

# Usability of Electronic Voting Systems: Results from a Laboratory Study



Frederick Conrad  
Brian Lewis  
Emilia Peytcheva  
Michael Traugott  
*University of Michigan*

Michael Hanmer  
*Georgetown University*

Paul Herrnson  
*University of Maryland*

Richard Niemi  
*University of Rochester*

Ben Bederson  
*University of Maryland*

# Acknowledgements

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  - Federal Election Commission (FEC), Maryland State Board of Elections, National Institute of Standards and Technology (NIST)
- Vendors:
  - Hart InterCivic, ES&S, NEDAP, Avante

# Lab Study

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- 42 participants visited lab in Ann Arbor, MI in Summer, 2004
  - 31 with limited computer experience
    - “less than two times a week” or less
  - 29 older than 50 years of age
  - Each paid \$50 for up to 2 hours

# Take Home Points

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- People have problems using these voting systems, particularly for some tasks
  - E.g. changing votes, writing-in votes
- Errors are accompanied by other signs of trouble
  - Longer, more effortful
- Same tasks can be problematic for different reasons, due to different designs



# Results:

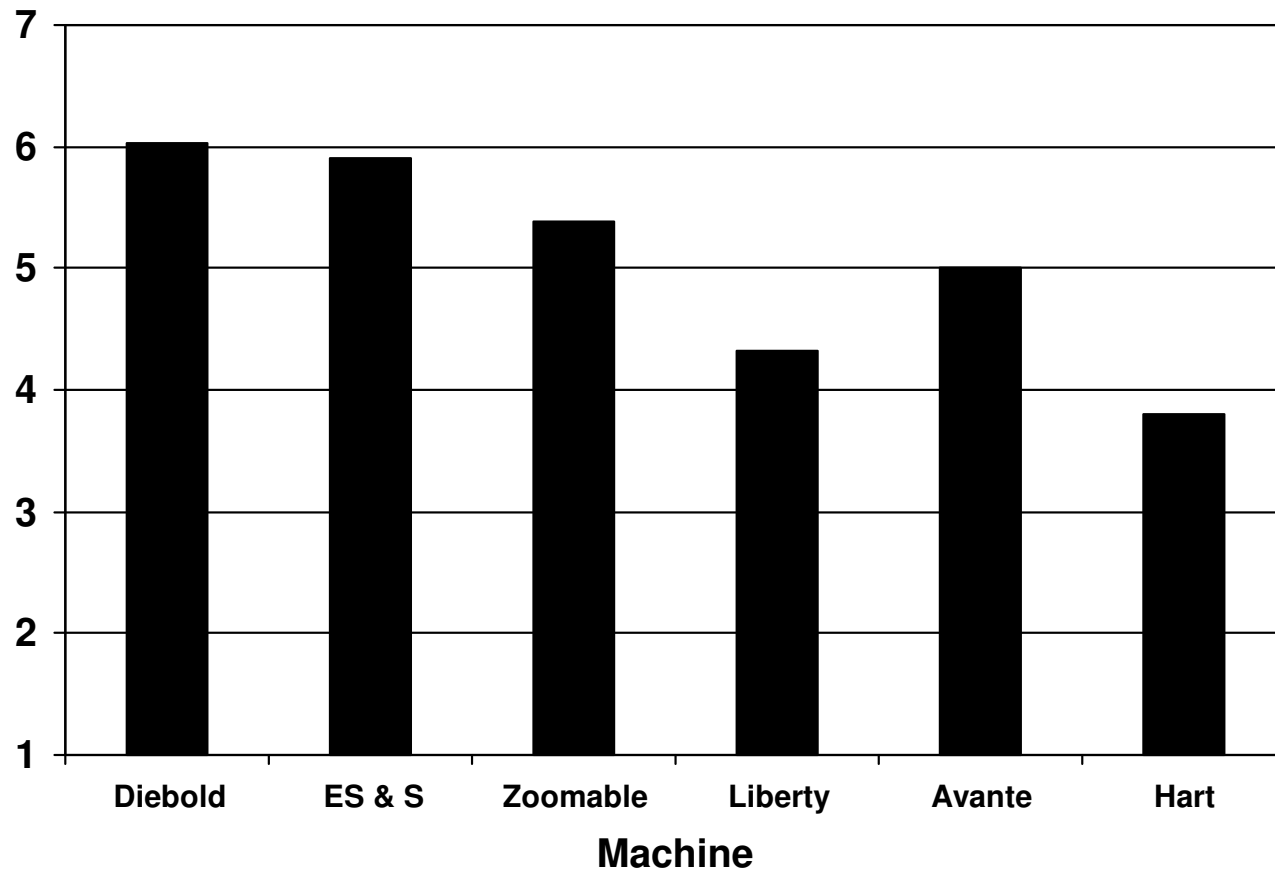
## Satisfaction and Effort

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- Different levels of satisfaction seems related to the user (voter) interface
  - Diebold given highest and Hart lowest satisfaction ratings
  - Diebold requires relatively few actions and the least time, Hart requires most actions and most time
  
- Even if used as intended, Diebold requires one action (touch) per vote but Hart requires two (dial and enter)

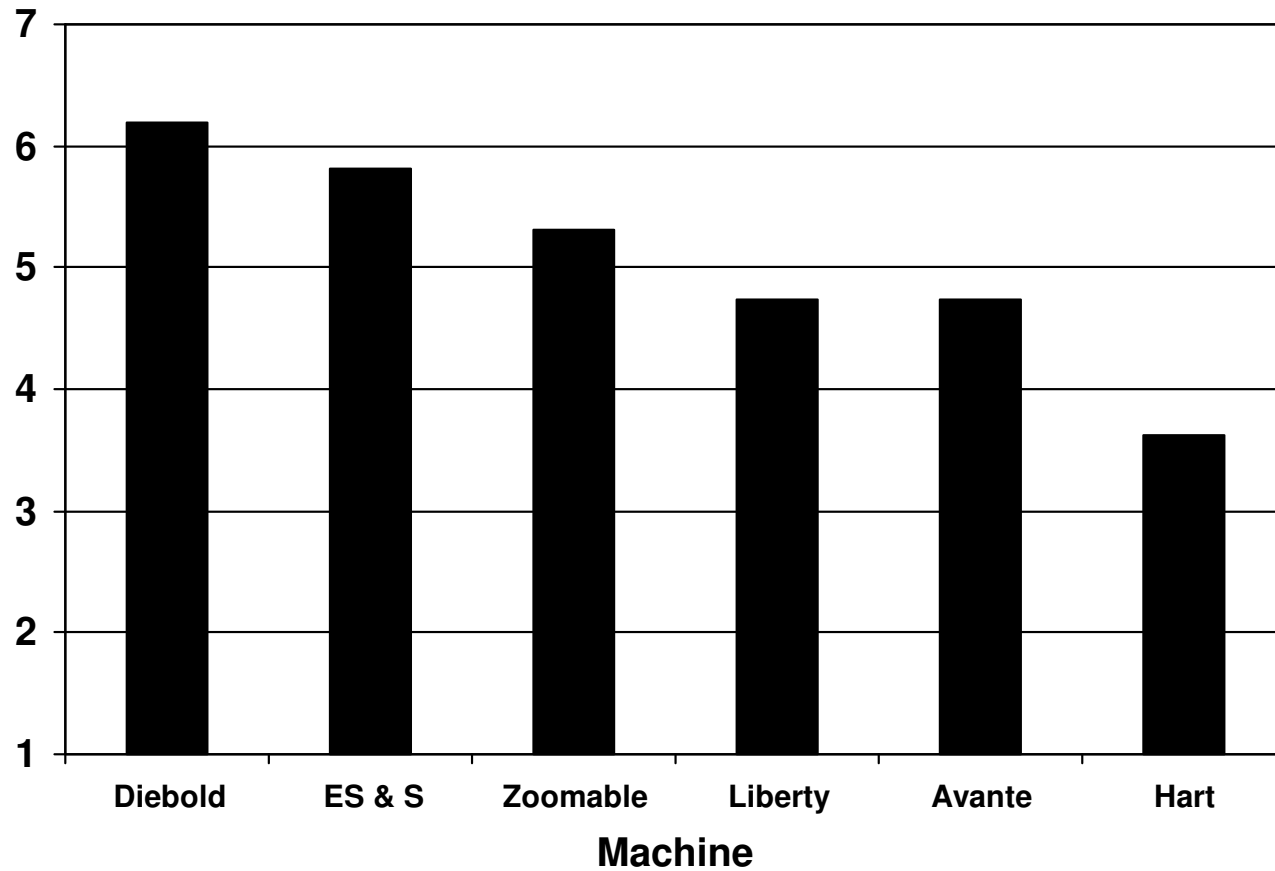
# “The voting system was easy to use”

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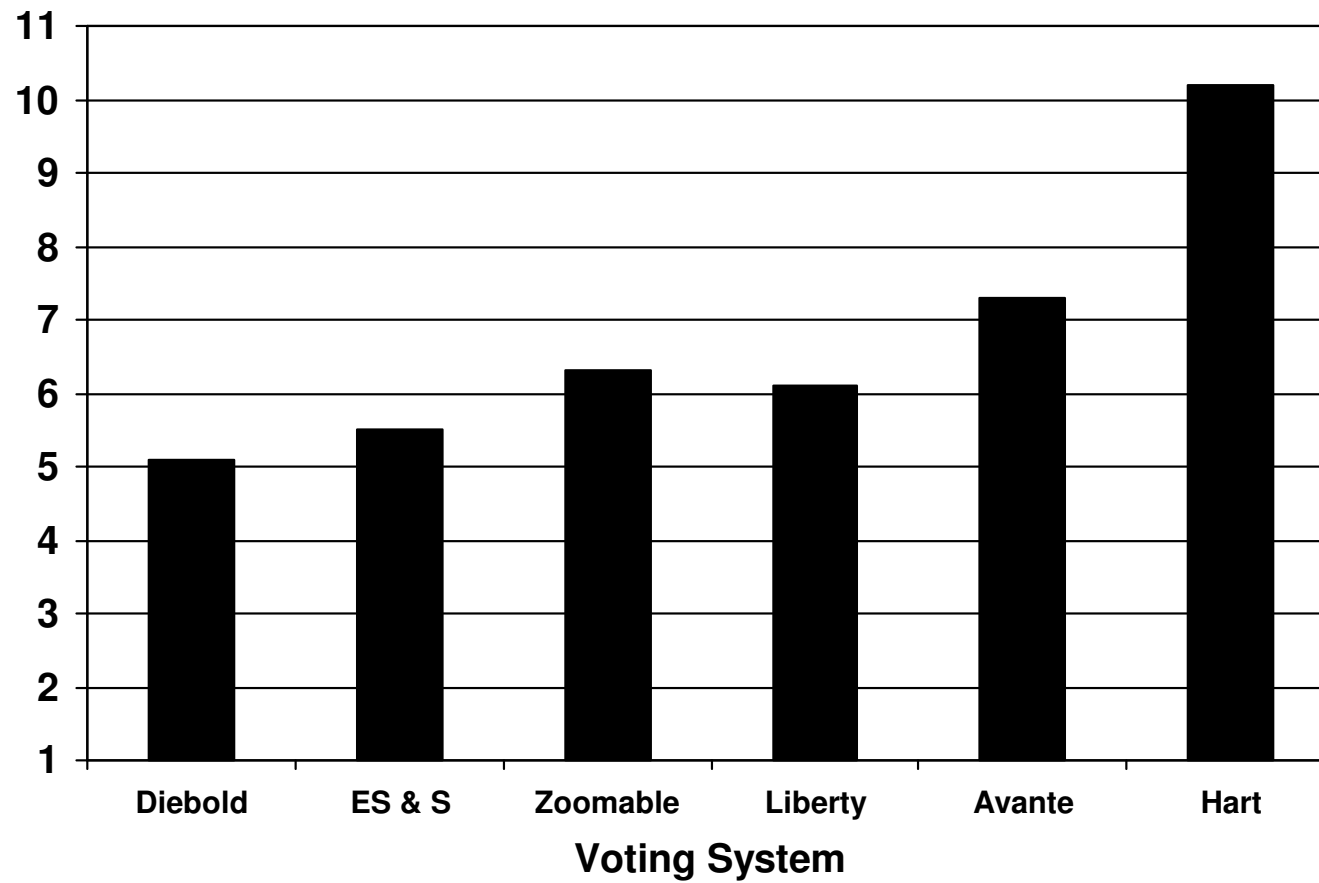
# “I felt comfortable using the system”

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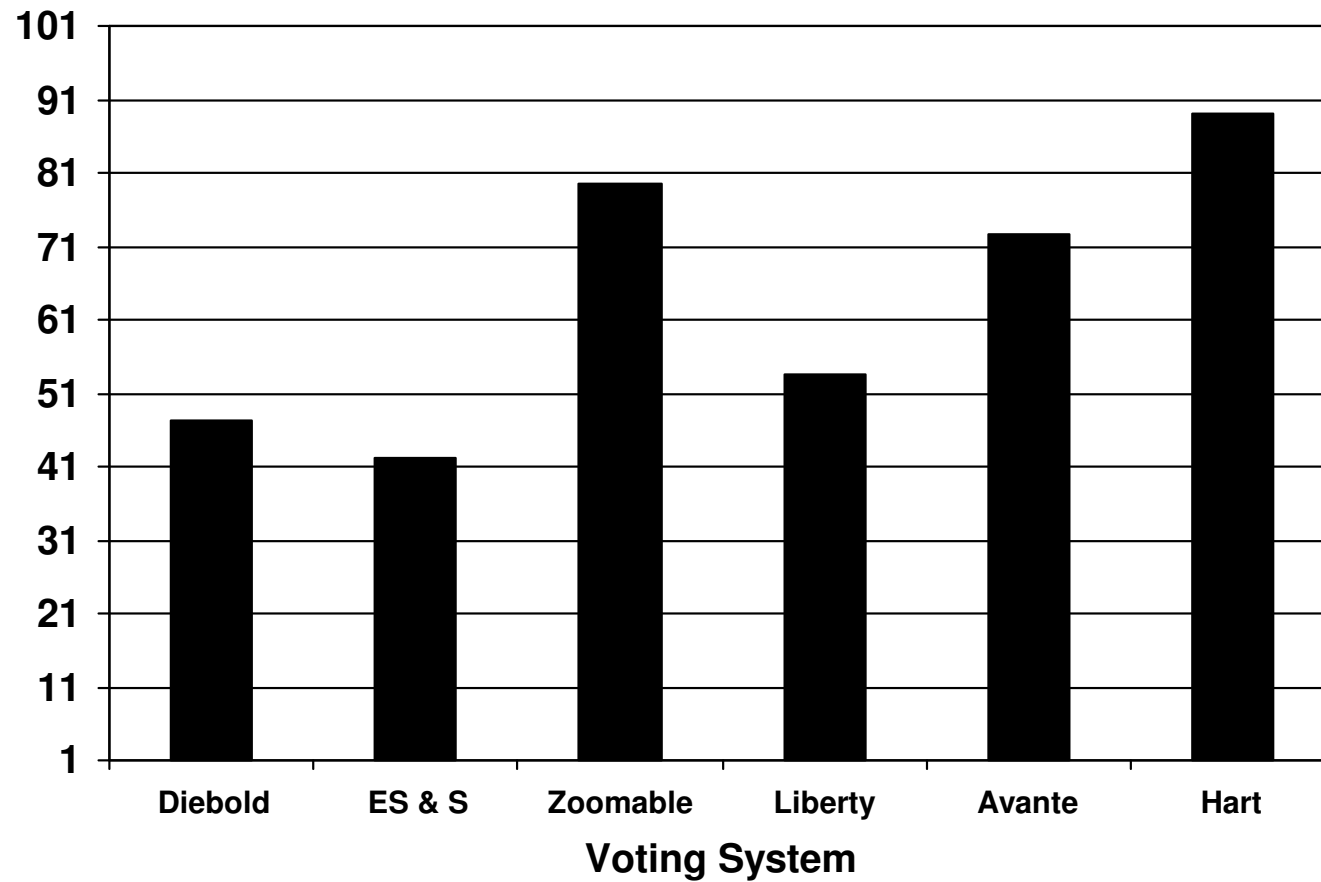
# Duration

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# Number of Actions

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# Results:

## Effort and Satisfaction

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- The more effort required to vote, the less satisfied voters are with the experience
  - Effort: Number of Actions, Duration
  - Satisfaction: "easy to vote" and "comfortable voting"\*

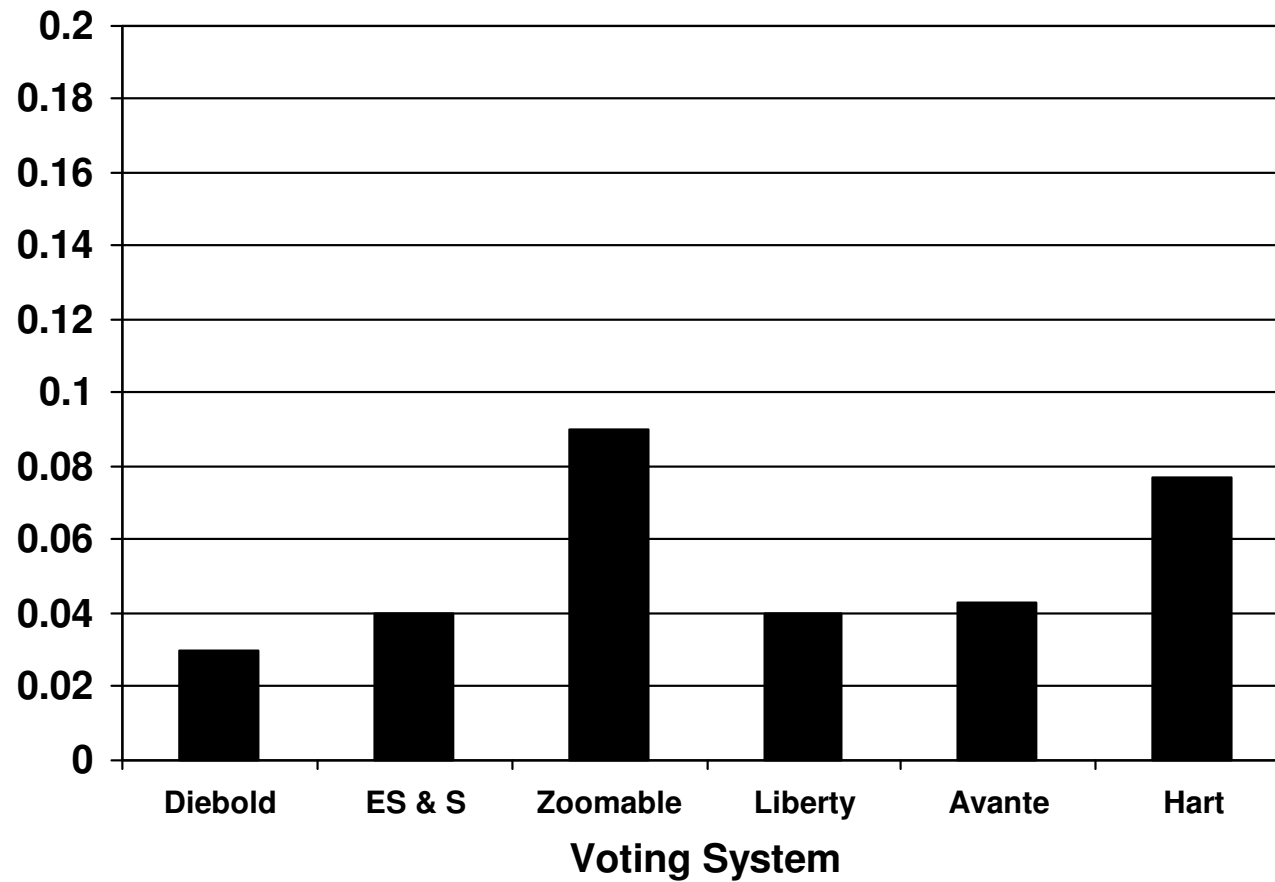
	<u>Satisfaction</u>	
<u>Effort</u>	Ease	Comfort
Duration	-0.40	-0.37
Number of Actions	-0.33	-0.33

$p < .001$  for all correlations

\*Agreement scale (1 = strongly disagree, 7 = strongly agree)

# Errors (Inaccuracy)

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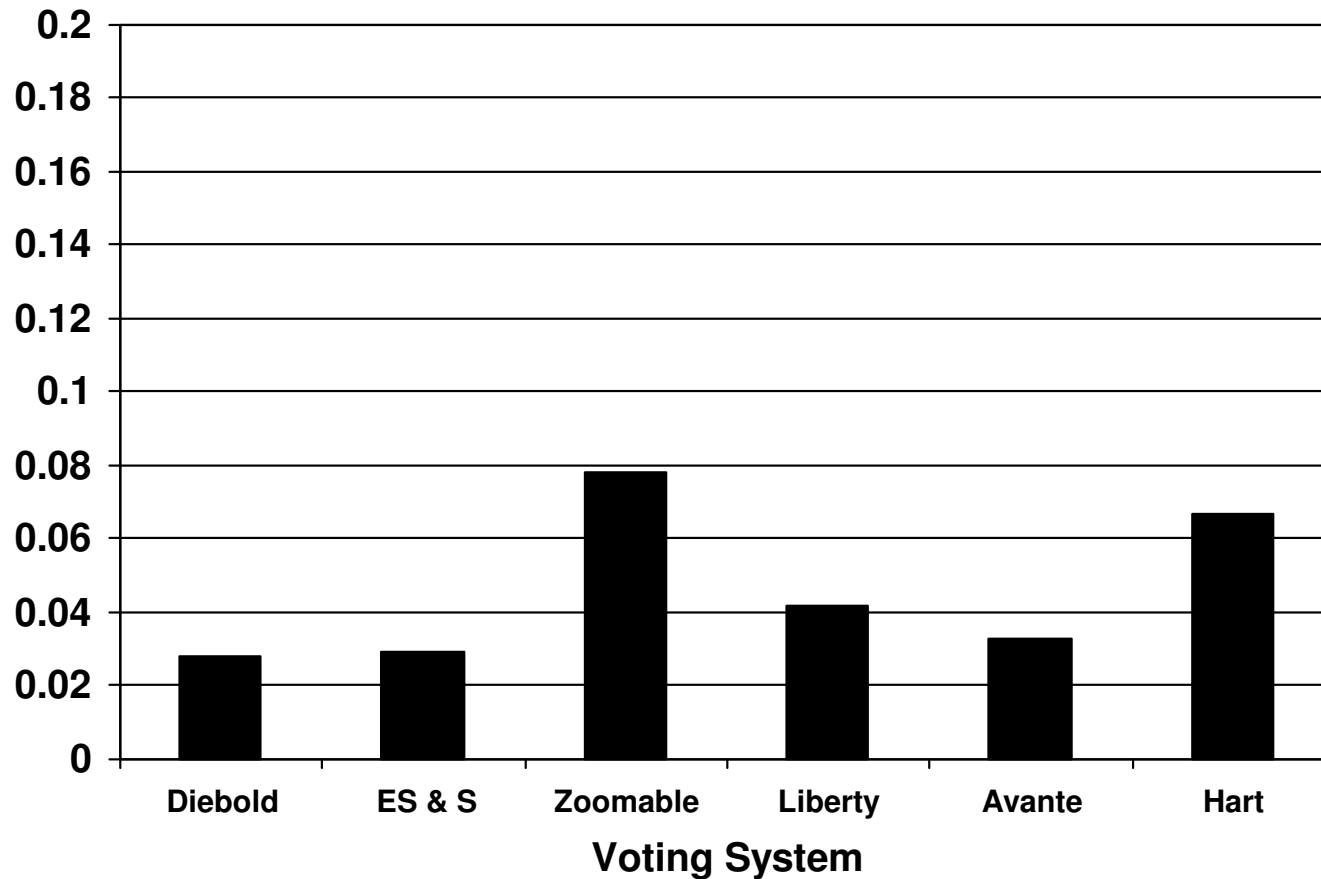
# Results: Errors and Satisfaction

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- As voters make more errors they are less satisfied
  - Easy to use ( $\rho = -0.23, p < .001$ )
  - Comfortable using ( $\rho = -0.18, p < .005$ )
  
- Suggests that errors are associated with frustration, not simply wrong

# Errors for simple voting tasks: one candidate, no changes, no-write-in

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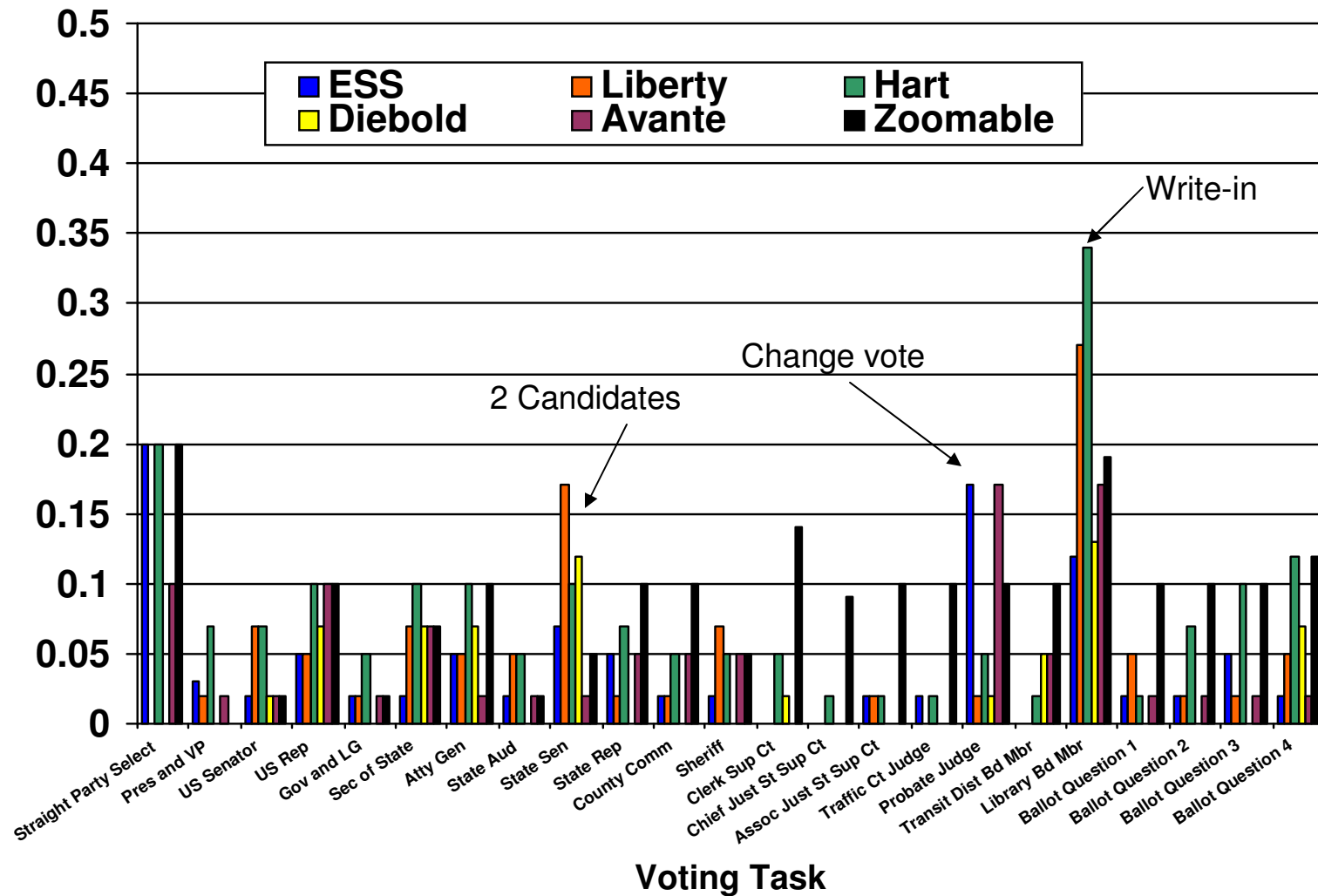
# Results:

## Particular voting tasks across systems

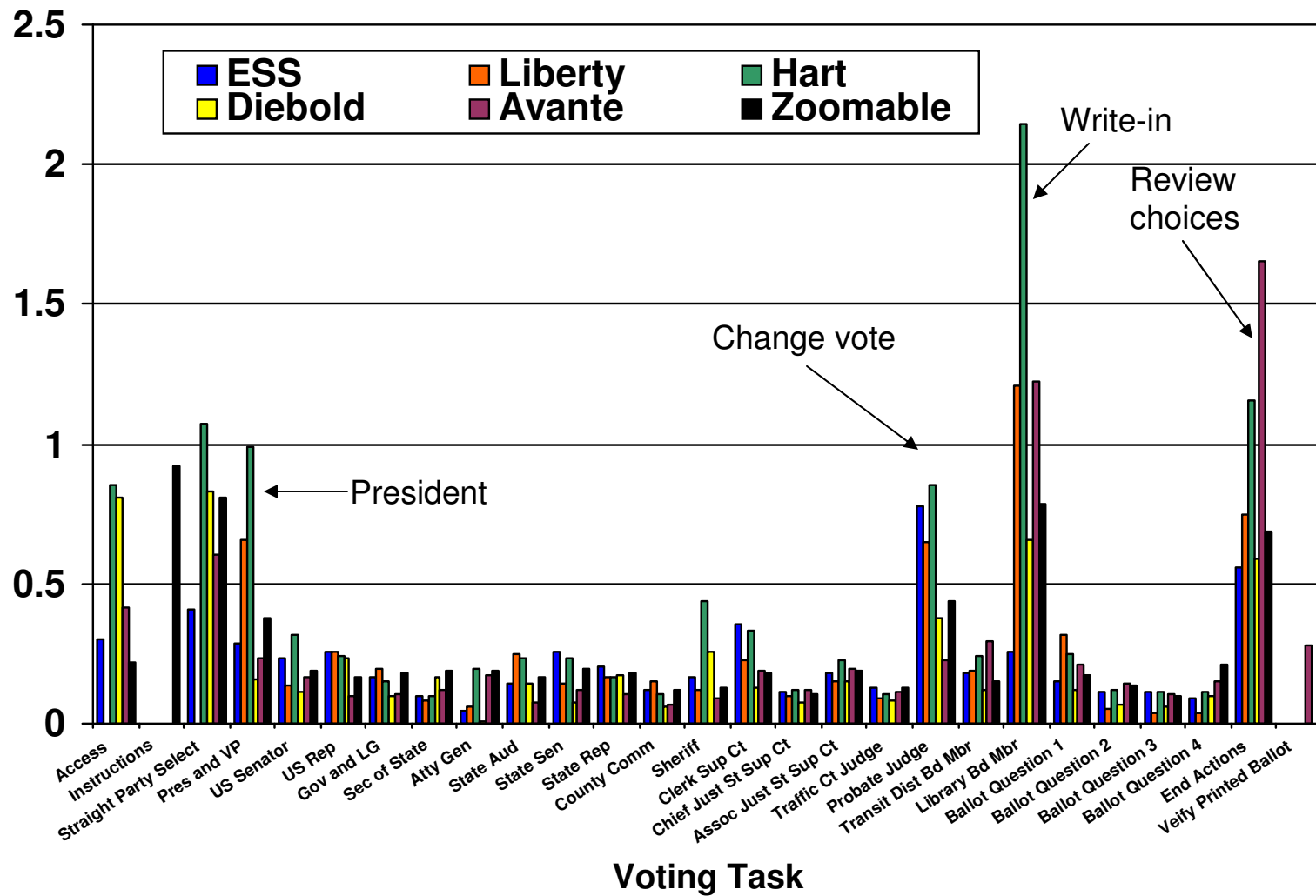
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- Are some tasks more problematic than others?

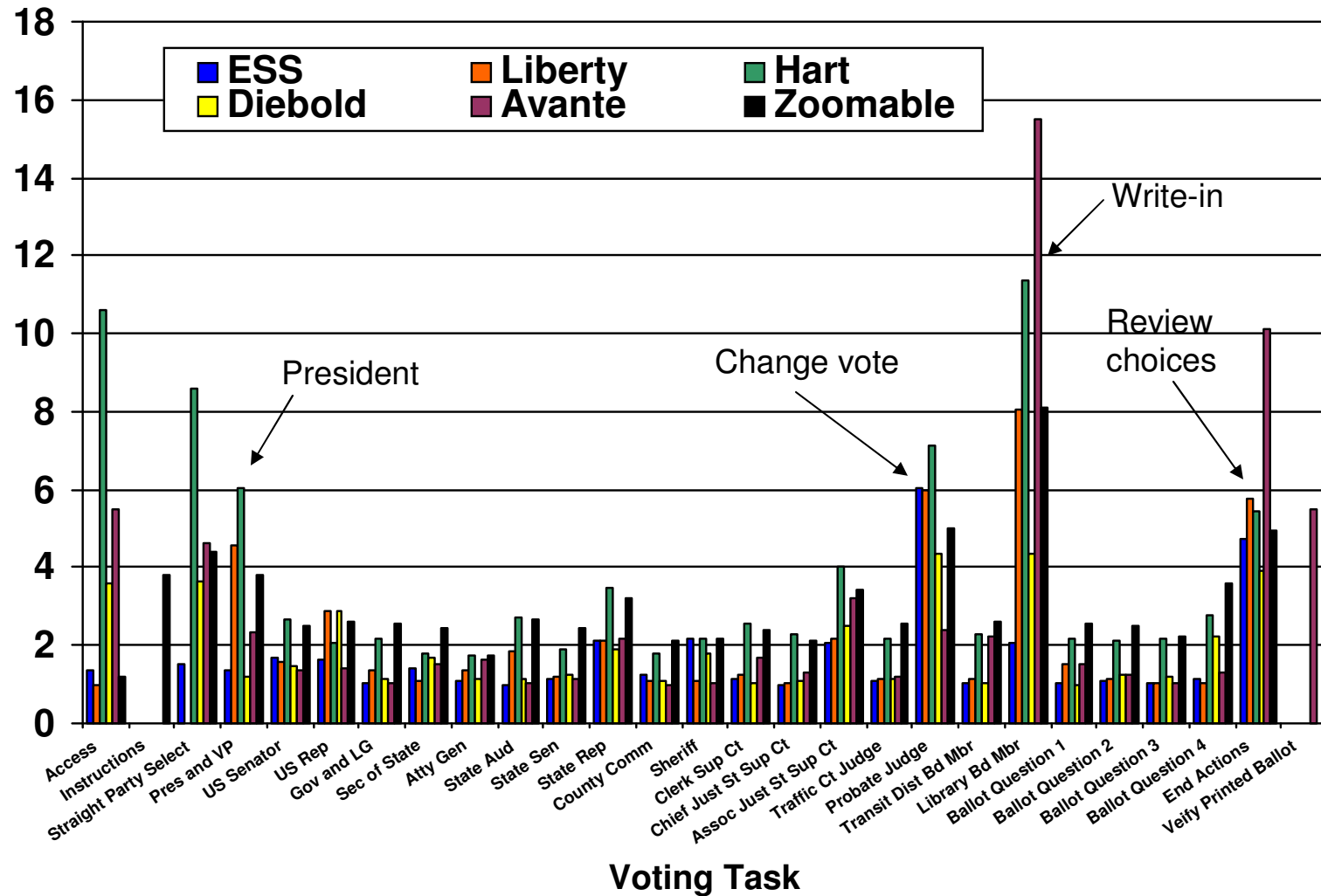
# Errors (Inaccuracy)



# Duration



# Number of Actions



# Changing a Vote

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- For Probate Judge, voters instructed to first choose Jeanette Anderson and then change to Kenneth Hager

<i>System</i>	Errors
Diebold	.04
ESS	.22
Avante	.18
Zoomable	.10
Liberty	.02
Hart	.07

Vote-change video examples: [Diebold](#), [Avante](#)

# Writing-in a vote

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- For write-in task, voters given name of candidate to enter

<i>System</i>	Errors
Diebold	.16
ESS	.12
Zoomable	.19
Liberty	.27
Avante	.17
Hart	.34

Write-in video examples: [Avante](#), [Hart](#), [Zoomable](#)

# Paper Trail

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- “Voter verified paper audit trail” makes recounts possible despite vanishing character of e-voting
- But critical that voters verify
- Usability of Avante printed receipt interferes with voter verification
  - System times out, automatically depositing (unverified receipt) for 38% (16/42) voters
  - 24% (10/42) voters deposited (verified) receipt without looking at it
  - Only 26% (11/42) follow ideal sequence of looking at receipt then depositing
- [Video example of paper record verification](#)

# Conclusions

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- ❑ In a situation designed to maximize usability problems, the systems fared reasonably well
- ❑ But did exhibit serious usability problems and, for some systems, errors were disturbingly frequent
  - Particularly for complex voting tasks
  - For different reasons for different interfaces
- ❑ Errors associated with problems in general
  - Voters were unhappy when they made errors
- ❑ An unsatisfying experience could well translate to lower turnout and lower confidence in process

# Implications

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- Many design problems can be identified with usability engineering techniques
  - But industry and election officials need to make a priority
- Unparalleled design challenge:
  - Systems should be usable by all citizens all the time, even if used once every few years



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Thank you!

# Lab Study Design

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Ballot Design	Computer Experience	
	Low	High*
Office Block	21	9
Straight Party	10	2

n = number voters

\* > twice a week