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VOTING TECHNOLOGY:

THE NOT-SO-SIMPLE ACT OF CASTING A BALLOT

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P R O C E E D I N G S

MR. MANN: Good morning! Thank you all for coming to Brookings this morning on the eve of this holiday weekend - this Easter weekend. I'm Tom Mann, a Senior Fellow here at Brookings. This session on voting technology, built around the book, *Voting Technology: The Not-So-Simple Act of Casting a Ballot,* is sponsored by the AEI-Brookings Election Reform Project which I co-direct with my colleague from AEI, Norm Ornstein, and in association as well with John Fortier of AEI who's with us as well. We also have Tim Ryan and Molly Reynolds who have been working on this project, which is really designed to try to encourage, facilitate research on election administration issues, and to link that research up with a policy process. For those of you who haven't discovered the website or the biweekly newsletter of the project, it is electionreformproject.org, and I hope you will tune in and join our community. As I said, the occasion of this session is the publication by The Brookings Institution Press of this wonderful new book that is a collaboration of our four colleagues here today, as well as two others who were not able to be with us. Yesterday, we had a session at Brookings on "Get Out The Vote." And in many respects, it was from the same line and vein of research and implications for policy and politics as our one today. That is, it is a volume and a body of work involving randomized

experiments of the efficacy of various forms of get-out-the-vote activity, and what we have found is that over time, serious research can begin to replace urban legends and self-serving arguments by consultants who make a lot of money promoting robo-calls and such other unethical forms of get-out-the-vote activities. I think what is especially important about this book and this line of research in today's session is that we are beginning to see now a body of serious research develop that allows us to inform policymakers in a policy process, and I hope public debate more generally on matters of genuine importance to the functioning of our democracy. You'll recall that many of us got into this business in November of 2000 as a consequence of this dead heat, basically, in the popular vote and the difficulties of deciding who, in fact, won the State of Florida. Since then, we've seen states move rather dramatically to alter their administrative procedures and the equipment they use in voting. We had the passage of the "Help America Vote Act" (HAVA). We've seen changes in the voting equipment -- it's hard to find lever machines or punch cards anymore. We have optical scan and direct-recording electronic (DRE) voting equipment for the most part. And yet, looking back over this period, you can't be terribly encouraged by the way in which it has proceeded. Often times, fears of a particular problem have led to reversals in policies without the kind of backup information and knowledge that would inform those

decisions. So, I think it's, again, it's really nice that we can point to the emergence of a body of research that will inform that process. It doesn't answer all of the questions on the table -- it's a beginning point, not an end. There's other work going on that supplements this work. In fact, we have found in bringing together scholars to work on these issues that what was once a community of a handful of people who could be brought together in a closet is now a growing community of researchers around the country. These gentlemen with me today are very much a part of that community.

You have in the packet of materials biographies of the individuals, and I'm just assuming they are legends in their own time and don't need elaborate introductions. So what I would like to do is introduce them briefly in the order in which they will make some initial presentations: Paul Herrnson on my right is Director of the Center for American Politics and Citizenship and a professor in the department of Government and Politics at the University of Maryland and really the instigator of this broader research project. Then on my far left, Michael Traugott, an old friend and colleague from the University of Michigan, is a professor of Communication Studies and Senior Research Scientist in the Center for Political Studies at the University of Michigan. Then on my immediate left is Richard Niemi who is a professor of Political Science at the University of

Rochester. Like a number of us, his Ph.D. is from the University of Michigan, but he's been a major scholar working on a range of issues for 40 years at the University of Rochester. Our final participant is Michael Hanmer who is an assistant professor of Government and Politics at the University of Maryland who's been a key member of the team. Our plan this morning is for Paul to take some time to give you an overview of the study, the various features of it, and then we will turn to colleagues to talk about a particular feature of it. Mike Traugott is going to discuss the laboratory studies and some of the findings from that. Dick Niemi, the field studies that were involved in testing the equipment. Then, Mike Hanmer is going to talk about the special effort to assess the vote verification systems that are either in place or emerging, and talk about the opportunities and problems associated with them. I think the overarching theme of this research is that it is important in developing new equipment and new administrative procedures for utilizing that equipment, and to focus on the usability of that equipment. How ordinary citizens encounter this equipment, since that really is the source of many of the errors that develop in the voting system. It's an emphasis different from others that have gained more attention and prominence and salience in recent years, but one that is central to the enterprise. So with that introduction, let's turn to Paul.

MR. HERRNSON: Thanks very much Tom, and thank you all for coming. Before I start giving an overview of the book, I just want to acknowledge some folks that helped us do the research. First, the National Science Foundation, the Carnegie Corporation of New York, and the Maryland State Board of Elections all provided financial and other support for the research. We could not have done this research without the support of those organizations. Also, we owe a debt of gratitude to the voting system manufacturers and some others: Avante, Diebold, ES&S, Hart InterCivic, NEDAP, Scytl, VoteHere, and the MIT Media Lab all made their systems available to us to test. And thanks, also of course, to The Brookings Institution for publishing our book, and to the AEI-Brookings Election Reform Project for hosting this event.

MR. MANN: Which I must say is funded by the Knight Foundation, a point I neglected to mention.

MR. HERRNSON: And thank you to the Knight Foundation. So, as Tom said, the 2000 presidential elections didn't go so well in many ways. They pointed out to the world that casting a vote may seem simple, but the interactions between voters and voting systems are, in deed, complex. And our book studied six issues related to voting systems. These are: voter satisfaction with and trust in the voting process, voters' abilities to vote without needing help, voters' abilities to cast their ballots

accurately, the impact of ballot design on the voting experience, and the impact of voters' background characteristics on their voting experiences. We also looked at the impact of vote verification systems, such as paper trails, on voting. Our top-line findings are that most of the systems we tested performed reasonably well, but under some circumstances, they can distort election outcomes. Fortunately, the systems we tested –- almost all of them could be significantly improved by modifications that can be readily made by their manufacturers or election officials. So one might ask, "How did we reach these conclusions?" Well, our study had many components and methodologies. Our first step was to review all of the systems available commercially at the time of the study and to select a set of systems that represented all of the design principles available. We wanted to be able to test every facet possible and leave nothing out. The systems we picked -- we selected are on your handout. First there's a paper ballot, precinct-based optical scan system, and that is the ES&S Model 100. Second is the standard direct-recording or DRE system, and it's a touch-screen system, the Diebold AccuVote TS. The third system is a touch-screen system with automatic advance navigation, it moves the voter through the ballot, and a paper trail, and that's the Avante VoteTracker. The fourth system is a DRE system featuring a mechanical interface; it has buttons and a dial people use to vote, and that's the Hart

InterCivic eSlate. The fifth system is a DRE system that displays the entire ballot, complete with all the offices, all the candidates' names, and other information at one time on a big board, and that's the NEDAP LibertyVote. And then we also developed a system we call the zoomable prototype, which is a touch-screen system that presents the offices at one time. When you touch the offices, it zooms open and shows you the candidates and their information and enables you to vote in that race. So we tested each of these systems, using two ballot styles that are representative of those that are currently used in the United States, and we tested them using three methodologies. First, an expert review, which is commonly used in the field of computer science. Second, a lab study. And third, a field study involving 1540 voters. The verification system study Mike will say more about; we had fewer voters participating.

So what are our major findings? First, in terms of overall voter satisfaction with the systems. All of the systems were evaluated favorably, they all did well. Still, the top rated systems were the standard touch-screen system--the Diebold--and the zoomable prototype. The paper ballot optical scan system was the third highest rated system. Generally speaking, we find that the systems with more visible computerization were rated somewhat more favorably than the systems that presented the least computerization, including the system with the

buttons and the dial, and the one that displays the entire ballot at once. Here are some specific findings: The top rated touch-screen systems inspired somewhat more confidence among the voters that their votes would be accurately recorded than the other systems, including the paper ballot optical scan system. The top rated touch-screen systems also were evaluated a little more favorably in terms of understanding how to use the system, the ease of changing a vote or correcting a mistake, readability, and most other features. The paper ballot system was rated better in terms of casting a write-in vote, but there's a major irony in here which I'll discuss later, in that voters make more mistakes on paper than they do on the electronic systems when it comes to a write-in. Second, in terms of the need for help, fewer voters reported feeling the need for help when voting on the best performing touch-screen system than they did when voting on systems with less visible computerization, including the paper ballot optical scan system. The third issue we looked at was voter accuracy; that is, the ability of voters to cast their votes as intended, a pretty important thing. And here we find that when performing simple tasks, like voting for president, all of the systems performed well, even on the system that performed worst, almost 97% of the voters were able to vote as they intended when voting for president. Now, you might say, "Hey, 3% error rate, that's pretty good. We're professors, it's great." But,

as we learned in 2000, 3% is not good enough in an election because it can change the outcome of an election. And so this shows us quite clearly that there is room for improvement. Our studies show that touch-screen systems have some advantages in terms of avoiding errors. Even when voting for president, voters make slightly fewer errors, and slightly fewer of the worst kinds of errors, on the best touch-screen systems than they did on the others. And the worst error a voter can make is not forgetting to vote or not voting for more candidates than you're allowed –- in fact, these electronic systems don't let you do that –- but it's making what we call the proximity error, voting for the candidate immediately before or immediately after the candidate you want to vote for. Why is it especially bad to vote for the candidate immediately before or after the other candidate? Well, it's because it's a double whammy. Not only does your candidate not get your vote, but your vote often goes to the candidate who's your candidate's major opponent. So that's pretty bad.

In terms of other issues with errors, the best touch-screen systems result in fewer errors in races that ask voters to vote for more than one candidate, such as state delegate in the State of Maryland or associate justice in many states. And the best touch-screen systems also lead to fewer errors when voters try to change a vote. And that happens actually fairly commonly when people are put in front of systems that they

haven't tried before. You know, faculty, students, and everyday folks try to mess with them just to see how they work. Now, write-in form is a special class of voting. We don't use them very often, but in some cases, a write-in will decide who gets elected, such as a mayoral Democratic primary in D.C. And here our study shows a great irony. Most voters report that casting a write-in vote is easiest when using a paper ballot. Why? Because you just write the name. Maybe. However, one-fourth of those write-in votes that are cast on a paper ballot would not be counted in an election. Why? Because the person wrote in the name, but they forgot to fill in the bubble that signifies to the voting system that a write-in vote has been cast. Now this contrasts sharply with the 4% error rate on the direct-reporting electronic systems. It is much much larger.

The fourth issue we looked at is a very important issue, ballot type, and we found that the type of ballot programmed on the system, no matter what system it is, has a very strong and pervasive impact. Voters who use the standard office-block ballot committed fewer errors and needed less help than those using a ballot with a straight-party option or a party column ballot, and you'll see in the handout we have pictures of these three ballots. So, the first subject covered in the book deals with the quality of the voting experience, and the question we address is whether voters' backgrounds influence their voting

experiences. Well, when it comes to satisfaction with the voting process, the voters' backgrounds really don't have much of an impact. However, when it comes to the need for help, voters with little computer experience, low incomes, women, and the elderly are more likely to feel the need for help when voting than others. Third, younger, wealthier, better educated individuals consistently vote more accurately than others. The same is true of frequent computer users, women, whites, and native English speakers. Now, there may be a cultural pattern behind at least one of these results. Women indicate they are more likely to ask for help, but they end up making fewer mistakes than men. The obvious analogy is classic. The analogy is driving. Women drivers are more likely to ask for directions than men, and men are more likely to get lost. My wife complains about that often.

So, the sixth and final subject of the book is the impact of voter verification on election audit systems. These are designed to provide voters and election officials with an independent check on the vote. We tested four systems. A paper trail, a system that relies on cryptography -- Mike can explain that, it's very complicated -- a system that allows voters to review their votes on a separate computer monitor, and an audio system that has just a basic portable tape recorder and headphones. The bottom line, none of the verification systems

substantially improved the voting experience, and most had the opposite effect, resulting in voters needing additional help and additional time to cast their ballots. These systems were also very difficult to set up and operate.

So, we conclude the book with a number of generalizations. First, in terms of voter satisfaction, the need for help and voters' abilities to cast their votes accurately, the best touch-screen systems performed somewhat more favorably. They performed slightly better than the paper ballot optical scan system and better than the DREs with mechanical interfaces -- the buttons and dial system -- or the DRE that presents the entire ballot and all of its information at once. Why did the touch-screen systems perform better? Well, we have some ideas. First, their programming allows voters to make changes easily. It also prevents them from voting for more candidates than they're allowed to vote for. Second, their review screens provide helpful feedback. They enable voters to check their ballots for under-votes and other areas, including voting for the wrong candidate. The paper-based touch-screen systems we tested didn't have these features. These findings suggest that those who believe that paper ballot systems are the answer to the U.S.'s voting challenges should take pause and consider the evidence.

A second generalization: People vote more accurately on systems that give them more control over the voting process and present less information at one time.

Third generalization: The more straightforward and simple the ballot, the more positive the voting experience and the more accuracy with which people can vote.

And the fourth generalization: Voting systems, ballot designs, and voters' background experiences interact to influence the voting experience, including accuracy. Clearly, one voting system may not suit all best.

So, our results lead to a number of implications. First, voting system manufacturers should perform usability tests, like ours, to improve their prototypes before mass manufacturing them. Second, election officials should use comparative usability tests, like ours, to look at different systems before they purchase new voting systems. Make sure the system you order works best for your voters and your poll workers. Third, regardless of the voting system used, the system should be programmed with a straightforward ballot that has been tested for usability. This is very important. If a state has a voting system, they should make sure that the ballot they program on it works best. It's cheaper than going out and buying a new system. Another implication is

that voting systems and poll workers should be allocated on the basis of projections about the number of voters expected to vote, the amount of help the voters will need, and the time it takes them to vote. And as we found, these factors varied by voters' age, education, computer experience, and other background characteristics. And last, voter education is important when introducing new voter systems.

So, we hope our book helps voting manufacturers, election officials, and others involved in the election process improve the voting process for everyone. Thanks.

MR. MANN: Thank you Paul. Now we're going to focus in on some particular aspects of the study, and we'll begin with Mike Traugott, talking about the laboratory studies.

MR. TRAUGOTT: Thank you very much Tom. I'm going to be describing some of the work that was conducted in a usability lab that we constructed or put together at the University of Michigan. This work was substantially the effort of our colleague Fred Conrad, but I helped Fred in this work. You can think about research design or the study of political phenomenon as either applying kind of a telescopic view, taking a broad distant perspective on phenomenon, or in a microscopic view, taking a very close and intense look at a more limited set of subjects. The usability lab work is part of our project and represents really this kind of

microscopic view. What we did was, we recruited 42 citizens from Ann Arbor, and we actually selected them based upon characteristics that they had that might indicate that they could have difficulty with these voting machines. That is, we recruited older people; we specifically looked for people who had limited computer experience. We brought them to a central location where these six machines were set up, and we got permission to videotape them. So for these 42 subjects, we have more than 80 hours of videotape of their actual experience voting on these machines. We essentially taped over their shoulder as they trying to work through this exercise. And we had a small number of hypotheses that were related to this activity. First of all, the more overall effort that it required to vote, the less satisfying the experience would be for them. Second, voters might become concerned about inaccuracy when they think it takes more effort or it seems to be frustrating to them. And third, the specific interfaces on these machines might increase the effort that's required and, therefore, also reduce satisfaction. In our studies generally -- not only in the usability lab, but also in the work that Dick is going to describe -- we wanted to hold a feature of the process constant. So we created a simulated election that was embodied in a voter pamphlet that each person got, and we asked these people to select their own candidates. This was the embodiment of voter intent and also became a

way to measure the accuracy of the votes that they cast. Then, we randomly assigned them to vote the same way on each of the six machines. The random assignment was related to the possibility that they might learn something about how the machines functioned and so on, and it allowed us to control for that. And so we had these 42 people for whom we videotaped their experience, and using a particular set of software, it was actually possible to code their activity at the action level; that is as they worked their way through the ballot --and Paul has described these two different ballots --and also as they worked their way through each of these two different machines. In general, many of these voters saw these machines for the first time. Most of them were not machines, for example, that were in use in Michigan. Also, given their characteristics on occasion relatively frequent, they got lost in the process. This was obviously related to inaccuracy; the lack of familiarity was related to inaccuracy. It was related to taking more extra actions; that is, moving through the ballot in less than what might be conceptualized as the optimal way. It also did produce, as we expected, negative relationships between their satisfaction with the process and the amount of effort that they used. In the usability lab, we also found that for two machines as Paul mentioned, the error rates were significantly higher. One of the particular features of the interfaces that was relevant to some of these tasks was the ability to write-

in votes. The mechanism on each machine that allowed them to enter the first name and the last name, in the right order, whether there was capitalization or not, an explicit space bar, and things like that. And also some features of the machine that presented problems because ballots were prematurely submitted so that under-voting at the bottom of the ticket, at the bottom of the ballot, became more prevalent. There's a table in the book -- or two tables in the book -- 2-1 and 2-2, that lay out the features of the interfaces, and you'll be able to develop a better sense of the commonalities and also the differences in the devices.

Speaking more broadly about the results from the usability lab and their implications, they suggest very strongly that voter education is a critical component of the use of new voting technology. By education, I mean not only voters, but also poll workers, to make them familiar with the devices and the application of the ballots to specific devices. If we think about the employment of new voting technology -- one application of this is that once you decide to employ technology, as we find in these current machines, it also means that in specific elections or in a series of elections, the technology is very likely to be changing from one election to another; maybe because of small hardware changes, maybe because of software changes. So, therefore, voters may be having slightly different experiences from one election to another; another point that emphasizes

the need for voter education and for poll worker education. We know that one of the characteristics that's related to success in using these machines is age, and we also know that poll workers tend to be older citizens, perhaps less familiar with computers. So this is another issue that's related to the recruitment of poll workers as well as to the training of poll workers.

MR. MANN: Thank you Mike. Dick, are we moving to the telescope from the microscope, or what?

DICK NIEMI: I think so. But, since Tom mentioned at the beginning, the 2000 election, I have to tell a short story. The first time I got involved in any of this was at a conference here in the Washington area, sponsored by the National Science Foundation, in October of 2000. And it was actually about internet voting, the possibilities that one could eventually vote on the internet. So we spent at least a day and a half talking about internet voting, and at one point during this day and a half, someone said "Well, what about electronic voting at the polling places?" Well, there was mostly silence. And eventually I think someone actually expressed the attitude, "Who cares?" Well, a month later, people decided that maybe this was something we actually should pay a little bit of attention to.

Moving to the telescope, so to speak, I'll go back a little bit to what Paul referred to, the field study that we conducted. Paul mentioned that we had over 1500 people. We had a quite diverse set of people, especially not knowing exactly what we would find. So we had samples of people in three different states. I'm from New York, we had a sample around Rochester, around Ann Arbor, and in the Baltimore area. We went to shopping malls. As I'm sure you know from observing shopping malls, you get quite a variety of people there. We went to -– there was especially one we went to where –- it's sad to say, just basic literacy seemed to be a problem. So we didn't simply go to upscale places. We went to senior citizen centers, we went to other places where there were likely to be senior citizens, so we had a very good mix of individuals, wide variations in age, computer experience, and so on. The participants voted on each of the machines as in the lab study. We did randomize the order so that, as Mike mentioned, if there were learning experiences, it wouldn't affect the results generally. We had two kinds of ballots, that's been mentioned. The two kinds of ballots were: one, an office-block ballot where all of the candidates in a given office are collected together under that office name. So first we had a vote for president and all the candidates were there, and then we had a vote for senator, and so on. Altogether, we had about 20 races for ballot issues at the end. The ballot

was a bit long, but not any longer than one finds on ballots around the country. I've made a collection of ballots from 2000, surprisingly even that had been very little done. And I got the idea to do it for my undergraduate class, frankly, to show them something of what ballots around the country actually looked like. It was pretty interesting. I don't have time to -– it's not quite the place to go into some of the problems with ballots themselves, but just looking at the ballots suggests one way in which elections can be improved. So, we put together a ballot that looked very much like ballots around the country. One as I said was the office-block ballot. The other was an office-block ballot, but with a straight-party device on it, on paper it simply was a box where the voters could fill in an oval that was -– would vote in the partisan contest, would vote straight Republican or straight Democratic, or what have you. We did have partisan offices, we had non-partisan offices. We did have, as Paul mentioned, two offices in which people voted for more than one candidate because that's something that occurs on quite a few ballots around the country. We did ask people to change one of their votes. We asked them to vote one way, and then to change that vote so that we would see their experience at having to make a new selection or having to change who they voted for, and we had them write in a candidate. I should say that writing in the candidate was –- we made sure that the names they wrote in

were very similar. We did not give some short names and some very long names. We came up with a series of names that were all very similar in length, but each unique, and that allowed us then to also connect up the individual ballot that was cast with the voting booklet that they had in which indicated what their preferences were. That's how we could then determine whether they had voted the way they intended. The participants voted randomly and in order on the machines. After they voted on each machine, they filled out a questionnaire about that machine. I think that's important so that they didn't wait until the end and then have to remember, was it this machine or that machine or some other machine that had this particular feature that I liked or didn't like. They completed the questionnaire immediately after voting on the machine. At the end they voted –- excuse me, they filled out a background questionnaire, which gave their age, their computer experience, things of that sort.

So that was the kind of study we did. Paul has mentioned some of the major findings. I might give a few more specifics. The most interesting contrast, I think, was with the paper ballot or the paper ballot optical scan combination. I certainly expected, and I think other people probably would expect, that the paper ballot would be the standard by which everything else would be compared. At least until recently, many of us when we thought about voting, think about a paper ballot, we've all

used paper ballots in one context or another, even if only back in school and so on. But a paper ballot seems so obvious and so simple to do that my expectation was that everything else would be judged in relation to that, and quite frankly, would probably be seen as in some way or other less adequate or harder to use than a paper ballot. In fact, that wasn't the case. Particularly significant, I think, was that the three touch-screen systems, the most computerized systems, were more highly rated on the question of confidence that one's vote would be accurately recorded. So I thought that was particularly significant. There was dissatisfaction about changing the vote on a paper ballot. Strictly speaking, what voters should have done was to turn in the ballot, get a new ballot, so that erasures wouldn't make it a problem at all in counting the ballots. Many of them actually erased anyway, but then often the voters indicated dissatisfaction with the paper ballot process. They noted that it lacked any feedback mechanism. That's interesting also because in one sense, the feedback, so to speak, is right in front of you. You have the ballot; you can look at it anytime you want. But somehow that wasn't as useful to many of the voters as the kind of feedback system that occurred on the computerized systems. Paul mentioned we had a wheel-and-button system. Voters found it difficult to use that. The wheel, in particular, was -- one would frequently turn it and go quickly past where you intended to land, who you

intended to vote for, even the office you intended to vote in. That would result in a little confusion, but quickly people would discover they weren't where they wanted to be, they would turn it back, sometimes going back to where they were or even further back than they had been, and so they would go back and forth until finally landing where they wanted to. And on that system, changing votes or casting a write-in ballot was particularly cumbersome to have to dial the individual letters. Also very interesting to me, being from New York where, by the way, we still will have this year lever machines. Our state, as I'm sure most of you know, has been a little bit slow in adopting a new system. But the full-screen system one also might have thought would be so straightforward, so obvious, that it would be judged very well. You've got everything laid out in front of you, that's the whole point of a full-screen system. In fact, the particular system we tried, we tested, was not judged so well. I think part of it had to do with the fact that it was full-faced, that there's actually too much information presented all at once, and it becomes a bit overwhelming. But also some of the characteristics of the machine, what we call membrane buttons that you touch, had to push a little bit to cast a vote, were judged harder to use. The process for casting a write-in ballot, a write-in vote, was particularly hard because the letters and the screen for showing what you

had cast for the write-in vote was down at the bottom of this very large screen, and it was somewhat difficult to use.

And one general thing on all of the machines, it was relatively harder for voters to change a vote or to correct mistakes than it was to do other things. One of the things that, if you're used to computers, would not have been a problem -- you'd very quickly discover it, and that was the need to deselect before reselecting another choice. For some voters, that was a real problem. They would touch a new candidate, and nothing would happen. It took a while for them to figure out that they would have to touch the candidate that they'd already voted for to deselect that one and then reselect another one.

The major findings regarding help were interesting. For one thing, just the number of people who needed help; even on the paper ballot, some of them needed help. What was especially surprising and, I think unanticipated, were the differences that we found between the two ballot types. We created both ballot types because we know that they're used around the country, thought we should include that sort of variation. I don't think in advance we realized that as many people as occurred really didn't seem to understand what was involved in voting a straight party. To someone who studied political science, it's perfectly obvious and we know exactly what it entails. But if you aren't a political scientist, if

you aren't a political junkie, voting a straight ticket isn't necessarily something apparently that you think about a lot. One of the ways in which this was evidenced was on the paper ballot where people would vote the straight party in the circumstances in which it was there and which they were instructed to do so. Then they would go through all of the partisan offices and vote again, voting the same way. Or they'd vote straight Democratic say, and then they would go through and vote for all of the Democratic candidates that, in fact, they had just voted for by casting the straight-party ballot. Another thing that sometimes would happen is that they wouldn't really understand that the straight party applied to the partisan part of the ballot, but that they still would have to cast votes in the non-partisan part of the ballot. So, I think that was interesting, but also quite unexpected.

Paul mentioned accuracy; I'm not going to say much more about that except that there are a couple of ways you can look at accuracy. Paul mentioned one particular thing where for any given office, accuracy was typically very high. It was lower as one added a little complexity. Certainly when we asked people to change their vote, accuracy dropped. Even when you simply ask people to vote for two candidates for a given race, that lowered the accuracy a little bit. So again, I think the notion that on a very straightforward, very simple ballot people in general have very

little problem with it is true. But people are not political scientists. The moment you start to add something that's a little bit more complex, even sometimes just a little bit more complex, people will have a little bit more need to ask for help and a little bit less accuracy. There's a second way really of looking at accuracy, and that's to say, take the individual as the object of interest and ask across the entire ballot, how many mistakes, if any, did the voter make. And it turns out that many voters did make at least one error.

On the office bloc ballot, the straight office bloc ballot, about 80 percent made no errors. But that means that about 20 percent made at least one error someplace on their ballot when they cast the votes for about 20 races and issues.

On the straight party ballot, it was even more. The percentage making no errors was just a tad over 70 percent. So almost 30 percent made at least one error when casting their ballots. I think those are pretty large, I would say even perhaps shocking, numbers of errors.

I think Paul pretty much summarized the results for the need for help and for satisfaction, so I think that this is perhaps a good place to stop.

MR. MANN: Dick, just to clarify a procedural matter, you went out to shopping centers, to senior citizen's homes to recruit respondents.

MR. NIEMI: Right.

MR. MANN: I gather you set up sort of mini-labs in each of these places with the equipment, rented a room or arranged for a room and brought people in?

MR. NIEMI: Yeah. The only thing I would say is, we didn't set up a lab of the sort that Michael talked about. But, yeah, we roped off an area. Exactly how depended on the circumstances at the mall. In Ann Arbor, I think they had a separate room --

MR. TRAUGOTT: Rented a room.

MR. NIEMI: -- rented a room and put up a sign and made it clear to people as they went by that we were doing this. We did pay people a small amount because it took a while to do this and we got all sorts of people coming in and we would sit them down, we would give them an overview as to what we were doing. We would, as in the lab study, go through the ballot with them, show them what was expected of them and then they would vote and fill out the questionnaires.

MR. MANN: Good. That helps. Now the third feature of the study involved expert reviews that we're not going to talk about here, but it's well described in the volume itself. But there was a piece of the study that was added on really that dealt with voter verification. This comes out of a broad concern, if not in the public as a whole, certainly among many

people who are expert in this area, of the potential for hacking electronic voting machines, raising the question of what verification systems might be available. But as part of this, I think there were also questions raised about how such systems can be audited and what the potential for recounts is as well. So a feature was added to the study and Mike's going to tell us something about what was done and what was learned.

MR. HANMER: Sure. Thanks, Tom. The verification study in a lot of ways mirrors the main study that you've heard described today except on a couple of things that I want to highlight.

First, we looked just in the state of Maryland. We had 815 participants from the state of Maryland. We also had an expert review. And here what we did was, with the other study, there really wasn't a natural control or base system. As you can see from some of the tables in the book and the descriptions of the voting systems, the voting systems in the other study varied on a variety of dimensions. What we wanted to do here with the verification study is isolate the mechanism used for voters to verify the votes. So here the interface that was used was that of the Diebold touch screen voting system. So that was common across all of the verification systems. So we had one system that didn't have any verification at all. That was just a standard Diebold system, the same system that was just tested in the main study.

We also had a system with a paper trail and this was manufactured by Diebold. It was a single unit, basically just attached to the Diebold voting system that had a small window that would print out at the end of the voting process the offices and the candidates that were selected to allow the voter to check their intentions against that paper record.

We also looked at a system by VoteHere called the Sentinal which is a cryptographic system, and we didn't test the full operational capacity. There are a couple different ways to do this. What we had was a system that gave a receipt to voters with special codes that they could then go to the internet or a phone and check that the codes that they had matched the codes that were in the system. It would tell them whether or not their votes had been cast.

There's another way to think about operationalizing this system that we didn't test whereby some set of voters would be randomly selected. They would have a set of codes that would represent their votes. They could then match them against codes that election officials would have that would show them, yes, that the code that they have matches the code that the election official has. It wouldn't say the candidate obviously, because you can't give the individual any record that they can take with them that lists the actual people that they voted for in order to prevent vote buying.

We also studied the MIT audio system that basically consisted of an analog cassette recorder and headphones and the way verification worked with this system was that each voter, as they made their selection, would hear through the headphones a computerized voice repeat the choice. And so obviously if they heard something that didn't match with what they thought they just pressed on the screen, they could then go ahead and correct it. At the end of the process though, there wasn't any sort of additional verification. It was simultaneous throughout the process.

And then the final verification system was a system by a company named Scytl and this consisted of a separate computer monitor that was relatively small that sat beside the voting system and at the end of filling out the ballot, voters would then be queued to go to the separate computer monitor and race-by-race they would see the selections that they made and were asked to verify. So they voted for president. If they voted for Candidate Jones, it would hopefully say Jones on the computer monitor. If it said this, they would hit the button to advance to the next race. So race-by-race they would go through and verify their votes.

So what we did was we compared the set of responses in terms of matching voter's intentions using the voter booklet and the votes recorded on each of the verification systems against the base system without any verification. We also used the same measures in terms of overall

satisfaction and need for help, with some tweaks here and there because each of the systems presented a slightly different set of issues that we wanted to measure.

So overall the results from this process, from voter's perspective, were that the verification systems overall were rated quite highly. But so too was the system without any verification and essentially there weren't any substantive differences between the voter's ratings of the verification systems, in terms of competence that the vote would be recorded, and the system without any verification.

In terms of voters need for help, what we looked at here was the need for help just with the verification process. So we set aside any sorts of concerns voters might have had with touch screen voting in general. Here we found that again voter education is something that is going to have to be part of any effort that puts forth a verification system because this was another complexity that added some confusion to the process and so between 5 and 8 percent of the voters in the study did express the need for help and got actual help from our staff of poll workers during the process.

Our final concern in terms of the voter's perspective was voter accuracy. Here we used just the office bloc ballot and we used a shorter ballot as well. It had just five races. But again we also had races where

we asked people to change a vote. We had a race where we had multiple candidates to be elected.

Starting at the top of the ticket, the office for president, what we found was that the voter verification systems really didn't offer any improvement in terms of accuracy over and above the baseline system that didn't have any verification process. Where the verification system seemed to have some improvement was when we asked voters to vote in a race where two candidates were to be elected. So the verification process there acted as sort of an extra signal to voters to check that they in fact had cast votes for both of the candidates that they intended to. And here we saw some slight improvement in overall accuracy.

Again, given that in this case we had the ability to compare directly the verification systems to a similar system where the only difference really was the ability to verify or not, we were able to look at, through the randomization process of voters voting on various machines, the extent to which voters were more likely to make errors on the verification systems versus the control system or more likely to make errors on the control system than in the verification system.

We found was that roughly 70 percent of people made the same number of errors on both systems. And usually that was zero. That was definitely the most common occurrence. But we found a fair proportion of

people did improve in terms of their accuracy when using the verification systems, but we also found the opposite. A fair number of people also improved their accuracy when using the system without any verification relative to the verification system. And with all but the MIT audio system, there was a small net advantage in accuracy from the verification system. But it was relatively slight.

Just one other thing I need to mention. The voting process isn't just about voters. It's also about election administration, what administrators and poll workers have to do. And the verification systems we found added another layer of complexity for the poll workers. And as one of those poll workers in the field, I can tell you that we struggled with some of these systems. We had trouble getting the paper roll in the correct way. It wouldn't print on one side. And so we realized, ah, we must have to flip this around. We had trouble getting the paper loaded from time to time. The computer monitor system, we often joked how many political scientists does it take to set up a computer monitor. The answer was zero. We couldn't do it. We had one of the undergraduates sometimes on the phone internationally. I couldn't figure out how to connect this thing. He was the only one that could do it. So poll worker training is important. We thought that we were trained pretty well on setting these up.

MR. MANN: The ugly truth is out.

MR. HANMER: But the bottom line, when you're in the field, you have people lined up, you have people in the mall or in an office ready to come and vote. Even in the simulated election, they're excited to get going. There is some pressure and some of these systems were difficult to set up, so I want to emphasize that point that education of voters and poll workers is crucial as we move forward in thinking about these verification systems.

MR. MANN: Mike, thank you. Paul is going to make some brief remarks about where we go from here and then we're going to turn to your questions. So please think about those. Paul.

MR. HERRNSON: Well, one of the issues is about the future of voting. And if you take a long, historical sweep, a lot of improvements have been made in voting. Since the days of punch cards, lever systems, hand-counted paper ballots, we are clearly doing better and we are certainly doing much better than during the day where people used a voice vote or raised their hand in an election, which happened in the early days of our country. So our hope is that the voting systems and ballots used in elections will improve, but, you know, it's hard to tell.

On the one hand, since we've done our study, there have been modifications to the systems including some in response to our study. There have been new systems introduced that are very promising. But on

the other hand, there have been some steps backwards and a lot of those, well, a few of those involve, what I would call, less informed decisions, so we hope that book will help some people.

One example is in Cuyahoga County, Ohio. Cuyahoga County, Ohio had a lot of problem with their system in the past election. It was the Diebold with the paper trail and Mike's talked about that. So in response, they went to a paper ballot optical scan system. Well, the system doesn't perform as well as the touch screen systems in terms of usability, but the set up they selected is one that has some serious problems. Instead of having a precinct count optical scanner where you could put your ballot in and get a check, they chose the central count optical scanner. So voters would fill out the paper and throw it in the box without having any opportunity to put it in the optical scanner to see if they overvoted or undervoted and correct their ballot. So that was a step backwards.

So we're hopeful that things will continue to move forward, that vendors will continue to invest and try to create new systems and election officials will take the advice my father always used to give me, keep it simple, sweetie. Make their ballots not too complicated. And that the future we think looks bright, but we just hope that people are careful, because to return to the title of the book, *Voting Technology: The Not-So-Simple Act of Casting a Ballot*, is what reality is.

MR. MANN: Thank you, Paul. And thanks to everyone. We'd like your questions and we'll do our best to respond.

The first one is going to be over here. Wait for the mike and then please introduce yourself before posing the question.

MR. EPSTEIN: Thank you. Jeremy Epstein with Verified Voting. Great presentation. This is fascinating research. I have two questions. I come from the community of computer scientists and we've obviously had many differences in the computer security field. Many of the comments that have gotten in the press from your study have been we don't need to worry about security. Usability is the only thing that matters. And, of course, many of the computer scientists are saying the opposite. So my first question is how do we get to the point where we're not fighting over which is more important and work together because we recognize, I think most people recognize, that both are important. The computer scientists actually very much agree with you on what happened in Cuyahoga was a huge mistake. We agree with you that precinct based optical scan is a much better choice than central count.

My second question is somewhat related which is there's, one of the real things we worry about in the computer science community is wholesale fraud, not just the retail fraud of individual ballots being corrupted. Is there an analogy in your research wholesale deliberate

misdesign of ballots? I say deliberate misdesign of ballots so as to disenfranchise some community, perhaps the poor voters, less technically astute, or one party. Do you see that that has happened or might happen and that might be an outcome of your result as to avoid the deliberate wholesale fraud by misdesign as opposed to by technical failure? Thank you.

MR. HERRNSON: Can I take a crack at that?

MR. MANN: Yeah, please, Paul.

MR. HERRNSON: Sure. Well, let me just start out with something that is amplified by the press or misrepresented by the press. In terms of security, we agree with you. And so do the computer scientists who disagree with you on other issues. We think security is really important. And we chose not to study it because that wasn't the problem that the United States faced in 2000. It wasn't the problem that was faced in 2006 in Florida. The problem that our country has faced is usability. Problems with people being able to cast their votes as intended, the need for help which kludges up the lines and people walking away not feeling satisfied and trusting the elections and feeling that, you know, maybe things aren't legitimate. So that was the problem we attacked because that was the problem we saw. Security has been a tremendous problem throughout the history of the United States, and here's an area we didn't study, to be

quite frank about it, and an area in which not everyone on the team agrees. So the computer scientists on the team are very concerned about hacking computerized voting systems. So are we. The difference is we don't really know, at least I'll speak for myself, I don't really know the dos and dads to do it.

The political scientists, at least I'll speak for myself, are concerned with what we call wholesale fraud. And wholesale fraud in the United States is something that's taken place many times with paper ballots. How did it happen? Well, Lyndon Johnson got elected. There was a missing ballot box. At least one. The idea of taking ballots and sticking more than one in the box is, you know, the historical record. The removal of some ballots and the replacement of other ballots, also historical record. And this is wholesale fraud because it's done by an organization, or it was done by political parties and organizations that wanted to sway elections. So we have a history of that and we're very concerned about that.

We recognize that voting systems with computerization can be hacked, including the optical scan voting systems. But hacking at least takes a break-in. Paper ballots, easy to break in. There's a terrific video of a Diebold voting system being hacked into by some Princeton professors. And they are quite good at it. They make it compelling and it really makes me nervous. Really a security threat.

There's another video that when I showed it to a friend of mine who never went to college, you know, the Princeton ad, he said, I can give you. I said, what do you think about paper ballots? He goes, Paul, this is how we do it. You carry in a box. I put my Coke on top of it. I say hello, ask you how the election is going. I put my Coke on the other box, go the men's room, come back and carry out the box with the Coke on the top. Which one has the real ballots? Do you know?

So that's wholesale fraud and it doesn't take hacking. So security is critical and the key to security, from I guess the election administrative point of view, which we do hopefully have in place, is to have two eyes watching everything. A system not based on trust, but a system based on distrust where you have Democrats and Republicans watching paper ballots move around, watching computer chips move around and checking on coding and things like that. So we think security is important. We just didn't look at it. And again, there's differences of opinion on the team and some others might want to address that.

MR. MANN: Mike.

MR. TRAUGOTT: I'd like to add one comment that goes to the term that you used of deliberate misdesign. And the concept, as I would interpret it, of deliberate misdesign has to do with the intent of people who either design, print, produce ballots. And we don't have any indication that

among people working in the industry in that way, or among election administrators, that there are deliberate attempts to misdesign ballots.

We do know and we have a lot of research background on this, primarily based on questionnaire design, that it's possible to make errors in the design of ballots that have to do with formatting, highlighting and so on, which we would incorporate under the heading of usability criteria. And if you go back to, for example, the butterfly ballot in Palm Beach County, the best answer to the possibility of this occurring is, of course, to do pre-testing, which is the term that we use in survey research to take the questionnaire, or in this case to take the ballot design, and to try it out on people. In the case of an egregious or large size error, as in the case of the butterfly ballot, this would have shown up very quickly.

So, again, I think that this is a potential change or shift in procedures that might become more necessary as we adopt more technology and the ballot formats in a technical sense, you know, change more frequently over time that ought to be adopted. But the question of intent, I think, is a completely different issue.

MR. MANN: All right. Norm.

MR. ORNSTEIN: Just a comment on the last exchange and then a question. Excepting that the potential for wholesale fraud with paper ballots is great and that you need two eyes out there, it is very much worth

emphasizing that absentee ballots, which are all paper ballots, which are not there for two eyes to watch on one day, but which can sit someplace unattended for weeks or months, offer such enormous potential for wholesale fraud that it deserves an emphasis because election officials, who love absentee votes because it takes the pressure off them on election day and reduces their expenses, simply glide over that fact.

The question is this, and it's a familiar one to you, Paul. Recognizing all of the usability issues that you've talked about, and the questions of verification, look at the next stage. We have a close election that requires a recount. Which of the systems that you looked at will give a level of confidence to a suspicious electorate given our recent experience if you have to do a recount? That this isn't just taking a set of numbers that are there, looking at a machine and saying well that's what we recorded. But really give people a sense of confidence that you can actually do a recount in a close election and have a result that is accurate.

MR. HERRNSON: Well that's a question I think we've discussed. I've thought about. I'm not sure I have a great answer to it. There's the fear with paper that paper disappears or that paper printers, paper trails don't work. So in Cuyahoga County, they found with their Diebold system with a paper trail that about 20 percent of them failed. So, are you going to count on the paper and ignore the 20 percent that maybe showed up in

the morning or in the afternoon when the paper trailed? Or are you going to count the electronic situation?

Some of the systems we tested including Nedap Liberty Vote, you're voting on the screen. It's recording it electronically, but there's a paper trail inside that you don't know about. The Diebold system also can produce paper print out.

So, I guess, your question is what is the ballot of record. And my inclination is with an electronic system, I would go with the electronic count as a ballot of record. I would also hope, that to reinforce people's confidence in that, that a system of random testing would be put in place. I can't remember the exact name of it, but where electronic voting systems are pulled off-line and checked for their accuracy. Parallel testing, thank you. That's Roy Saltman. And tested intermittently throughout the day so you can know within a high degree of probability that things are accurate.

I would also say the answer to your question will change with time. We first voted with paper ballot. You write down the name. You circle the name. And people were trusting of that. Then we began to vote with lever machines where it's a big green or gray box with levers, or black in some places. Where I voted, they were big green monsters and they weighed like 1,000 pounds each. But people soon began to trust that even though it wasn't transparent.

So voter trust is a tricky issue and I think if we were to stick with touch screens, people would pretty much universally start to trust those. And there are a lot of surveys out there. Some show that voters are less trusting of electronic systems. Some show they are more trusting of electronic systems. So my answer is the vote of official record, I guess I would lean towards the electronic vote because at least it has to be hacked over the paper vote.

I'd also like to see from the political scientist out there, someone do a study and just find out in different precincts when there are paper ballots and there are electronic ballots, and then when there are both, as in an electronic system with paper trails, does the number of total votes match up to the number of people that actually said they voted and see if there are differences by those systems. So it's not an exact answer.

MR. MANN: Dick.

MR. NIEMI: I whispered to Tom that I had an answer for you.

UNIDENTIFIED MALE SPEAKER: Oh, there you go.

MR. NIEMI: But it's not my personal preference so much as a comment on public perceptions and I think that, at the moment, I think the paper ballot with an optical scan is what more people would perceive as what's really useful to have for recounting. I agree with I think 99 percent, maybe 100 percent, of what Paul said and yet if you frame the question in

terms of what do people out there, and both some people who are not so vocal and people who are very vocal about it, I think at the moment we don't have computer systems that are completely convincing to people and a paper ballot seems at least like a really good hard, it is a hard copy. We call it that. A good copy of and how can you go wrong, some people would think, at least. If you have that, you can literally count them by hand, although God help the people who have to do that in a really large precinct or a whole state or something. But nonetheless it gives the impression of being very accurate. So if you ask the question in that way, that's the answer that I would give.

MR. MANN: Mike.

MR. TRAUGOTT: I would just add one other comment which is I believe, first of all, the loss in confidence is real. It's not the result of personal experiences that people have. It's a mediated reaction to the coverage of elections, either specifically or in broader thematic terms. And there are a group of projects, research projects, underway pursuing the idea of audits, election audits, as a way to make the process clearer and more transparent to voters.

Now, in the current stage of things, there's a disagreement about what an audit is. For some people it's a recount and it really just goes to the issue of accuracy. But for other people, the concept of an audit is

what happens on election day when people show up if they don't find themselves, for example, on the registration polls, books, can they get a provisional ballot and so on. So more disclosure. Over time it has to be repeated about the nature of the process and how well it's functioning I think is one very good potential response to this. It's not going to have any immediate effect, but greater transparency and repeated presentation of data about how the system is functioning I think is the best way to address this.

MR. MANN: Roy.

MR. SALTMAN: I'm Roy Saltman, author of --

MR. MANN: Use the mike.

MR. SALTMAN: -- *History and Politics of Voting Technology*. Your study is very important. I'm glad it's been done. We all need, I'm sure in five years from now as voting technology changes, you may have to do this very thing over again because of new technology, but that's the way the world works.

I want to expand on the issue of security. Professor Hanmer did a study on voter verification only from the point of view of whether voters would find it more difficult or less difficult or to what extent it added difficulty. Of course that's not really the issue with verification. It's like asking the customers of ENRON to decide that the, what the auditors

found later. Of course the customers couldn't do that and the customers are like the voters. The issue of voter verification is for the help of the auditors who will determine that the vote was adequately cast.

Now Mike has raised the issue and put it in a larger context of voters finding that they're not on the roles and that's an issue of voter registration. It's a much larger issue than what you've considered, and that, of course, is another big problem that we have in this country which is not covered at all by your report and we can talk about research that needs to be done in that area.

Of course, the problem in auditing is that the customers, that is the voters, may find it a little more difficult, but the auditors need it in the larger context. Mike briefly raised the issue of the larger issue of public confidence from an overall point of view as opposed to the individual voter's confidence in that he did or she did the right thing. I'm glad to hear, I didn't know, that Ohio had changed from their horrible paper trail problem that they had to a centralized optical scan reading which is, I agree, a terrible step backward. Precinct count optical scan, we know is better. First of all, you can get the voter to get the ballot back to correct it and we found that in Florida, in 2000, we know that those counties that had centralized optical scan had a much higher error rate than those counties that had precinct optical scan. But my issue, I guess, is simply to

look at the auditing capability, there are two things in verification. One, yeah, it may hurt the voter to -- we want to minimize the additional work that the voter has to do and yet provide the necessary information to the auditors so that it can be determine that the vote was adequately cast.

MR. MANN: Thank you, Roy. Do Mike or Paul want to --

MR. HANMER: I'll just offer, I mean, you're right we didn't study the auditing capacities and, for example, a couple of the systems had computers behind the scenes that were separate audit devices. So you can have verification and audit or just audit without verification. I agree that both of these issues are important. We did study this from the voters' perspective rather than the perspective of what's going to happen in a recount. We couldn't do everything, so that's what we chose to focus on.

MR. HERRNSON: I'd like to follow up on that because there's auditing capability and theory and then there's auditing in reality. Now one of the problems with auditing in reality, let's say you're using a punch screen system or a paper ballot system and is figuring out how the person voted. Someone on a paper ballot might intend to vote for Candidate A, but when it's put through the optical scanner, because they first voted for Candidate B and didn't completely erase it, comes out as an overvote. How do you decide what the person intended to do at that point? Well, we learned in 2000 very often you can't.

The second point about auditing reality, as we learned in 2000, is it doesn't always happen. At some point of another, some impatient politicians file a lawsuit hoping to close things down so their person wins, and some court says okay, we're with you, and the ballots don't get counted. So there is a difference between capability theory and reality and we need to be sensitive to that, whether we're talking about electronic systems or paper-based systems of any kind.

MR. MANN: Len.

MR. SHAMBAN: Lenny Shambon, a Ford-Carter Commission Staffer. When Georgia switched from punch card machines to touch screen machines, in I believe 1982, they found an improvement in the so-called undervote rate, the rate of blank races. With punch card, they were 3 percent and then when they went statewide to touch screen, they went to .86 percent. So that was a gain, a real measurable gain in counted votes.

You see, may be saying, from your study that you see a differential between touch screen machines and optical scan machines and that the touch screen are also capturing more votes correctly. They are more accurate than the optical scan machines. In the recent debate over computer security, we have now a measurable improvement in captured votes, recorded votes by going to touch screen versus the concern about

computer security. So we have a measurable gain in votes by being in touch screen universe versus an unmeasured, more speculative question about lost votes through computer security issues. Do you think this is a good thing to be putting the balance toward the computer security side in this debate since most states in the recent past have been moving away from touch screen to optical scan? And my second question is do you think it's an advisable thing for the federal government to be dictating any particular voting system technology at this point in the development of technology?

MR. HERRNSON: That's a great question. I guess my own personal view, I'm concerned with election security not computer security and there are problems with security hypothetical with computers and computerized voting systems including the scanners, and then there are problems historical with paper ballots. So I think, you know, the so-called disagreement between security people and usability people, I think the press plays that up because the press is biased just to show conflict. We think that there, I personally think they're both very important. I looked at one because that's what I saw as the most important problem.

And the federal government dictating voting systems? Well, I can speak for myself. I think the more systems that are out there, the better, because when we compete, we get better products and also because

different types of people have different needs in terms and abilities and senior citizens are more comfortable with one system than are young people and I think that there should be variety. When we start getting to the point where the federal government says you all have to use this one voting system, we might be at the point where we all have to wear little blue suits and I don't want to wear one.

MR. MANN: Mike.

MR. TRAUGOTT: Well, I think your question indirectly also points to this issue of audits, because the concept that you're describing, which has been called residual votes, is an amalgam of a variety of problems, undervotes, overvotes, spoiled ballots and so on, which currently we don't have the ability to measure with any precision, or only in some places because the records are kept differently. So part of the difference in the systems and the way people talk about their systems is in this global heterogeneous way of residual votes, but partly, particularly with regard to, for example, the Ohio experience, focuses primarily on overvotes and the ability of some devices to detect overvotes and at least eliminate that proportion. So I think if we had better information, better data, we could address these differences more precisely.

With regard to the federal government dictating voting systems, this is a description of some contention, as you know. We should distinguish

between the part of HAVA that says you shouldn't use lever machines and punch cards any more because lever machines haven't been manufactured in 25 years and there's a potential spare parts disaster looming. Right? And we know that punch card ballots can degrade over time, so the act of actually recounting them several times can introduce problems of its own. That kind of policy proposal from saying you shall only buy this kind of machine, and the Government hasn't said you shall only buy this kind of machine, but they've threw the allocation of funds (inaudible). They tried to eliminate some potentially problematic machines. Given the 2000 experience, this seems to me relatively reasonable.

MR. MANN: Dick.

MR. NIEMI: Just a brief comment. We didn't really study undervoting much and I think very few people have and one has to be careful in thinking about undervoting. Undervoting means you don't vote for some offices and we're not required to vote for all offices. So if a voter decides to simply vote, let's say, for the top for the top of the ticket, for president and then vote for nothing else, that's not necessarily an inaccurate or problematic ballot at all. It may be a perfect expression of that particular voter's intent. So one needs to be very careful in talking about undervoting and exactly even how you evaluate it, what you think of

it, may vary from one person to another. Is getting everyone to vote a complete ballot the goal? Well, I think one can take issue with that.

MR. MANN: We won't -- yeah.

MR. SHAMBON: Just a quick follow up on undervoting. The drop from 3 percent in Georgia to .86 percent assumed, and the Ford-Carter Commission concluded, that there is about a half a percent of intentional undervoting. They were only looking at the top of the ticket and they were comparing the rates of undervoting between two systems. So I think to that extent, it was a controlled experiment.

MR. MANN: And then there is the example discussed in the book, of course, of Florida 13 in 2006, which was clearly a problem and not an intention. We're running out of room. We're going to try to sneak in a couple of questions. One right here, John, and then this gentlemen right here with the beard and then we're going to call it.

MR. FORTIER: John Fortier. I'm going to oversimplify a little bit, but two types of error you can imagine. First, a machine checking error that you might make initially and then some sort of later, looking at a ballot and fixing the error after the fact, either on an opti-scan or the summary screen. Did you have some sense of the balance of these things and which worked better? And were people making, were more of the errors initial errors? Or were there problems with correcting errors after the fact?

And was there a difference among the technologies on that?

MR. HERRNSON: I think best part of the study to speak to that was the lab study, because there we had video tape of people things and it was really a documentary of trials and tribulations. Maybe Mike, you want to talk about that a little bit?

MR. TRAUGOTT: Well, the difficulty with the lab study, of course, is that we only had a few subjects whom we could study, look at intently. And I would say that the main factor there was, in the aggregate, looking at errors in the aggregate and what the result was at the end. If you could think of each of these devices as having an optimal path through it, fewest number of motions, strokes or behaviors. The more that a person deviated from the optimum, which didn't mean obviously that they took fewer actions than required. It always meant they took more actions than required. Generally the higher the error rate was. So that's why we feel pretty comfortable talking about how important these interfaces are, these usability interfaces, because when voters -- I'll use the term get lost, but the meaning of get lost here is spend more time moving through the device trying to figure out how to get to the place where they can cast the votes they want, the likelihood of an error increases. So actions along the way, for example, telling a voter at the time that they cast two votes for the same office when only one is allowed, would be probably important for

these people. Although in the grand scheme of things, it goes back to voter education and helping them to navigate appropriately and efficiently through the ballot.

MR. MANN: Yes. Our final question right here. This gentlemen.

UNIDENTIFIED MALE SPEAKER: Yes, well –

MR. MANN: No. Right here. Right here. This gentlemen right here. Please.

MR. ALTMAN: Okay. Thank you.

MR. MANN: Beard, right.

MR. ALTMAN: I'm Fred Altman and I'm a poll worker/poll judge in Montgomery County and there a couple things that weren't commented on. We use poll books, which will allow us to find any voter in the state if in our precinct or not, so that's very convenient. And it also tallies up the total number of people who are authorized to vote, so that can easily be compared to the machines and prevent overvoting.

The voting machines themselves do have a printer in them. We print out the zero reports and the reports at the end of the day. That printer could easily print out the individual's vote. They could put that in a box. You would not use that as the official count, but you could compare it to the machine and say, you know, it's at least consistent with, even if there are some people who didn't put it in (inaudible) under. That would

be a fairly easy way of providing an audit trail.

And the one remaining comment is, it's really hard to recruit people for 15 hour days.

MR. HERRNSON: The EAC has a program that is designed to help with that. And actually my center at Maryland recruited college students. I think we got in a space of two weeks, 132 students to be election judges. So, I'm with you. We have to find more ways to get people to serve as election judges. We've got to pay them more. We've got to make them work less. And maybe we ought to give them better cookies, but it's a real issue.

MR. MANN: Any other? Well, listen, remind you all this book is available in the Brookings Book Store, *Voting Technology: The Not-So-Simple Act of Casting a Ballot*. I want to thank our colleagues here for the book and presentation today and thank you all for coming. We are adjourned.

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