

The Help America Vote Act and [how I got to develop] Voting System Standards for Usability and Accessibility

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The Help America Vote Act (HAVA) was enacted in 2002 as Public Law 107-252

- Provided funds to States to replace punch card voting systems
- Established the Election Assistance Commission to assist in the administration of Federal elections and to otherwise provide assistance with the administration of certain Federal election laws and programs
- Establish minimum election administration standards for States and units of local government with responsibility for the administration of Federal elections

The U. S. Election Assistance Commission's mission is based on HAVA

- The Election Assistance Commission (EAC) is an independent bipartisan agency charged with
 - Disbursing payments to states for replacement of voting systems and election administration improvements,
 - Serving as a national clearinghouse and resource of information regarding election administration, and
 - **Adopting “voluntary voting system guidelines”***

*voluntary for the States to adopt, but they won't get funding if they don't

The National Institute of Standards and Technology (NIST) was called upon in HAVA to provide technical assistance

- NIST is part of the US Department of Commerce
- Mission: To strengthen the U.S. economy and improve the quality of life by working with industry to develop and apply technology, measurements, and standards. NIST's vision is to provide U.S. industry with the world's best technical infrastructure and return the best possible value to the economy and society.
- My affiliation:
 - Information Technology Lab
 - Information Access Division
 - Visualization and Usability Group, manager

HAVA called for the formation of the Technical Guidelines Development Committee to develop standards to improve voting systems

- TGDC has 15 members and the chair is the Director of NIST
- NIST provides **technical support** to the TGDC
- The TGDC has 3 subcommittees:
 - **Human Factors and Privacy**
 - Security
 - Core Requirements and Technology
- [NIST is also developing a national program for accrediting voting system testing laboratories (VSTLs)]

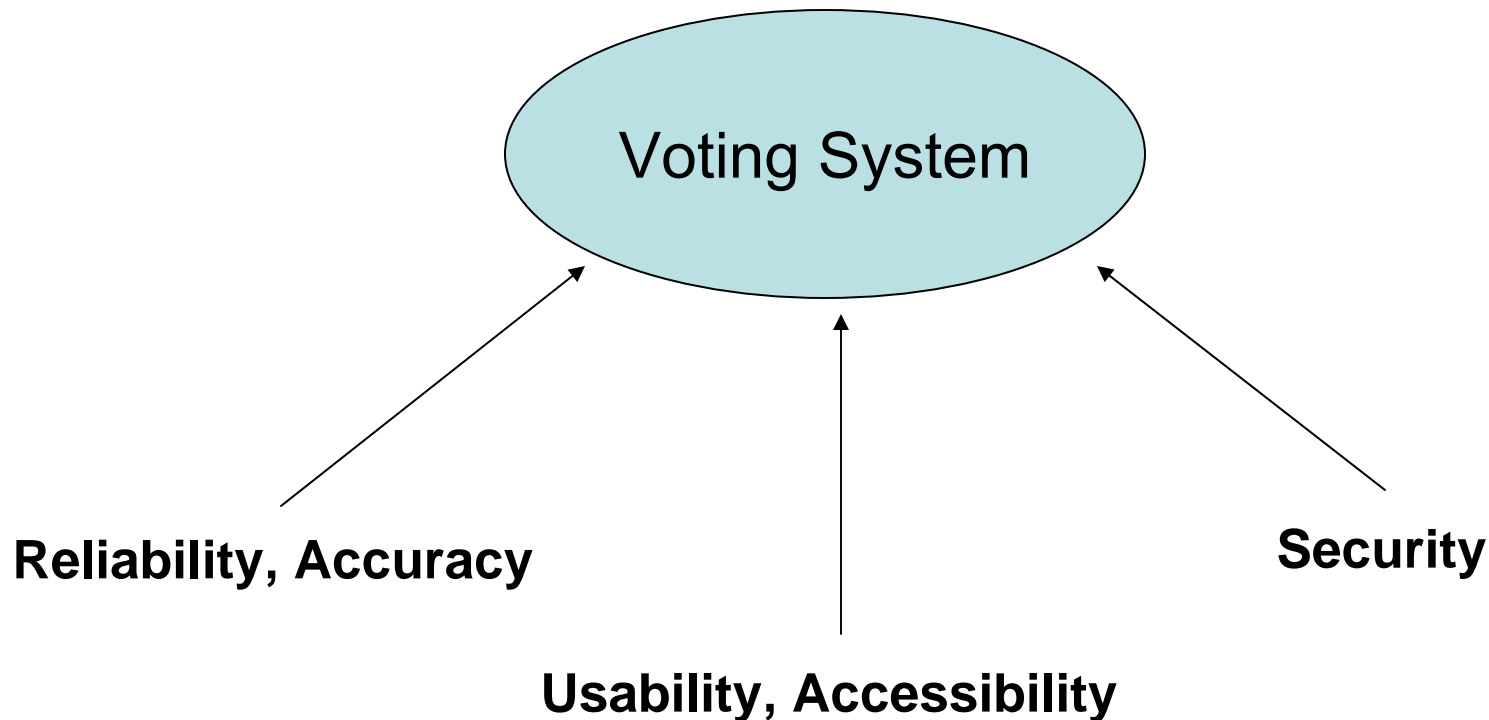
Pre-HAVA voting system standards background

- Starting in 1990, the Federal Election Commission and the National Association of State Election Directors developed Voting System Standards (VSS 1990, 2002)
- Voting equipment was “qualified” to conform to the VSS by “Independent Test Authorities” approved by NASED.
- Current systems are qualified to the VSS 2002

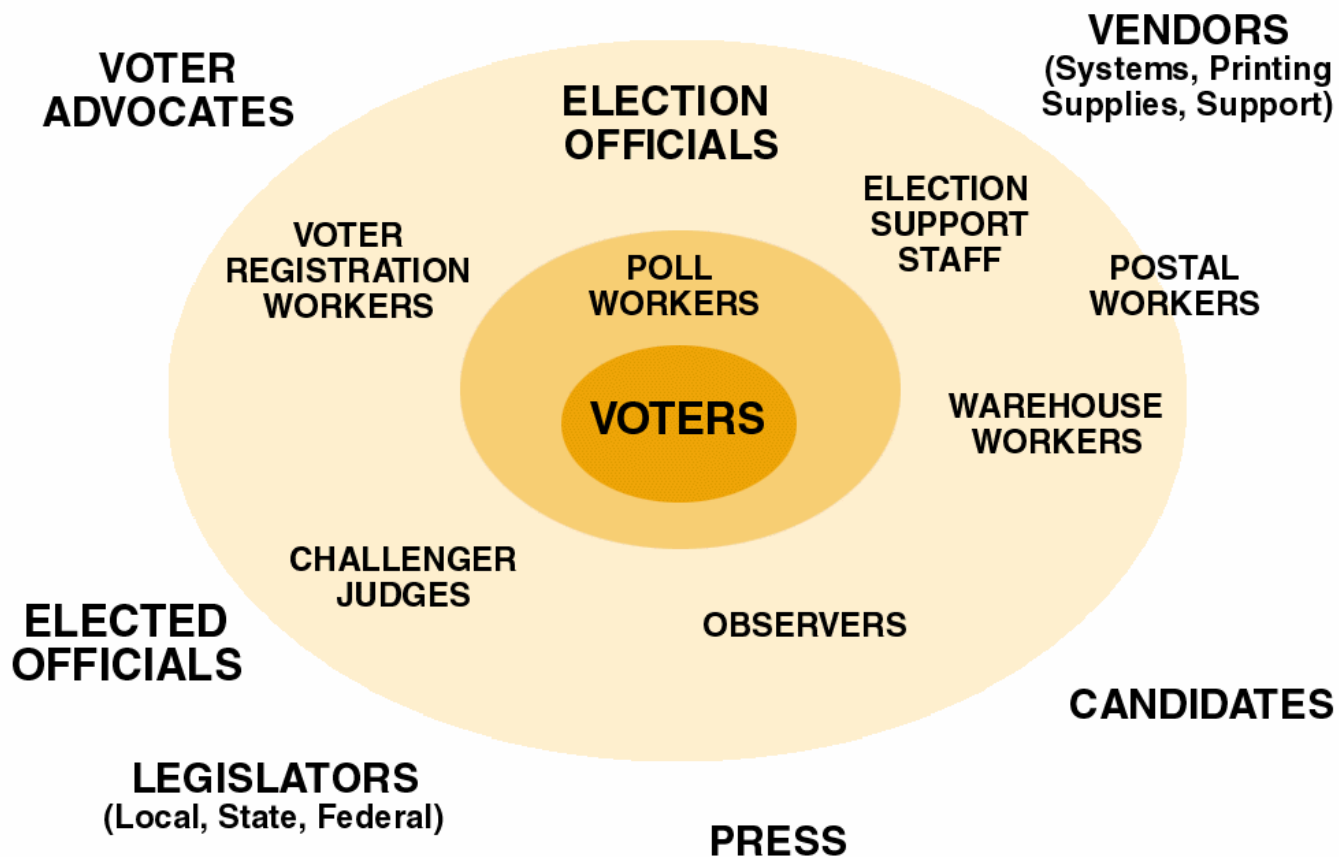
Post-HAVA voting system standards background

- The TGDC delivered a new set of standards: the Voluntary Voting System Guidelines to the EAC in 2005
- The EAC released the VVSG 05 in December 2005
- NIST has produced an accreditation plan for approving Voting System Test Laboratories (VSTLs) to do conformance testing to the VVSG
- EAC is producing a certification plan for “certifying” voting equipment that conforms to the standard
- The TGDC (with NIST) is developing the VVSG 07 to be delivered in July
- NIST will be developing conformance test methods for the VVSG

Three sets of requirements are equally important for voting systems to reliably capture and count votes. Ignore any one and risk failures.



THE VOTING ECO-SYSTEM



Source: UPA 2004 Voting and Usability Workshop

Human Factors/Usability Perspective on Voting Systems: Voters

- Cognitive and physical nature of the voters
- Physical environment
- Psychological environment
- Voting product
- Usability is determined by the demands of the system and the voter's ability to perform under those demands

Language in HAVA guides our usability and accessibility work

- The system must be “accessible for individuals with disabilities, including non-visual accessibility for the blind and visually impaired, in a manner that provides the same opportunity for access and participation (including privacy and independence) as for other voters.” -- 301 (a)(3)(A)
- At least one voting system “equipped for individuals with disabilities” must be used at each polling place for federal elections held on or after January 1, 2006. --. 301 (a)(3)(B).
- And “provide alternative language accessibility as already required by section 203 of the Voting Rights Act.” -- 301 (a)(4).
- Report by NIST on human factors research for voting systems -- 234
- Technical support from NIST for the VVSG includes “human factors in the design and application of voting systems” --221(e)(D).

Definitions for accessibility and usability

- Accessibility
 - The degree to which a system is available to and usable by individuals with disabilities
- Usability
 - A measure of the effectiveness, efficiency and satisfaction achieved by a specified set of users performing specified tasks with a given product
 - Metrics: errors causing a vote cast not as intended or a vote not cast, (errors prior to success), and time to cast vote, subjective satisfaction

Designing and testing for usability for voting systems: who and what

- Vendors: user-centered design
- Vendors: formative (diagnostic) evaluation and summative usability testing
- Researchers: innovation and experiments
- EAC/TGDC with NIST technical support: VVSG
- NIST: test methods for conformance to the VVSG
 - Design guidelines: primarily expert review
 - Usability testing to performance benchmarks—a specialized form of summative testing
- VSTLs: testing to certify voting equipment
- State election officials: evaluation for procurement and testing ballot design

Guiding principles for standards for accessible, usable voting systems

- Universal access
 - Removing barriers to access
 - Designed for every voter
- Usability
 - All voters can easily cast a valid vote the way they intended
 - Voters: all US citizens eligible to vote
 - Poll workers and election officials

TGDC Resolutions on four key principles also guide the work on accessibility, usability and privacy

- Human factors and privacy rely on both having **well designed systems**, and the effective deployment of those systems **in the polling place** (#3-05)
- Human abilities exist on a wide spectrum. Strong **universal usability** requirements make all voting systems not only **more usable**, but **accessible to more people**. (#6-05)
- Ballot design, instructions and error messages are a **critical** part of the **voting experience**. They are of particular importance for people with cognitive disabilities (#8-05)
- Setting **performance**, rather than design, **standards** will **encourage innovation** to address the complex, interlocking requirements for accessibility, functionality, security and trust. (#5-05)

Five additional resolutions direct our approach to human factors and privacy requirements

- **Accessibility requirements** are a top priority under HAVA (#2-05)
- Other human factors and privacy requirements cover aspects of **accurately capturing indication of a voter's choice** (#4-05)
- **All requirements** involving human interaction must ensure that basic usability, accessibility, and privacy are maintained. (#9-05)
- The **standards** themselves must be **usable**. Voting system standards should be written in **plain language** understandable by both test experts and by voting officials who are not experts in human factors or design. (#10-05)
- Voting machines must be available to validate conformance tests and establish **performance benchmarks**. (#11-05)

Challenges in developing the usability and accessibility guidelines

- Few requirements in VSS 2002
- Heterogeneous user population: all citizens eligible to vote
- Tension between security and usability/accessibility
 - E.g., Voter verifiable paper audit trail vs. accessibility
- Guide but don't specify the implementation
- Design guidelines are easy to test, set a baseline for accessibility, but do not necessarily guarantee usability
- Usability performance benchmarks are better, but require research and can be costly to test
- Requirements for the equipment vs. deployment guidance
- Requirements must be "testable"
- Cost of testing must be reasonable
- VVSG should go beyond the status quo, but not cause all vendor products to fail certification

Some critical decisions were made in applying the resolutions to the initial VVSG

- Primary focus on general equipment vs. election specific
- Requirements should be testable
 - Deferred developing conformance tests for equipment
- Performance vs. design guidelines
 - Performance guidelines preferred
- Recognition of environment for deployment of equipment
 - Focus on guidance for ballot design, setup, instructions, etc. in VVSG 07
- “shoulds” will migrate to “shalls”
- VVSG 07 will include performance benchmarks

VVSG 05 strengthens and further defines the accessibility and usability requirements in VSS 2002

- Accessibility updated and enhanced from VSS 2.2.7
- Limited English Proficiency requirements added
- Usability updated and enhanced from VSS 3.4.9, VSS 2.4.3, NASED Technical Guide #1, and Usability Appendix
- Privacy requirements added
- 3 pages → over 20 pages of requirements, ~130 requirements

VVSG Usability and Accessibility Section draws on many industry standards and regulatory sources

- HAVA itself
- Federal Voluntary Voting System Standards VSS 2002
- 36 CFR Part 1194 (“Section 508”)
- ADA Accessibility Guidelines (ADAAG)
- ANSI INCITS 354 Common Industry Format (CIF) for Reporting Summative Usability Tests
- Draft IEEE P1583
- NASED Technical Guide #1
- NIST Human Factors Report, NIST SP 500-256, May 2004

Outline of VVSG 05, Chapter 3

Usability and Accessibility Requirements

3.1 Usability Requirements

- 3.1.1 Usability Testing
- 3.1.2 Functional Capabilities
- 3.1.3 Alternative Languages
- 3.1.4 Cognitive Issues
- 3.1.5 Perceptual Issues
- 3.1.6 Interaction Issues
- 3.1.7 Privacy
 - 3.1.7.1 Privacy at the Polls
 - 3.1.7.2 No Recording of Alternate Format Usage

3.2 Accessibility Requirements

- 3.2.1 General
- 3.2.2 Vision
 - 3.2.2.1 Partial Vision
 - 3.2.2.2 Blindness
- 3.2.3 Dexterity
- 3.2.4 Mobility
- 3.2.5 Hearing
- 3.2.6 Speech
- 3.2.7 English Proficiency
- 3.2.8 Cognition

Highlights: Accessibility

- Requirements for clearance and reach
 - Updated to meet 2004 ADAAG
 - Added requirement for visibility of controls
- Summative usability testing by the vendor required (“shalls”)
- Requirements for audio-tactile ballot interface
 - Rewritten, but keeps basic requirements
 - Adds explicit requirement, ATI have same functionality as other ballot interfaces
 - Provides for repetition, pause and resume, skip-ahead
 - Provides for standard audio jack, volume control, and headphone
- Wireless T-coil coupling for phone handsets
- No electromagnetic interference, hearing aids
- Volume control

Highlights: Accessibility

- The audio presentation: proper enunciation, normal intonation, appropriate rate of speech, and low background noise. Candidate names should be pronounced as the candidate intends.
- Low vision
 - Color contrast (usability)
 - 2 font sizes (usability)
 - Distinguishable buttons and controls
 - Synchronized audio/screen display
- Minimize accidental touch screen activation
- Time out warning (usability)

Highlights: Limited English Proficiency (LEP)

- Alternative language requirements for Limited English Proficiency added
 - Candidate names displayed or pronounced in English
 - Alternative language ballots and instructions
 - Audio ballots for illiterate voters

Highlights: VVPAT

“If the normal procedure includes VVPAT, the Acc-VS should provide features that enable voters who are visually impaired and voters with an unwritten language to perform this verification. If state statute designates the paper record produced by the VVPAT to be the official ballot or the determinative record on a recount, then the Acc-VS shall provide features that enable visually impaired voters and voters with an unwritten language to review the paper record.”

Highlights: Usability

- Summative usability testing by the vendor required (“shalls”)
- Usability moved from VSS Appendix and enhanced
 - Review of ballot
 - Notification of overvoting and undervoting
 - No scrolling, clear feedback, help anytime

Highlights: Privacy

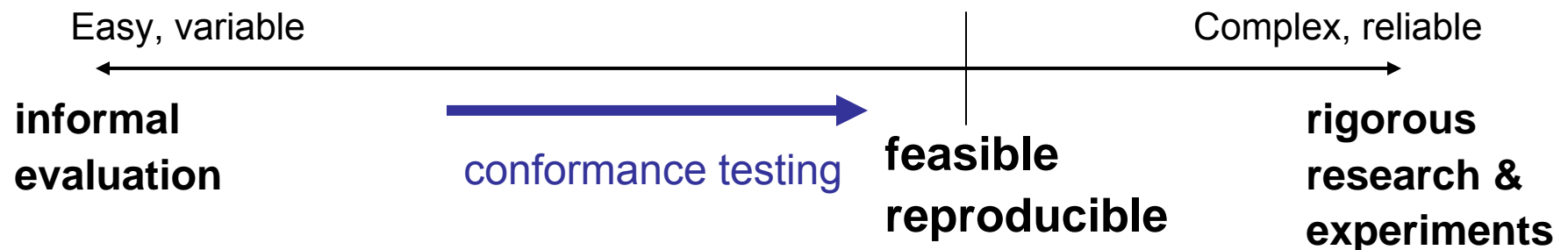
- Marking ballot in privacy
 - Enhances this requirement
 - Visual privacy
 - Audio privacy
 - Overvote notification preserves privacy
 - Voter anonymity for alternative format ballots

Research is underway for VVSG 07

- **Usability performance benchmarks**
- **Plain language guidance for ballots, instructions, error messages**
- Guidance for ballot design
- Guidance for interaction design
- Further refinement of accessibility guidelines
- Usability of the standards
- Usability of documentation
- Test methods

Usability performance measurement for conformance testing

- We currently do not measure usability of voting systems
 - E.g., select/deselect
 - Need high degree of usability
 - Following design guidelines does not necessarily insure usability
 - Usability engineering provides measurement methods, but not necessarily to the degree we need specifically for voting



Example of how we do research to support standards development for voting equipment

- We wanted to address the issue of cognitive disabilities
- We are working with Ginny Redish to develop plain language guidance for ballots, instructions, error messages
- This also supports our goal of universal usability

Clear and simple ballot instructions are critical to voting success, but

- Voting instructions are developed mainly by election officials and vendors
- Rarely are they subject to field testing and experimentation
- Yet there is a large body of research and best practice guidelines in other domains:
 - cognitive psychology, human-computer interaction, information design, interface design, linguistics, plain language, reading, and technical and legal writing.
 - Resources include: www.plainlanguage.gov,
www.usabilityprofessionals.org/usability_resources.

Universal Usability: Instructions and messages should be designed for the diverse population of voters.

- Everyone benefits from clear instructions
 - Voters with wide variations in cognitive skills
 - Tired voters and aging voters
 - Voters with limited English proficiency or limited reading skills
- Poll workers also benefit from clear instructional material

We did a review and observed that most, if not all, ballots, both on paper and on screen, violate at least some of the best practices.

- We focused on the language of instructions and other messages that voters encounter and compared those instructions and messages to best practice.
- This included instructions to voters, messages during voting, and system messages
- We reviewed materials from 4 DRES, >100 paper ballots from 50 states and DC <http://vote.nist.gov/ballots.htm> *

*Thanks to Richard Niemi for sharing his collection.

An example:

For one DRE, the card the voter uses has three different names:

The plastic card that the voter is given to insert into the machine says:

VOTER CARD.

The place to insert it into the machine has the instruction:
Insert **voter activate card** here.

The message on the screen at the beginning of the process says:

To Begin Voting Insert Voter Card Into Slot Below.

The message at the end of voting calls the card: **Vote Card.**

Improving U.S. Voting Systems

- NIST activities supporting the Help America Vote Act

Put instructions before they are needed – not after.

X The instructions come after the voting options.

Many voters will not notice the instructions until after they have voted.

FOR DISTRICT COURT JUDGE
DISTRICT 8, DEPT. 3

Shall Judge **Kenneth R. Neill** of the Eighth Judicial District, Department 3, of the State of Montana be retained in office for another term?

YES

NO

(Blacken the oval before the word "YES" if you wish the official to remain in office. Blacken the oval before the word "NO" if you do not wish the official to remain in office.)

✓ The instructions come before the voting options.

This is the logical order for voters.

In voting for judges:

If you want the judge to stay in office for another term, blacken the oval before the word YES.

If you do not want the judge to stay in office for another term, blacken the oval before the word NO.

**For District Court Judge
District 8, Dept. 3**

Do you want Judge Kenneth R. Neill of the Eighth Judicial District, Department 3, of the State of Montana to stay in office for another term?

YES

NO

Put warnings about consequences before – not after –
the voter is likely to act.

x Poor Practice

Ballot not complete!

You have not made a choice in some contests.

Press "Confirm" or the Vote button to finish casting
your ballot.

Note: Once you press "Confirm" you can not return
to the ballot to make changes.

Press "Return to ballot" to make changes or selections.

✗ Voters may act on this
instruction without reading
further down the screen.

✗ If they act on the instruction above
this, they may miss out on changes
they would have made if the note and
final instruction had come earlier on
the screen.

√ Good Practice

Ballot not complete!

You have not made a choice in some contests.

Note: Once you press "Confirm," you cannot return to the ballot to make changes.

To make changes or selections, press "Return to ballot."

To finish casting your ballot, press "Confirm" or the Vote button.

√ In this version, we make the consequence clear before the instruction.

√ In this version, the instruction that cannot be undone comes last. As the final instruction, it should come at the end.

On DREs, wait to highlight the option to cast the vote until voters have been through all the races and measures.

x Poor Practice

DRE: As one DRE gets to the last page of the ballot, the VOTE button at the top lights up. It is very bright and attracts attention. That button is a form of instruction. It is an imperative verb, calling to the voter to push it.

It is at the top of the device so the voter sees it before reading anything else on the page – even though the rest of the page includes races or measures not yet voted.

√ Good Practice

DRE: Set the VOTE button to light up only after the voter has been through all the pages of the ballot – and after the voter has been given the opportunity to return to any undervoted part of the ballot.

Use simple English words that voters know.

x Poor practice

remain

retain

reverse side

such candidate as you desire

√ Good practice

stay

keep

back of

the candidate that you want

On DREs, do not use technical, computer jargon.

X Computer jargon

Your electronic ballot is activated.

✓ Plain language

You may now start to vote.

X Computer jargon

navigate forward through the ballot

✓ Plain language

move to the next ballot page

x Poor practice → **√ Good practice**

ElectNID.txt file could not be found.

What the message means

The manual says that likely causes of this problem are

- the compact flash card is missing
- the compact flash card is not properly seated in the terminal

More useful for a poll worker:

Cannot find a necessary file from the compact flash card.

picture of
flash card

If you do not have the card:

- get it
- put it in the correct slot in the voting machine

picture of
machine,
showing slot
and how to
put card in

If you have the card:

- take it out of the slot
- reinsert it firmly in the correct slot

If you cannot find the card,
or if reinserting it does not solve the problem,
call [company name's] customer service.

[give number if possible]

We developed 20 guidelines for clear ballot instructions for both paper and 7 guidelines for writing clear system messages on electronic voting machines.

- These can be found in the report “Guidelines for Writing Clear Instructions for Voters and Poll Workers” by Ginny Redish under “Documents and Meetings” at <http://vote.nist.gov>
- Each guideline or “best practice” has a rationale and an example.

These guidelines have not specifically been studied in the context of voters working with ballots. Research is needed to assess their importance and relevance to the specific situation of voting.

- Guidelines need to be tested in the context of voters working with ballots and equipment.
 - Do voters read instructions on ballots?
 - How do organization and wording affect reading behavior?
- Research is needed to find out which words voters know and which they do not.
 - Cast a ballot
 - Contest/race
 - Partisan
 - Straight ticket
 - Split ticket

For more information:

- VVSG 05 and EAC activities: <http://www.eac.gov>
- TGDC and NIST activities: <http://vote.nist.gov>
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