Science Club explores puzzles of politics and voting

Over the last few decades, the divide between the two major political parties in the United States has deepened. Studies of Congressional voting patterns show that politicians take increasingly polarized positions, and that those positions drift farther and farther apart over time. Not voters, though. Since the 1960s, voters have stayed in the middle, usually preferring centrist or moderate policy positions over extremes.

This contrast gives rise to a paradox: If voters have stayed in the middle, why are the parties drifting farther apart? At the latest meeting of SFI’s Virtual Science Club on Sept. 16, Vicky Chuqiao Yang, an SFI Omidyar Fellow and Peters Hurst Scholar, showed off attendees how dynamic mathematic models can help us make sense of this and other puzzles of politics and voting.

“As part of a growing body of SFI work related to belief dynamics, Vicky uses mathematics to model the impact of different learning, decision-making, and group formation rules on emergent, political outcomes,” says Will Tracy, SFI’s Vice President for Applied Complexity. “She also explores predictive models that connect polarization at different levels of political granularity, a topic that is particularly relevant on the eve of the U.S. presidential election.” Following the presentation, SFI External Professor Sean Carroll (Caltech) asked about an interesting interaction between Yang’s current projects on group formation and learning rules. Other participants posed questions and conversed on topics related to Yang’s unpublished research on how “us vs. them” dynamics impact moderate voters, and what happens when the majority of voters “follow the crowd.”

Membership in the Science Club is one of several benefits extended to SFI’s financial supporters at the Emergence Circle level ($1,000) and up. In 2020, meetings moved to a virtual platform, which organizer Alanna Faust, SFI’s Applied Complexity Associate, says has increased engagement well beyond the immediate Santa Fe community. Politics is just one of many topics Science Club members grapple with in direct conversation with leading complexity researchers. Past meetings delved into climate, quantum computing, the science of cities, maladaptive medical beliefs, and other captivating regions where science meets society.

To be part of the conversation and the next scientific advances, go to www.santafe.edu/support. > MORE ON PAGE 3

SFI @SciWri: Researchers unveil massive analysis of online hate & counter-speech

In a special presentation for the online Science-Writers 2020 conference in October, SFI’s Joshua Garland and Mirta Galesic will present the first large-scale analysis of tens of millions of instances of hate and counter hate speech on Twitter. Their preliminary findings, which have not yet been peer-reviewed, suggest that organized movements to counteract hate speech on social media are more effective than stirring out on one’s own.

“I’ve seen this big shift in civil discourse in the last two or three years towards being much more hateful and much more polarized,” says Garland, a mathematician and Applied Complexity Fellow at SFI. “So, for me, an interesting question was: what’s an appropriate response when you’re being a bit bullied or when you’re receiving hate speech online? Do you respond? Do you try to get your friends to help protect you? Do you just block the person?”

To study such questions scientifically, researchers must first have access to a wealth of real-world data on both hate speech and counter-speech, and the ability to distinguish between the two. That data existed, and Garland and collaborator Keyan Chai-Zahedi at the Max Planck Institute in Germany found it in a three-year interaction that played out over German Twitter: As an all-right group took to the platform with hate speech, an organized movement rose up to counter it.

“The beauty of these two groups is they were self-labeling,” explains Mirta Galesic, the team’s social scientist and a resident professor at SFI. She says researchers who study counter-speech usually have to employ hundreds of students to hand-code thousands of posts. But Garland and Chai-Zahedi were able to input the self-labeled posts into a machine-learning algorithm to automate large swaths of the classification. The team also relied on 20-30 human coders to check that the machine classifications matched up with intuition about what registers as hate and counter-speech.

The result was a dataset of unprecedented size that allows the researchers to analyze not just isolated instances of hate and counter-speech, but also compare long-running interactions.

Examples of Twitter conversations (reply trees) with labeled hate (red), counter (blue), and neutral speech (white). (Figure: Garland et al.)

> MORE ON PAGE 5

Have you no humanities?

The sciences and humanities are often characterized as disparate curricula. Scientists quantify the natural world, studying patterns produced by the forces of nature. Humanities scholars dissect texts, stories, and human-made artifacts, studying patterns produced by the forces of culture. As archives of digital texts expand and become widely available, though, digital tools are becoming not only useful but also necessary to advance fields that don’t fall under the STEM umbrella. Experts at SFI say the computational and quantitative tools used by scientists have a potentially transformative role to play in advancing the humanities.

Later this year, supported by a grant from the National Endowment for the Humanities, SFI will launch a new NEH institute called “Foundations and Applications of Humanities Analytics,” to introduce early-career humanities scholars to new ways of studying culture using a wide range of computational tools. Leading researchers in the humanities and sciences will draw on models and ideas in information theory, statistics, and computer science for new insights into the dynamics of literature, history, and the arts.

In its first year, the institute will be offered online to a wide audience through SFI’s Complexity Explorer platform. In years two and three, a smaller group of students will be invited to SFI for an in-person intensive school.

“This institute puts SFI in a position to bridge cultural gaps that don’t need to be there,” says philosopher David Kinney, an Omidyar Fellow at SFI who is leading the new institute. “We want to introduce people who study the humanities to new ways of seeing everything from the experience of reading a poem to the arc of global history,” says SFI External Professor Simon DeDeo, a cognitive scientist at Carnegie Mellon University who is co-leading the institute with Kinney and Carrie Cowan, SFI’s Director for Education.

Recognizing the opportunity to introduce complexity science to a new audience, Cowan enlisted...
The impact of the pandemic has been highly uneven sector-by-sector and state-by-state. In Pennsylvania, the Accommodation and Food Services industry lost 29.2% of jobs, Manufactur- ing 7.0%, and Health Care and Social Assistance 6.7%. The majority of layoffs occurred in April, with only 4% of layoffs happening in May. Leisure and Hospitality experienced the largest reduction in employment with the Accommo- dation and Food Services industry losing 7.0% (5.3 million jobs), and the Arts, Entertainment and Recreation industry 9.1% ($700,000 jobs) as of August. Hawaii has the most remote state from the mass of infections — is down 24.9% (with a loss of 61,000 jobs).

The economic effects of the pandemic have been compounded by challenges to both physical and psychological wellbeing. The Implications of Covid-19 for Mental Health and Substance Use” Nirmuta Pandula a policy ana- lyst at the Commonwealth Fund shares work with colleagues at the Kaiser Family Foundation and her colleagues found that “More than one in three adults in the US have reported symptoms of anxiety or depressive disorder during the pan- demic (weekly average for May 35.6%, weekly average for June 36.3%, weekly average for July 40.4%).” They describe a related study in which 13.3% of adults report substance use a means to manage stress related to the coronavirus.

How early ‘infotech’ fueled collective computation & growth

In the last 10,000 years, the human species has gone from a population of perhaps one million people — almost all living as mobile hunter-gatherers — to close to 8 billion. The ancient civilizations at the beginning of this rapid expansion across the globe differed in many ways. Each had its own culture, religion and system of government. But one characteristic all tended to share was a reliance on innovations in collective information processing to grow beyond a certain size and scale, according to research published in Nature Communications earlier this year by Santa Fe Institute’s External Professor Tim Kohler (Washington State University), and their colleagues. (See also “Size and sleep,” below.)

A sweeping Aeon essay told about the origin story of origins of life research, with perspectives from Professor Chris Krems, External Professor Eric Smith, External Professor Sara Walker, and President David Krakauer. For Smithsonian, FSI Postdoctoral Fellow Natalie Grofstencom mented on the requirements for massapogampera, in an article about research on recent findings that bacterial chaps sur- vived for three years on the outer surface of the International Space Station.

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To delve further into this intriguing pattern in history, Wolpert and Kohler have shared his perspective on the eco- nomic effects of the pandemic. In a data visualization titled “The Risk That Students Could Arrive at School With The Coronavirus,” The New York Times featured work by FSI Professor Michael Lachmann, and by Spencer Fox and External Professor Laurens Ancel Meyers at the University of Texas Austin. It built on Lachmann and Fox’s essay for SFI’s “Transmission” series, add- ing a heat-map and county-level cases to show how many infected students & person- nel would arrive in schools of dif ferent sizes.

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A new journal for collective intelligence

Since the 1980s, the Santa Fe Institute has championed the investigation of collective behavior and intelligence in diverse systems, from cell tissues to animal societies to human organizations and robot swarms. This fall, two of SFI’s faculty will help launch Collective Intelligence, a new transdisciplinary online journal devoted entirely to this fruitful area of research.

Collective Intelligence will welcome contributions from computer science, physics, biology, mathematics, economics, psychology, sociology, philosophy, anthropology, and political science, as well as from non-academic practitioners.

SFI Professor Jessica Flack is one of the journal’s four Founding Editors, along with SFI External Professor Scott Page at the University of Michigan, Panos Ipeirotis at New York University and Geoff Mulgan at University College London.

The online-only journal will be co-owned by the Association for Computing Machinery (ACM) and SAGE Publishing with support from and in collaboration with the innovation foundation Nesta.

On-line hate page from 1

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"Unfettered Journey" (Chikagan Press, 2020) by SFI Trustee Gary F. Bengier is “an adventure for the mind on many levels,” according to SFI External Professor and Science Board member Rassia D’Souza (UC Davis). The speculative fiction novel follows protagonist Joe Denkensmith through a journey in a realistic near-future world, one that seems a natural extension of today. With a computer chip embedded directly into their brains — an evolution of our cell phones — people struggle to keep up with Moore’s law as their biological “wetware” tags behind at the pace of just sixty bits per second. The hard-science novel envisions a cyborg vision, but instead is populated by strong characters dealing with issues we face today — privacy, an economic system lacking jobs due to automation, and social injustice.

Bengier writes as a philosopher and technologist who has spent 20 years studying astrophysics and philosophy and writing speculative fiction, following a career in Silicon Valley.

New books by SFI authors

Calling Bullshit: The Art of Skepticism in a Data-Driven World
(Random House, 2020) by former SFI External Professor Carl T. Bergstrom (University of Washington) andevin D. West (University of Washington) explores how misinformation has leached into every corner of society, from misleading statistics and gaslighting politicians to press release-driven science. In a world where unmanaged bullshit abounds, the authors call for a healthy dose of skepticism in science, media, and everyday life. Bergstrom, who is fascinated by network phenomena and has studied how diseases spread over networks, takes a similar approach to studying the spread of bullshit over social media.

Unsolved Problems in Ecology
(Princeton University Press, 2020) is an essay collection curated by External Professor Andrew Dobson (Princeton University) and External Professor David Tilman (University of Minnesota). From the social systems of songbirds to the ecosystems of disease, the topics that inspire some of today’s top ecologists reflect a surprisingly diverse array of scientific questions. The essays in this collection consider unanswered questions about scaling, population biology, ecosystems and communities, collective behavior, and conservation, among other themes. From graduate students seeking new areas of study to established researchers inspired by fresh ideas, this book is ideal for ecologists of all stripes.

“If you go back to Aristotle, he was interested in things still studied at the Santa Fe Institute and still mentioned in this book,” Dobson says. “But now we have a more formal scientific framework in which to think about them.”

ECOLOGY FOR PANDEMIC PREVENTION

What would it cost to prevent the pandemic from happening again? In a policy forum article for the journal Science, ecologist and SFI External Professor Andrew Dobson (Princeton University) and co-authors estimate that $260 billion over ten years — about 2% of Covid-19 economic damage — could substantially decrease humanity’s risk of contracting and spreading a pandemic viral pathogen from wildlife. The researchers’ suggestions for mitigating pandemic risk include activities such as stepping up the monitoring and regulation of the wildlife trade, and promoting the deforestation and fragmenting of tropical forests.

“There is substantial evidence that the rate of emergence of novel diseases is increasing and that their economic impacts are also increasing,” the researchers write. “Positioning a global strategy to reduce pandemic risk would lead to continued coining costs.”

LEADERSHIP FOR A SUSTAINABLE FUTURE

Sustainability science focuses on ways to meet the needs of the present without jeopardizing the future. It’s a deep and complex area of research that encompasses many systems, from the environment to economics, and draws on the strengths of a spectrum of disciplines that meet at the intersection of nature and culture.

In the journal Sustainability Science, leaders of sustainability organizations including Christopher Boone, Dean of Arizona State University’s School of Sustainability, and Jennifer Dunne, SFI’s VP for Science, report on valuable lessons they’ve distilled from their own successful leadership experiences. The work describes pathways to success for tomorrow’s organizations and highlights five areas that can contribute to success, including intellectual resources, institutional policies, financial security, a physical space, and governing boards. Together, the authors propose, these resources can form a foundation for interdisciplinary and transdisciplinary researchers to identify solutions to complex problems.

Read the paper at doi.org/10.1007/s11625-020-00823-9

LITTLE SETS OF NODES STICK TOGETHER

Within real-world networks, groups of nodes often have similar patterns of connections. People in a social network may have many friends within a group/community but few outside it. While there are multiple ways to divide the network into communities that do a comparable job summarizing its structure, those divisions can look drastically different.

In a recent Physical Review E paper, network scientists Maria Riolo, SFI Omidyar Fellow, and External Professor Mark Newman (University of Michigan) reported that while working on a community detection algorithm that sampled possible divisions of the network, they noticed little sets of nodes often stick together — even if that set of nodes was never identified as a separate community. “In many cases, the various good divisions of the network could be assembled using a small number of ‘building blocks’ of nodes that rarely get split up,” Riolo says.

Read the paper at doi.org/10.1010/PhysRevE.101.052306

PREDICTING LINKS IN ONLINE NETWORKS

“Networks are a powerful tool for modeling complex biological and social systems. However, most networks are incomplete, and missing connections can negatively affect scientific analyses,” write External Professor Aaron Clauset (CU Boulder) and coauthors in a new study published in Proceedings of the National Academy of Sciences. After applying top link prediction algorithms to 500 real-world networks, the researchers show that social networks are easier to predict than biological ones, and that no link prediction algorithm is best or worst overall. The techniques build on SFI Professor David Wolpert’s famous “no free lunch” theorem for machine learning, which proves that if a machine-learning algorithm excels at solving one type of problem, it has to fail at others.

Read the paper at doi.org/10.1073/pnas.1914950117

ARE SCIENTIFIC PAPERS TOO MAINSTREAM?

It’s possible to determine whether scientific papers are out-of-the-box, mainstream, or interdisciplinary. From the papers authors cite, you can infer what they read and which “crowd” or “specialty” they belong to. In a recent PLoS ONE paper, SFI External Professor Stefan Thurner (Complexity Science Hub Vienna) and coauthors present a bibliographic coupling network to visualize the position of every paper with respect to these crowds.

If your paper falls within the center of a cluster, it’s mainstream. If it’s at the surface of a cluster, it’s an out-of-the-box paper. If it’s between clusters, it’s interdisciplinary. “Our measures allow us to see general trends during the past 100 years within physics literature,” says Thurner. “Surprising-ly, we found a trend across the past decade toward more mainstream papers and less willingness to publish interdisciplinary and out-of-the-box papers — at least within the physics domain.”

Read the paper at doi.org/10.1371/journal.pone.0230325