Physics meets democracy in this modeling study

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A study in the journal *Physica A* leverages concepts from physics to model how campaign strategies influence the opinions of an electorate in a two-party system.

Researchers created a numerical model that describes how external influences, modeled as a random field, shift the views of potential voters as they interact with each other in different political environments.

The model accounts for the behavior of conformists (people whose views align with the views of the majority in a social network); contrarians (people whose views oppose the views of the majority); and inflexibles (people who will not change their opinions).

"The interplay between these behaviors allows us to create electorates with diverse behaviors interacting in environments with different levels of dominance by political parties," says first author Mukesh Tiwari, Ph.D., associate professor at the Dhirubhai Ambani Institute of Information and Communication Technology.

"We are able to model the behavior and conflicts of democracies, and capture different types of behavior that we see in elections," says senior author Surajit Sen, Ph.D., professor of physics in the University at Buffalo College of Arts and Sciences.

Sen and Tiwari conducted the study with Xiguang Yang, a former UB physics student. Jacob Neiheisel, Ph.D., associate professor of political science at UB, provided feedback to the team, but was not an author of the research.

The model described in the paper has broad similarities to the random field Ising model, and "is inspired by models of simple magnetic systems," Sen says.

The team used this model to explore a variety of scenarios involving different types of political environments and electorates.

Among key findings, as the authors write in the abstract: "In an electorate with only conformist agents, short-duration high-impact campaigns are highly effective. … In electorates with both conformist and contrarian agents and varying level(s) of dominance due to local factors, short-term campaigns are effective only in the case of fragile dominance of a single party. Strong local dominance is relatively difficult to influence and long-term campaigns with strategies aimed to impact local level politics are seen to be more effective."

"I think it's exciting that physicists are thinking about social dynamics. I love the big tent," Neiheisel says, noting that one advantage of modeling is that it could enable researchers to explore how opinions might change over many election cycles—the type of longitudinal data that's very difficult to collect.

Mathematical modeling has some limitations: "The real world is messy, and I think we should embrace that to the extent that we can, and models don't capture all of this messiness," Neiheisel says.

But Neiheisel was excited when the physicists approached him to talk about the new paper. He says the model provides "an interesting window" into processes associated with opinion dynamics and campaign effects, accurately capturing a number of effects in a "neat way."

"The complex dynamics of strongly interacting, nonlinear and disordered systems have been a topic of interest for a long time," Tiwari says.

"There is a lot of merit in studying social systems through mathematical and computational models. These models provide insight into short- and long-term behavior. However, such endeavors can only be successful when social scientists and physicists come together to collaborate."

More information: Mukesh Tiwari et al, Modeling the nonlinear effects of opinion kinematics in elections: A simple Ising model with random field based study, *Physica A: Statistical Mechanics and its Applications* (2021). DOI: 10.1016/j.physa.2021.126287

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