

Sarasota Panel: Vote-o-graph results from Iowa

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Opinions expressed here are those of the author and not necessarily those of the University of Iowa nor any agency of the United States Government.

A narrative view:

- Nov. 4, 2006: Sarasota Herald-Tribune reports:
“A few citizens reported troubling screen oddities – with check marks vanishing, or appearing when they shouldn't – as they voted”
- Nov. 7, 2006: 18000 undervotes, about 1 in 6.
Widespread reports of “vote flipping.”
- Feb. 2007, Audit Report, FL Dept of State:
“No evidence ... that ... results did not reflect actual votes cast,” but that “in-depth study is warranted ... in the area of ... effective ballot design.”

A typical problem report:

- Nov 3, 2006:

“I had a report from one friend that her vote for Christine Jennings ... was not present on her review of her ballot choices. She had to hit the machine at least two times before it finally registered her correct choice. Two days later, a second person reported that in reviewing her ballot she learned that her choice for Christine and also for the Democratic candidate for attorney general had been disappeared from her initial selection.”

The narrative continues

- Feb. 2008, Ted Selker, MIT-Caltech WP 61:
Experiment with the ballot design used in Sarasota,
“16.7% missed the race in question” largely because
of the ballot layout.
- May. 2008, Sarah Everett, Rice Dissertation:
“over 60% of voters do not notice if their votes as
shown on the review screen are different than how
they were selected.”
- NOTICE: $60\% \times 16\% \approx 10\%$
but actual rate was 16% on DREs

U.S. REPRESENTATIVE IN CONGRESS
13TH CONGRESSIONAL DISTRICT
(Vote for One)

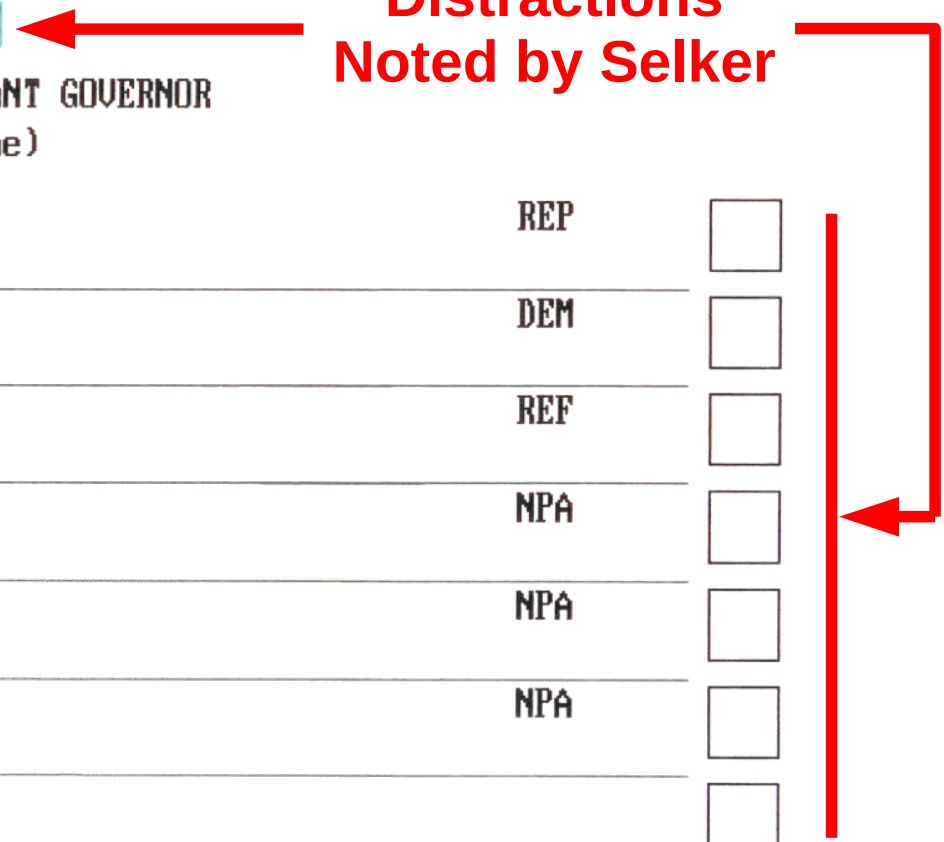
Vern Buchanan	REP	<input type="checkbox"/>
Christine Jennings	DEM	<input type="checkbox"/>

STATE

GOVERNOR AND LIEUTENANT GOVERNOR
(Vote for One)

**Distractions
Noted by Selker**

Charlie Crist Jeff Kottkamp	REP	<input type="checkbox"/>
Jim Davis Daryl L. Jones	DEM	<input type="checkbox"/>
Max Linn Tom Macklin	REF	<input type="checkbox"/>
Richard Paul Dembinsky Dr. Joe Smith	NPA	<input type="checkbox"/>
John Wayne Smith James J. Kearney	NPA	<input type="checkbox"/>
Karl C.C. Behm Carol Castagnero	NPA	<input type="checkbox"/>
Write-In		<input type="checkbox"/>



The Narrative Continues

- Aug. 15, 2006: ES&S memo to FL Users

“... some of your machines are exhibiting slow response times ... as a result of a smoothing filter in iVotronic firmware versions 8.x and higher ...”
- Hypotheses to explain Sarasota
 - Banner blindness
 - Touch screen insensitivity
 - Touch screen mis-calibration (vote flipping?)
 - Actual vote flipping by software

Our Hypothesis:

- Appropriate event logging would have helped
- For banner blindness
log “navigate to race from review screen” events?
- For touch-screen insensitivity
log duration of touch as proxy for force?
- For touch-screen mis-calibration
log location of touch relative to button?
- To detect actual vote flipping
log “navigate to race from review screen” events?

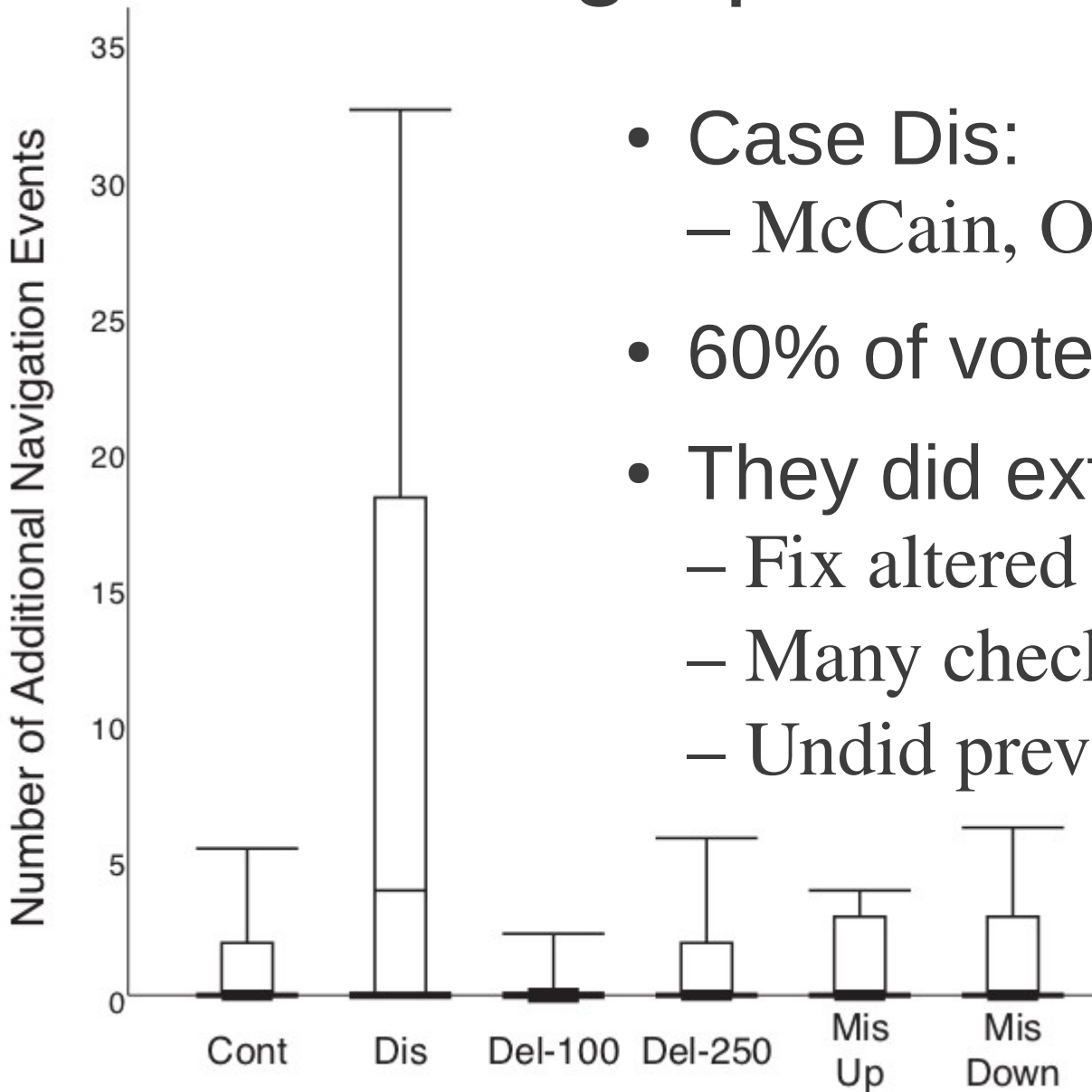
Our Experiment, the Vote-o-graph

• **Towards Publishable Event Logs that Reveal Touchscreen Faults** EVT/WOTE 2010

Andrea Mascher, Paul Cotton, Douglas Jones

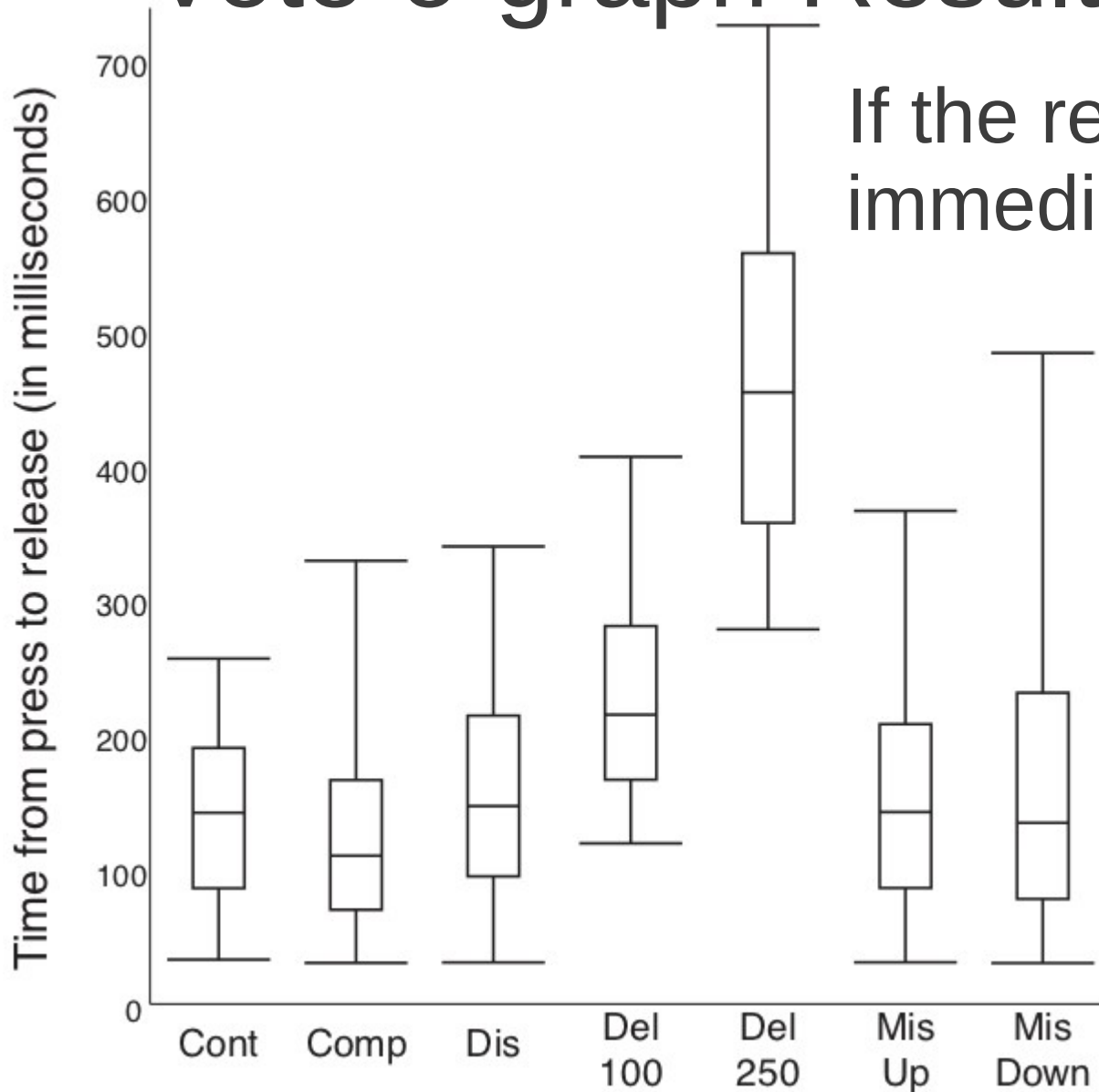
- Touch-screen voting machine GUI on laptop
 - for some voters, bad ballot design (like Sarasota)
 - for others, insensitive (delayed response)
 - for others, simulated mis-calibrated touch screen
 - for others, actually flip votes on summary screen
- Johnson County, Iowa 2008 election ballot
- 100 subjects, all voters who voted in 2008

Vote-o-graph Results (2010):



- Case Dis:
 - McCain, Obama switched
- 60% of voters noticed
- They did extra navigations
 - Fix altered race
 - Many checked other races
 - Undid previous votes?

Vote-o-graph Results (2010):



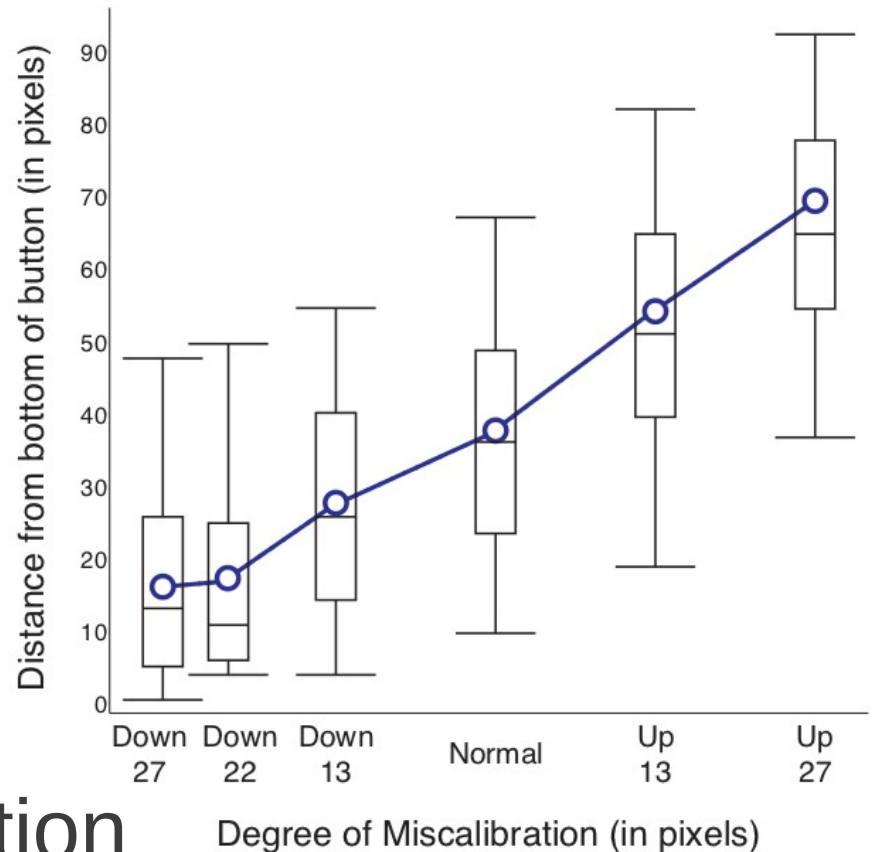
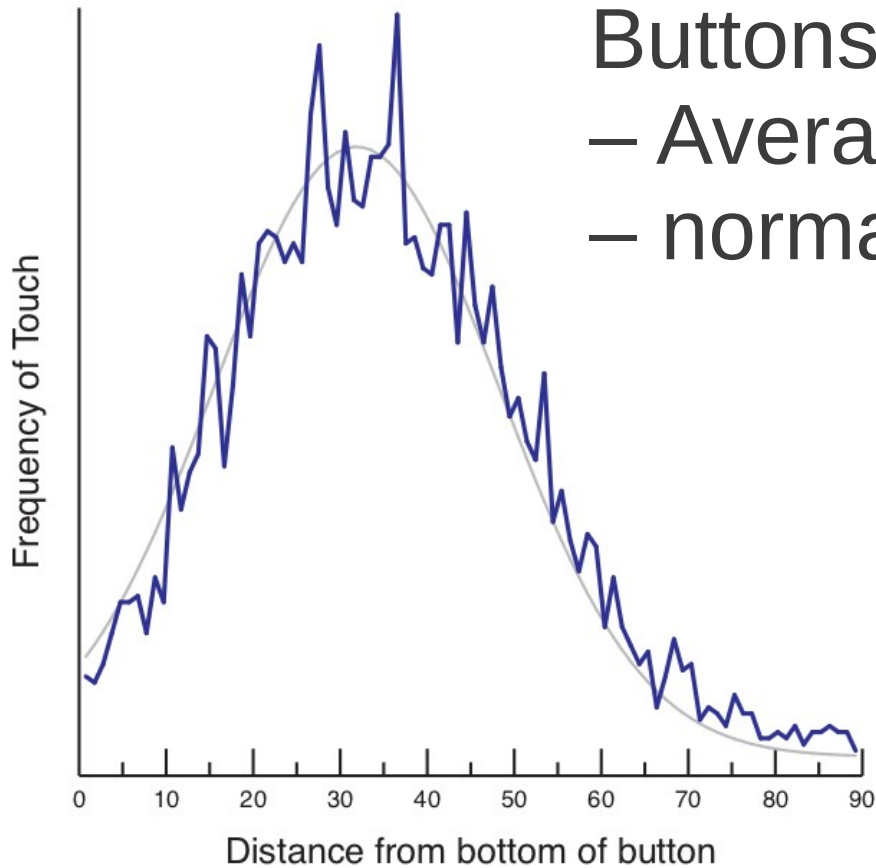
If the response isn't immediate, voters press.

Normally, Voters just tap.

Vote-o-graph Results (2010):

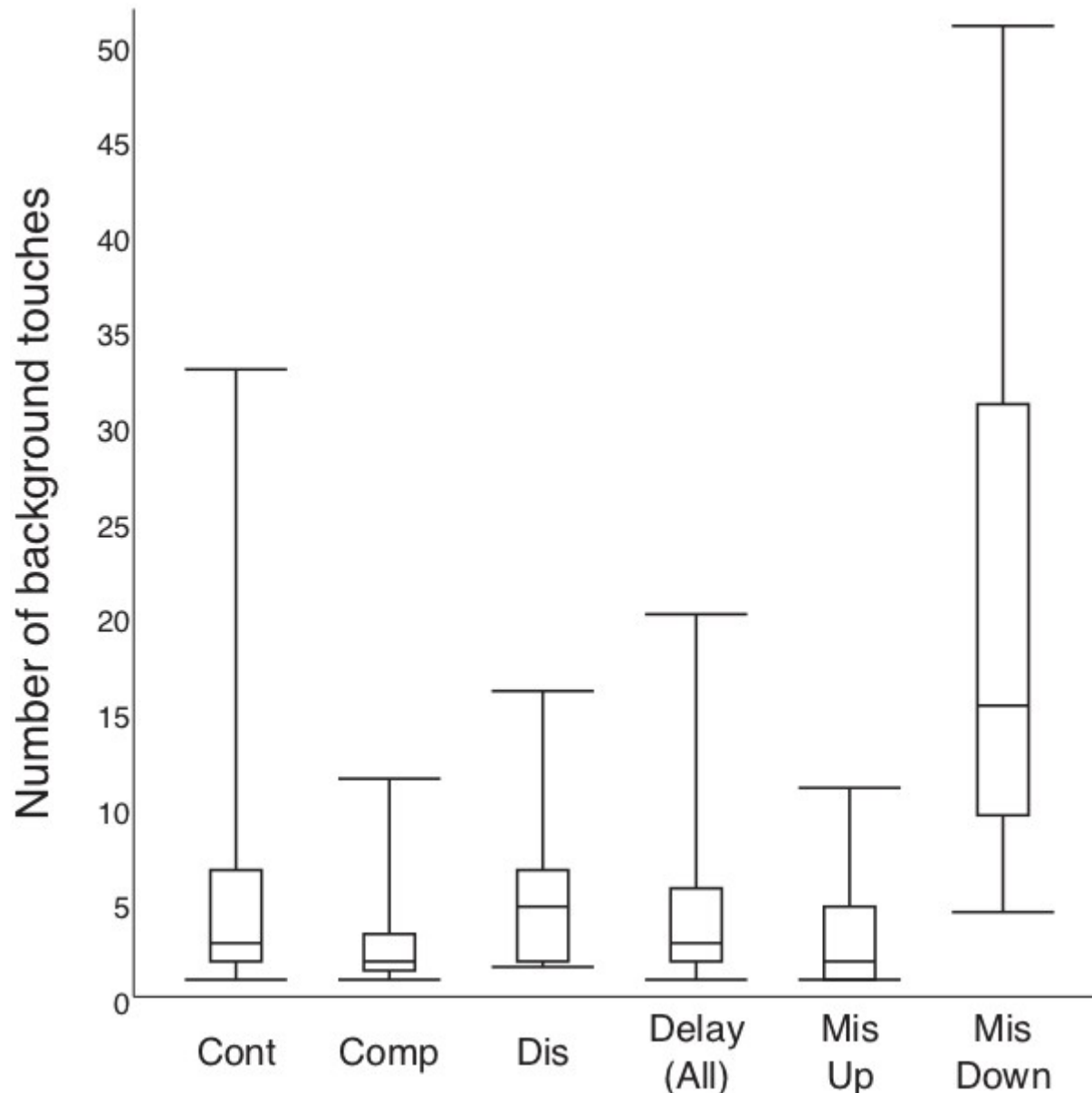
Buttons 18.4 mm high.

- Average touch position is stable
- normally below button center



– and it tracks mis-calibration

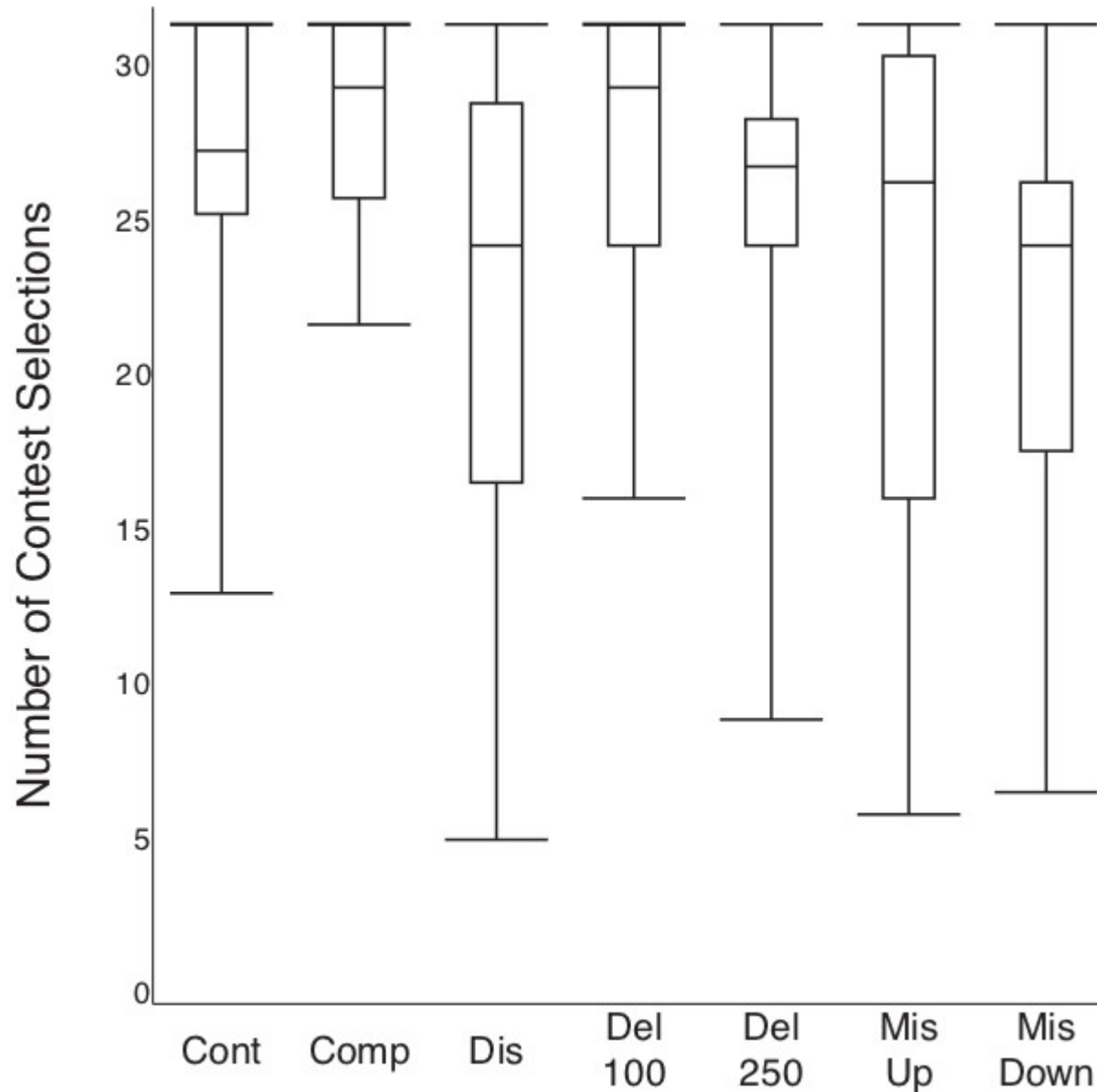
Vote-o-graph Results (2010):



Downward mis-calibration causes Many voters to miss buttons.

- Gutter below navigation button
- Screen below candidate list

Vote-o-graph Results (2010):



Undervote rate goes up when voting system is Hard to use:

- Dishonest review
- Insensitive (Del)
- Mis-calibrated

Compressed ballot reduces undervote – despite banner blindness problem

Vote-O-Graph Results (New)

- Could have logged just the following:
 - **navcount** – number of inter-screen navigations
 - **navmiss** – number of background touches (button misses) immediately before a navigation
 - **calibration** – average touch position in a button
- Logs may be on a per-ballot-cast basis
- Logs may be time-stamped or sequential if:
 - Minimum **navcount** visits each race exactly once
- Navigation buttons must have gutters

Vote-o-graph decision tree

Paul Cotton's work

- If average **navmiss** $> 0.15 \times \text{navcount}_{\min}$
Suggests possible miscalibration
- Else if average **calibration** above center
Suggests possible miscalibration
- Else if average **navcount** near **navcount**_{min}
Possible touch screen insensitivity
- Else if average **navcount** $> 1.3 \times \text{navcount}_{\min}$
Suggests voters surprised by summary screen
- Else no suggestion

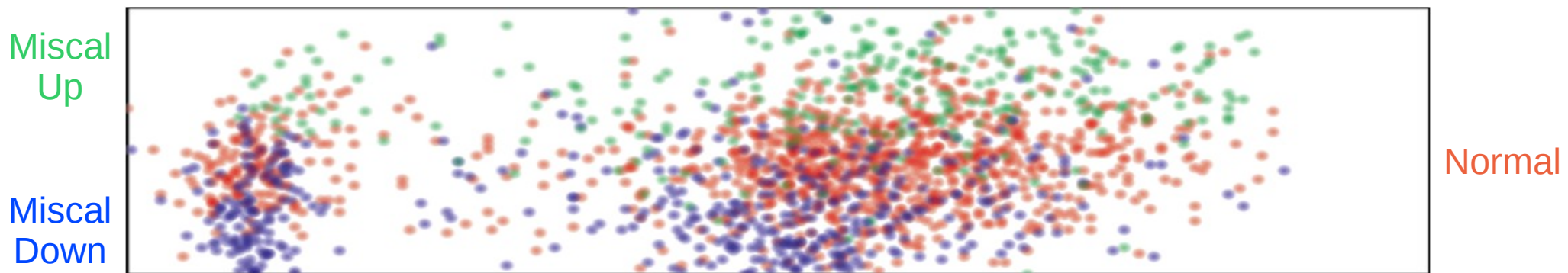
Warning: Numbers will change with different button sizes and may not scale with ballot size

Vote-o-graph touch distributions

- For buttons that look like this (18.4 mm high):



- Voters touch here:



Left handed? Right handed? Forgot about write-in keypad?

Conclusions

- Voter problem reports are misleading

Some voter reports of “vote flipping” come from missing races they'd intended to vote in.

- Ballot design caused the CD-13 undervote

Banner blindness is probably the root cause.

- Touch-screen Insensitivity contributed

Review screens less effective when voters frustrated.

- We can log enough to diagnose such problems.