SEVENTEEN

THERE IS NO SUCH THING AS PUBLIC OPINION

You're a good citizen of the United States of America, or some other more or less liberal democracy. Or maybe you're even an elected official. You think the government should, when possible, respect the people's will. So you want to know: What do the people want?

Sometimes you can poll the hell out of the people and it's still tough to be sure. For example: do Americans want small government? Well, sure we do—we say so constantly. In a January 2011 CBS News poll, 77% of respondents said cutting spending was the best way to handle the federal budget deficit, against only 9% who preferred raising taxes. That result isn't just a product of the current austerity vogue—year in, year out, the American people would rather cut government programs than pay more taxes.

But *which* government programs? That's where things get sticky. It turns out the things the U.S. government spends money on are things people kind of like. A Pew Research poll from February 2011 asked Americans about thirteen categories of government spending: in eleven of those categories, deficit or no deficit, more people wanted to increase spending than dial it down. Only foreign aid and unemployment insurance—which, combined, accounted for under 5% of 2010 spending—got

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the ax. That, too, agrees with years of data; the average American is always eager to slash foreign aid, occasionally tolerant of cuts to welfare or defense, and pretty gung ho for increased spending on every single other program our taxes fund.

Oh, yeah, and we want small government.

At the state level, the inconsistency is just as bad. Respondents to the Pew poll overwhelmingly favored a combination of cutting programs and raising taxes to balance state budgets. Next question: What about cutting funding for education, health care, transportation, or pensions? Or raising sales taxes, state income tax, or taxes on business? Not a single option drew majority support.

"The most plausible reading of this data is that the public wants a free lunch," economist Bryan Caplan wrote. "They hope to spend less on government without touching any of its main functions." Nobel Prize–winning economist Paul Krugman: "People want spending cut, but are opposed to cuts in anything except foreign aid. . . . The conclusion is inescapable: Republicans have a mandate to repeal the laws of arithmetic." The summary of a February 2011 Harris poll on the budget describes the self-negating public attitude toward the budget more colorfully: "Many people seem to want to cut down the forest but to keep the trees." It's an unflattering portrait of the American public. Either we are babies, unable to grasp that budget cuts will inevitably reduce funding to programs we support; or we are mulish, irrational children, who understand the math but refuse to accept it.
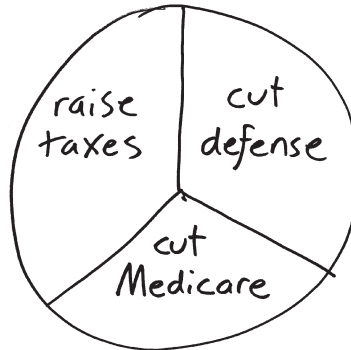
How are you supposed to know what the public wants when the public makes no sense?

RATIONAL PEOPLE, IRRATIONAL COUNTRIES

Let me stick up for the American people on this one, with the help of a word problem.

Suppose a third of the electorate thinks we should address the deficit by raising taxes without cutting spending; another third thinks we should cut defense spending; and the rest think we should drastically cut Medicare benefits.

Two out of three people want to cut spending; so in a poll that asks "Should we cut spending or raise taxes?" the cutters are going to win by a massive 67–33 margin.

So what to cut? If you ask, "Should we cut the defense budget?" you'll get a resounding no: two-thirds of voters—the tax raisers joined by the Medicare cutters—want defense to keep its budget. And "Should we cut Medicare?" loses by the same amount.

That's the familiar self-contradicting position we see in polls: We want to cut! But we also want each program to keep all its funding! How did we get to this impasse? Not because the voters are stupid or delusional. *Each voter has a perfectly rational, coherent political stance.* But in the aggregate, their position is nonsensical.

When you dig past the front-line numbers of the budget polls, you see that the word problem isn't so far from the truth. Only 47% of Americans believed balancing the budget would require cutting programs that helped people like them. Just 38% agreed that there were worthwhile programs that would need to be cut. In other words: the infantile "average American," who wants to cut spending but demands to keep every single program, doesn't exist. The average American thinks there are plenty of non-worthwhile federal programs that are wasting our money and is ready and willing to put them on the chopping block to make ends meet. The problem is, there's no consensus on which programs are the worthless ones. In large part, that's because most Americans think the programs that benefit them personally are the ones that must, at all costs, be preserved. (I didn't say we weren't selfish, I just said we weren't stupid!)

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The "majority rules" system is simple and elegant and feels fair, but it's at its best when deciding between just two options. Any more than two, and contradictions start to seep into the majority's preferences. As I write this, Americans are sharply divided over President Obama's signature domestic policy accomplishment, the Affordable Care Act. In an October 2010 poll of likely voters, 52% of respondents said they opposed the law, while only 41% supported it. Bad news for Obama? Not once you break down the numbers. Outright repeal of health care reform was favored by 37%, with another 10% saying the law should be weakened; but 15% preferred to leave it as is, and 36% said the ACA should be expanded to change the current health care system *more* than it currently does. That suggests that many of the law's opponents are to Obama's left, not his right. There are (at least) three choices here: leave the health care law alone, kill it, or make it stronger. And each of the three choices is opposed by most Americans.[*]

The incoherence of the majority creates plentiful opportunities to mislead. Here's how Fox News might report the poll results above:

Majority of Americans oppose Obamacare!

And this is how it might look on MSNBC:

Majority of Americans want to preserve or strengthen Obamacare!

These two headlines tell very different stories about public opinion. Annoyingly enough, both are true.

But both are incomplete. The poll watcher who aspires not to be wrong has to test each of the poll's options, to see whether it might break down into different-colored pieces. Fifty-six percent of the population disapproves of President Obama's policy in the Middle East? That impressive figure might include people from both the no-blood-for-oil left and the nuke-'em-all right, with a few Pat Buchananists and devoted libertarians in the mix. By itself, it tells us just about nothing about what the people really want.

Elections might seem an easier case. A pollster presents you with a simple binary choice, the same one you'll face at the ballot box: candidate 1, or candidate 2?

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* Added in press: A CNN/ORC poll in May 2013 found that 43% favored the ACA, while 35% said it was too liberal and 16% said it wasn't liberal enough.

But sometimes there are more than two. In the 1992 presidential election, Bill Clinton drew 43% of the popular vote, ahead of George H. W. Bush with 38% and H. Ross Perot at 19%. To put it another way: a majority of voters (57%) thought Bill Clinton shouldn't be president. And a majority of voters (62%) thought George Bush shouldn't be president. And a really big majority of voters (81%) thought Ross Perot shouldn't be president. Not all those majorities can be satisfied at once; one of the majorities won't get to rule.

That doesn't seem like such a terrible problem—you can always award the presidency to the candidate with the highest vote tally, which, apart from Electoral College issues, is what the American electoral system does.

But suppose the 19% of voters who went with Perot broke down into 13% who thought Bush was the second-best choice and Clinton the worst of the bunch,* and 6% who thought Clinton was the better of the two major-party candidates. Then if you asked voters directly whether they preferred to have Bush or Clinton as president, 51%, a majority, would pick Bush. In that case, do you still think the public wants Clinton in the White House? Or is Bush, who most people preferred to Clinton, the people's choice? Why should the electorate's feelings about H. Ross Perot affect whether Bush or Clinton gets to be president?

I think the right answer is that there are no answers. Public opinion doesn't exist. More precisely, it exists sometimes, concerning matters about which there's a clear majority view. Safe to say it's the public's opinion that terrorism is bad and *The Big Bang Theory* is a great show. But cutting the deficit is a different story. The majority preferences don't meld into a definitive stance.

If there's no such thing as the public opinion, what's an elected official to do? The simplest answer: when there's no coherent message from the people, do whatever you want. As we've seen, simple logic demands that you'll sometimes be acting contrary to the will of the majority. If you're a mediocre politician, this is where you point out that the polling data contradicts itself. If you're a good politician, this is where you say, "I was elected to lead—not to watch the polls."

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* People argue to this day about whether Perot took more votes from Bush or from Clinton, or whether the Perot voters would have just sat it out rather than vote for either of the major-party candidates.

And if you're a master politician, you figure out ways to turn the incoherence of public opinion to your advantage. In that February 2011 Pew poll, only 31% of respondents supported decreasing spending on transportation, and another 31% supported cutting funding for schools; but only 41% supported a tax hike on local businesses to pay for it all. In other words, each of the main options for cutting the state's deficit was opposed by a majority of voters. Which choice should the governor pick to minimize the political cost? The answer: don't pick one, pick two. The speech goes like this:

"I pledge not to raise taxes a single cent. I will give municipalities the tools they need to deliver top-quality public services at less cost to the taxpayers."

Now each locality, supplied with less revenue by the state, has to decide on its own between the remaining two options: cut roads or cut schools. See the genius here? The governor has specifically excluded raising taxes, the most popular of the three options, yet his firm stand has majority support: 59% of voters agree with the governor that taxes shouldn't rise. Pity the mayor or county executive who has to swing the axe. That poor sap has no choice but to execute a policy most voters won't like, and suffers the consequence while the governor sits pretty. In the budget game, as in so many others, playing first can be a big advantage.

VILLAINS OFTEN DESERVE WHIPPING, AND PERHAPS HAVING THEIR EARS CUT OFF

Is it wrong to execute mentally retarded prisoners? That sounds like an abstract ethical question, but it was a critical issue in a major Supreme Court case. More precisely, the question wasn't "Is it wrong to execute mentally retarded prisoners?" but "Do Americans believe it's wrong to execute mentally retarded prisoners?" That's a question about public opinion, not ethics—and as we've already seen, all but the very simplest questions about public opinion are lousy with paradox and confusion.

This one is not among the very simplest.

The justices encountered this question in the 2002 case *Atkins v. Virginia*. Daryl Renard Atkins and a confederate, William Jones, had

robbed a man at gunpoint, kidnapped him, and then killed him. Each man testified that the other had been the triggerman, but the jury believed Jones, and Atkins was convicted of capital murder and sentenced to die.

Neither the quality of the evidence nor the severity of the crime was in dispute. The question before the court was not what Atkins had done, but what he was. Atkins's counsel argued before the Virginia Supreme Court that Atkins was mildly mentally retarded, with a measured IQ of 59, and as such could not be held sufficiently morally responsible to warrant the death penalty. The state supreme court rejected this argument, citing the U.S. Supreme Court's 1989 ruling in *Penry v. Lynaugh* that capital punishment of mentally retarded prisoners doesn't violate the Constitution.

This conclusion wasn't reached without great controversy among the Virginia justices. The constitutional questions involved were difficult enough that the U.S. Supreme Court agreed to revisit the case, and with it *Penry*. This time, the high court came down on the opposite side. In a 6–3 decision, they ruled that it would be unconstitutional to execute Atkins or any other mentally retarded criminal.

At first glance, this seems weird. The Constitution didn't change in any relevant way between 1989 and 2012; how could the document first license a punishment and then, twenty-three years later, forbid it? The key lies in the wording of the Eighth Amendment, which prohibits the state from imposing "cruel and unusual punishment." The question of what, precisely, constitutes cruelty and unusualness has been the subject of energetic legal dispute. The meaning of the words is hard to pin down; does "cruel" mean what the Founders would have considered cruel, or what we do? Does "unusual" mean unusual then, or unusual now? The makers of the Constitution were not unaware of this essential ambiguity. When the House of Representatives debated adoption of the Bill of Rights in August 1789, Samuel Livermore of New Hampshire argued that the vagueness of the language would allow softhearted future generations to outlaw necessary punishments:

> The clause seems to express a great deal of humanity, on which account I have no objection to it; but as it seems to have no meaning in

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it, I do not think it necessary. What is meant by the term excessive bail? Who are to be the judges? What is understood by excessive fines? It lies with the court to determine. No cruel and unusual punishment is to be inflicted; it is sometimes necessary to hang a man, villains often deserve whipping, and perhaps having their ears cut off; but are we in future to be prevented from inflicting these punishments because they are cruel?

Livermore's nightmare came true; we do not now cut people's ears off, even if they were totally asking for it, and what's more, we hold that the Constitution forbids us from doing so. Eighth Amendment jurisprudence is now governed by the principle of "evolving standards of decency," first articulated by the Court in *Trop v. Dulles* (1958), which holds that contemporary American norms, not the prevailing standards of August 1789, provide the standard of what is cruel and what unusual.

That's where public opinion comes in. In *Penry*, Justice Sandra Day O'Connor's opinion held that opinion polls showing overwhelming public opposition to execution of mentally deficient criminals were not to be considered in the computation of "standards of decency." To be considered by the court, public opinion would need to be codified by state lawmakers into legislation, which represented "the clearest and most reliable objective evidence of contemporary values." In 1989, only two states, Georgia and Maryland, had made special provisions to prohibit execution of the mentally retarded. By 2002, the situation had changed, with such executions outlawed in many states; even the state legislature of Texas had passed such a law, though it was blocked from enactment by the governor's veto. The majority of the court felt the wave of legislation to be sufficient proof that standards of decency had evolved away from allowing Daryl Atkins to be put to death.

Justice Antonin Scalia was not on board. In the first place, he only grudgingly concedes that the Eighth Amendment can forbid punishments (like cutting off a criminal's ears, known in the penological context as "cropping") that were constitutionally permitted in the Framers' time.[*]

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[*] On May 15, 1805, Massachusetts outlawed cropping, along with branding, whipping, and the pillory, as punishments for counterfeiting money; if those punishments had been understood to be forbidden by the Eighth Amendment at the time, the state law would not have been necessary

But even granting this point, Scalia writes, state legislatures have not demonstrated a national consensus against execution of the mentally retarded, as the precedent of *Penry* requires:

> The Court pays lip service to these precedents as it miraculously extracts a "national consensus" forbidding execution of the mentally retarded . . . from the fact that 18 States—less than half (47%) of the 38 States that permit capital punishment (for whom the issue exists)—have very recently enacted legislation barring execution of the mentally retarded. . . . That bare number of States alone—18—should be enough to convince any reasonable person that no "national consensus" exists. How is it possible that agreement among 47% of the death penalty jurisdictions amounts to "consensus"?

The majority's ruling does the math differently. By their reckoning, there are thirty states that prohibit execution of the mentally retarded: the eighteen mentioned by Scalia and the twelve that prohibit capital punishment entirely. That makes thirty out of fifty, a substantial majority.

Which fraction is correct? Akhil and Vikram Amar, brothers and constitutional law professors, explain why the majority has the better of it on mathematical grounds. Imagine, they ask, a scenario in which forty-seven state legislatures have outlawed capital punishment, but two of the three nonconforming states allow execution of mentally retarded convicts. In this case, it's hard to deny that the national standard of decency excludes the death penalty in general, and the death penalty for the mentally retarded even more so. To conclude otherwise concedes an awful lot of moral authority to the three states out of step with the national mood. The right fraction to consider here is 48 out of 50, not 1 out of 3.

In real life, though, there is plainly no national consensus against the death penalty itself. This confers a certain appeal to Scalia's argument.

(*A Historical Account of Massachusetts Currency*, by Joseph Barlow Felt, p. 214). Scalia's concession, by the way, doesn't reflect his current thinking: in a 2013 interview with *New York* magazine, he said he now believes the Constitution is A-OK with flogging, and presumably he feels the same way about cropping.

It's the twelve states that forbid the death penalty* that are out of step with general national opinion in favor of capital punishment; if they don't think executions should be allowed at all, how can they be said to have an opinion about which executions are permissible?

Scalia's mistake is the same one that constantly trips up attempts to make sense of public opinion; the inconsistency of aggregate judgments. Break it down like this. How many states believed in 2002 that capital punishment was morally unacceptable? On the evidence of legislation, only twelve. In other words, the majority of states, thirty-eight out of fifty, hold capital punishment to be morally acceptable.

Now, how many states think that executing a mentally retarded criminal is worse, legally speaking, than executing anyone else? Certainly the twenty states that are okay with both practices can't be counted among this number. Neither can the twelve states where capital punishment is categorically forbidden. There are only eighteen states that draw the relevant legal distinction; more than when *Penry* was decided, but still a small minority.

The majority of states, thirty-two out of fifty, hold capital punishment for mentally retarded criminals in the same legal standing as capital punishment generally.†

Putting those statements together seems like a matter of simple logic: if the majority thinks capital punishment in general is fine, and if the majority thinks capital punishment for mentally retarded criminals is no worse than capital punishment in general, then the majority must approve of capital punishment for mentally retarded criminals.

But this is wrong. As we've seen, "the majority" isn't a unified entity that follows logical rules. Remember, the majority of voters didn't want George H. W. Bush to be re-elected in 1992, and the majority of voters didn't want Bill Clinton to take over Bush's job; but, much as H. Ross Perot might have wished it, it doesn't follow that the majority wanted neither Bush nor Clinton in the Oval Office.

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* Since 2002, the number has risen to seventeen.

† This is not precisely Scalia's computation; Scalia didn't go so far as to assert that the no-death-penalty states thought execution of mentally retarded criminals no worse than execution in general. Rather, his argument amounts to the claim that we have no information about their opinions in this matter, so we shouldn't count these states in our tally.

The Amar brothers' argument is more persuasive. If you want to know how many states think executing the mentally retarded is morally impermissible, you simply ask how many states outlaw the practice— and that number is thirty, not eighteen.

Which isn't to say Scalia's overall conclusion is wrong and the majority opinion correct; that's a legal question, not a mathematical one. And fairness compels me to point out that Scalia lands some mathematical blows as well. Justice Stevens's majority opinion, for instance, remarks that execution of mentally retarded prisoners is rare even in states that don't specifically prohibit the practice, suggesting a public resistance to such executions beyond that which state legislatures have made official. In only five states, Stevens writes, was such an execution carried out in the thirteen years between *Penry* and *Atkins*.

Just over six hundred people in all were executed in those years. Stevens offers a figure of 1% for the prevalence of mental retardation in the U.S. population. So if mentally retarded prisoners were executed at exactly the same rate as the general population, you'd expect about six or seven members of that population to have been put to death. Viewed in this light, as Scalia points out, the evidence shows no particular disinclination toward executing the mentally retarded. No Greek Orthodox bishop has ever been executed in Texas, but can you doubt Texas would kill a bishop if the necessity arose?

Scalia's real concern in *Atkins* is not so much the precise question before the court, which both sides agree affects a tiny segment of capital cases. Rather, he is worried about what he calls the "incremental abolition" of capital punishment by judicial decree. He quotes his own earlier opinion in *Harmelin v. Michigan*: "The Eighth Amendment is not a ratchet, whereby a temporary consensus on leniency for a particular crime fixes a permanent constitutional maximum, disabling the States from giving effect to altered beliefs and responding to changed social conditions."

Scalia is right to be troubled by a system in which the whims of one generation of Americans end up constitutionally binding our descendants. But it's clear his objection is more than legal; his concern is an America that loses the habit of punishment through enforced disuse, an America that is not only legally barred from killing mentally retarded

murderers but that, by virtue of the court's lenient ratchet, has forgotten that it wants to. Scalia—much like Samuel Livermore two hundred years earlier—foresees and deplores a world in which the populace loses by inches its ability to impose effective punishments on wrongdoers. I can't manage to share their worry. The immense ingenuity of the human species in devising ways to punish people rivals our abilities in art, philosophy, and science. Punishment is a renewable resource; there is no danger we'll run out.

FLORIDA 2000, THE SLIME MOLD, AND HOW TO CHOOSE A WINGMAN

The slime mold *Physarum polycephalum* is a charming little organism. It spends much of its life as a tiny single cell, roughly related to the amoeba. But, under the right condition, thousands of these organisms coalesce into a unified collective called a plasmodium; in this form, the slime mold is bright yellow and big enough to be visible to the naked eye. In the wild it lives on rotting plants. In the laboratory it really likes oats.

You wouldn't think there'd be much to say about the psychology of the plasmodial slime mold, which has no brain or anything that could be called a nervous system, let alone feelings or thoughts. But a slime mold, like every living creature, makes decisions. And the interesting thing about the slime mold is that it makes *pretty good* decisions. In the slime mold's limited world, these decisions more or less come down to "move toward things I like" (oats) and "move away from things I don't like" (bright light). Somehow, the slime mold's decentralized thought process is able to get this job done very effectively. As in, you can train a slime mold to run through a maze. (This takes a long time and a lot of oats.) Biologists hope that by understanding how the slime mold navigates its world, they can open a window into the evolutionary dawn of cognition.

And even here, in the most primitive kind of decision-making imaginable, we encounter some puzzling phenomena. Tanya Latty and Madeleine Beekman of the University of Sydney were studying the way slime molds handled tough choices. A tough choice for a slime mold looks something like this: On one side of the petri dish is three grams of oats.

On the other side is five grams of oats, but with an ultraviolet light trained on it. You put a slime mold in the center of the dish. What does it do?

Under those conditions, they found, the slime mold chooses each option about half the time; the extra food just about balances out the unpleasantness of the UV light. If you were a classical economist of the kind Daniel Ellsberg worked with at RAND, you'd say that the smaller pile of oats in the dark and the bigger pile under the light have the same amount of utility for the slime mold, which is therefore ambivalent between them.

Replace the five grams with ten grams, though, and the balance is broken; the slime mold goes for the new double-size pile every time, light or no light. Experiments like this teach us about the slime mold's priorities and how it makes decisions when those priorities conflict. And they make the slime mold look like a pretty reasonable character.

But then something strange happened. The experimenters tried putting the slime mold in a petri dish with *three* options: the three grams of oats in the dark (3-dark), the five grams of oats in the light (5-light), and a single gram of oats in the dark (1-dark). You might predict that the slime mold would almost never go for 1-dark; the 3-dark pile has more oats in it and is just as dark, so it's clearly superior. And indeed, the slime mold just about never picks 1-dark.

You might also guess that, since the slime mold found 3-dark and 5-light equally attractive before, it would continue to do so in the new context. In the economist's terms, the presence of the new option shouldn't change the fact that 3-dark and 5-light have equal utility. But no: when 1-dark is available, the slime mold actually changes its preferences, choosing 3-dark more than three times as often as it does 5-light!

What's going on?

Here's a hint: the small, dark pile of oats is playing the role of H. Ross Perot in this scenario.

The mathematical buzzword in play here is "independence of irrelevant alternatives." That's a rule that says, whether you're a slime mold, a human being, or a democratic nation, if you have a choice between two options A and B, the presence of a third option C shouldn't affect which of A and B you like better. If you're deciding whether you'd rather have a Prius or a Hummer, it doesn't matter whether you also have the option

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of a Ford Pinto. You *know* you're not going to choose the Pinto. So what relevance could it have?

Or, to keep it closer to politics: in place of an auto dealership, put the state of Florida. In place of the Prius, put Al Gore. In place of the Hummer, put George W. Bush. And in place of the Ford Pinto, put Ralph Nader. In the 2000 presidential election, George Bush got 48.85% of Florida's votes and Al Gore got 48.84%. The Pinto got 1.6%.

So here's the thing about Florida in 2000. Ralph Nader was not going to win Florida's electoral votes. You know that, I know that, and every voter in the state of Florida knew that. What the voters of the state of Florida were being asked was not actually

"Should Gore, Bush, or Nader get Florida's electoral votes?"

but

"Should Gore or Bush get Florida's electoral votes?"

It's safe to say that virtually every Nader voter thought Al Gore would be a better president than George Bush.* Which is to say that a solid 51% majority of Florida voters preferred Gore over Bush. And yet the presence of Ralph Nader, the irrelevant alternative, means that Bush takes the election.

I'm not saying the election should have been decided differently. But what's true is that votes produce paradoxical outcomes, in which majorities don't always get their way and irrelevant alternatives control the outcome. Bill Clinton was the beneficiary in 1992, George W. Bush in 2000, but the mathematical principle is the same: it's hard to make sense of "what the voters really want."

But the way we settle elections in America isn't the only way. That might seem weird at first—what choice, other than the candidate who got the most votes, could possibly be fair?

Here's how a mathematician would think about this problem. In

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* Yes, I, too, know that one guy who thought both Gore and Bush were tools of the capitalist overlords and it didn't make a difference who won. I am not talking about that guy.

fact, here's the way one mathematician—Jean-Charles de Borda, an eigh-teenth-century Frenchman distinguished for his work in ballistics—*did* think about the problem. An election is a machine. I like to think of it as a big cast-iron meat grinder. What goes into the machine is the prefer-ences of the individual voters. The sausagey goop that comes out, once you turn the crank, is what we call the popular will.

What bothers us about Al Gore's loss in Florida? It's that more peo-ple preferred Gore to Bush than the reverse. Why doesn't our voting system know that? Because the people who voted for Nader had no way to express their preference for Gore over Bush. We're leaving some rel-evant data out of our computation.

A mathematician would say, "You shouldn't leave out information that might be relevant to the problem you're trying to solve!"

A sausage maker would put it, "If you're grinding meat, use the whole cow!"

And both would agree that you ought to find a way to take into ac-count people's full set of preferences—not just which candidate they like the most. Suppose the Florida ballot had allowed voters to list all three candidates in their preferred order. The results might have looked some-thing like this:

Bush, Gore, Nader	49%
Gore, Nader, Bush	25%
Gore, Bush, Nader	24%
Nader, Gore, Bush*	2%

The first group represents Republicans and the second group liberal Democrats. The third group is conservative Democrats for whom Nader is a little too much. The fourth group is, you know, people who voted for Nader.

How to make use of this extra information? Borda suggested a simple

* And surely there were some people who liked Nader best and preferred Bush to Gore, or who liked Bush best and preferred Nader to Gore, but my imagination is not strong enough to under-stand what sort of people these could possibly be, so I'm going to assume their numbers are too small to materially affect the computation.

and elegant rule. You can give each candidate points according to their placement: if there are three candidates, give 2 for a first-place vote, 1 for second, 0 for third. In this scenario, Bush gets 2 points from 49% of the voters and 1 point from 24% more, for a score of

$$2 \times 0.49 + 1 \times 0.24 = 1.22.$$

Gore gets 2 points from 49% of the voters and 1 point from another 51%, or a score of 1.49. And Nader gets 2 points from the 2% who like him best, and another point from the liberal 25%, coming in last at 0.29.

So Gore comes in first, Bush second, Nader third. And that jibes with the fact that 51% of the voters prefer Gore to Bush, 98% prefer Gore to Nader, and 73% prefer Bush to Nader. All three majorities get their way!

But what if the numbers were slightly shifted? Say you move 2% of the voters from "Gore, Nader, Bush" to "Bush, Gore, Nader." Then the tally looks like this:

Bush, Gore, Nader	51%
Gore, Nader, Bush	23%
Gore, Bush, Nader	24%
Nader, Gore, Bush	2%

Now a majority of Floridians like Bush better than Gore. In fact, an absolute majority of Floridians have Bush as their first choice. But Gore still wins the Borda count by a long way, 1.47 to 1.26. What puts Gore over the top? It's the presence of Ralph "Irrelevant Alternative" Nader, the same guy who spoiled Gore's bid in the actual 2000 election. Nader's presence on the ballot pushes Bush down to third place on many ballots, costing him points; while Gore enjoys the privilege of never being picked last, because the people who hate him hate Nader even more.

Which brings us back to the slime mold. Remember, the slime mold doesn't have a brain to coordinate its decision making, just thousands of nuclei enclosed in the plasmodium, each pushing the collective in one direction or another. Somehow the slime mold has to aggregate the information available to it into a decision.

If the slime mold were deciding purely on food quantity, it would rank 5-light first, 3-dark second, and 1-dark third. If it used only darkness, it would rank 3-dark and 1-dark tied for first, with 5-light third.

Those rankings are incompatible. So how does the slime mold decide to prefer 3-dark? What Latty and Beekman speculate is that the slime mold uses some form of *democracy* to choose between these two options, via something like the Borda count. Let's say 50% of the slime mold nuclei care about food and 50% care about light. Then the Borda count looks like this:

5-light, 3-dark, 1-dark	50%
1-dark and 3-dark tied, 5-light	50%

5-light gets 2 points from the half of the slime mold that cares about food, and 0 from the half of the slime mold that cares about light, for a point total of

$$2 \times (0.5) + 0 \times (0.5) = 1.$$

In a tie for first, we give both contestants 1.5 points; so 3-dark gets 1.5 points from half the slime mold and 1 from the other half, ending up with 1.25. And the inferior option 1-dark gets nothing from the food-loving half of the slime mold, which ranks it last, and 1.5 from the light-hating half, which has it tied for first, for a total of 0.75. So 3-dark comes in first, 5-light second, and 1-dark last, in exact conformity with the experimental result.

What if the 1-dark option weren't there? Then half the slime mold would rate 5-light above 3-dark, and the other half would rate 3-dark above 5-light; you get a tie, which is exactly what happened in the first experiment, where the slime mold chose between the dark three-gram pile of oats and the bright five-gram pile.

In other words: the slime mold likes the small, unlit pile of oats about as much as it likes the big, brightly lit one. But if you introduce a *really* small unlit pile of oats, the small dark pile looks better by comparison; so much so that the slime mold decides to choose it over the big bright pile almost all the time.

This phenomenon is called the "asymmetric domination effect," and slime molds are not the only creatures subject to it. Biologists have found jays, honeybees, and hummingbirds acting in the same seemingly irrational way.

Not to mention humans! Here we need to replace oats with romantic partners. Psychologists Constantine Sedikides, Dan Ariely, and Nils Olsen offered undergraduate research subjects the following task:

> You will be presented with several hypothetical persons. Think of these persons as prospective dating partners. You will be asked to choose *the one* person you would ask out for a date. Please assume that all prospective dating partners are: (1) University of North Carolina (or Duke University) students, (2) of the same ethnicity or race as you are, and (3) of approximately the same age as you are. The prospective dating partners will be described in terms of several attributes. A percentage point will accompany each attribute. This percentage point reflects the relative position of the prospective dating partner on that trait or characteristic, compared to UNC (DU) students who are of the same gender, race, and age as the prospective partner is.

Adam is in the 81st percentile of attractiveness, the 51st percentile of dependability, and the 65th percentile of intelligence, while Bill is the 61st percentile of attractiveness, 51st of dependability, and 87th of intelligence. The college students, like the slime mold before them, faced a tough choice. And just like the slime mold, they went 50-50, half the group preferring each potential date.

But things changed when Chris came into the picture. He was in the 81st percentile of attractiveness and 51st percentile of dependability, just like Adam, but in only the 54th percentile of intelligence. Chris was the irrelevant alternative; an option that was plainly worse than one of the choices already on offer. You can guess what happened. The presence of a slightly dumber version of Adam made the real Adam look better; given the choice between dating Adam, Bill, and Chris, almost two-thirds of the women chose Adam.

So if you're a single guy looking for love, and you're deciding which

friend to bring out on the town with you, choose the one who's pretty much exactly like you—only slightly less desirable.

Where does irrationality come from? We've seen already that the apparent irrationality of popular opinion can arise from the collective behavior of perfectly rational individual people. But individual people, as we know from experience, are *not* perfectly rational. The story of the slime mold suggests that the paradoxes and incoherencies of our everyday behavior might themselves be explainable in a more systematic way. Maybe individual people seem irrational because they aren't really individuals! Each one of us is a little nation-state, doing our best to settle disputes and broker compromises between the squabbling voices that drive us. The results don't always make sense. But they somehow allow us, like the slime molds, to shamble along without making too many terrible mistakes. Democracy is a mess—but it kind of works.

USING THE WHOLE COW, IN AUSTRALIA AND VERMONT

Let me tell you how they do it in Australia.

The ballot down under looks a lot like Borda's. You don't just mark your ballot with the candidate you like best; you rank *all* the candidates, from your favorite to the one you hate the most.

The easiest way to explain what happens next is to see what Florida 2000 would have looked like under the Australian system.

Start by counting the first-place votes, and eliminate the candidate who got the fewest. In this case, that's Nader. Toss him! Now we're down to Bush vs. Gore.

But just because we threw Nader out doesn't mean we have to throw out the ballots of the people who voted for him. (Use the whole cow!) The next step—the "instant runoff"—is the really ingenious one. Cross Nader's name off every ballot and count the votes again, as if Nader had never existed. Now Gore has 51% of the first-place votes: the 49% he had from the first round, plus the votes that used to go to Nader. Bush still has the 49% he started with. He has fewer first-place votes, so he's eliminated. And Gore is the victor.

What about our slightly modified version of Florida 2000, where we

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moved 2% from "Gore, Nader, Bush" to "Bush, Gore, Nader"? In that situation, Gore still won the Borda count. By Aussie rules, it's a different story. Nader still gets knocked off in the first round; but now, since 51% of the ballots place Bush higher than Gore, Bush takes the prize.

The appeal of instant-runoff voting (or "preferential voting," as they call it in Australia) is obvious. People who like Ralph Nader can vote for him without worrying that they're throwing the race to the person they like least. For that matter, Ralph Nader can *run* without worrying about throwing the race to the person he likes least.[*]

Instant-runoff voting (IRV) has been around for more than 150 years. They use it not only in Australia but in Ireland and Papua New Guinea. When John Stuart Mill, who always had a soft spot for math, heard about the idea, he said it was "among the very greatest improvements yet made in the theory and practice of government."[†]

And yet—

Let's take a look at what happened in the 2009 mayoral race in Burlington, Vermont, one of the only U.S. municipalities to use the instant-runoff system.[‡] Get ready—a lot of numbers are about to come flying at your face.

The three main candidates were Kurt Wright, the Republican; Andy Montroll, the Democrat; and the incumbent, Bob Kiss, from the left-wing Progressive Party. (There were other minor candidates in the race, but in the interest of brevity I'm going to ignore their votes.) Here's the ballot count:

Montroll, Kiss, Wright	1332
Montroll, Wright, Kiss	767
Montroll	455
Kiss, Montroll, Wright	2043
Kiss, Wright, Montroll	371

* I'll concede it's not clear Ralph Nader actually worries about this.

† To be precise, Mill was actually talking about the closely related "single transferable vote" system.

‡ But not any more—in a narrowly decided referendum, Burlington voters repealed instant-runoff voting in 2010.

Kiss	568
Wright, Montroll, Kiss	1513
Wright, Kiss, Montroll	495
Wright	1289

(Not everyone was on board with the avant-garde voting system, as you can see: some people just marked their first choice.)

Wright, the Republican, gets 3297 first-place votes in all; Kiss gets 2982; and Montroll gets 2554. If you've ever been to Burlington, you probably feel safe in saying that a Republican mayor was not the people's will. But in the traditional American system, Wright would have won this election, thanks to vote splitting between the two more liberal candidates.

What actually happened was entirely different. Montroll, the Democrat, had the fewest first-place votes, so he was eliminated. In the next round, Kiss and Wright each kept the first-place votes they already had, but the 1332 ballots that used to say "Montroll, Kiss, Wright" now just said "Kiss, Wright," and they counted for Kiss. Similarly, the 767 "Montroll, Wright, Kiss" votes counted for Wright. Final vote: Kiss 4314, Wright 4064, and Kiss is reelected.

Sounds good, right? But wait a minute. Adding up the numbers a different way, you can check that 4067 voters liked Montroll better than Kiss, while only 3477 liked Kiss better than Montroll. And 4597 voters preferred Montroll to Wright, but only 3668 preferred Wright to Montroll.

In other words, a majority of voters liked the centrist candidate Montroll better than Kiss, and a majority of voters liked Montroll better than Wright. That's a pretty solid case for Montroll as the rightful winner— and yet Montroll was tossed in the first round. Here you see one of IRV's weaknesses. A centrist candidate who's liked pretty well by everyone, but is nobody's first choice, has a very hard time winning.

To sum up:

   Traditional American voting method: Wright wins
   Instant-runoff method: Kiss wins
   Head-to-head matchups: Montroll wins

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Confused yet? It gets even worse. Suppose those 495 voters who wrote "Wright, Kiss, Montroll" had decided to vote for Kiss instead, leaving the other two candidates off their ballot. And let's say 300 of the Wright-only voters switch to Kiss too. Now Wright has lost 795 of his first-place votes, setting him back to 2502; so he, not Montroll, gets eliminated in the first round. The election then goes down to Montroll vs. Kiss, and Montroll wins, 4067–3777.

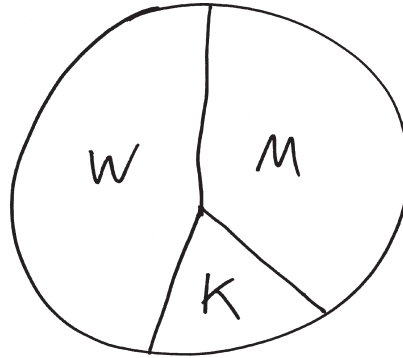See what just happened? We gave Kiss more votes—and instead of winning, he lost!

It's okay to be a little dizzy at this point.

But hold on to this to steady yourself: at least we have some reasonable sense of who *should* have won this election. It's Montroll, the Democrat, the guy who beats both Wright and Kiss head to head. Maybe we should toss all these Borda counts and runoffs and just elect the candidate who's preferred by the majority.

Do you get the feeling I'm setting you up for a fall?

THE RABID SHEEP WRESTLES WITH PARADOX

Let's make things a little simpler in Burlington. Suppose there were just three kinds of ballots:

Montroll, Kiss, Wright	1332
Kiss, Wright, Montroll	371
Wright, Montroll, Kiss	1513

A majority of voters—everybody in the pie slices marked K and W—prefers Wright to Montroll. And another majority, the M and K slices, prefers Kiss to Wright. If most people like Kiss better than Wright, and most people like Wright better than Montroll, doesn't that mean Kiss should win again? There's just one problem: people like Montroll better than Kiss by a resounding 2845 to 371. There's a bizarre vote triangle: Kiss beats Wright, Wright beats Montroll, Montroll beats Kiss. *Every* candidate would lose a one-on-one race to one of the other two candidates. So how can anyone at all rightfully take office?

Vexing circles like this are called *Condorcet paradoxes*, after the French Enlightenment philosopher who first discovered them in the late eighteenth century. Marie-Jean-Antoine-Nicolas de Caritat, Marquis de Condorcet, was a leading liberal thinker in the run-up to the French Revolution, eventually becoming president of the Legislative Assembly. He was an unlikely politician—shy and prone to exhaustion, with a speaking style so quiet and hurried that his proposals often went unheard in the raucous revolutionary chamber. On the other hand, he became quickly exasperated with people whose intellectual standards didn't match his own. This combination of timidity and temper led his mentor Jacques Turgot to nickname him *"le mouton enragé,"* or "the rabid sheep."

The political virtue Condorcet did possess was a passionate, never-wavering belief in reason, and especially mathematics, as an organizing principle of human affairs. His allegiance to reason was standard stuff for the Enlightenment thinkers, but his further belief that the social and moral world could be analyzed by equations and formulas was novel. He was the first social scientist in the modern sense. (Condorcet's term was "social mathematics.") Condorcet, born into the aristocracy, quickly came to the view that universal laws of thought should take precedence over the whims of kings. He agreed with Rousseau's claim that the "general will" of the people should hold sway on governments but was not, like Rousseau, content to accept this claim as a self-evident principle. For Condorcet, the rule of the majority needed a mathematical justification, and he found one in the theory of probability.

Condorcet lays out his theory in his 1785 treatise *Essay on the Application of Analysis to the Probability of Majority Decisions*. A simple version: suppose a seven-person jury has to decide a defendant's guilt. Four

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say the defendant is guilty, and only three believe he's innocent. Let's say each of these citizens has a 51% chance of holding the correct view. In that case, you might expect a 4–3 majority in the correct direction to be more likely than a 4–3 majority favoring the incorrect choice.

It's a little like the World Series. If the Phillies and the Tigers are facing off, and we agree that the Phillies are a bit better than the Tigers—say, they have a 51% chance of winning each game—then the Phillies are more likely to win the Series 4–3 than to lose by the same margin. If the World Series were best of fifteen instead of best of seven, Philadelphia's advantage would be even greater.

Condorcet's so-called "jury theorem" shows that a sufficiently large jury is very likely to arrive at the right outcome, as long as the jurors have some individual bias toward correctness, no matter how small.* If the majority of people believe something, Condorcet said, that must be taken as strong evidence that it is correct. We are mathematically justified in trusting a sufficiently large majority—even when it contradicts our own preexisting beliefs. "I must act not by what I think reasonable," Condorcet wrote, "but by what all who, like me, have abstracted from their own opinion must regard as conforming to reason and truth." The role of the jury is much like the role of the audience on *Who Wants to Be a Millionaire?* When we have the chance to query a collective, Condorcet thought, even a collective of unknown and unqualified peers, we ought to value their majority opinion above our own.

Condorcet's wonkish approach made him a favorite of American statesmen of a scientific bent, like Thomas Jefferson (with whom he shared a fervent interest in standardizing units of measure). John Adams, by contrast, had no use for Condorcet; in the margins of Condorcet's books he assessed the author as a "quack" and a "mathematical charlatan." Adams viewed Condorcet as a hopelessly wild-eyed theorist whose ideas could never work in practice, and as a bad influence on the similarly inclined Jefferson. Indeed, Condorcet's mathematically inspired Girondin Constitution, with its intricate election rules, was never adopted, in France or anywhere else. On the positive side, Condorcet's practice of

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* Of course, there are lots of assumptions in place here, most notably that the jurors' judgments are arrived at independently from each other—surely not quite right in a context where the jurors confer before voting.

following ideas to their logical conclusions led him to insist, almost alone among his peers, that the much-discussed Rights of Man belonged to women, too.

In 1770, the twenty-seven-year-old Condorcet and his mathematical mentor, Jean le Rond d'Alembert, a coeditor of the *Encylopédie*, made an extended visit to Voltaire's house at Ferney on the Swiss border. The mathophile Voltaire, then in his seventies and in faltering health, quickly adopted Condorcet as a favorite, seeing in the young up-and-comer his best hope of passing rationalistic Enlightenment principles to the next generation of French thinkers. It might have helped that Condorcet wrote a formal *éloge* (memorial appreciation) for the Royal Academy about Voltaire's old friend La Condamine, who had made Voltaire rich with his lottery scheme. Voltaire and Condorcet quickly struck up a vigorous correspondence, Condorcet keeping the older man abreast of the latest political developments in Paris.

Some friction between the two arose from another of Condorcet's *éloges*, the one for Blaise Pascal. Condorcet rightly praised Pascal as a great scientist. Without the development of probability theory, launched by Pascal and Fermat, Condorcet could not have done his own scientific work. Condorcet, like Voltaire, rejected the reasoning of Pascal's wager, but for a different reason. Voltaire found the idea of treating metaphysical matters like a dice game to be offensively unserious. Condorcet, like R. A. Fisher after him, had a more mathematical objection: he didn't accept the use of probabilistic language to talk about questions like God's existence, which weren't literally governed by chance. But Pascal's determination to view human thought and behavior through a mathematical lens was naturally appealing to the budding "social mathematician."

Voltaire, by contrast, viewed Pascal's work as fundamentally driven by religious fanaticism he had no use for, and rejected Pascal's suggestion that mathematics could speak to matters beyond the observable world as not only wrong but dangerous. Voltaire described Condorcet's *éloge* as "so beautiful that it was frightening . . . if he [Pascal] was such a great man, then the rest of us are total idiots for not being able to think like him. Condorcet will do us great harm if he publishes this book as it was sent to me." One sees here a legitimate intellectual difference, but also a mentor's jealous annoyance at his protégé's flirtation with a philosophi-

cal adversary. You can almost hear Voltaire saying, "Who's it gonna be, kid, him or me?" Condorcet managed never to make that choice (though he did bow to Voltaire and tone down his praise of Pascal in later editions). He split the difference, combining Pascal's devotion to the broad application of mathematical principles with Voltaire's sunny faith in reason, secularism, and progress.

When it came to voting, Condorcet was every inch the mathematician. A typical person might look at the results of Florida 2000 and say, "Huh, weird: a more left-wing candidate ended up swinging the election to the Republican." Or they might look at Burlington 2009 and say, "Huh, weird: the centrist guy who most people basically liked got thrown out in the first round." For a mathematician, that "Huh, weird" feeling comes as an intellectual challenge. Can you say in some precise way what *makes* it weird? Can you formalize what it would mean for a voting system *not* to be weird?

Condorcet thought he could. He wrote down an *axiom*—that is, a statement he took to be so self-evident as to require no justification. Here it is:

If the majority of voters prefer candidate A to candidate B, then candidate B cannot be the people's choice.

Condorcet wrote admiringly of Borda's work, but considered the Borda count unsatisfactory for the same reason that the slime mold is considered irrational by the classical economist; in Borda's system, as with majority voting, the addition of a third alternative can flip the election from candidate A to candidate B. That violates Condorcet's axiom: if A would win a two-person race against B, then B can't be the winner of a three-person race that includes A.

Condorcet intended to build a mathematical theory of voting from his axiom, just as Euclid had built an entire theory of geometry on his five axioms about the behavior of points, lines, and circles:

- There is a line joining any two points.
- Any line segment can be extended to a line segment of any desired length.

- For every line segment L, there is a circle that has L as a radius.
- All right angles are congruent to each other.
- If P is a point and L is a line not passing through P, there is exactly one line through P parallel to L.

Imagine what would happen if someone constructed a complicated geometric argument showing that Euclid's axioms led, inexorably, to a contradiction. Does that seem completely impossible? Be warned—geometry harbors many mysteries. In 1924, Stefan Banach and Alfred Tarski showed how to take a sphere apart into six pieces, move the pieces around, and reassemble them into two spheres, each the same size as the first. How can it be? Because some natural set of axioms that our experience might lead us to believe about three-dimensional bodies, their volumes, and their motions simply can't all be true, however intuitively correct they may seem. Of course, the Banach-Tarski pieces are shapes of infinitely complex intricacy, not things that can be realized in the crude physical world. So the obvious business model of buying a platinum sphere, breaking it into Banach-Tarski pieces, putting the pieces together into two new spheres, and repeating until you have a wagonload of precious metal is not going to work.

If there were a contradiction in Euclid's axioms, geometers would freak out, and rightly so—because it would mean that one or more of the axioms they relied on was not, in fact, correct. We could even put it more pungently—if there's a contradiction in Euclid's axioms, then points, lines, and circles, as Euclid understood them, *do not exist.*

That's the disgusting situation that faced Condorcet when he discovered his paradox. In the pie chart above, Condorcet's axiom says Montroll cannot be elected, because he loses the head-to-head matchup to Wright. The same goes for Wright, who loses to Kiss, and for Kiss, who loses to Montroll. There is no such thing as the people's choice. It just doesn't exist.

Condorcet's paradox presented a grave challenge to his logically grounded worldview. If there is an objectively correct ranking of candidates, it can hardly be the case that Kiss is better than Wright, who is

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better than Montroll, who is better than Kiss. Condorcet was forced to concede that in the presence of such examples, his axiom had to be weakened: the majority could sometimes be wrong. But the problem remained of piercing the fog of contradiction to divine the people's actual will—for Condorcet never really doubted there was such a thing.