ELECTION SELECTION

Are we using the worst voting procedure?

BY ERICA KLARREICH

As Election Day approaches, voters must be feeling a sense of déjà vu. With recent reports of malfunctioning voter machines and uncounted votes during primaries in Florida, Maryland, and elsewhere, reformers are once again clamoring for extensive changes. But while attention is focused on these familiar irregularities, a much more serious problem is being neglected: the fundamental flaws of the voting procedure itself, say various researchers who study voting.

Nearly all political elections in the United States are plurality votes, in which each voter selects a single candidate, and the candidate with the most votes wins. Yet voting theorists argue that plurality voting is one of the worst of all possible choices. "It's a terrible system," says Alexander Tabarrok, an economist at George Mason University in Fairfax, Va., and director of research for the Independent Institute in Oakland, Calif. "Almost anything looks good compared to it."

Other voting systems abound. One alternative is the instant runoff, a procedure used in Australia and Ireland that eliminates candidates one at a time from rankings provided by each voter. Another is the Borda count, a point system devised by the 18th-century French mathematician Jean Charles Borda, which is now used to rank college football and basketball teams. A third is approval voting, used by several scientific societies, in which participants may cast votes for as many of the candidates as they choose.

Unlike these procedures, the plurality system looks only at a voter's top choice. By ignoring how voters might rank the other candidates, it opens the floodgates to unsettling, paradoxical results.

In races with two strong candidates, plurality voting is vulnerable to the third-party spoiler—a weaker candidate who splits some of the vote with one of the major candidates. For instance, in the hotly contested 2000 U.S. presidential race, Republican George W. Bush won the state of Florida—and, consequently, the presidency—by just a few hundred votes over Al Gore, the Democratic candidate. Green Party candidate Ralph Nader won 95,000 votes in Florida, and polls suggest that for most Nader voters, Gore was their second choice. Thus, if the race had been a head-to-head contest between Bush and Gore, Florida voters probably would have chosen Gore by a substantial margin. Should Nader have withdrawn from the race, as many angry Democrats asserted? Certainly not, says mathematician Donald Saari of the University of California, Irvine. "We live in a democracy, and anyone should be able to run for any office," he says. "The problem was the bad design of the election."

Mathematics can shed light on questions about how well different voting procedures capture the will of the voters, Saari says. In ongoing work, he has been using tools from chaos theory to identify just which scenarios of voter preferences will give rise to disturbing election outcomes. "With the muscle power of mathematics, we can address these questions and finally get some results," he says.

SINGULAR PLURALITY In elections with only two candidates, plurality voting works just fine, since the winner is guaranteed to have been the top choice of more than half the voters. But as soon as three or more candidates are on the ballot, the system can run into trouble. ·

In races with a large slate of candidates, plurality voting dilutes voter preferences, creating the possibility of electing a leader whom the vast majority of voters despise. In the French election last April, with 16 candidates on the ballot, extreme right-wing candidate Jean-Marie le Pen—widely accused of racism and anti-Semitism—managed to place second with just 17 percent of the vote. He then advanced to a runoff against the top candidate, incumbent President Jacques Chirac. Political analysts scrambled to explain le Pen's success, putting it down to voter disenchantment and a surge in right-wing fervor across Europe. But the real reason, voting theorists say, is that the plurality vote distorted the preferences of the voters.

"The fact that le Pen was in the runoff had nothing to do with what the people wanted," Saari says. The runoff election, in which Chirac trounced le Pen with 82 percent of the vote, suggests that while le Pen was at the top of a few voters' lists, he was near the bottom of many more. "There is no question that under almost any other system, le Pen would not have made it to the runoff," says Steven Brams, a political scientist at New York University.

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>
> —ALEXANDER TABARROK

If it weren't for the plurality system, Abraham Lincoln might never have become president, Tabarrok says. In the four-candidate 1860 election, Lincoln was a polarizing figure, popular with many Northerners but abhorred by many Southerners. Stephen Douglas, Lincoln's closest competitor, was more broadly popular, and although he didn't get as many first-place rankings as Lincoln did, he was nearly everyone's second choice, historians hold. In 1999, Tabarrok and Lee Spector, an economist at Ball State University in Muncie, Ind., calculated that if almost any other voting system had been used, history books would refer to President Douglas, not President Lincoln. "On paper, Lincoln's victory looks overwhelming, but he actually didn't have broad-based support," Tabarrok says. With Lincoln now a folk hero, the result of that election might seem good in retrospect. But that's a separate matter from whether the voters actually preferred Lincoln on Election Day, 1860.

History is full of similar situations, Tabarrok says. "One thing we've discovered is how radically the outcome of an election can change by even a small change in the voting system," he says.

In some elections, in fact, any one of the candidates can be the winner, depending on what voting system is being used (see box, page 281). Saari has calculated that in three-candidate elections, depending on the voting system, more than two-thirds of all possible configurations of voters' preferences will yield different outcomes.

NO ONE'S PERFECT Is there a best voting procedure? In 1952, Kenneth Arrow, a professor emeritus of economics at Stanford University in Palo Alto, Calif., proved that no voting system is completely free from counterintuitive outcomes. Arrow looked at voting systems that satisfy two harmless-sounding properties. First, if everyone prefers candidate A to candidate B, then A should be ranked higher than B. Second, voters' opinions about candidate C shouldn't affect whether A beats B—after all, if you prefer coffee to tea, finding out that hot chocolate is available shouldn't suddenly make you prefer tea to coffee. These sound like reasonable restrictions, yet Arrow proved that the only voting system that always satisfies them is a dictatorship, where a single person's preferences determine the outcome.

The paradoxical behavior Arrow studied crops up all the time. Saari points to the 2000 Bush-Gore-Nader race in Florida. "It's a beautiful example of Arrow's theorem at work," Saari says.

While Arrow's theorem shows that no system is flawless, many capture voter preferences more effectively than plurality voting does. For instance, the paradoxical outcome of the Florida race might have been avoided under the instant runoff, which is advocated by the Center for Voting and Democracy in Takoma Park, Md. In that system, voters rank the candidates, then the candidate with the fewest first-place votes is dropped. That candidate is erased from the voters' preference lists, and ballots of voters who had placed him first are converted into votes for their second choice. From the remaining candidates, once again the one with the fewest first-place votes is dropped. When only two candidates remain, the one with more top votes wins. Since voters communicate their entire ranking when they vote, there's no need to hold repeated elections. In Florida, Nader would probably have been eliminated in an instant runoff, most of his votes converted into votes for Gore.

An instant runoff also reduces the dangers inherent in an election with many candidates. In the French election, most of the voters who selected one of the weaker candidates probably preferred Chirac or the then–prime minister, Socialist Lionel Jospin, to le Pen. Then in an instant runoff, as candidates were eliminated, their votes would have gone to Chirac and Jospin.
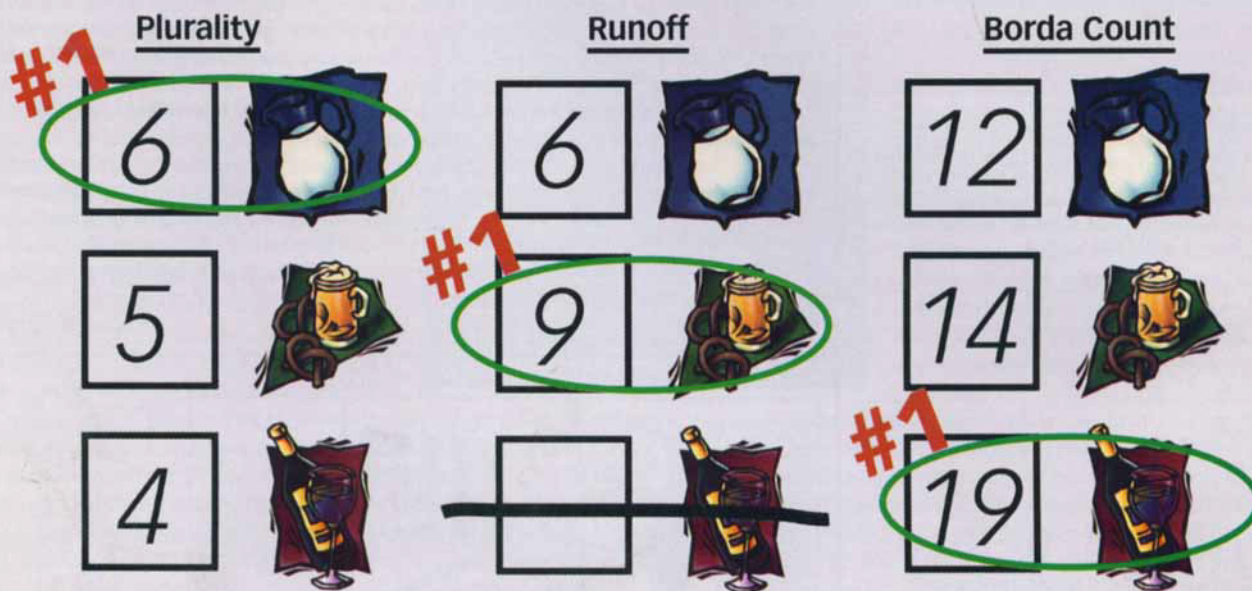
Instant-runoff voting could make campaigns both more civil and more issue oriented, suggests Terry Bouricius, New England regional director for the Center for Voting and Democracy. "To win, you have to be highly ranked by a majority of voters, and you also have to appeal to a bunch of voters strongly enough to get their first-place votes," he says. "So, you have to distinguish yourself from the other candidates but also build coalitions."

CHAOS IN THE POLLING PLACE Whatever its potential benefits, instant-runoff voting is prone to one of voting theory's most bewildering paradoxes. If a candidate is in the lead during an election season, making a great speech that attracts even more supporters to his cause shouldn't make him lose. But in the instant-runoff system, it can. Suppose, for example, that 35 percent of voters prefer A first, B second, and C third; 33 percent prefer B first, C second, and A third; and 32 percent prefer C first, A second, and B third. In an instant runoff, C will be eliminated, leaving A and B to face each other. A scoops up C's first-place votes, winning a resounding 67 percent to 33 percent victory over B. But suppose A makes such an inspiring speech that some voters who liked B best move A into first place, so now 37 percent rank the candidates as A-B-C, 31 percent as B-C-A, and 32 percent as C-A-B. Now, A faces C in the runoff, not B. The votes that ranked B first become votes for C, and C beats A, 63 percent to 37 percent.

And the winner is?

Different voting methods can produce very different results

In some elections, any candidate can win, depending on which voting system is used, says Donald Saari of the University of California, Irvine. Consider 15 people deciding what beverage to serve at a party. Six prefer milk first, wine second, and beer third; five prefer beer first, wine second, and milk third; and four prefer wine first, beer second, and milk third. In a plurality vote, milk is the clear winner. But if the group decides instead to hold a runoff election between the two top contenders—milk and beer—then beer wins, since nine people prefer it over milk. And if the group awards two points to a drink each time a voter ranks it first and one point each time a voter ranks it second, suddenly wine is the winner. Although this is a concocted example, it's not an anomaly, Saari insists. —E.K.

Plurality	Runoff	Borda Count
#1 6 (milk)	6 (milk)	12 (milk)
5 (beer)	#1 9 (beer)	14 (beer)
4 (wine)	—	#1 19 (wine)

In an article to be published early next year in the *Journal of Economic Theory*, Saari has catalogued scenarios that give rise to this type of paradox. It can occur in any voting procedure with more than one round, he has found, but never in one-round procedures.

Saari's result draws on a seemingly unrelated field of mathematics: chaos theory, which studies physical systems, such as the weather, in which tiny changes in the starting conditions can have drastic repercussions. Chaos researchers look for points at which the systems' parameters stabilize momentarily and then change direction, since only near those points can a small change produce dramatic effects. Saari realized that in voting theory, only when an election is nearly tied does a small change in voter preferences swing the election in a new direction. By looking at arrangements of ties, Saari has classified the possible paradoxical outcomes for a wide range of procedures.

Saari argues that the way to identify the best voting procedure is to consider which scenarios should result in ties. If three voters have what researchers call cyclic preferences—one prefers A-B-C, one B-C-A, one C-A-B—there should be a tie, he says. Likewise, if two voters have exactly opposite preferences—one prefers A-B-C, say, and the other, C-B-A—their votes should cancel. The only common voting procedure that would give a tie to both of these cases is the Borda count, which gives two points to a voter's top choice and one point to his second choice in a three-candidate election.

Like the instant runoff, the Borda count gives weight to a voter's entire preference ranking. If the Borda count had been used, second-place votes would probably have tipped the 2000 race in Gore's favor, Saari and Brams say. And in France, it's highly unlikely that le Pen would have come in second, Saari says.

Saari has shown that the Borda count is much less prone to the kinds of paradoxes that Arrow studied than most other systems are. Using ideas from chaos theory, Saari has found, for instance, that plurality voting in a six-candidate election gives rise to 10^{50} times as many paradoxical situations as the Borda count does.

APPROVE OR DISAPPROVE Not all the researchers are fans of the Borda count, however. Brams objects that it forces voters to rank all the candidates, even when there are some about whom they have no strong opinion, potentially leading to outcomes that don't really reflect voter preferences.

Brams prefers approval voting, in which people vote for as many candidates as they like. Approval voting, Brams says, gives voters more sovereignty by enabling them to express the intensity of their preferences: a voter who strongly favors one candidate can vote for just that candidate, while a voter who can't stand one candidate can vote for everyone else. A voter with more- moderate views can vote for any number of candidates between these two extremes.

It's hard to predict the outcome of an approval vote since voters' choices depend on where they draw the line between approval and disapproval. But Brams argues that approval voting would significantly alter voter behavior in many elections. In the 2000 presidential race, for instance, approval voting would have enabled Nader supporters to vote for him and also for one of the two stronger contenders.

While the instant runoff, Borda count, and approval voting each has drawbacks, most voting theorists would be happy to replace plurality voting with any one of them. "All methods that allow voters to express their views fully rather than to single out one candidate convey a much more nuanced message to the political machine," says Hannu Nurmi, a political scientist at the University of Turku in Finland.

The fact that U.S. elections have always been plurality votes is no reason to resist change, Tabarrok says. "We chose our voting systems before voting theory existed," he says. "I don't think any voting theorist would choose plurality rule today."

The real lesson to draw from recent election anomalies, voting theorists say, is that citizens should think carefully not just about how well the election machinery counts up the votes but also about how they want the votes to count. ∎

Maynard Frank Wolfe

"Used for describing any very complicated invention, machine, scheme, etc., laboriously contrived to perform a seemingly simple operation." That's how *Webster's New World Dictionary* defines *Rube Goldberg*. To most, the words also convey a spirit of wild originality with a twist of wry humor. The man whose name inspired the description, a.k.a. Reuben Lucius Goldberg, was a Pulitzer Prize–winning cartoonist whose comics and editorials appeared in as many as a thousand newspapers annually from 1904 through the late 1960s. Yet what has earned Goldberg a coveted place in the collective lexicon and imagination is his inventions—some 2,000 intricate contraptions devised to carry out mundane tasks while brilliantly illuminating the consequences of hyper-complication.

Celebrating the artist and his legacy, *Rube Goldberg: Inventions* brings together the best of Goldberg's elaborate, ludicrous creations and a charming biography. Showcasing more than 200 unique "invention machines," the book also offers a glimpse into a surprisingly visionary mind. After all, Goldberg wrote hit songs and stories and was, in succession, a star in vaudeville, motion pictures, newsreels, radio, and, finally, television.

Rube Goldberg: Inventions spotlights the cartoonist's most outlandish concoctions for accomplishing the most basic acts. The creations are grouped as:

Eating & drinking, from a pioneering, economical automatic dishwasher (tomcat required) to an acrobat-powered pulley for securing food at a buffet supper without battling hungry mobs.

Good grooming, from an amazing nonchemical way for balding men to grow hair (or, at least, borrow a few strands) to an invigorating self-scrubbing bath brush (monkey not included).

Travel and work, from a handy, changeable electronic sign to spare drivers the strain of shouting expletives at other drivers to a killer (literally) stock-market share-price indicator.

Simon and Schuster, 2000, 191 pages, 10 ¼" x 8 ¼", hardcover, $25.00   —Simon and Schuster

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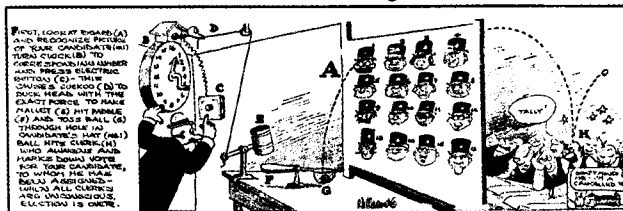
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