Avoiding Social Disappointment in Elections

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ABSTRACT

Mechanism design is concerned with settings where a policy maker (or social planner) faces the problem of aggregating the announced preferences of multiple agents into a collective (or social), system-wide decision. One of the most important ways for aggregating preference that has been used in multi-agent systems is election. In an election, the aim is to select the candidate who reflects the common will of society. Despite the importance of this subject, in real-world situations, under special circumstances, the result of the election does not respect the purpose of those who execute it and the election leads to dissatisfaction of a large amount of people and in some cases causes polarization in societies. To analyze these situations, we introduce a new notion called social disappointment and we show which voting rules can prevent it in elections. In addition, we propose new protocols to prevent social disappointment in elections. A version of the impossibility theorem is proved regarding social disappointment in elections, showing that there is no voting rule for four or more candidates that simultaneously satisfies avoiding social disappointment and Condorcet winner criteria. We empirically compared our protocols with seven well-known voting protocols and we observed that our protocols are capable of preventing social disappointment and are more robust against manipulations.

KEYWORDS

mechanism design; social choice theory; voting procedures; impossibility theorem; social disappointment; manipulation

ACM Reference Format:
Mohammad Ali Javidian, Pooyan Jamshidi and Rasoul Ramezanian. 2019. Avoiding Social Disappointment in Elections. In *Proc. of the 18th International Conference on Autonomous Agents and Multiagent Systems (AAMAS 2019), Montreal, Canada, May 13–17, 2019,* IFAAMAS, 3 pages.

1 THEORETICAL RESULTS

In elections, it is desirable that the alternative (candidate) defeated by a majority in pairwise contests against any other alternatives (i.e., Condorcet loser), and also the alternative that is at the bottom of at least half of the individual preference profiles should not be elected-both to make less likely the election of candidates with limited overall support and to mitigate ethnic conflict in divided societies [5, 7]. To avoid social disappointment in voting mechanisms, we introduce the following criterion:

Definition 1.1. (*Social disappointment*): Social disappointment (SD) in voting happens when the outcome of an election (with three or more alternatives) includes an alternative which is at the bottom of at least half of the individual preference lists. Also, we say that a voting system satisfies the *social disappointment criterion* (SDC), if prevents SD in elections.

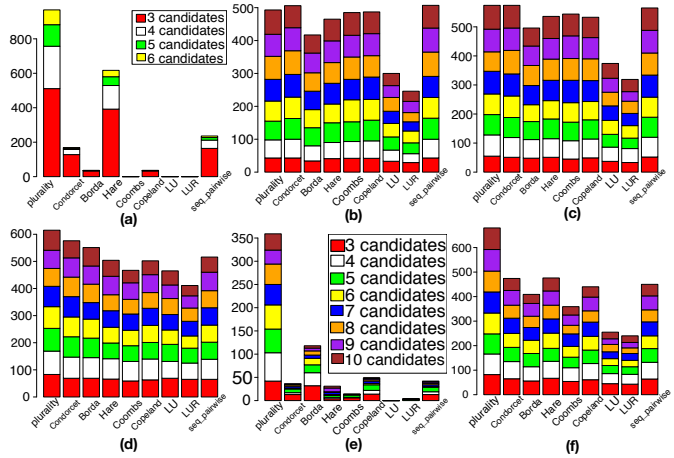

Figure 1: (a) Performances of voting procedures based on social disappointment criterion; (b)-(f) Performances of voting procedures against manipulation in different scenarios explained in [6, Secction 5.1].

Note that Condorcet loser and social disappointment criteria are two distinct concepts in voting systems and none of them implies the other one [6, Proposition 3.3]. Coombs's method satisfies SDC. However, Coombs does not satisfy the monotonicity criterion. Monotonicity criterion, which formalizes the crucial idea that increased support for a candidate never hurts, and may help her to win. Otherwise, voters would be afraid to cast their ballots in an *honest way*, aware that a vote for their sincere first choice could harm the cause of electing her. We, therefore, want to pursue a voting procedure to satisfy the monotonicity criterion [8]. For this purpose, we propose a new voting protocol that satisfies monotonicity and prevents SD in voting systems.

Definition 1.2. (*The Least Unpopular (LU) procedure*) The social choice(s) in the least unpopular procedure (LU) is (are) the alternative(s) that appear(s) less than the others at the bottom of individual preference lists.

This protocol satisfies the always-a-winner (AAW), Monotonicity, and social disappointment criterion, but does not satisfy the Condorcet winner condition (CWC), Condorcet loser condition (CLC), Pareto, and independence of irrelevant alternatives (IIA) criterion [6]. The Pareto criterion is important in the context of Arrow's impossibility theorem [1, 2]. However, LU does not satisfy this criterion. Here, we introduce a new voting protocol that satisfies

Proc. of the 18th International Conference on Autonomous Agents and Multiagent Systems (AAMAS 2019), N. Agmon, M. E. Taylor, E. Elkind, M. Veloso (eds.), May 13–17, 2019, Montreal, Canada.

Pareto and monotonicity, and also prevents social disappointment in elections.

Definition 1.3. (*The Least Unpopular Reselection (LUR) Procedure*) First, the set of alternatives appearing least often at the bottom of individual preference lists (i.e., the set of least unpopular alternatives) is chosen. If this set has only one member, it is the social choice. Otherwise, the remaining alternatives (if any) are removed and the procedure LU is run for the set obtained from the previous stage. This procedure is repeated until it cannot be continued (because a new set of alternatives cannot be produced). The set obtained in the last repetition is the set of social choice.

This protocol satisfies the AAW, Monotonicity, Pareto, and SDC criteria, but does not satisfy the CWC, CLC, and IIA criteria [6].

Some of results from this paper are summarized in Table 1. This table provides the answers to 63 questions of the form "Does method X satisfy criterion Y ?" The rows are indexed by 9 methods. The columns are indexed by 7 criteria: always-a-winner, the Condorcet winner, Pareto, monotonicity, independence of irrelevant alternatives, social disappointment, and Condorcet loser criterion.

Table 1: Comparison of voting procedures

	AAW	CWC	Pareto	Mono	IIA	SDC	CLC
Condorcet	NO	YES	YES	YES	YES	NO	YES
Plurality	YES	NO	YES	YES	NO	NO	NO
Borda	YES	NO	YES	YES	NO	NO	YES
Hare	YES	NO	YES	NO	NO	NO	NO
Seq. Pairs	YES	YES	NO	YES	NO	NO	YES
Copeland	YES	YES	YES	YES	NO	NO	YES
Coombs	YES	NO	YES	NO	NO	YES	NO
LU	YES	NO	NO	YES	NO	YES	NO
LUR	YES	NO	YES	YES	NO	YES	NO

Now, we provide a version of the impossibility theorem [1, 2, 9] regarding the notion of social disappointment in elections, showing that there is no voting rule for four or more candidates that simultaneously satisfies SDC and CWC. This theorem can be seen as part of the story of the difficulty with "reflecting the will of the people." The proof of this theorem, like that of Arrow's theorem, makes critical use of the voting paradox of Condorcet [4] (see [6] for the proofs of the following theorem and proposition).

Theorem 1.4. *There is no voting procedure for* ***four or more*** *alternatives that satisfies the SDC and the Condorcet winner criterion.*

Proposition 1.5. *There is a voting procedure for* ***three*** *alternatives that satisfies the SDC and the Condorcet winner criterion.*

2 EXPERIMENTAL RESULTS

We empirically evaluated the performance of the nine voting protocols from two point of views: *avoidance of social disappointment* and *resistance to manipulation* via strategic voting [3]. For this purpose, we designed two different setups (explained in [6]) and we conducted a sensitivity analysis to evaluate the performance of voting rules in both cases. The code and data are available at: https://github.com/majavid/AAMAS2019.

Figure 1(a) shows the performance of voting protocols against SD. As we expected [6, Section Section 3], SD does not happen for Coombs, LU, and LUR methods. However, other procedures cannot prevent SD. Among voting procedures, Plurality has the worst performance. An interesting observation is that the number of SD occurrence in elections decreases when the number of candidates increases as one can see in Figure 1(a). Another noticeable point is that Borda and Copeland violate SDC in fairly few cases, indicating that SD happens for these methods just in rare cases (see theoretical results in [6] that support this observation).

Comparing the outcome of original elections with the outcome of elections after each manipulation scenario (explained in [6, Section 5.1]) show that:
(1) *Constructive Control by Adding/Deleting Voters' Ballots*: In this scenario, as shown in Figure 1(b),(c), LU and LUR are more robust against manipulation compared to other procedures. Figure 1(b),(c) shows that the number of affected elections in this scenario is independent of the number of candidates. Except for LU and LUR, other procedures perform as bad as plurality rule in this scenario.
(2) *Constructive Control by Adding/Deleting Candidates*: As shown in Figure 1(d), Coombs, LU and LUR are more robust against manipulation compared to other procedures. In contrast with first scenario i.e., constructive control by adding/deleting voters' ballots, Copeland performs slightly better than Borda in this case. The number of affected elections in this scenario does not depend on the number of candidates.
(3) *Bribery/Self-manipulation*: As shown in Figure 1(e), LU and LUR are more robust against manipulation in this scenario compared to other procedures. In contrast with first and last scenario, Borda surprisingly does not perform as good as Copeland, Condorcet, Seq. Pairs., Hare, and Coombs.
(4) *Social Network and Social Media Influence on Voters' Preference Lists*: As shown in Figure 1(f), LU and LUR are more robust against manipulation. The worst performance belongs to plurality, and Coombs method has the best performance after LU and LUR. The number of affected elections in this scenario is independent of the number of candidates.

Compared to seven well-known voting rules, all of experimental results indicate that LU and especially LUR' voting protocols are considerably better and more resistant to manipulations. The implication of this study is that election experts who have been advocating the alternative vote/instant runoff may advocate also LU and especially LUR to avoid SD and electing extremist candidates with substantial first round but little overall support in elections.

3 CONCLUSIONS

In this paper, we proposed a new concepts called social disappointment -to make less likely the election of candidates with limited overall support and to mitigate ethnic conflict and polarization in divided societies. We designed two new voting rules to prevent social disappointment in elections. In addition, a version of the impossibility theorem stated and proved regarding social disappointment in elections, showing that there is no voting rule for four or more candidates that simultaneously satisfies avoiding social disappointment and Condorcet winner criteria. Finally, we empirically evaluated the occurrence of social disappointment and we showed that the performance of our proposed protocols are superior than other seven well-known voting rules against manipulation in four different scenarios.

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