Heuristics and Voting Behavior in Multi-Winner Approval Voting

Jaelle Scheuerman[1], Jason L. Harman[2], Nicholas Mattei[1], K. Brent Venable[3,4]

[1]Tulane University, [2]Louisiana State University, [3]Institute for Human and Machine Cognition, [4]University of West Florida

Goal:

- Examine voter behavior and use of heuristics in approval voting contexts.

Motivation:

- Using computational methods, researchers in the field of Computational Social Choice (COMSOC) analyze issues arising from aggregating preferences across groups of agents (i.e winner determination and manipulation) under various voting rules.
- Much of the theoretical work assumes complete information and infinite time and resources to determine optimal strategies.
- Some efforts have been made to examine voting rules in the presence of uncertain information or when agents are not perfectly rational, but the conceptualization is often intuitive and not empirical.

Key Takeaways:

- Most individuals did not vote truthfully (for all candidates with positive utility) in these contexts.
  (1-winner: 33.6%, 2-winner: 33.6%, 3-winner: 46.1%)
- Optimal manipulation was not the dominant strategy, but was achieved more often for larger numbers of winners increased.
  (1-winner: 25.6%, 2-winner: 38.4%, 3-winner: 49.6%)
- On average, participants voted for 2.44 candidates.
  (1-winner: 2.26, 2-winner: 2.61, 3-winner: 2.58)
- Take the X best captured a significant proportion of voting profiles.
  (1-winner: 50.6%, 2-winner: 43.8%, 3-winner: 34.4%)
- In situations with a disliked candidate (i.e. Scenario 5), regret minimization was not often used.
  (1-winner: 9.6%, 2-winner: 12.3%, 3-winner: 9.3%)
- Participants changed their voting strategies depending on the number of winners. In most scenarios, they did not change their strategy as the level of uncertainty increased, even when this led to a less than optimal strategy.

  Scenarios 3 and 5 are exceptions, with strategies significantly changing as the amount of uncertainty increases.

Future Work:

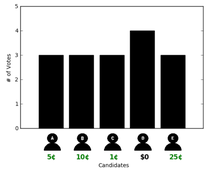
- Determine how effective heuristics such as take the X best are in manipulating approval voting rules that have been shown to be computationally complex to manipulate (Proportional Approval Voting and Re-weighted Approval Voting).
- Develop a taxonomy of heuristics used in voting and demonstrate their effectiveness under various voting rules and contexts.

Experiment

For each scenario below, participants were asked to vote for 0+ candidates in single-winner elections (n=104) and in either a 2-winner (n=50) or 3-winner (n=54) approval election. Ties are broken randomly.

Scenarios 1 and 2: Do subjects vote for candidates with trivial utility? (no)

1. Candidate with trivial utility



winners

# missing votes	1	2	3
0	0.12 Take 1	0.22 Take 1	0.31 Take 2
1	0.11 Take 1	0.21 Take 2	0.30 Take 2
3	0.11 Take 1	0.20 Take 2	0.29 Take 2

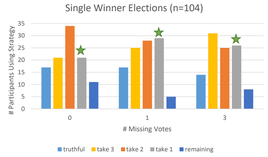
Maximum Expected Utility and Best Heuristic

χ^2 analysis:
Significant differences ($P < 0.005$) in strategies were identified when comparing responses in the following environments.

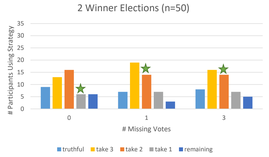
Across all uncertainty levels:
- Single winner vs 2 winner elections
- Single winner vs 3 winner elections
- 2 winner vs 3 winner elections

Strategies were not sensitive to changes in uncertainty, even when the underlying optimal strategy changed.

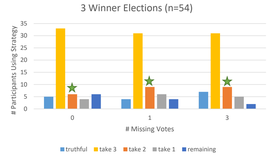
Single Winner Elections (n=104)



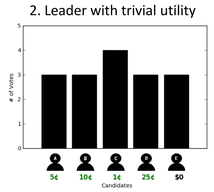
2 Winner Elections (n=50)



3 Winner Elections (n=54)



2. Leader with trivial utility



winners

# missing votes	1	2	3
0	0.13 Take 1	0.26 Take 1	0.36 Take 2
1	0.12 Take 1	0.22 Take 2	0.31 Take 2
3	0.11 Take 1	0.21 Take 2	0.29 Take 2

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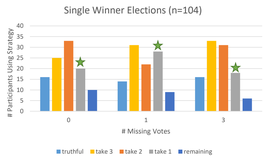
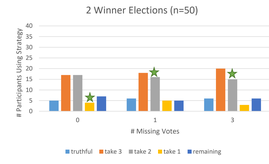


2 Winner Elections (n=50)



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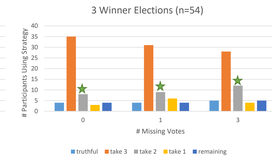
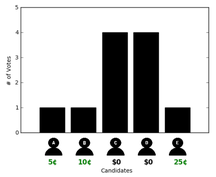


Scenarios 3 and 4: Will subjects vote truthfully when their favored candidates are dominated by neutral candidates? (yes)

3. No-win scenario for 1 and 2 winner elections



winners

# missing votes	1	2
0	--	--
1	--	--
3	0.006 Truthful	0.035 Truthful

Maximum Expected Utility and Best Heuristic

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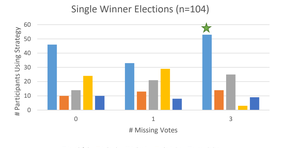
Across all uncertainty levels:
- Single winner vs 2 winner elections

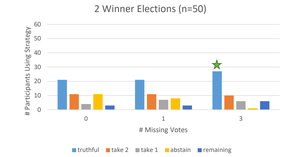
Single Winner:
- 0 missing votes vs 3 missing votes
- 1 missing votes vs 3 missing votes

2 Winner:
- 0 missing votes vs 3 missing votes
- 1 missing votes vs 3 missing votes

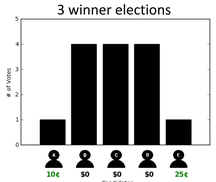
Single Winner Elections (n=104)



2 Winner Elections (n=50)



4. No-win scenario for 3 winner elections



winners

# missing votes	3
0	--
1	--
3	0.05 Truthful

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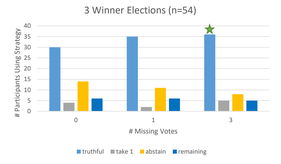
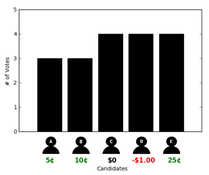
3 Winner Elections (n=54)



Scenario 5: When a disliked candidate is present, do subjects vote truthfully, use regret minimization, or some other strategy? (depends on the number of winners)



winners

# missing votes	1	2	3
0	0.25 Truthful Take 1 Take 2	0.25 Regret Min, [C,E]	-0.03 Regret Min
1	0.10 Truthful	0.06 Regret Min	-0.10 Regret Min
3	0.03 Regret Min	-0.03 Regret Min	-0.17 Regret Min

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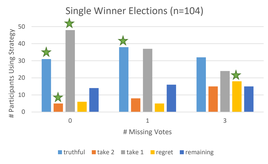

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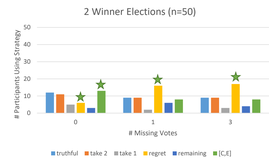

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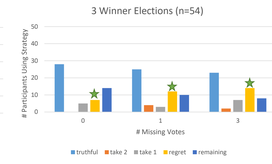
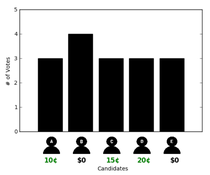


Scenario 6: When a neutral candidate is leading, do subjects vote truthfully, or use some other strategy? (truthful voting dominates)



winners

# missing votes	1	2	3
0	0.11 Truthful	0.23 Truthful	0.35 Take 2
1	0.11 Truthful	0.22 Take 2	0.32 Truthful
3	0.11 Take 2	0.21 Truthful	0.31 Truthful

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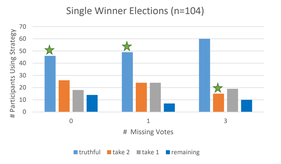
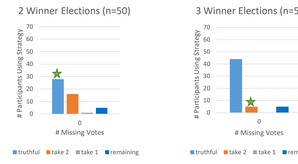


2 Winner Elections (n=50)



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