

## THE IRONY OF ELECTRONIC VOTING MACHINES

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Thank you, very much. Kim started out by telling a few stories, or one story in particular about being in a room speaking to 35 judges. I must say, he has me beat by quite a margin. I was on a case in New York where there were seven, eight, nine judges; I forget what it was. That was daunting enough. Kim, I can't imagine being in front of 35. My case was settled, so I never really actually had to testify. I was in the room with them, but never had to testify.

I also wanted to tell you, actually, I should say, Kim, if you continue to give this speech I have to do some checking, because around my part of the state, the lever machine is usually associated with Rochester. And someone in Rochester, I think, contributed. I know there were a number of people who perhaps invented lever machines at about the same time. Jamestown should get some credit, I think, but I believe Rochester should too, so I have to defend my turf.

Also, I want to tell you that I was at an NSF sponsored conference about internet voting in October of 2000, just before the election, and there were a lot of political scientists there, but also quite a number of really top notch computer security people. And since it was focused on internet voting, computer security was the main, almost the entire focus of the discussion. The conclusion was then, and I think still is, that in the United States at least, internet voting is just not going to work; it can't be made secure. But along the way, someone raised the question: what about electronic voting in the polling place? And the reaction was: who cares? Well, a month later, people decided that perhaps it was pretty important. We spent about 15 minutes of that conference talking about electronic voting at the polling place, most of which was ignored because of this attitude of who cares.

Now my talk today, my brief talk, is called *The Irony of Electronic Voting Machines*. The first slide that I talk about asks the question: DRE's, direct recording electronic systems, are they better than paper ballots? And the point I try to make is that, there are, indeed, a number of reasons to think that DREs are better than paper ballots. And with paper ballots, I am including the idea of paper ballots with optical scan systems, so any form of paper ballot.

DREs, as most of you probably know, prevent overvotes. You simply cannot vote for more than the number of individuals you're supposed to vote for; typically one. So typically you cannot, it is not possible, to vote for two candidates. Feedback on the electronic systems is more complete. They highlight your vote, and typically who you voted for is a part of that. So it lights up, and there may be an X, a fairly big X, that may be lit up in green to show you that you indeed voted for that office, and who you voted for. There is typically some kind of review screen at the end, so after you're done, you get a second chance to look at who you voted for to make sure, if you wish, that you voted for all of the offices. It highlights, in one way or another, undervotes. So if you have not voted for a particular office, it is called to your attention.

DREs prevent mismarking. There are all sorts of ways you can mark it a paper ballot. Typically you connect an arrow, or you fill in a circle or oval, and people have inventive ways of doing other things: putting an X in the circle instead of filling it in; putting a check mark in the circle instead of filling it in; or circling the name, even though, to most of us, it seems patently obvious that what you are supposed to do is fill in the oval. You cannot mismark a DRE. There is no way in which you can do the equivalent of putting an X or a check mark down instead of filling in the oval.

Straight party voting. We don't have straight party voting in New York, but a number of states do, and it's easier with electronic systems. With an electronic system, if you touch a part of the screen (they are mostly touch screens) you touch the part of the screen saying you want to vote straight Democratic or straight Republican, whichever, it automatically casts, and typically shows you that it cast your votes, by filling in the vote for all of the partisan offices. I'll talk a little bit later about this, as to why this makes a difference compared to paper ballots. It is obviously easier to program a DRE, which is essentially a computer, to show you how to vote, or to display the ballot and the instructions in multiple languages. On paper, you either have to have separate ballots, or

you have to have a single ballot in more than one language, so that, obviously, means there is more on the ballot. It can make it harder to read simply because there's a lot more there.

It is possible with electronic machines to avoid two sets of machines, one for able-bodied voters, and one for those with special needs because you can do different things, again, with computers. The simplest, perhaps most obvious change is to simply make the print bigger for people who have difficulty reading.

Other information about DREs comes from the work that Paul and I, and others have done. We had voters in simulated elections rate various machines, and voters in these—well I will tell you the results in a minute. We had field studies similar to what Paul talked about, although what he was talking about were systems with verification systems. Prior to that, we did some studies on systems without verification systems. We did field studies with more than 1,500 people in several states, including New York. People voted on six different systems in this study in a random order, and then we had them rate each machine right after voting on it—on things like ease of use, confidence that one's vote is recorded accurately, and so on.

The next slide shows average satisfaction on these voting systems from these 1,500 or so people. The best of the DREs came out at the top. Now there is variation. One of the DREs had an automatic advance, so the moment you touched the screen and voted for someone, it immediately flipped to the next race, so you did not have a chance to see who you voted for more than for an instant right after you touched it. That one came out lower, judged less satisfactorily overall. The paper ballot, in contrast, came out looking pretty good, but, in fact, the best of the DREs actually came out as rated more highly than the paper ballot, and that is one of the points I want you to take home from, well both my entire talk, but from this particular slide especially.

What about paper ballot and optical scan systems? Well you might expect paper ballots to be the standard by which all other systems would be judged. I certainly, as we went into this, thought that that would be the case. What could be more straightforward than paper? We've used paper for a long time. We use paper in other circumstances, for some things similar to votes.

I think everyone, everyone here, because you have all gone to college and beyond in many instances, have taken various exams: SAT exams; perhaps GREs, graduate record exams; or law school exams. Typically, those have—these days it's becoming more

common to do those on the computer, but typically, those sorts of exams have been fill-in-the-oval. So we have experience with that sort of thing. So I, and I think others, anticipated that the paper ballot would be the standard, and everything else might be looked at a little less favorably.

In fact, the paper ballot, even connected with an optical scan system, was criticized as being old-fashioned. Kim mentioned this, in passing I think, that when DREs came into existence, some other methods, but particularly paper ballots, were seen as something out of the past and not as what we use now. We are much more used to, particularly the younger generation, but increasingly what was once the very young generation and is now becoming more middle-aged, and so on, as we know, so a lot of people in the electorate are used to things being done electronically. Most notably at banks. We get money, I certainly get money most often from a—what do we call them? An ATM. From an ATM, and I know what they are, even if I cannot remember the name. A Diebold ATM, yes. And so we are used to getting money from them, and many people remarked that the paper ballot was simply out of date.

But even on confidence, that particular question specifically asking individuals about how confident they were that their vote would be recorded accurately, the paper ballot-optical scan system was rated lower than the best of the DRE systems; so I think that was significant. That lower rating, perhaps, was due to spill-over effects. There were other things that they did not like about paper ballots, and so, somehow, that affected their confidence. We would like to do more work on that, but for whatever reason, paper ballots were rated lower, a bit lower, on confidence than the best of the DREs.

That is perhaps due to the fact that even a properly filled out paper ballot may still not be counted properly. There was an issue, not so long ago, perhaps a year ago, a year and a half ago, that I think was actually reported first at some conference in Albany, if I recall correctly. I didn't think to look that up until this morning and it was too late, but it involved SAT exams, so if you individually were a parent with an 18-year old high school senior or if you were a college professor and pay attention to these things, you certainly noticed the story in the newspapers about how some SAT exams were scored improperly. Kids got the wrong scores, and that could have tremendous effects for their futures. The reason, it finally came out, evidently was that the paper had

warped, and so the scores were literally not counted properly even though they were marked properly on the paper.

The next slide I talk about has more about paper ballots. There was certainly dissatisfaction among the people we used in the simulated elections when changing a vote. That was one of the things that we asked them to do. Theoretically, you are supposed to get a new ballot. If you erase on a paper ballot, it may not record properly. You may not erase entirely; there may be a faint image there. You should get a new ballot. So if you need to make a change, or if you accidentally overvote and want to correct your ballot, you should get a new ballot. That is a major pain, and certainly the voters in our simulations did not appreciate that at all.

The paper ballot was criticized for lack of meaningful feedback. You do not have a screen at the end. Of course, you do have the ballot and you can check it, but to voters it seemed to be a bit different from having a review screen. There is certainly is no check for marking errors. If you circle the names instead of filling out the oval the way you are supposed to, the systems do not check for that. The system we used checked for overvotes one office at a time. So you would put the ballot into, slip the ballot into the machine, and it might send it back out saying you overvoted. You can correct that one overvote, put it back in, and it would tell you that you overvoted someplace else. This certainly was not something to make voters appreciate the system. There was no check for undervotes. No indication that you had not voted for some offices, and sometimes there is no precinct level scanning at all. Kim mentioned that you could have machines at the precinct that will scan and check the votes, and that is true, but there sometimes is not that kind of machine at the precinct.

The accuracy of voting. Paul mentioned that in the study he was reporting on, we looked at the accuracy of voting. We did the same sort of thing in the study about the different systems without the verification system. We compared intent to the voter guide, the names people had circled with the vote that they cast, and mostly there was little difference among the systems. Over 97 percent were accurate overall. Of the votes cast in the simplest situation, almost all were as people intended, with little difference across machines. But when a change had to be made, the DREs, in fact, were more accurate than the paper, and I think that was an interesting result. We have a slide that shows that; you can look at it if you wish. Again, not all DREs are created equally, and the

machine sort of in the middle of the picture, the Vote Trakker, the one that advanced immediately upon your casting the vote, that was the least accurate when a vote change was required, and it seems fairly straightforward to figure out why that was the case. But, in fact, the best of the DREs were better than paper ballots, in terms of accuracy, when a change had to be made.

The question of write-ins. Write-ins are legal in some states. All states, interestingly, don't have write-ins available to voters. But when you do have a write-in, the paper ballot I think, for obvious reasons, was judged to be very easy. You simply write in the name, but, in fact, it was judged to be equally easy with the best DREs. So as easy as paper ballots are, they weren't seen to be a whole lot better in that dimension than the best of the DREs, and there was a considerable problem, at least in some instances and some jurisdictions, a considerable problem with paper ballots. Typically, on paper ballots, there is an oval, or a complete-the-arrow, that you are supposed to fill in indicating that you are voting for a write-in candidate, and then you write in the name. The purpose of the oval is to signal to the counter, to the optical scan machine, that you, in fact, have voted for a write-in candidate. And if you forget to fill in that oval, it's not going to be detected.

Now in some jurisdictions, they may go through every ballot anyway to check for write-ins, but particularly in the larger ones, and where the emphasis is on counting by machine and sort of has to be, the fact that a large number of people, about a quarter of them, in fact, in our study, failed to fill in the oval when they wrote in a name, is a major drawback with paper ballots.

We have a picture on the need for help. Briefly, with the office block ballot, the regular office block ballot, which I won't get into—I won't get into describing the ballot here, but there, the paper ballot actually, there were fewer people that said they needed some kind of help with a straight-party device. In fact, more people said they needed help on the paper ballot than on one of the DREs, particularly, and very similar, on another of the DREs.

Now, I've said all of these things that suggest that DREs have a lot going for them. In many respects, DREs may be equal to, or even better than, paper ballots, but I still think that in the long run, over the next few years at least, as New York selects a system and other states consider changing systems again, that paper ballots with optical scan are likely to win out. Why? First, because there are misunderstandings about risk versus harm. The emphasis has been on the things that could go wrong under the

worst of circumstances. In fact, there are some scenarios under which you could have massive vote fraud with DREs, but one of the things that have been pointed out is that no events of this sort have occurred.

There are things that do occur, like lights going out and voting systems going down. Voting systems have battery back-up, so that one really is not such a serious problem, but there have been no events recorded in which there has been clear interference, intentional or otherwise, with people's voting for the candidates they think they have. There are certainly poorly designed DREs, both from the security point of view and from the usability point of view. And that's one reason I think that paper ballots will win out, because they are compared with DREs that are not as good as they could be.

There is a lack of recognition of the problems of paper ballots. Kim, again, I think referred to this a little bit; he mentioned the Chicago River. Over the years, we have certainly had ballot boxes that have been stuffed. DREs plus printers: printers jam, run out of ink, and it is very difficult sometimes to replace the paper. I mentioned that paper tears; paper warps; paper can be lost, unintentionally or intentionally, and these sorts of problems have occurred with some frequency.

Another irony is that optical scan systems may be poorly designed. Certainly the one in our study was not well designed; it had a very small readout. A readout of about this big (indicating 2 inches x 8 inches), so it was quite difficult to see to get the feedback as to whether you overvoted or not. There was no information about undervotes, and so on. The fact that I think paper ballots may win out in New York State is especially ironic because in New York State, DREs will probably not be accepted because fewer voters understand their workings, most don't know how they work and whether they are working. They may break down. They don't have a paper record of the votes. Well, all of those things are true of lever machines. I certainly don't know what happens when I pull the lever. I am told that it is something mechanical and it has to do with, I guess, wheels and things in the back, but I don't know how it operates, and I doubt that most of you do either. Nonetheless, we won't use DREs because we don't know how they work.

Regardless of the system chosen, to simply conclude, there is a need for training. Our study showed that many voters do not automatically know how to vote. Paper ballots are incorrectly

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marked. Straight party voting confuses people. Multi-person offices confuse some people. Write-in's are not well done, and the number of people who need help is surprising. If we have training, it should be extensive, it should reach all segments of society, it should begin before the first vote is cast with new equipment, and it should occur even if a paper ballot system is adopted. I think that is important, and, ultimately, in the longer run, I think it should be done in the high schools. I don't think it is very well done presently, and it should be done much better. And then, finally, since Paul didn't shamelessly advertise our forthcoming book, I will. We have a book coming out with Brookings Institution Press, very soon, the next few weeks, I think, called Voting Technology, The Not So Simple Act of Voting. You all ought to go buy it.