Recommendations for E-Voting System Usability: Lessons from Literature for Interface Design, User Studies and Usability Criteria

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Usable Security Lab
Crypto Lab

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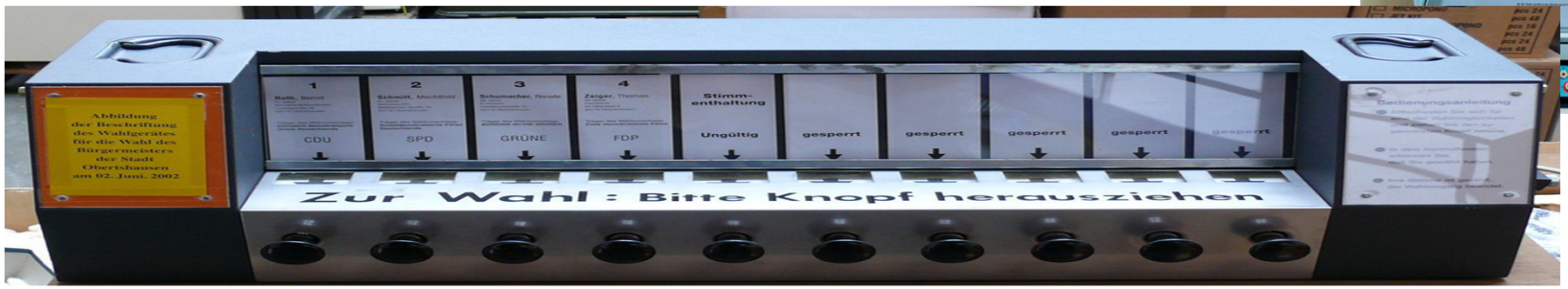
Motivation for this work

- Improve verifiability from the voter‘s perspective
- Carry out user studies to test usability
- Apply standard usability criteria

Methodology

- Identified relevant literature on usability and electronic voting
  - Scholar.google.com; Digital libraries: IEEE; ACM; Proceedings of HCI, usability, e-voting, security, democracy and governance conferences/workshops
- Papers from 1998 to date; conference papers, journal articles, position papers and reports
- Focus among others

helios



Methodology

- Lessons learned
  - Reviewed literature for findings relevant for:
    - E-voting system interface design
    - Conducting user studies
    - Usability criteria
- Recommendations
  - Takeaway from lessons learned
- Open research questions also identified

INTERFACE DESIGN

Recommendations: Ballot Design

- Design ballots in a standardized way that is familiar to voters
  E.g. imitate paper ballot design
- Alert voters when they have cast their votes successfully, and when they have completed the vote casting process
- Alert voters if they are about to cast an invalid vote
- Use the bubble ballot design where the ballots and candidate listing supports it

Bubble and Arrow Ballot Design

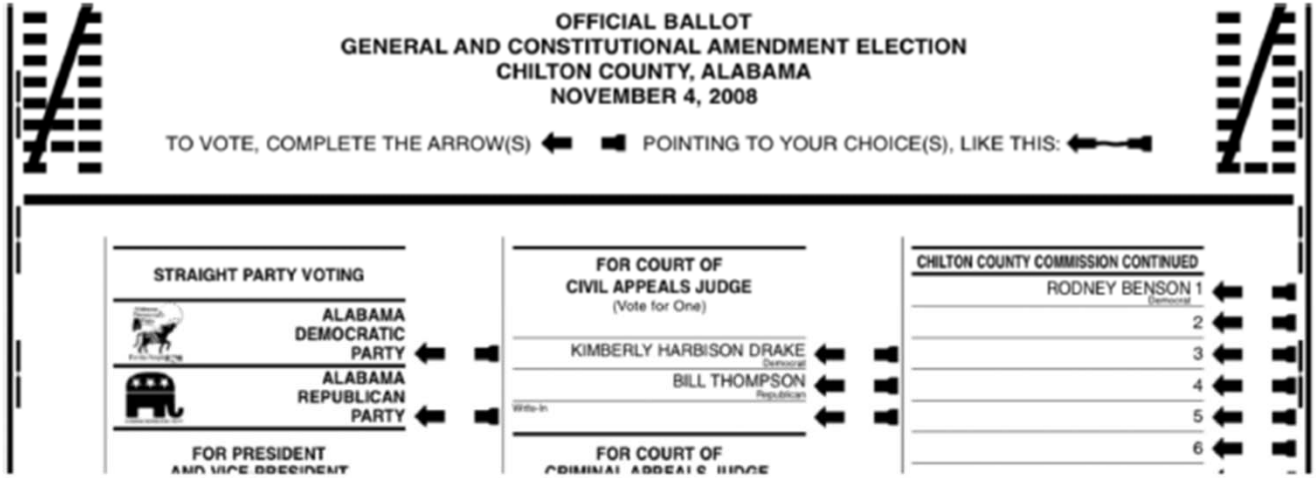
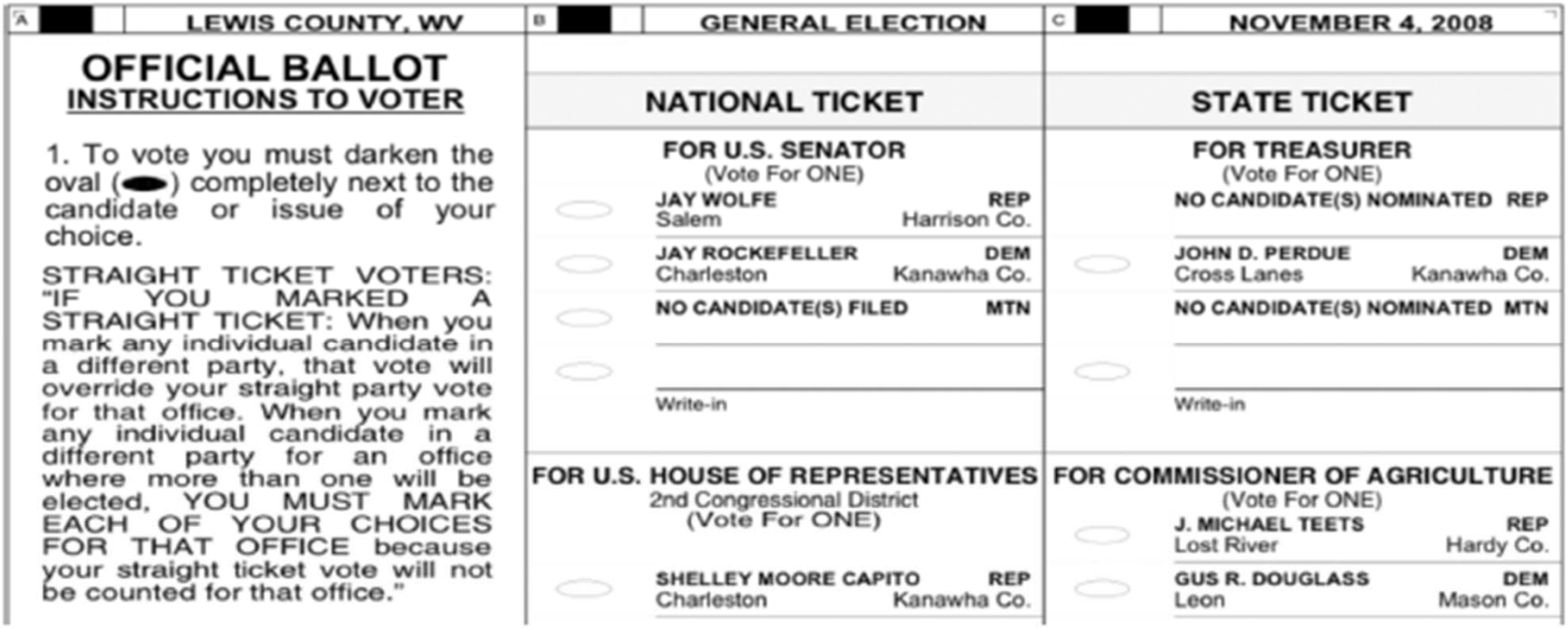


Fig. 1. Alabama ballot. Source: Campell and Byrne, 2009a

Ballot Instructions

- Use simple and clear instructions



A | LEWIS COUNTY, WV

OFFICIAL BALLOT
INSTRUCTIONS TO VOTER

1. To vote you must darken the oval (⬬) completely next to the candidate or issue of your choice.

STRAIGHT TICKET VOTERS: "IF YOU MARKED A STRAIGHT TICKET: When you mark any individual candidate in a different party, that vote will override your straight party vote for that office. When you mark any individual candidate in a different party for an office where more than one will be elected, YOU MUST MARK EACH OF YOUR CHOICES FOR THAT OFFICE because your straight ticket vote will not be counted for that office."

B | GENERAL ELECTION

NATIONAL TICKET

FOR U.S. SENATOR
(Vote For ONE)

JAY WOLFE	REP	
Salem		Harrison Co.
JAY ROCKEFELLER	DEM	
Charleston		Kanawha Co.
NO CANDIDATE(S) FILED	MTN	
Write-in		

FOR U.S. HOUSE OF REPRESENTATIVES
2nd Congressional District
(Vote For ONE)

SHELLEY MOORE CAPITO	REP	
Charleston		Kanawha Co.

C | NOVEMBER 4, 2008

STATE TICKET

FOR TREASURER
(Vote For ONE)

NO CANDIDATE(S) NOMINATED	REP	
JOHN D. PERDUE	DEM	
Cross Lanes		Kanawha Co.
NO CANDIDATE(S) NOMINATED	MTN	
Write-in		

FOR COMMISSIONER OF AGRICULTURE
(Vote For ONE)

J. MICHAEL TEETS	REP	
Lost River		Hardy Co.
GUS R. DOUGLASS	DEM	
Leon		Mason Co.

Fig. 3. West Virginia ballot. Source: Campell and Byrne, 2009a

Voting Tasks: Time, Speed, & Effort

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- Reduce the amount of time and effort voters must take to cast their vote
- Speed up voter processes carefully as faster voting may lead to more voter errors
- Provide both written and verbal instructions on what tasks participants are to carry out (User studies)

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Review / Confirmation Screens

- Use review screens
- Instruct voters to pay attention to the review screen (see: Ballot Instructions)
- Use interface design techniques such as additional coloring or highlighting to draw voters' attention at specific points

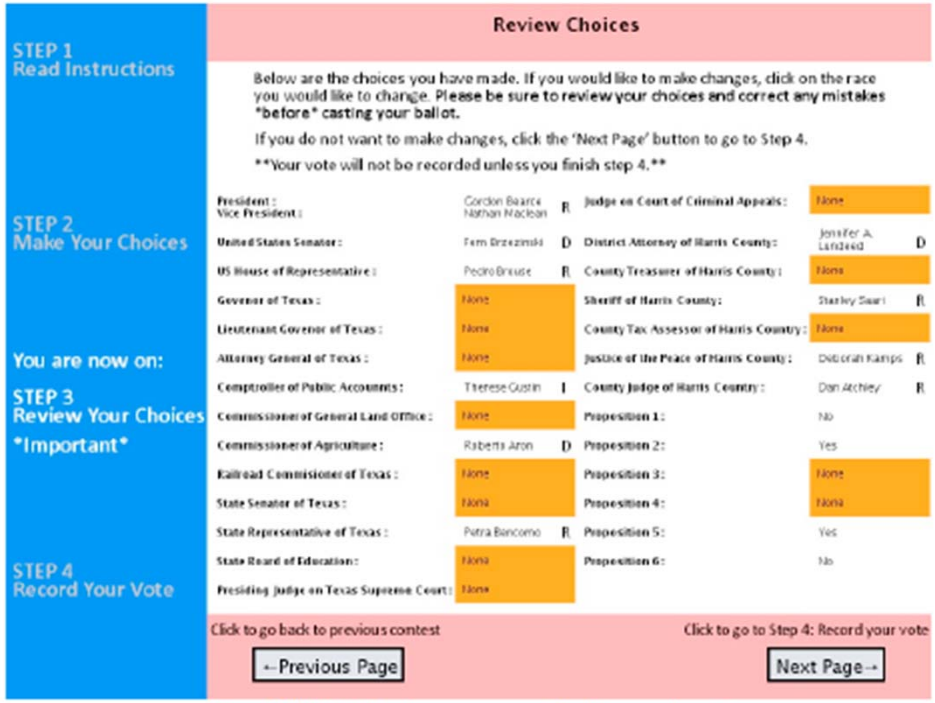


Figure 2. Updated review screen used in this experiment. Source: Campell and Byrne, 2009b

Providing Help Features

- Integrate help facilities to give voters information when they need it

Educating Voters & Poll Workers

- Educate voters and poll workers about new e-voting technology prior to use
- Consider the diversity of voters, e.g. their ages, experience with voting, and education levels

Identifying Mental Models

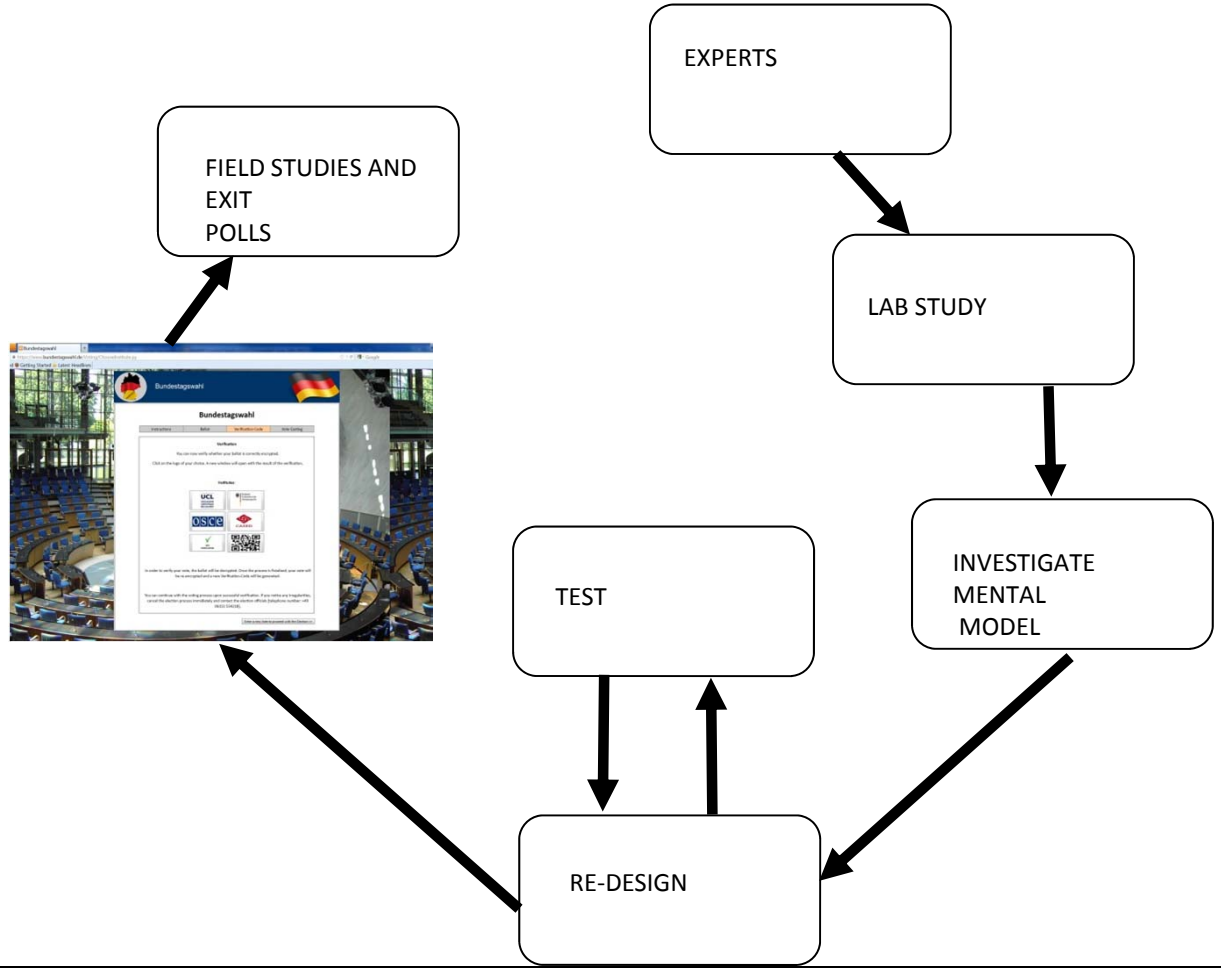
- Investigate the voters' mental model for new features such as cryptographic verifiability
- Educate voters on verifying their vote taking into account their mental models (see Educating Voters and Poll Workers)

Understanding in Crypto-Verifiable Voting

- Give voters clear instructions on how to verify their vote (see: Ballot Instructions)
- Integrate help facilities (see: Providing Help Features)
- Educate voters on cryptographic verifiability (see: Educating Voters and Poll Workers)

USER STUDIES

Relevant Methodology



Ecological Validity

- Use ballots similar to those used in real elections (see: Ballot Design)
- Provide ecological validity using (any of) the following:
  - Use a ballot similar to real ballots
  - Provide a voting environment similar to that of a real election
  - Give voters tasks similar to tasks in a real election
  - Run an election for which participants are more likely to be interested in the results, for example a charities' election

Ecological Validity (2)

- Fictitious candidates can be included in ballots for user studies
- User studies can either be set up in the participants' natural environment, or use the participant's equipment e.g. laptop for Internet voting, in order to be realistic

Maintaining Vote Secrecy

- Preserve vote secrecy where possible, or inform participants when it will not be preserved

General Recommendations

- Incentives for participants
- Number of participants
  - Determine the number of participants for their e-voting studies based on the resources available, the study design, previous studies, and whether statistically significant results are required
  - Field studies should have a large number of participants (from 100 to over 1,000)

General Recommendations (2)

- Ethical Issues
  - Study design and participants' tasks reviewed by an ethics board or institutional review board.
    - Researchers can separately report how they have met standard ethical requirements (see: Applying the ACS Code of Ethics by Oliver Burmeister, 2000).
  - Inform participants about the goals of the study either before or after the study
  - Have participants sign consent forms before participating in user studies

USABILITY CRITERIA

Definition

- These terms are used interchangeably
  - Metric – of or relating to measurement
  - Criterion – a rule or principle for evaluating or testing something
- Used when one wants to measure usability
- Typically done using usability testing

Metrics for Usability Evaluation

- Adopt a standardized approach to evaluate usability, for example, the three ISO measures of effectiveness, efficiency and satisfaction

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