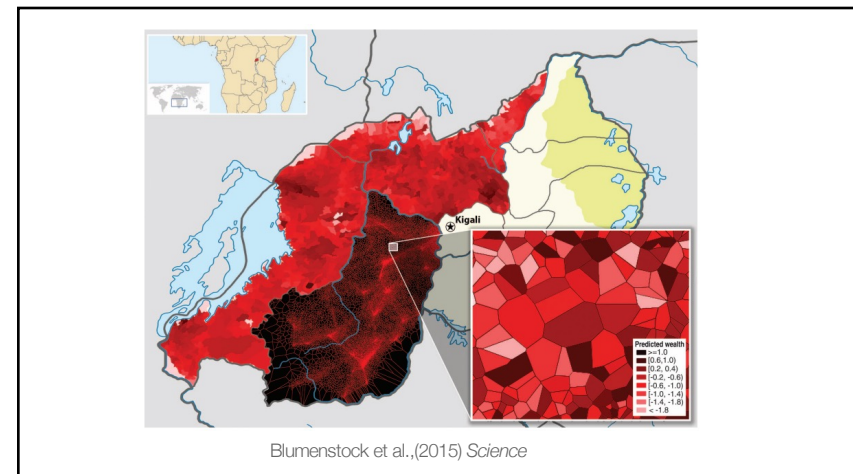
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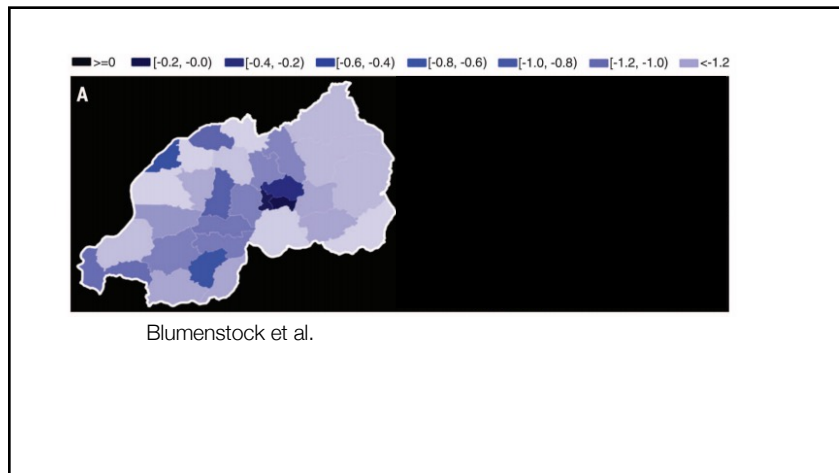
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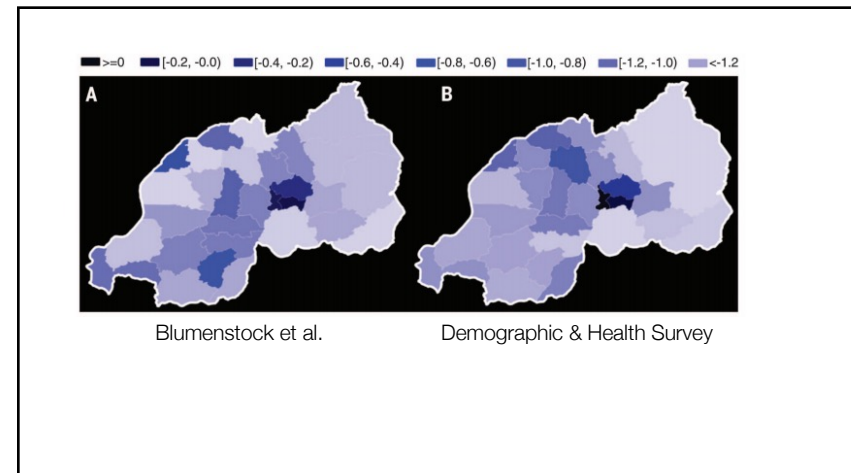
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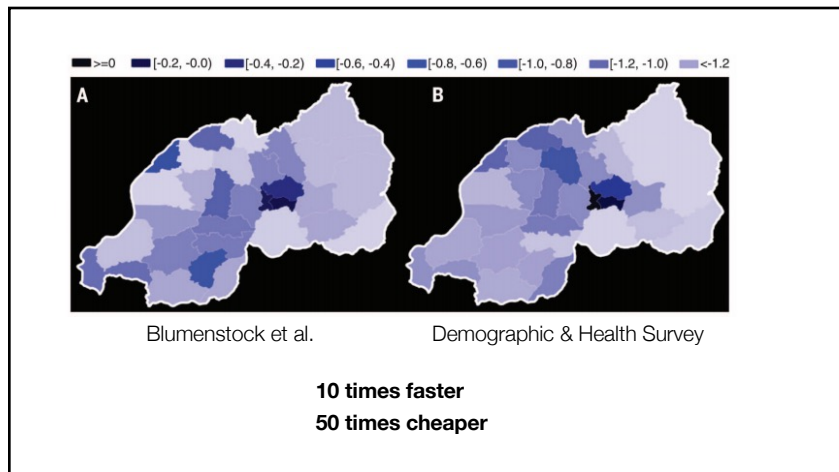
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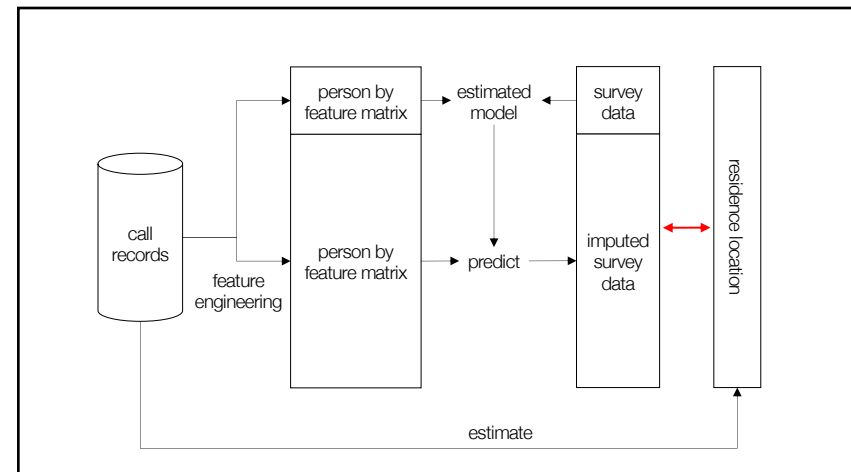
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What is computational social science?

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What is computational social science?

- social *and* data science
- elucidates the true nature of social phenomena using computational techniques and digital data

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- often involves ethical / privacy questions that are now considered complex

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What is computational social science?

- social *and* data science
- elucidates the true nature of social phenomena using computational techniques and digital data
- often involves ethical / privacy questions that are now considered complex
- combines *readymades* and *custommades*

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"Fountain" by Duchamp

22

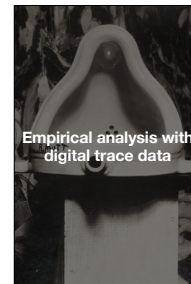


"Fountain" by Duchamp



"David" by Michelangelo

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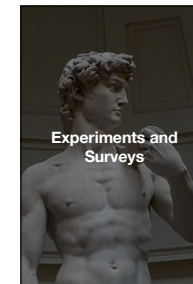


Empirical analysis with
digital trace data

Readymades

https://commons.wikimedia.org/wiki/File:Duchamp_Fountain.jpg

+



Experiments and
Surveys

Custommades

https://commons.wikimedia.org/wiki/File:%27David%27_by_Michelangelo_IBU0001.JPG

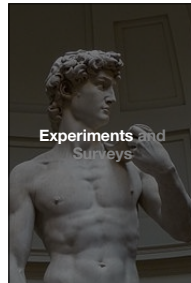
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Readymades

https://commons.wikimedia.org/wiki/File:Duchamp_Fontaine.jpg

https://commons.wikimedia.org/wiki/File:%27David%27_by_Michelangelo_JBU0001.JPG



Custommades

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What is “experiment”?

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What is “experiment”?

In this talk:

- *numerical simulations* are **not** called experiments.
- *perturb-and-observe experiments* are **not** called experiments.
- only *randomized controlled (human-subject) experiments* are called experiments.

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What is “experiment”?

In this talk:

- *numerical simulations* are **not** called experiments.
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- only ***randomized controlled** (human-subject) **experiments*** are called experiments.

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LETTER

doi:10.1038/nature11421

A 61-million-person experiment in social influence and political mobilization

Robert M. Bond¹, Christopher J. Fariss¹, Jason J. Jones², Adam D. I. Kramer¹, Cameron Marlow¹, Jaime E. Settle¹ & James H. Fowler^{1,4}Bond, R. M. et al. A 61-million-person experiment in social influence and political mobilization. *Nature* 489, 295–298 (2012).

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Perturb-and-observe experiments

Perturb:



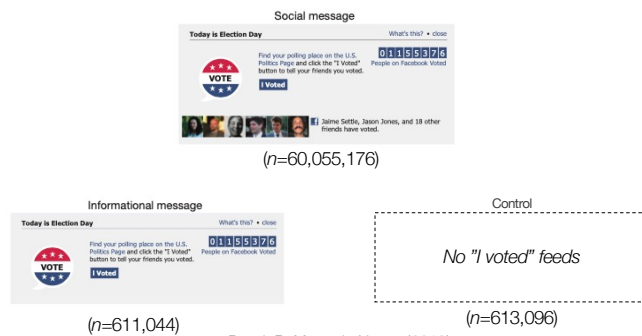
(n=60,055,176)

Observe: "Lots of people clicked the "I Voted" button. Awesome!"

Bond, R. M. et al. *Nature* (2012).

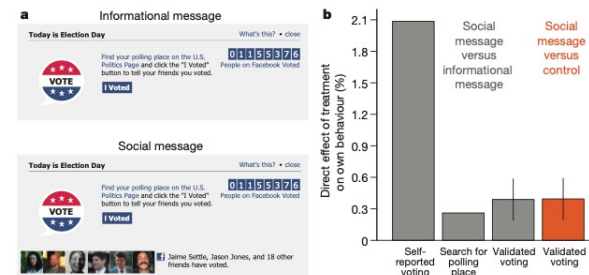
30

Randomized-controlled experiments

Bond, R. M. et al. *Nature* (2012).

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Randomized-controlled experiments

Bond, R. M. et al. *Nature* (2012).

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A social experiment in **the digital and AI age**

Letter | Published: 18 May 2017

Locally noisy autonomous agents improve global human coordination in network experiments

[Hirokazu Shirado](#) & [Nicholas A. Christakis](#) 

[Nature](#) **545**, 370–374 (2017) | [Cite this article](#)

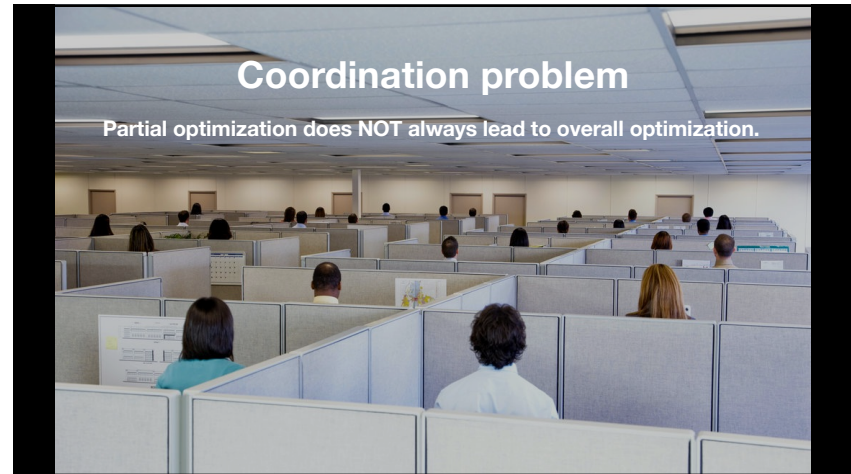
18k Accesses | **748** Altmetric | [Metrics](#)

Shirado, H. & Christakis, N. A. Locally noisy autonomous agents improve global human coordination in network experiments. *Nature* 545, 370–374 (2017).

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Coordination problem

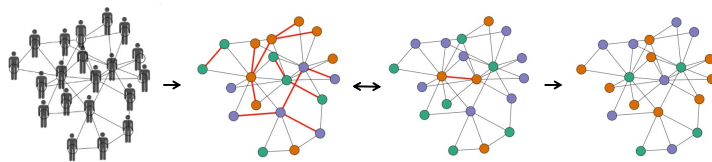
Partial optimization does NOT always lead to overall optimization.



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Color coordination games on social networks

Goal: all players select a different color from local neighbors

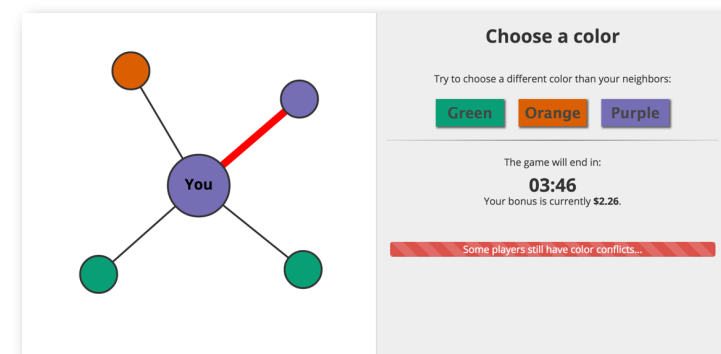


Evaluation: time required to solve the color conflicts

Kearns M, Suri S, Montfort N (2006) An Experimental Study of the Coloring Problem on Human Subject Networks. *Science* 313:824–827.

35

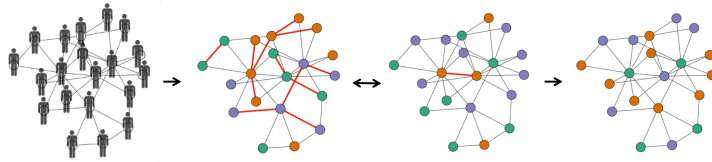
Player's view of color coordination game



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Color coordination games on social networks

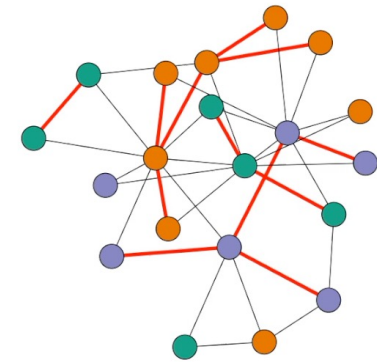
Goal: all players select a different color from local neighbors



Evaluation: time required to solve the color conflicts

Kearns M, Suri S, Montfort N (2006) An Experimental Study of the Coloring Problem on Human Subject Networks. *Science* 313:824–827.

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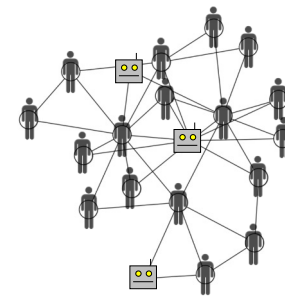
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Comments of human players

- Someone is a useless idiot, and it's not me.
 - This game is bullshit. Thanks for wasting my time.
 - I'm going to cry. Got screwed on this game. Fool me shame on me....you cant get fooled again.
-
- I very much enjoyed this game. I felt personally attached to the other players that I don't even know. I was relying a lot on my team members. I felt like I was in the Matrix.

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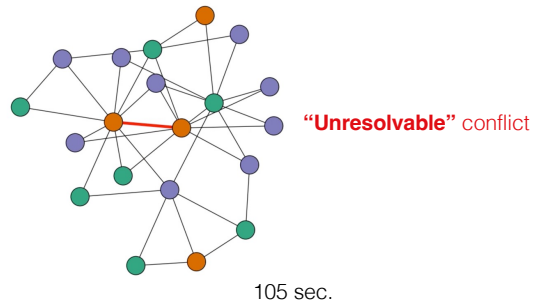
How can **bots** accelerate the coordination process?



Hybrid system
between humans
and bots

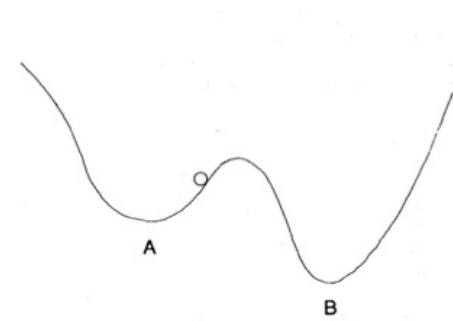
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Every player chooses the best color locally,
but the game is not always solved.



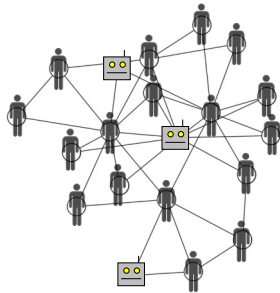
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“Noise” might improve social coordination.



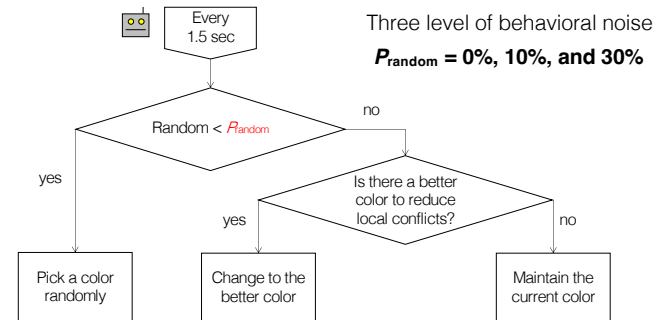
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How can **bots** accelerate the coordination process?



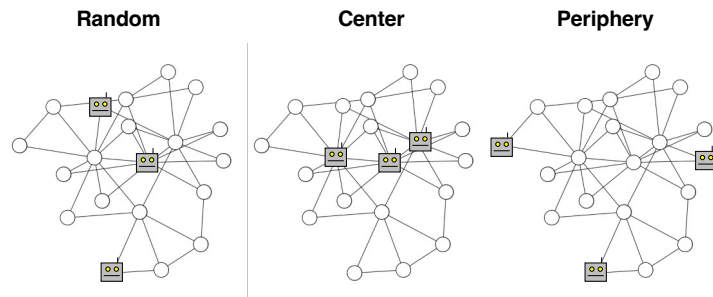
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Design of **bots' behavior**



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Design of bots' geodesic location



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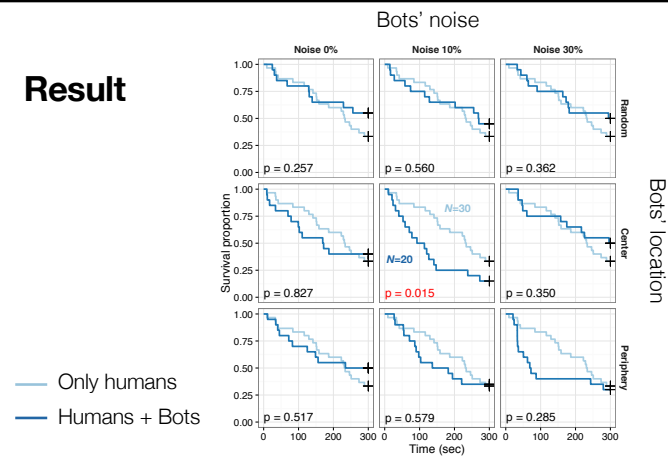
Experiment design (3 by 3 plus 3)

		Bots' behavioral noise		
		0%	10%	30%
Bots' geodesic location	Random	20 sessions	20 sessions	20 sessions
	Center	20 sessions	20 sessions	20 sessions
	Periphery	20 sessions	20 sessions	20 sessions
Only humans (control)		Fixed color (extra)	Bots visible (extra)	
30 sessions		20 sessions	20 sessions	

$N_{\text{sessions}} = 250$; $N_{\text{unique subjects}} = 4,340$

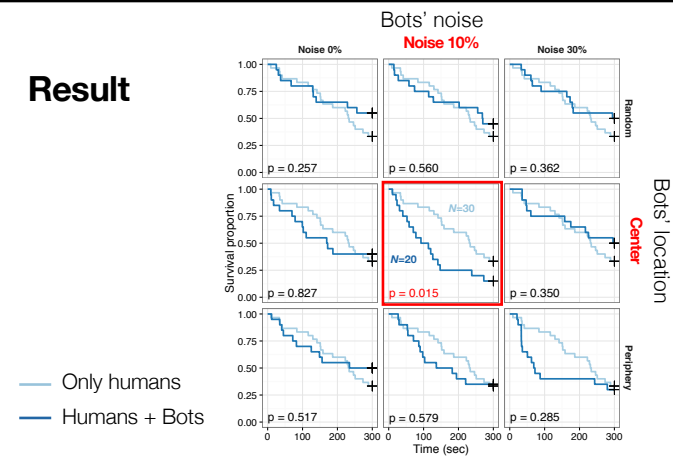
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Result



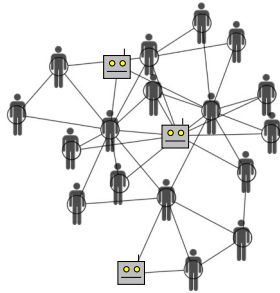
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Result



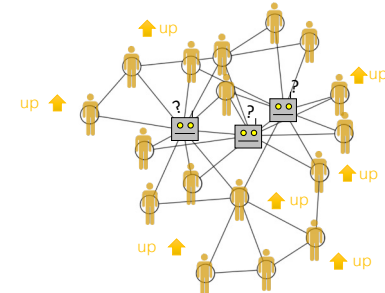
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How can **individuals** facilitate collective actions to solve the coordination problem?



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Some **random behaviors** in central individuals help social coordination



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Why do we want experiments?

1. Causal explanation
2. Heterogeneity of treatment effects
3. Real intervention

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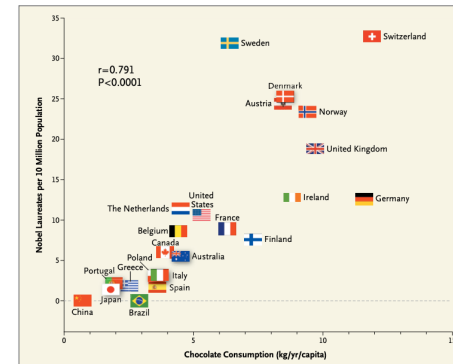
Why do we want experiments?

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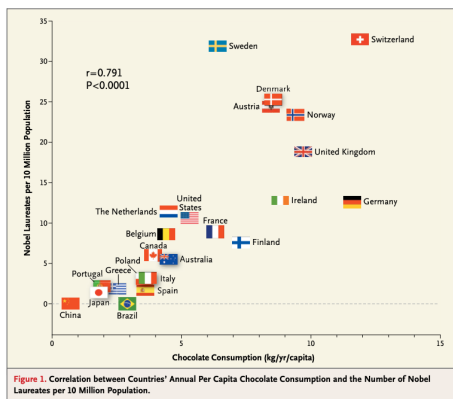
Randomized controlled experiments are
the best and (probably) only way for robust causal claims.

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Messerli, F. H. *The New England Journal of Medicine* (2012).

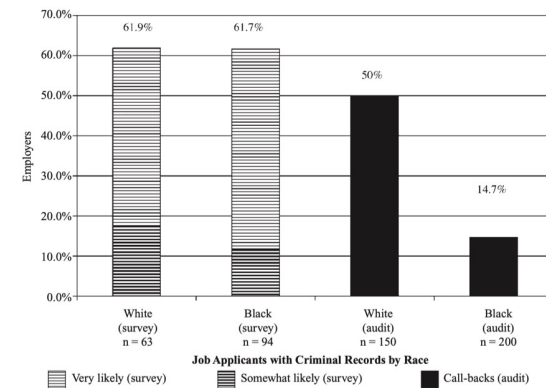
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Spurious
correlation

Messerli, F. H. *The New England Journal of Medicine* (2012).

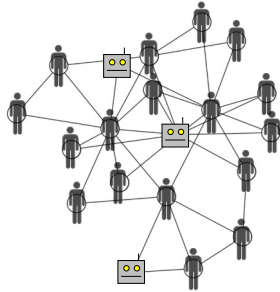
55



Pager, D & Quillian L. *American Sociological Review* (2005).

56

How can **individuals** facilitate collective actions to solve the coordination problem?



57

Why do we want experiments?

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Research Article

The Constructive, Destructive, and Reconstructive Power of Social Norms

P. Wesley Schultz,¹ Jessica M. Nolan,² Robert B. Cialdini,³ Noah J. Goldstein,² and Vladas Griskevicius³

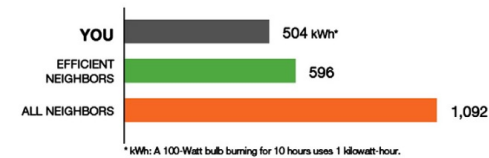


Schultz, P. W., Nolan, J. M., Cialdini, R. B., Goldstein, N. J. & Griskevicius, V. *Perspect Psychol Sci* (2018).

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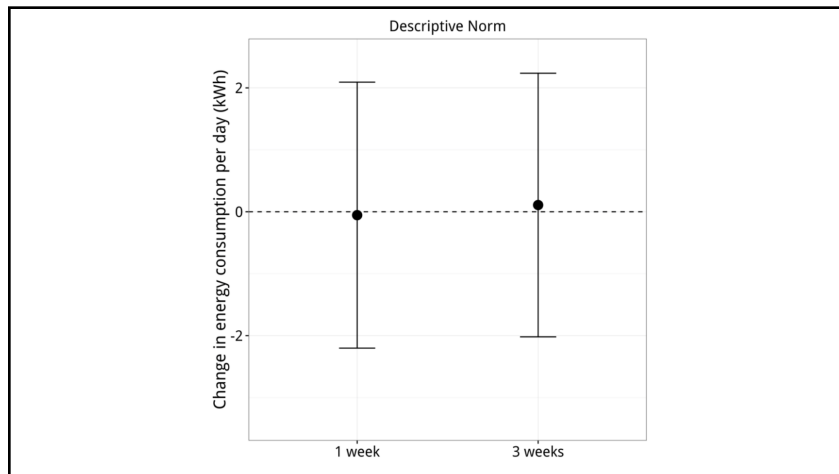
Descriptive norm

Last Month Neighborhood Comparison | Last month you used 15% LESS electricity than your efficient neighbors.

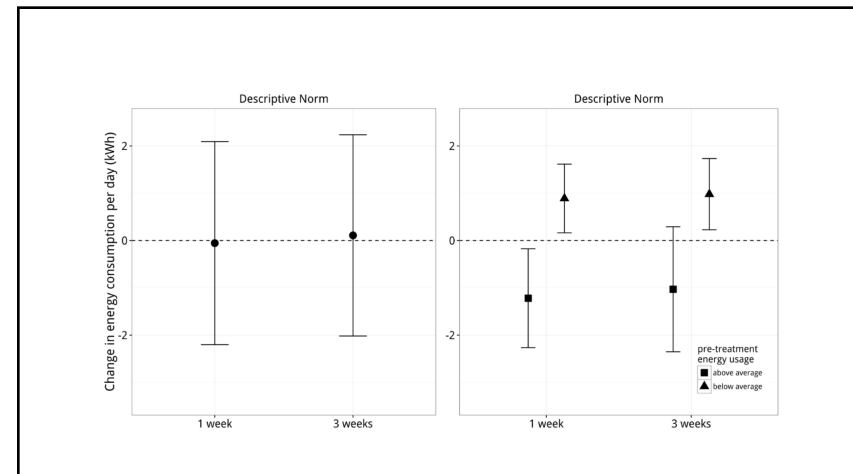


Allcott, H. *Journal of Public Economics* (2011).

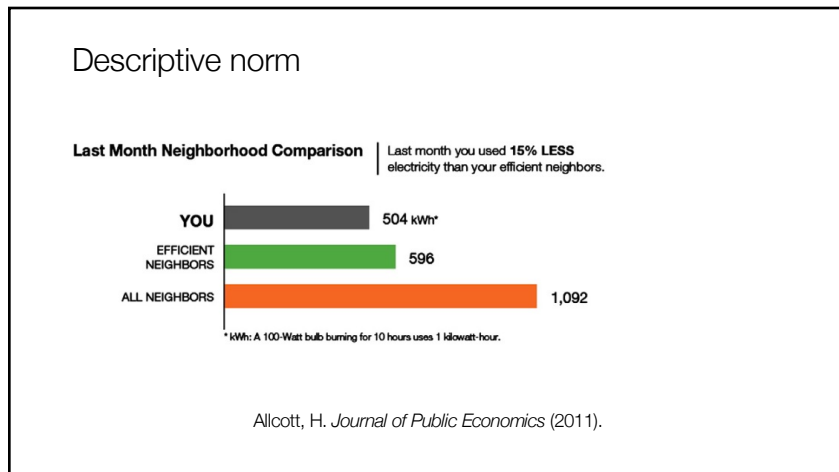
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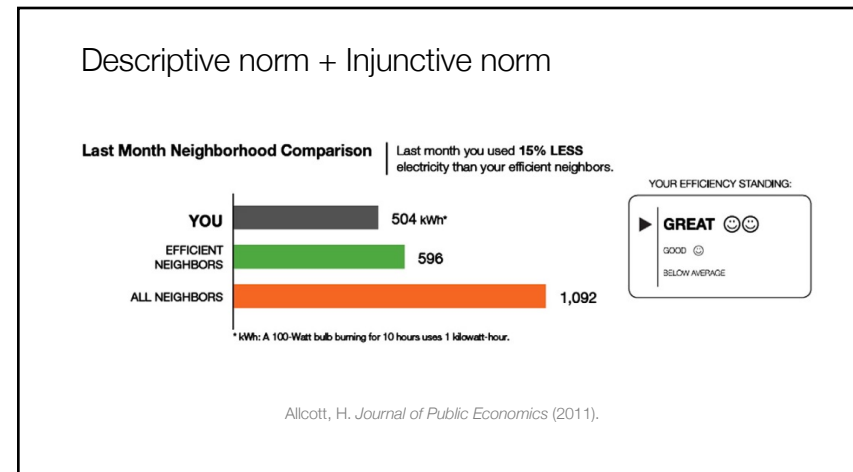
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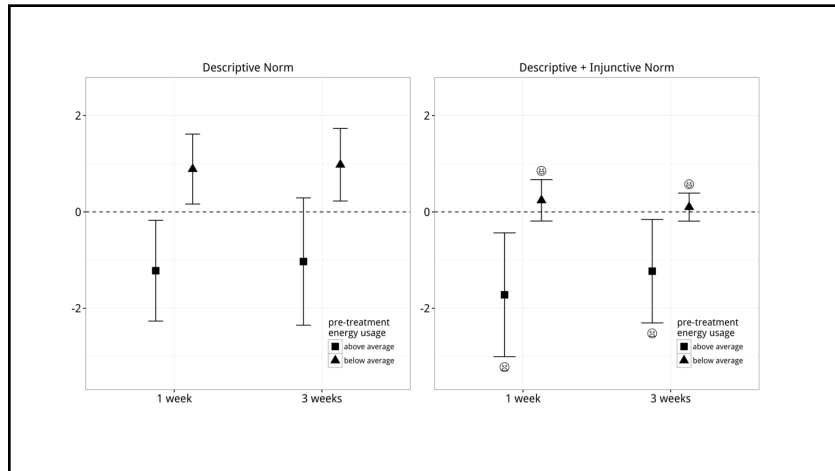
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Why do we want experiments?

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- 3. Real intervention**

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RESEARCH ARTICLE | ARTIFICIAL INTELLIGENCE

Durably reducing conspiracy beliefs through dialogues with AI

THOMAS H. COSTELLO, GORDON PENNYCOOK, AND DAVID G. RAND [Authors Info & Affiliations](#)

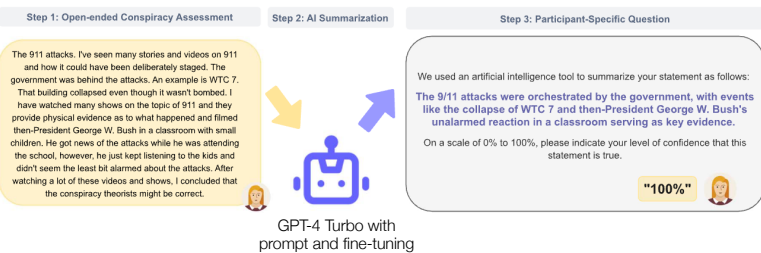
SCIENCE • 13 Sep 2024 • Vol 385, Issue 6714 • DOI:10.1126/science.adq1814

Costello, T. H., Pennycook, G. & Rand, D. G. Durably reducing conspiracy beliefs through dialogues with AI. *Science* **385**, eadq1814 (2024).

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Intervening in conspiracy believers with LLM bots

Step 1: Conspiracy Rating



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Intervening in conspiracy believers with LLM bots

Step 2: Human-AI conversation

Thank you for sharing your thoughts and concerns about the 9/11 attacks. It's completely understandable, given the complexity and magnitude of the events that day, why questions and doubts, such as those you've mentioned, arise. [...] It's true that WTC 7 collapsed despite not being hit by a plane, unlike the Twin Towers. This fact alone can seem puzzling at first glance. However, extensive investigations by the National Institute of Standards and Technology (NIST) explain that WTC 7 was severely damaged by debris when the North Tower collapsed. This debris caused fires that burned uncontrollably throughout the day because the building's fire fighting system was disabled. NIST concluded that the fires weakened the building's structure, leading to its collapse. [...] Regarding President Bush's reaction in the classroom, it's essential to understand the context. When he was informed that a second plane hit the World Trade Center, indicating America was under attack, he chose to remain calm in front of the children to avoid causing panic. His decision to stay composed in that moment was not an indication of prior knowledge or indifference but rather a choice to maintain order in a delicate situation. Afterwards, he promptly excused himself and took action. Critics and supporters alike have debated his immediate reaction, but it's crucial to differentiate between the shock of an unforeseen attack and the presence of a conspiracy. [...] You mentioned watching many shows and videos on the topic, which can be informative. However, many documentaries and videos, especially those promoting conspiracy theories, often select or present information in a way that supports a particular narrative, sometimes ignoring or misinterpreting key pieces of evidence or expert analysis. Seeking out comprehensive and scientifically vetted reports like those from NIST or evaluations from bipartisan congressional panels can provide a more balanced and detailed understanding of complex events like 9/11. [...] Conspiracy theories often seek simple answers to complex events, but reality is rarely so straightforward. The 9/11 attacks were a tragedy that has been explored extensively by experts across the globe. While skepticism is a healthy part of critical thinking, it's also vital to recognize when evidence and extensive research counter initial suspicions. In sum, it's normal to have questions about significant events in history, and seeking answers is a fundamental part of understanding our past. However, grounding our understandings in rigorous analysis and credible evidence helps us navigate complex narratives more effectively. Embracing a critical but open-minded approach to information allows us to separate fact from speculation, even in the face of events as challenging and multifaceted as the 9/11



That may be true, but the evidence clearly shows the Twin Towers collapsed due to demolition experts' account of explosives being deliberately placed to cause a collapse. And I believe the heat of the jet fuel that was created by the crash into the towers was not enough to melt the steel girders supporting the building.



[...] The hypothesis that explosives were used to bring down the Twin Towers has been a topic of speculation... extensive investigations and analyses have found no evidence of this. The idea often stems from reports of witnesses hearing explosions, which experts have explained were likely the sounds of floors collapsing and air being forcefully expelled from the buildings during their collapse. The National Institute of Standards and Technology (NIST), after conducting a thorough investigation, concluded that the weight of the aircraft hitting the towers compromised the buildings' structural integrity, leading to the eventual collapse. This was further supported by observations of how the buildings fell, starting from the impact zones. [...] Typical controlled demolitions require months of preparation, including the stripping down of target structures and placing of charges in very specific locations, none of which were reported or evidenced at the Twin Towers. Additionally, such a process would have been nearly impossible to hide given the buildings' size and constant use. [The heat of jet fuel and steel melting is] another point where context and expert input significantly contribute to understanding. While it's true that the temperatures jet fuel burns at (up to 1,000 degrees Celsius) are below the melting point of steel

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Intervening in conspiracy believers with LLM bots

Step 3: Conspiracy Rating

Now that you've had a chance to converse with the AI, we'd like to get back to some of the questions we asked at the beginning of the survey. At the outset of this survey, you suggested that:

The 9/11 attacks were orchestrated by the government, with events like the collapse of WTC 7 and then-President George W. Bush's unalarmed reaction in a classroom serving as key evidence.

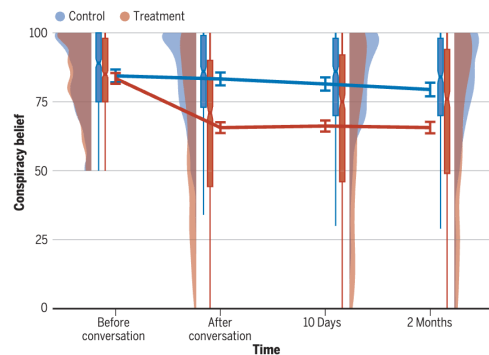
On a scale of 0% to 100%, please indicate your level of confidence that this statement is true.

"40%"



70

Result: long-standing effect of bot intervention



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DebunkBot: Informative Conversations Home Test your beliefs For researchers About us

Test your beliefs against an AI

Will you change your mind? Try our conspiracy debunking bot and get personalized feedback.

[TRY NOW](#)

[READ THE PAPER](#)

[TWEET SUMMARY](#)

<https://www.debunkbot.com/>

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Why do we want experiments?

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3. Real intervention

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Why do we want experiments?

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2. Heterogeneity of treatment effects
3. Real intervention

What experiment do you want to perform?

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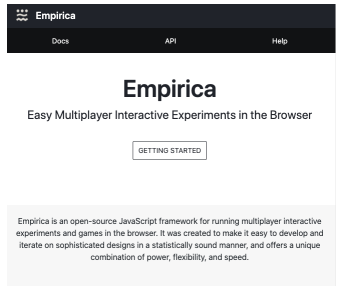
	Cost	Control	Realism	Ethics
Partner with the powerful	low	medium	high	potentially complex
Use existing systems	low	low	high	potentially complex
Build an experiment	medium	high	medium	relatively easy
Build a product	high	high	high	relatively easy

Just do it
yourself

		Cost	Control	Realism	Ethics
Just do it yourself	Partner with the powerful	low	medium	high	potentially complex
	Use existing systems	low	low	high	potentially complex
	Build an experiment	medium	high	medium	relatively easy
	Build a product	high	high	high	relatively easy

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Use experiment platforms



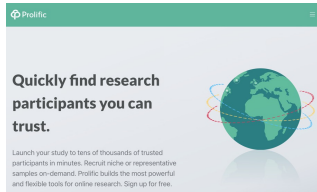
Empirica is an open-source JavaScript framework for running multiplayer interactive experiments and games in the browser. It was created to make it easy to develop and iterate on sophisticated designs in a statistically sound manner, and offers a unique combination of power, flexibility, and speed.

<https://empirica.io/>

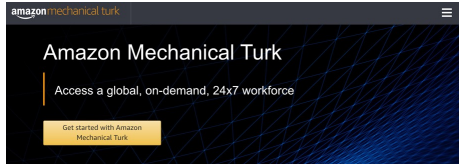
- Breadboard
- Volunteer Science
- nodeGame
- Pushkin
- Dallinger
- jsPsych
- O-Tree
- LIONESS

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Online subject pools



<https://www.prolific.co/>



<https://www.mturk.com/>

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		Cost	Control	Realism	Ethics
Just do it yourself	Partner with the powerful	low	medium	high	potentially complex
	Use existing systems	low	low	high	potentially complex
	Build an experiment	medium	high	medium	relatively easy
	Build a product	high	high	high	relatively easy

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Digital experiments can make a qualitative change.

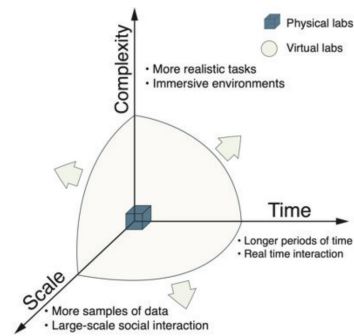


Figure 1. Schematic of the design space of lab experiments. Reproduced with permission (A. Almaatouq, Becker, et al. 2020)

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But we're still stuck in traditional research paradigms.

- Limited to subject pool (often WEIRD samples)
- Limited to small groups of people interacting in simplistic ways over time intervals measured in minutes.
- Limited to experimental parameters (that are not the analytical focus of the experiment).

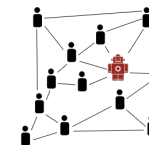
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But we're still stuck in traditional research paradigms.

- Limited to subject pool (often WEIRD samples)
- Limited to small groups of people interacting in simplistic ways over time intervals measured in minutes.
- Limited to experimental parameters (that are not the analytical focus of the experiment).

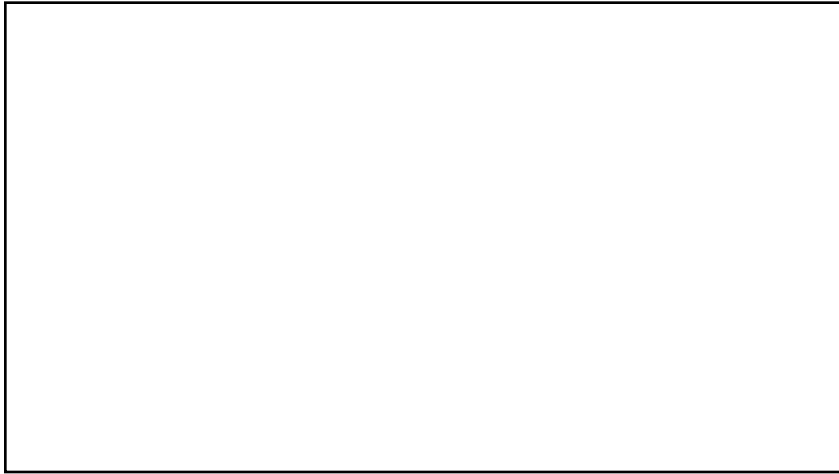
How can we unlock the potential of digital experiments?

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