Chaos at the polls: mathematicians proves that group decisions can be impossible to predict

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CHAOS AT THE POLLS: MATHEMATICIANS PROVE THAT GROUP DECISIONS CAN BE IMPOSSIBLE TO PREDICT

For several years, some political scientists and others have argued that group decisions such as elections are impossible to anticipate even if the preferences of the voters are well established and the decision-making rules are set.

Now there's a mathematical proof to back that proposition.

David Meyer of the University of California, San Diego and Thad Brown of the University of Missouri studied the well established phenomenon that says that whenever a group tries to choose among three or more options, its decision will cycle endlessly from one choice to another.

Mathematician Meyer and political scientist Brown looked at the phenomenon from a new angle. What if you knew how the voters would cast their ballots and the voting rules (majority rules, for example) were established, but the order in which the choices were presented changed? Meyer and Brown proved through a mathematical model that if the group's options are presented in different orders even when their preferences are fixed the result will become unpredictable, even "chaotic." Even if the order of choices is only slightly altered, their proof showed, the results will be completely unpredictable several elections down the line.

"If each member of a committee, for example, has his or her own preference for allocating a budget among two programs, the outcome will depend crucially on the order in which the alternative allocations are proposed," said Meyer, a member of UCSD's Project in Geometry and Physics and the independent Center for Social Computation and Institute for Physical Sciences. "Thus the person who sets the agenda the chairman can determine the outcome by changing the order of the alternatives."

"While some political scientists have suggested that there was a connection between the presence of these voting cycles and chaotic behavior, that was just a semantic observation, there was no precise statement of what that meant, nor a precise proof that that was the case. What we've done is make a precise statement and a precise proof."

While Meyer says this chaotic behavior is less evident in the United States because there are several mechanisms in place to dampen its effect, it is more relevant in countries that experience frequent changes in government.

"In this kind of cyclic, chaotic behavior, if one little thing changes," Meyer said, "then who knows what government is going to be in its place?"

Meyer and Brown's study, "Statistical Mechanics of Voting," appears in a recent edition of Physical Review Letters.

While much more work lies ahead to develop models that directly apply these studies to human politics, there is a more immediate application in the fields of computer science and simulation for developing "computerized agents," software-based mechanisms that can scan the Internet for information or simulate the outcome of a real-world scenario to aid in decision making. Such agents have been used, for example, to establish price ratios by simulating buying and selling commodities.

"If you're talking about people, there can be a huge debate about whether people are rational or not," said Meyer, "but if you're talking about software agents, they're just little bits of code that are programmed and they have exact sets of preferences, so if you're using them to search the web or gather information or simulate some social process, then there's no question that these results apply."

To help guide their research, Meyer and Brown looked at the behavior of a string of atoms in magnetic materials. By comparing the logic of the decision making process to the behavior of the string of atoms, Meyer and Brown demonstrated that the decision process is often unpredictable.

"We used the string as more than an analogy, it was a precise one-to-one correspondence," said Meyer. "It told us which questions to ask."

In addition to voting behavior, the field of chaos has taken hold in science because of its applications to communication engineering, chemistry, cardiology and psychiatry. Scientists have sought the answers that lie within chaotic situations, found in areas as diverse as chemical reactions inside power plants, weather patterns in the atmosphere and the ocean and even how dolphins are able to slice through the seas by vibrating their skin.

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