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# Interaction and Expressivity in Collective Decision-Making

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## Abstract

Collective decisions among human and artificial agents can be enhanced by allowing for more interaction among decision-makers and by letting them express more information about their preferences. In this paper I present ongoing research on two settings: iterative voting, which repeatedly applies a voting rule until decision-makers converge to an outcome, and delegative voting on multiple issues.

## 1 Introduction

There are many ways in which AI techniques and technologies can contribute to the improvement of collective decision-making processes among human or artificial agents. Many such research directions require that the classical social choice setting (independent voters expressing preferences over typically few independent alternatives) are generalised to more complex settings. In previous research I focused extensively on how to introduce a social network in the modelling of a collective decision problem (see Grandi [2017] for an overview, but many other papers appeared since then). In this paper I focus on two further improvements. First, study interactive mechanisms in which voters participate to an iterated election, each time receiving information about the current winner or the other voters' ballots. This setting is known as *iterative voting* (for a survey of initial work in this area see Meir [2017]). Second, give voters more expressivity by considering collective decisions on multiple issues, most notably in the setting of *delegative voting*. Both research directions aim at paving the way for some sort of *agent-mediated social choice*, an idea which I presented in a recent position paper [Grandi, 2019].[1]

**Context.** Current research in *computational social choice*[2] moved towards the design and the analysis of algorithms for digital democracy. Research directions have been outlined in a number of recent position papers [Brill, 2018; Shapiro, 2018; Brill, 2021; Talmon and Shapiro, 2022; Grossi, 2022].

[1] A similar program was put forward by César Hidalgo in a 2018 TED talk (see www.peopledemocracy.com).

[2] For an overview of this research field see Brandt *et al.* [2016].

## 2 Social Influence and Iterative Voting

Consider a simple collective decision in which a set of voters have preferences over a set of candidates or alternatives, and express it in the form of a plurality vote, thus submitting the name of their preferred candidate. Assume now that some of this information is shared among the voters. For instance, an agent can discover for whom other agents close to them have voted for, or get information about the score of each candidate from a publicly accessible poll. There are two ways in which a voter can react to such information: either be influenced, or respond strategically.

The combination of voting and social influence is a well-studied topic. For instance, settings where a group of voters is steered towards the majority vote [Hassanzadeh *et al.*, 2013] or when an external player aims at controlling an election on a social network [Faliszewski *et al.*, 2018; Wilder and Vorobeychik, 2018; Castiglioni *et al.*, 2020]. In past work I designed and analysed social influence models that are adapted to voting situations such as preferences over alternatives or multi-issue voting [Grandi *et al.*, 2015; Brill *et al.*, 2016; Botan *et al.*, 2019] and strategic models of social influence [Grandi *et al.*, 2021].

When agents are instead assumed to respond to the information received dynamically from the other voters by changing their reported vote or their reported preference, we enter in the realm of iterative voting. This setting was first proposed as an equilibrium selection mechanism for voting games [Meir *et al.*, 2010; Lev and Rosenschein, 2012], initiating a productive line of research. However, the repeated execution of a simple voting rule such as plurality can also be viewed as a novel voting procedure *per se*. This approach might solve a tension in the design of collective decisions, that are required to be easy to explain to voters while at the same time satisfy a number of good properties.

In previous work we assessed the quality of the result of a repeated election by measuring social welfare as the average position of the winner in the individual preferences as well as the frequency of election of Condorcet winners, showing the beneficial effects of iterative voting. We used both multiagent simulations in a standard voting-for-candidates situation [Grandi *et al.*, 2013] and a behavioural experiment in the lab for multi-issue voting [Grandi *et al.*, 2020].[3] We also

[3] A similar experiment did not find any statistically significant

designed and implemented a platform for organising iterated plurality elections online called Itero,[4] with the aim to promote iterative voting in outreach events and test it in realistic situations [Boudou *et al.*, 2022].

Iterative voting can be seen as a lightweight form of deliberation. Thus, this latter line of research supports the thesis that deliberation among voters can improve the quality of a collective decision and somehow escape the classical impossibilities in social choice (see, e.g., the work of Dryzek and List [2003], the analysis of List *et al.* [2013] on the data of deliberative polls, or the findings of Rad and Roy [2021]).

## 3 Delegations and Multi-issue Voting

A number of social choice problems can be modelled using multiple (binary) issues with the additional use of constraints. Elicitation of preferences, aggregation of partial ballots, and logical dependencies between issues are all problems that have been studied extensively (see, e.g., Lang and Xia [2016] and Endriss [2016] for overviews).

In recent work we focused on the setting of delegative voting and more particularly on a mechanism known as liquid democracy, in which voters have the possibility to express their opinion directly or to delegate their vote (and the delegations they received) to another voter. We first focused on the problem of solving delegation cycles, proposing a general language for agents to express ranked multi-agent delegations on multiple issues and proposing algorithms for their unravelling [Colley *et al.*, 2020; Colley *et al.*, 2022]. We then moved to study delegations in presence of constraints relating the multiple issues at stake. Generalising initial work by Brill and Talmon [2018] on pairwise preference delegations, and by Jain *et al.* [2021] on knapsack voting, we proposed polynomial algorithms for delegations under constraints that make use of a priority ordering over the issues that is elicited from the voters [Colley and Grandi, 2022].

## 4 Conclusions and Perspectives

In this paper I presented recent and ongoing research on enhancing collective decision-making with more interaction and more expressivity. Both topics are concerned with the design of algorithms and their analysis and are guided by philosophical considerations (deliberation can improve collective decisions) or practical applications (the rise of technologies supporting liquid democracy and electronic institutions). One step further is to assess the proposed mechanisms when used by artificial agents acting as proxies for human decision-makers. Initial work has been done, e.g., on assessing how simple reinforcement learning agents can perform in an iterated voting election [Airiau *et al.*, 2017].

Research on algorithms for digital democracy is experiencing a momentum, and the need for new applications in this domain is real. The rise of an interdisciplinary community around these subjects has the potential of unveiling new fascinating problems and research directions for the AI community studying collective decision-making. To give an example, in a recent experiment that we conducted online during the French presidential elections[5] we asked users to approve or disapprove more than one hundred political proposals, and to rank the approved ones, with the aim to construct a collective political program. The design of the platform showed us the need for novel social choice methods that are able to deal with large numbers of alternatives and heavily incomplete preference data, suggesting us a number of research directions for future work.

improvement in the social welfare of iterated elections [Meir *et al.*, 2020]. The set of voting situations they analyse was however less prone to improvements than the ones considered in our experiment.

[4] https://itero.irit.fr/

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