

Securing Digital Democracy

Lecture 7 | *Human Factors*



J. Alex Halderman
University of Michigan

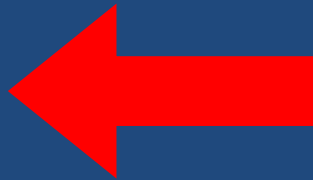
Usability

Integrity

The outcome matches voter intent.

Votes are cast as intended.

Votes are counted as cast.



7.1 Usability

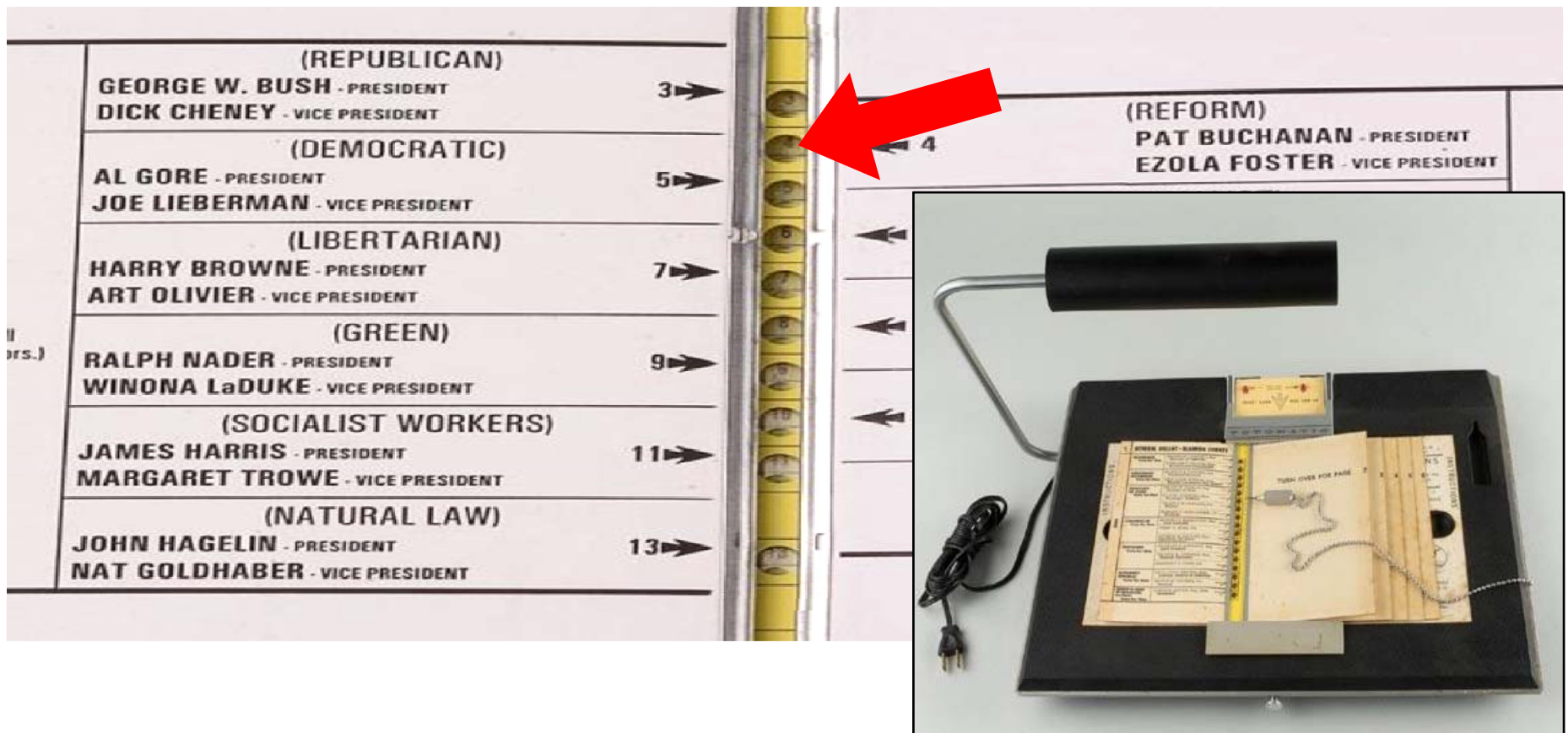
(REPUBLICAN)	
GEORGE W. BUSH - PRESIDENT	3 ➡
DICK CHENEY - VICE PRESIDENT	
(DEMOCRATIC)	
AL GORE - PRESIDENT	5 ➡
JOE LIEBERMAN - VICE PRESIDENT	
(LIBERTARIAN)	
HARRY BROWNE - PRESIDENT	7 ➡
ART OLIVIER - VICE PRESIDENT	
(GREEN)	
RALPH NADER - PRESIDENT	9 ➡
WINONA LaDUKE - VICE PRESIDENT	
(SOCIALIST WORKERS)	
JAMES HARRIS - PRESIDENT	11 ➡
MARGARET TROWE - VICE PRESIDENT	
(NATURAL LAW)	
JOHN HAGELIN - PRESIDENT	13 ➡
NAT GOLDHABER - VICE PRESIDENT	

(REFORM)	
PAT BUCHANAN - PRESIDENT	4 ⬅
EZOLA FOSTER - VICE PRESIDENT	
(SOCIALIST)	
DAVID McREYNOLDS - PRESIDENT	6 ⬅
MARY CAL HOLLIS - VICE PRESIDENT	
(CONSTITUTION)	
HOWARD PHILLIPS - PRESIDENT	8 ⬅
J. CURTIS FRAZIER - VICE PRESIDENT	
(WORKERS WORLD)	
MONICA MOOREHEAD - PRESIDENT	10 ⬅
GLORIA La RIVA - VICE PRESIDENT	
WRITE-IN CANDIDATE	
To vote for a write-in candidate, follow the directions on the long stub of your ballot card.	

Votomatic Butterfly Ballot

Florida, 2000


7.1 Usability



OFFICIAL GENERAL ELECTION BALLOT
SARASOTA COUNTY, FLORIDA
NOVEMBER 7, 2006

CONGRESSIONAL
UNITED STATES SENATOR
(Vote for One)

Katherine Harris	REP	<input type="checkbox"/>
Bill Nelson	DEM	<input type="checkbox"/>
Floyd Ray Frazier	NPA	<input type="checkbox"/>
Belinda Noah	NPA	<input type="checkbox"/>
Brian Moore	NPA	<input type="checkbox"/>
Roy Tanner	NPA	<input type="checkbox"/>
Write-In		<input type="checkbox"/>



Page 1 of 21
Public Count: 0

Next Page

iVotronic
DRE
Ballot

Sarasota, FL
2006

U.S. REPRESENTATIVE IN CONGRESS 13TH CONGRESSIONAL DISTRICT (Vote for One)		
Vern Buchanan	REP	<input type="checkbox"/>
Christine Jennings	DEM	<input type="checkbox"/>
STATE		
GOVERNOR AND LIEUTENANT GOVERNOR (Vote for One)		
Charlie Crist	REP	<input type="checkbox"/>
Jeff Kottkamp		
Jim Davis	DEM	<input type="checkbox"/>
Daryl L. Jones		
Max Linn	REF	<input type="checkbox"/>
Tom Macklin		
Richard Paul Denbinsky	NPA	<input type="checkbox"/>
Dr. Joe Smith		
John Wayne Smith	NPA	<input type="checkbox"/>
James J. Kearney		
Karl C.C. Behn	NPA	<input type="checkbox"/>
Carol Castagnero		
Write-In		<input type="checkbox"/>
Previous Page	Page 2 of 21 Public Count: 0	Next Page

14%
undervote rate!

~1%
undervote rate

Banner Blindness

Slow Responses

Miscalibrated Displays

21 Page Process!

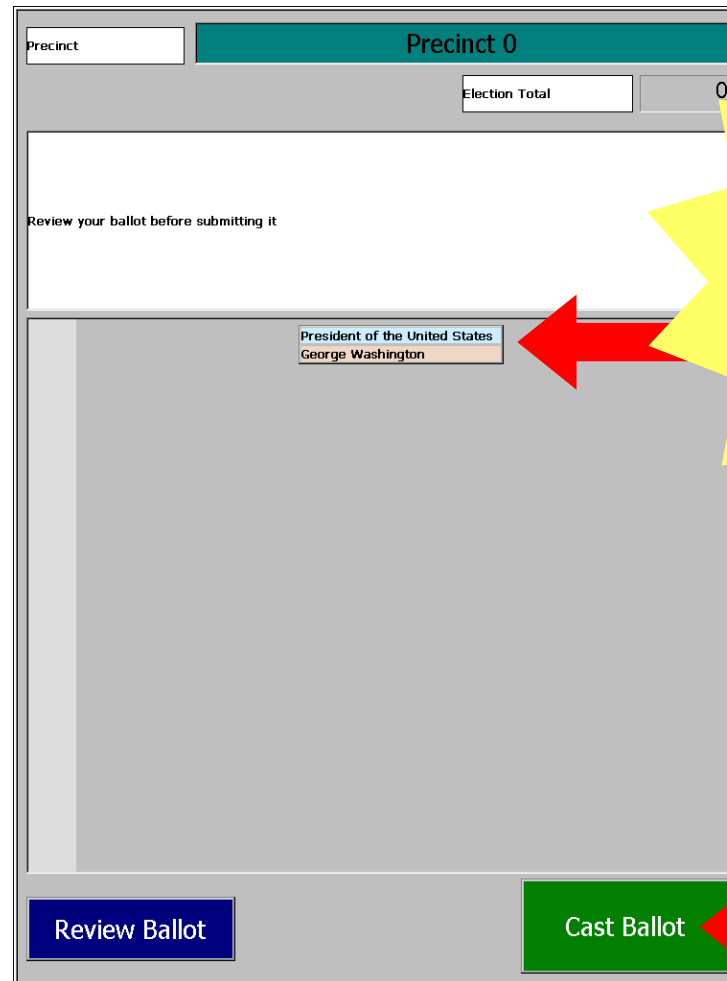
U.S. REPRESENTATIVE IN CONGRESS 13TH CONGRESSIONAL DISTRICT (Vote for One)	
Christine Jennings	REP <input type="checkbox"/>
	DEM <input type="checkbox"/>
STATE ←	
GOVERNOR AND LIEUTENANT GOVERNOR (Vote for One)	
	REP <input type="checkbox"/>
	DEM <input type="checkbox"/>
Max Linn	REF <input type="checkbox"/>
mbinsky	NPA <input type="checkbox"/>
h	NPA <input type="checkbox"/>
h	NPA <input type="checkbox"/>
erney	NPA <input type="checkbox"/>
Karl C.C. Behn	NPA <input type="checkbox"/>
nero	<input type="checkbox"/>

Previous
Page

Page 2 of 21
Public Count: 0

Next
Page

DRE Review Screens



The screenshot shows a web interface for a Direct Recording Electronic (DRE) system. At the top, there is a header with a 'Precinct' dropdown menu set to 'Precinct 0' and an 'Election Total' field showing '0'. Below the header, a message reads 'Review your ballot before submitting it'. The main area displays a ballot for the 'President of the United States' with 'George Washington' as the selected candidate. At the bottom, there are two buttons: 'Review Ballot' and 'Cast Ballot'. A yellow starburst annotation with the text 'WHAT COULD GO WRONG?' points to the 'Cast Ballot' button. A red arrow points from the 'Cast Ballot' button to the text '6% "fleeing voters"'. Another red arrow points from the 'Cast Ballot' button to the 'President of the United States' candidate box.

Precinct

Precinct 0

Election Total 0

Review your ballot before submitting it

President of the United States
George Washington

Review Ballot

Cast Ballot

Usability test results:
checked

**WHAT
COULD GO
WRONG?**

6% "fleeing voters"

Usable Paper Ballots

7.2 Usable Paper Ballots

Securing Digital Democracy

Voters Don't Read Instructions

10% missed
this question!

King County, Washington
Official General Election Ballot
November 3, 2009

Instructions	State of Washington	King County
Making selections Use a dark pen to completely fill in the oval next to your choice.	Passed by the Legislature and Ordered Referred by Petition Referendum Measure No. 71 The legislature passed Engrossed Second Substitute Senate Bill 5688 concerning rights and responsibilities of state-registered domestic partners and voters have filed a sufficient referendum petition on this bill. This bill would expand the rights, responsibilities, and obligations accorded state-registered same-sex and senior domestic partners to be equivalent to those of married spouses, except that a domestic partnership is not a marriage. Should this bill be: <input type="radio"/> APPROVED <input type="radio"/> REJECTED	Charter Amendment No. 4 Adding New Section 897 - High Conservation Value Properties Shall the King County Charter be amended to add a new Section 897 that would provide enhanced protection for certain county properties designated as high conservation value properties by prohibiting the county from conveying or relinquishing its interest in those properties or authorizing their expanded use, except in specified circumstances, as provided in Ordinance No. 16600? <input type="radio"/> YES <input type="radio"/> NO
Returning the ballot Insert completed ballot into security envelope. Insert security envelope containing completed ballot into return envelope. Sign the oath on the return envelope.	King County Charter Amendment No. 1 Repeat of Section 350.20.30 and Portions of Article 9 - Transitory Provisions Shall those no longer relevant portions of King County Charter Article 9 relating to the county's prior transition to a home rule charter and King County Charter Section 350.20.30, relating to the county's transition to a metropolitan form of government, be repealed, as provided in Ordinance No. 16484? <input type="radio"/> YES <input type="radio"/> NO	County Executive short and full term nonpartisan office vote for one <input type="radio"/> Susan Hutchison <input type="radio"/> Dow Constantine <input type="radio"/> Write-in
Optional Write-in To vote for a write-in candidate, write the name and darken the oval.	Charter Amendment No. 2 Repeat of Charter Section 475 - Work Programs and Allowments Shall King County Charter Section 475, relating to preparation of work programs and requested allotments and to appropriation transfers, be repealed, as provided in Ordinance No. 16546? <input type="radio"/> YES <input type="radio"/> NO	Sheriff nonpartisan office vote for one <input type="radio"/> Sue Rahr <input type="radio"/> Write-in
Making corrections To make a correction, draw a line through the candidate's name. You then have the option of making another choice.	Charter Amendment No. 3 Amendment of Section 800 - Charter Review Shall King County Charter Section 800 be amended to clarify that charter commission appointees are to be confirmed by the council and to provide that the council is required to consider proposed charter amendments and act on them at an open public meeting, as provided in Ordinance Nos. 16547 and 16599? <input type="radio"/> YES <input type="radio"/> NO	Assessor unexpired 2-year term nonpartisan office vote for one <input type="radio"/> Graham Albertini <input type="radio"/> Gene Lux <input type="radio"/> Lloyd Hara <input type="radio"/> Bob Rosenberger <input type="radio"/> Bob Blanchard <input type="radio"/> Write-in
State of Washington Proposed by Initiative Petition Initiative Measure No. 1033 Initiative Measure No. 1033 concerns state, county and city revenue. This measure would limit growth of certain state, county and city revenue to annual inflation and population growth, not including voter-approved revenue increases. Revenue collected above the limit would reduce property tax levies. Should this measure be enacted into law? <input type="radio"/> YES <input type="radio"/> NO	Judicial Court of Appeals, Division No. 1, District No. 1 Judge Position No. 3 nonpartisan office vote for one <input type="radio"/> Anne L. Ellington <input type="radio"/> Write-in	Port of Seattle Commissioner Position No. 1 nonpartisan office vote for one <input type="radio"/> John Creighton <input type="radio"/> Write-in

Continued on other side

To vote for a write-in candidate, write the name and darken the oval.

Ann
Write-in

Making corrections

To make a correction, draw a line through the candidate's name. You then have the option of making another choice.

Jane Doe

State of Washington

Proposed by Initiative Petition

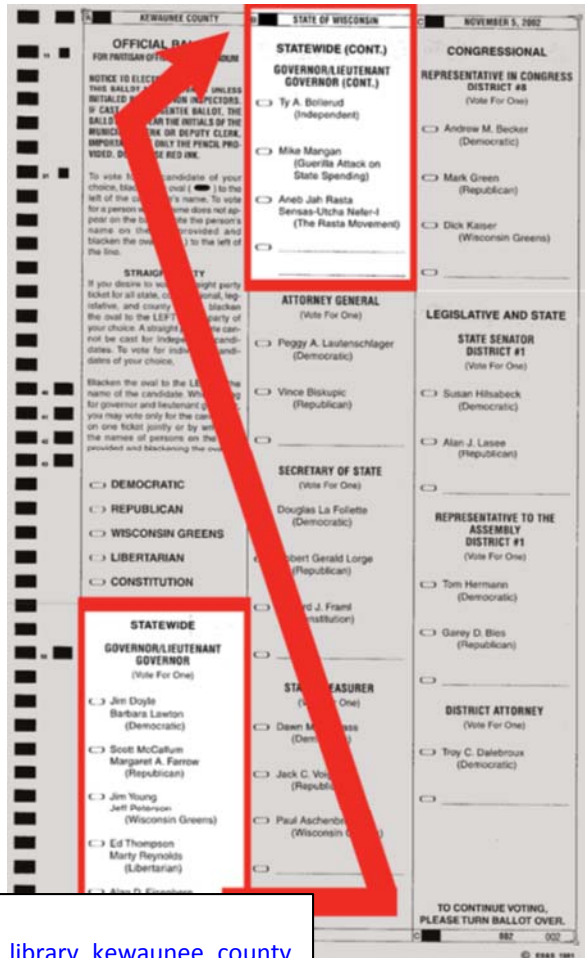
Initiative Measure No. 1033

Initiative Measure No. 1033 concerns state, county and city revenue. This measure would limit growth of certain state, county and city revenue to annual inflation and population growth, not including voter-approved revenue increases. Revenue collected above the limit would reduce property tax levies. Should this measure be enacted into law?

YES

NO

Complex Ballot Layouts



12% didn't cast
valid vote for
Governor!

Source: Brennan Center analysis

http://www.brennancenter.org/content/resource/ballot_library_kewaunee_county

7.2 Usable Paper Ballots

Securing Digital Democracy **M**

Inconsistent Design

17% missed
Senate race

PAGE 1

PRESIDENT AND VICE PRESIDENT

Vote for Party

JIMMY CARTER, for President WALTER F. MONDALE, for Vice President	Democratic	1 →	<input type="radio"/>
LESTER G. MADDOX, for President WILLIAM D. DYKE, for Vice President	American Independent	3 →	<input type="radio"/>
ROGER L. MACBRIDE, for President DAVID P. BERGLAND, for Vice President	Independent	5 →	<input type="radio"/>
GERALD R. FORD, for President ROBERT DOLE, for Vice President	Republican	7 →	<input type="radio"/>
MARGARET WRIGHT, for President BENJAMIN SPOCK, for Vice President	Peace and Freedom	9 →	<input type="radio"/>
GUS HALL, for President JARVIS TYNER, for Vice President	Independent	11 →	<input type="radio"/>
PETER CAMEJO, for President WILLIE MAE REID, for Vice President	Independent	13 →	<input type="radio"/>

CONGRESSIONAL

UNITED STATES SENATOR

Vote for One

JACK MCCOY, American Independent Painting, Decorating Contractor	15 →	<input type="radio"/>
JOHN V. TUNNEY, Democratic United States Senator	16 →	<input type="radio"/>
DAVID WALD, Peace and Freedom Research Engineer, Teacher	17 →	<input type="radio"/>
S. I. "SAM" HAYAKAWA, Republican University President Emeritus	18 →	<input type="radio"/>
	19 →	<input type="radio"/>

2013 BE

PAGE 3

REPRESENTATIVE IN CONGRESS
22nd District

Vote for One

ROBERT L. SALLEY, Democratic State Commissioner-Educator	20 →	<input type="radio"/>
CARLOS J. MOORHEAD, Republican Member of Congress	21 →	<input type="radio"/>

STATE SENATOR
21st District

Vote for One

RAYMOND J. LOFTUS, Democratic College Instructor-Businessman	26 →	<input type="radio"/>
NEWTON R. "NEWT" RUSSELL, Republican State Senator, 21st District	27 →	<input type="radio"/>

MEMBER OF THE ASSEMBLY
42nd District

Vote for One


FRANK LANTERMAN, Republican Incumbent Member of the Assembly, California Legislature	31 →	<input type="radio"/>
PATRICK JOHNSTON, Democratic Attorney at Law	32 →	<input type="radio"/>

3001 C-E

Source: Brennan Center analysis

http://www.brennancenter.org/content/resource/ballot_library_kewaunee_county

7.2 Usable Paper Ballots

OFFICIAL BALLOT		
ALAMEDA COUNTY, CALIFORNIA		
NOVEMBER 2, 2010 GENERAL ELECTION		
RANKED-CHOICE VOTING BALLOT		
INSTRUCTIONS TO VOTERS: USE BLACK OR BLUE BALLPOINT PEN ONLY. To vote for a candidate of your choice, complete the arrow  to the right of the candidate's name. To vote for a qualified write-in candidate, PRINT the person's name in the blank space provided and complete the arrow. You may rank up to three choices. Vote across in each race.		
1	Mark your first choice in Column 1.	
2	Mark your second choice in Column 2. This choice must be different from your first choice.	
3	Mark your third choice in Column 3. This choice must be different from your first and second choices.	


NONPARTISAN CITY FOR MAYOR	NONPARTISAN CITY FOR MAYOR	NONPARTISAN CITY FOR MAYOR
1 FIRST CHOICE <small>Vote for One</small>	2 SECOND CHOICE <small>(This must be different from your first choice.) Vote for One</small>	3 THIRD CHOICE <small>(This must be different from your first and second choices.) Vote for One</small>
ELEANOR ROOSEVELT	ELEANOR ROOSEVELT	ELEANOR ROOSEVELT
BOOKER T. WASHINGTON	BOOKER T. WASHINGTON	BOOKER T. WASHINGTON
DIEGO RIVERA	DIEGO RIVERA	DIEGO RIVERA
ARTHUR MILLER	ARTHUR MILLER	ARTHUR MILLER
SHIRLEY HORN	SHIRLEY HORN	SHIRLEY HORN
BRUCE LEE	BRUCE LEE	BRUCE LEE

Faulty Mental Models

NONPARTISAN CITY FOR MAYOR	
1	FIRST CHOICE
<small>Vote for One</small>	
ELEANOR ROOSEVELT	<input type="checkbox"/>
BOOKER T. WASHINGTON	<input type="checkbox"/>
DIEGO RIVERA	<input type="checkbox"/>
ARTHUR MILLER	<input type="checkbox"/>
SHIRLEY HORN	<input type="checkbox"/>
BRUCE LEE	<input type="checkbox"/>
	<input type="checkbox"/>

NONPARTISAN CITY FOR MAYOR	
2	SECOND CHOICE
<small>(This must be different from your first choice.) Vote for One</small>	
ELEANOR ROOSEVELT	<input type="checkbox"/>
BOOKER T. WASHINGTON	<input type="checkbox"/>
DIEGO RIVERA	<input type="checkbox"/>
ARTHUR MILLER	<input type="checkbox"/>
SHIRLEY HORN	<input type="checkbox"/>
BRUCE LEE	<input type="checkbox"/>
	<input type="checkbox"/>

NONPARTISAN CITY FOR MAYOR	
3	THIRD CHOICE
<small>(This must be different from your first and second choices.) Vote for One</small>	
ELEANOR ROOSEVELT	<input type="checkbox"/>
BOOKER T. WASHINGTON	<input type="checkbox"/>
DIEGO RIVERA	<input type="checkbox"/>
ARTHUR MILLER	<input type="checkbox"/>
SHIRLEY HORN	<input type="checkbox"/>
BRUCE LEE	<input type="checkbox"/>
	<input type="checkbox"/>



7.2 Usable Paper Ballots

Design Best Practices

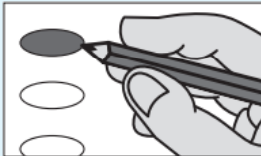
Simple instructions,
plain language

Meaningful use of
color and contrast

Official Ballot for General Election
Tuesday, November 02, 2004 1 / 5

Instructions


Making selections



Fill in the oval to the left of the name of your choice. You must blacken the oval completely and do not make any marks outside of the oval. You do not have to vote in every race.

! Do not cross out or erase, or your vote may not count. If you make a mistake or a stray mark, ask for a new ballot from the poll workers.

Optional write-in

 or write-in:

President and Vice President of the United States

Vote for 1 pair

☐ John F. Kerry and John Edwards

Columns and layout reinforce organization

☐ Peter Miguel Camejo Independent

☐ or write-in:

U.S. Representative

Vote for 1

☐ Brad Plunkard Democrat

☐ Bruce Reeder Republican

☐ Brad Schott Libertarian

☐ or write-in:

County Commissioners

! Vote for up to 2

☐ Camille Argent Democrat

☐ Chloe Witherspoon Republican

☐ Amanda Marracini

Vote for 1

Large text
Avoid ALL CAPS

Instructions where
voters need them

http://www.aiga.org/archivedmedia/ballot-design-samples/DFD_OpticalScan_SampleBallot_Proposed.pdf

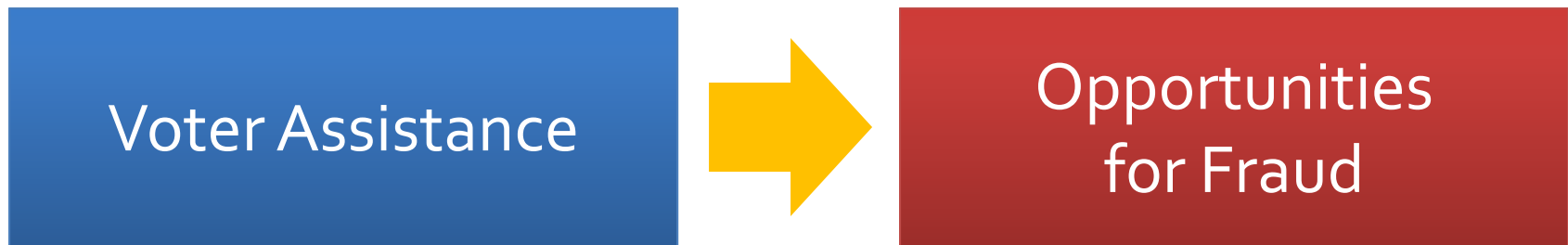
Based on Design for Democracy and EAC guidelines, adapted by Drew Davies and Joe Sparano, Oxide Design Co.

Accessibility

Voters with Disabilities

In the U.S. ... **1.8 million** unable to see
2.7 million use a wheelchair
9.1 million need a cane, crutches, etc.
1 million unable to hear

People 15 and older, based on US. Census Bureau data



An accessible secret ballot
for everyone?



**DREs
to the
Rescue?**

VVPATs?

Physical Access Problems



Source: California Top-to-Bottom Review

<http://www.sos.ca.gov/voting-systems/oversight/ttbr/accessibility-review-report-california-ttb-absolute-final-version16.pdf>

Difficult Controls



Source: California Top-to-Bottom Review

<http://www.sos.ca.gov/voting-systems/oversight/ttbr/accessibility-review-report-california-ttb-absolute-final-version16.pdf>

Problematic Audio Ballots



Source: California Top-to-Bottom Review

<http://www.sos.ca.gov/voting-systems/oversight/ttbr/accessibility-review-report-california-ttb-absolute-final-version16.pdf>

Making Paper Ballots Accessible

<http://www.memco.net/ballot.htm>

Smithtown, Massachusetts 1998 Election Ballot
City Council (vote for three persons only)

● ROBERT ANDERSON (D) 785 Greenery St.

● JOSEPH CLASSMAN (D) 85 Boston Rd.

● SANDRA HOLMES (D) 150 Riverside Dr.

● TARA SMITH (R) 75 Massachusetts Ave.

● JOHN THOMPSON (R) 11 Main St.

● JAMES VITALE (R) 33 Milk St.

● ALICE WHITSON (D) 15 Park Ave.

Braille Ballot System

Instructions:

1. Line up top and left edges of paper ballot with the top and left edges of the braille template.
2. Secure the braille template and paper ballot in a clipboard.
3. A vote is indicated by placing a mark next to the candidates name with a pencil.

**Merrimack Engraving
& Marking Co.**
PO Box 5145
Haverhill, Ma 01831
tel: 978-373-4000

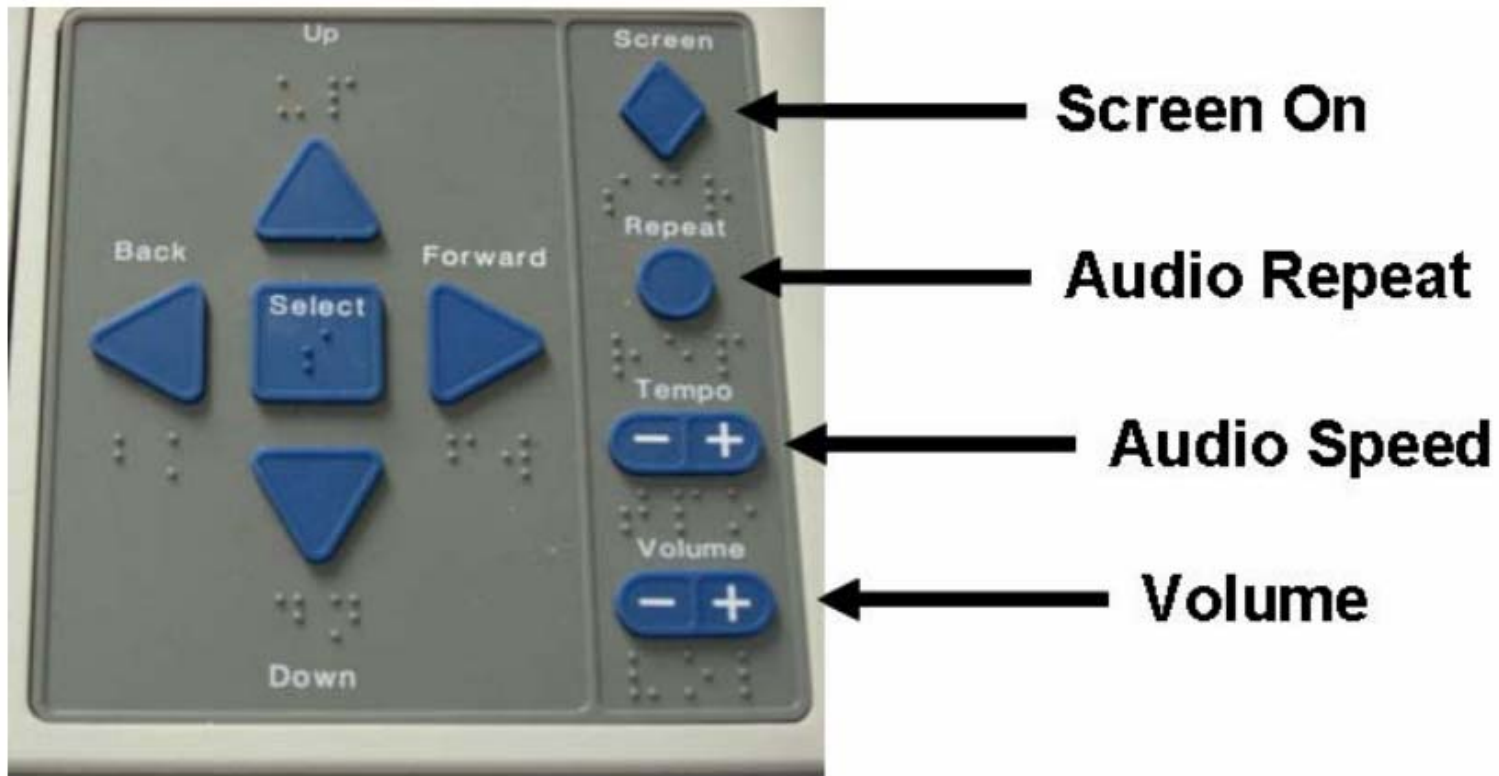
Toll Free: 1-800-726-1719

Web Site: www.memco.net

Making Paper Ballots Accessible



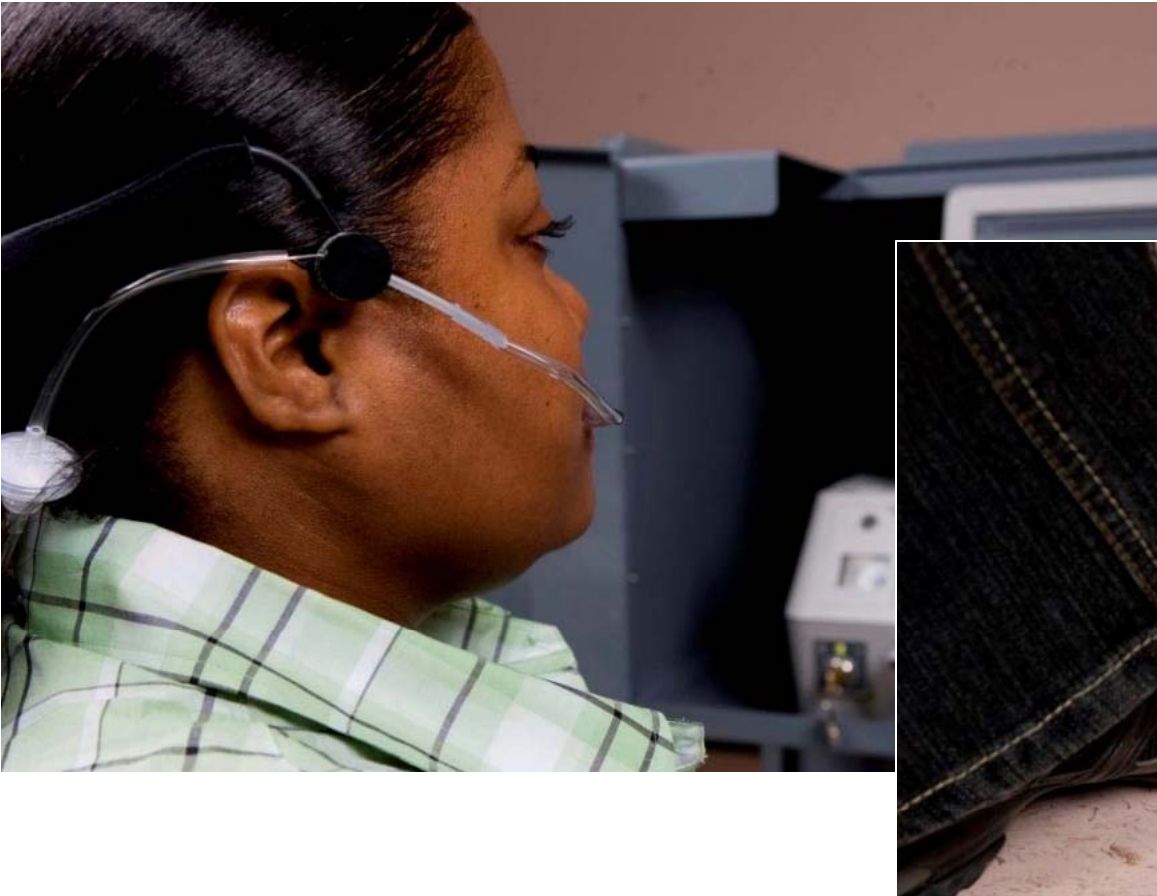
Image from ES&S Brochure, <http://www.essvote.com/HTML/products/automark.html>



Source: New York Board of Elections

<http://www.vote.nyc.ny.us/pdf/documents/boe/bmd/english/AccessibleVotingEnglish.pdf>

7.3 Accessibility



Source: New York Board of Elections
<http://www.vote.nyc.ny.us/pdf/documents/boe/bmd/english/AccessibleVotingEnglish.pdf>

Absentee Voting

Absentee Voting



No
Excuse

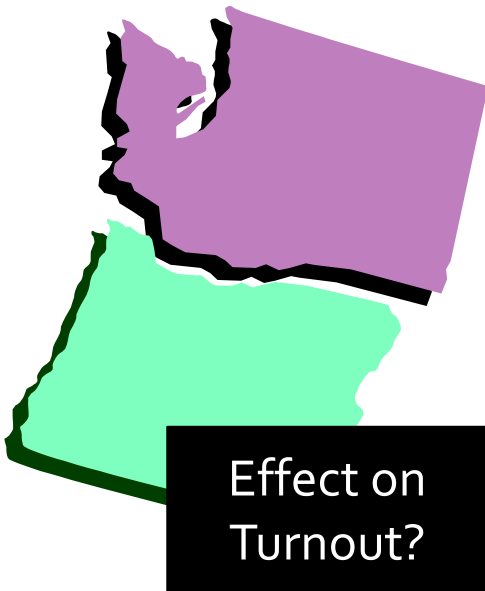
Early Voting

Proxy Voting

Remote Voting

7.4 Absentee Voting

Securing Digital Democracy **M**

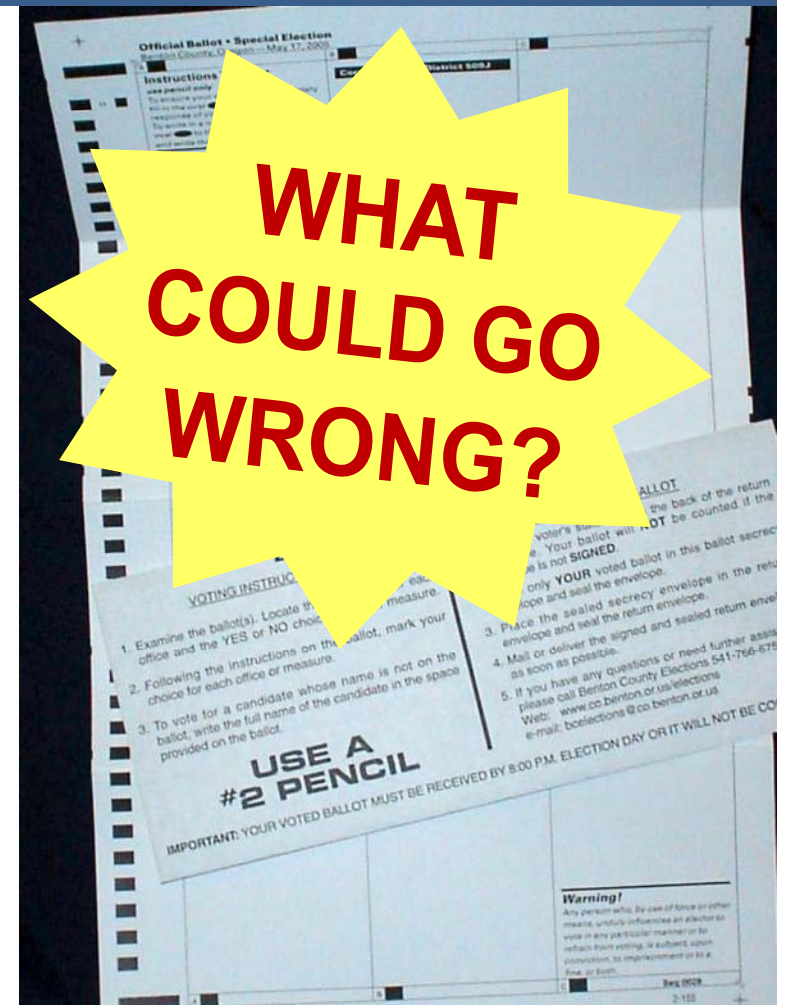
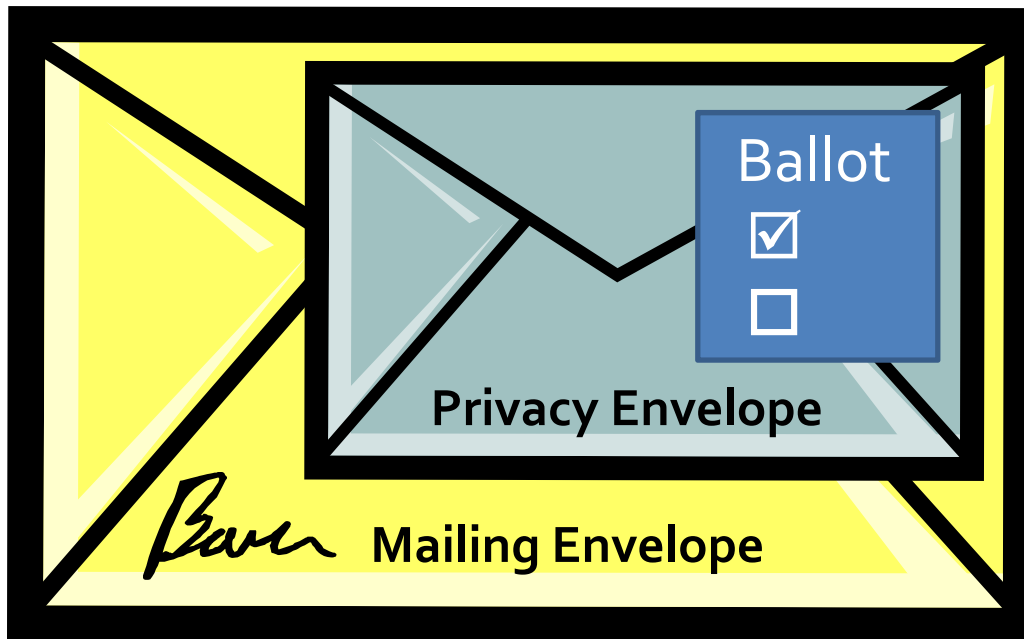


Postal Voting



Photo by Chris Phan (Clipdude) licensed under a Creative Commons Attribution-Share Alike 3.0 Unported license
Via Wikimedia Commons, http://en.wikipedia.org/wiki/File:Oregon_ballot_return_box.jpg

7.4 Absentee Voting



7.4 Absentee Voting

Ballot Misdirection

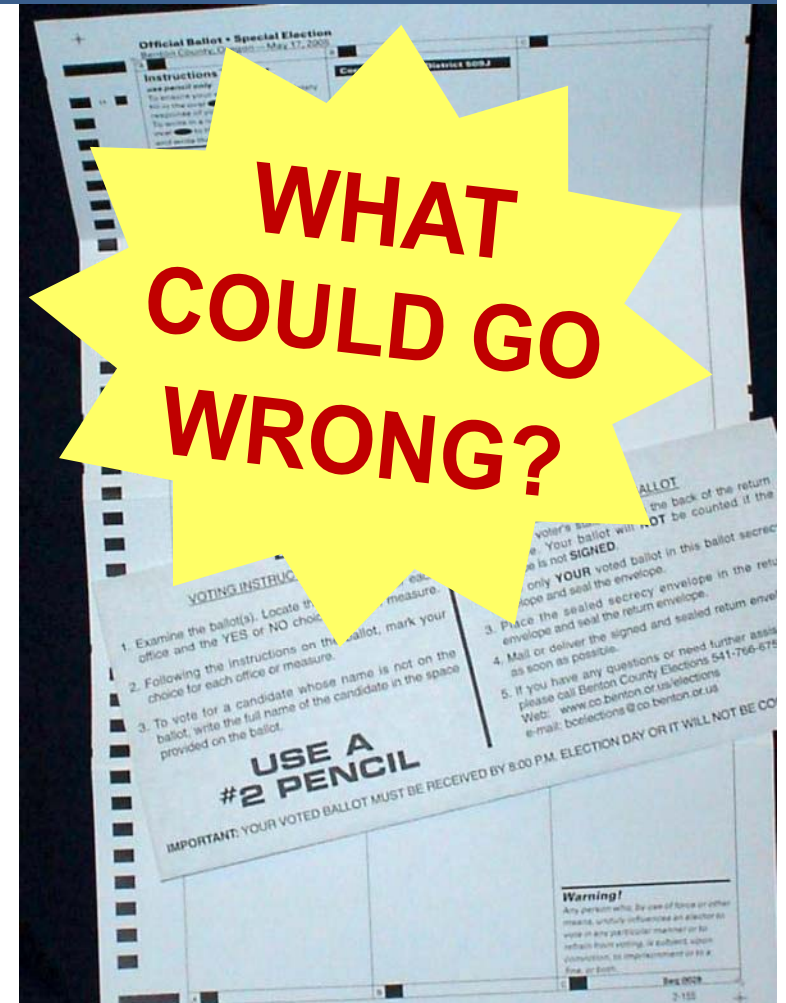
Blank Ballot Theft

Voted Ballot Theft

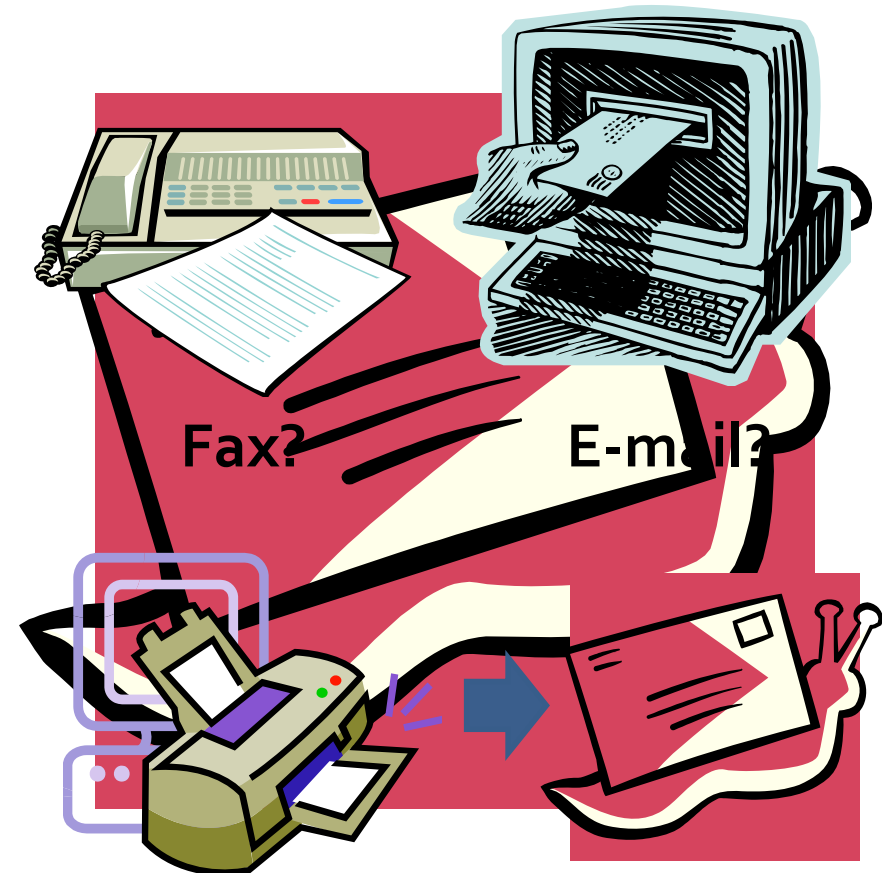
Vote Buying

Coercion

**WHAT
COULD GO
WRONG?**



Overseas Voters?



Print blank ballot & mail back

Securing Digital Democracy

Lecture 7 | *Human Factors*



J. Alex Halderman
University of Michigan