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# Divided majority and information aggregation: Theory and experiment☆

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ABSTRACT

We propose a theory-based experimental approach to compare the properties of *approval voting* (AV) with those of *plurality*. This comparison is motivated by the theoretical prediction that, in our aggregate uncertainty setup, AV should produce close to first-best outcomes, while plurality will not. The experiment shows, first, that welfare gains are substantial. Second, both aggregate and individual responses are in line with theoretical predictions, and thus with strategic voting. Finally, subjects' behavior under AV highlights the need to study equilibria in asymmetric strategies.



## 1. Introduction

Election procedures are a defining feature of democracies. They also determine how decisions are made in smaller groups, from parliaments to board committees. Designing a voting system that produces the best possible outcome given voter preferences and information is thus essential.[1] The literature proposes a variety of voting systems, each of them with potential strengths and weaknesses, yet only a few are used in practice (Bormann and Golder, 2013). Not that there is either an empirical proof or even a common belief that those in use are actually better. To the contrary, their flaws have been repeatedly emphasized. But we lack evidence that the alternatives would perform sufficiently better, and this stalls reform.[2]

Enhancing our knowledge about the capacity of alternative voting systems to outperform the ones currently in use requires a combination

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[1] The voting system must be able to aggregate heterogeneous preferences (see e.g., Borda, 1781; Arrow, 1951; Brams and Fishburn, 1978; Myerson and Weber, 1993; Myerson, 1999, 2002; Castanheira, 2003; Myatt, 2007; Bouton, 2013, Felsenthal and Machover, 2012, and the references therein) and/or heterogeneous information (see e.g., de Condorcet, 1785; Austen-Smith and Banks, 1996; Feddersen and Pesendorfer, 1996, 1997, 1998; Myerson, 1998; Piketty, 2000; Bhattacharya, 2012; Mandler, 2012; McMurray, 2013 and the references therein).

[2] These limitations resonate in civil society, where there is growing frustration with existing electoral systems. A large number of activists lobby in favor of reforming the electoral system (e.g., the Electoral Reform Society (www.electoral-reform.org.uk) and the Fair Vote Reforms initiative (www.fairvote.org)), and many official proposals have been introduced. A recent example comes from the UK, which held a national referendum in 2011 on whether to replace plurality voting with alternative voting.

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of theory and empirics: we need theory to identify which electoral systems are potentially best performing. We need empirics to test whether theoretical predictions are met in practice. The empirical question is twofold: first, do voters actually behave as theory predicts (in particular, are they strategic or sincere)? Second, can a change in the voting system actually deliver the predicted welfare gains? A strong limitation to empirical work is that observational data are scant, since only a handful of electoral systems are used in practice.

In this paper, we adopt a theory-based experimental approach to achieve a dual objective: (i) comparing the welfare properties of two voting systems, and (ii) shedding new light on the debate about whether voters behave strategically. Theory shows that, in large electorates, *approval voting* (AV) should produce close to first-best welfare results if voters face aggregate uncertainty and behave strategically (Bouton and Castanheira, 2012).[3] With the objective of testing our results in the laboratory, we develop a model to compare AV with *plurality voting* (the system used e.g., in the U.S. and the U.K.) for any electorate size. We show that AV should produce significant welfare gains.

Our laboratory experiments confirm these predictions. The welfare-maximizing alternative wins with much higher probability under AV, and welfare gains are actually higher than theory predicts. This is for three reasons: first, the subjects' behavior is closer to the theoretical prediction in AV than in plurality. The multiplicity of equilibria in plurality produces coordination failures, which reduces welfare compared to theoretical predictions. Second, AV appears more robust to collective mistakes than plurality. Third, the experiment shows that voters "specialize" in AV (i.e., adopt asymmetric strategies) in ways that produce higher welfare than predicted by the symmetric strategy equilibrium.

In our setup, majority voters have common value preferences but face aggregate uncertainty: they are divided by opposing information as to which of two majority alternatives is the best. The minority supports another candidate, who is a Condorcet loser.[4] In plurality, we find that aggregate uncertainty produces a novel "informative equilibrium" in which all three alternatives receive a strictly positive vote share. This equilibrium coexists with "Duverger's Law equilibria" in which majority voters coordinate all their ballots on a single candidate.[5] The experiment identifies when each equilibrium gets selected: subjects select a Duverger's Law equilibrium when the size of the minority is large — the informative equilibrium would then result in much lower welfare. When the minority is small, subjects select the informative equilibrium, even when it results in moderately lower welfare than a Duverger's Law equilibrium. In contrast, AV typically features a unique (symmetric) equilibrium, which produces strictly higher welfare than any equilibrium in plurality.

While our setup differs from the traditional one (no aggregate uncertainty, and voters have full information about the relative value of each alternative), we perceive that an aggregate uncertainty setup is both more realistic and necessary to capture empirically relevant voting behavior. The voters' imperfect information captures "rational ignorance" and actually explains why inferior equilibria disappear in AV (see Bouton and Castanheira, 2012 for more detail). The common value component also provides majority voters with two conflicting incentives: on the one hand, they benefit from aggregating the information dispersed in the electorate — this requires dividing their ballots across the two majority alternatives. On the other hand, they want to defeat the Condorcet loser — this requires coordinating their ballots on a single majority alternative. Varying the size of the minority in the lab alters the relative value of these two incentives, and allows us to test novel implications of the model on the subjects' strategic responses.

Our results have several implications for future research. Regarding plurality, our finding that aggregate uncertainty produces an empirically-relevant "informative" equilibrium shows that one cannot systematically associate "sincere voting" with "non-strategic" or non "short term instrumentally rational" voting (Cox, 1997). Which ballot is a voter's best response actually depends on which equilibrium is selected by the rest of the electorate. This modifies the way in which we typically measure strategic voting (see a.o. Guarnaschelli et al., 2000; Feddersen, 2004; Hortala-Vallve and Llorente-Saguer, 2010; Kawai and Watanabe, 2013; Esponda and Vespa, 2014, Bouton et al., forthcoming, and Spenkuch, 2015). In our experiment, and taking account of equilibrium selection, the fraction of "strategic" subjects is found to comprised between a lower bound of 27.78% and an upper bound of 72.23% across treatments.

Regarding approval voting, the experiment also reveals that subjects coordinated on an *asymmetric* equilibrium. In that equilibrium, some subjects (almost) always double vote for the two majority alternatives, and other subjects (almost) always single vote for their preferred alternative, given their signal. We verify that such asymmetric equilibria in pure strategy exist theoretically, and produce higher welfare than the symmetric equilibrium. This pattern points to the need to consider equilibria in asymmetric strategies in future theoretical research (see also Ladha et al., 1996). It also suggests that the subjects can actually much better exploit the favorable properties of AV than what is typically perceived (see e.g., the debates between Brams and Fishburn, 1983, versus Niemi, 1984; Saari and Van Newenhizen, 1988; Nagel, 2007).

There are obviously other voting systems that could and should be considered (a.o. runoff voting and Borda count). Our focus on plurality voting and approval voting is arbitrary to some extent but several reasons justify it. First, plurality voting is one of the most widely used electoral systems around the world (see e.g., Bormann and Golder, 2013). The other main contender is runoff voting, which also suffers from significant weaknesses, some similar to those of plurality (see Bouton, 2013; Bouton and Gratton, 2015). Second, the voting literature highlights that approval voting has desirable properties (see e.g., Brams and Fishburn, 1978, 1983; Myerson, 1999, 2002; Weber, 1995; Forsythe et al., 1996; Laslier, 2010; Nuñez, 2010; Bouton and Castanheira, 2012). By contrast, a voting system like Borda features significant weaknesses, in particular a lack of decisiveness (see Myerson and Weber, 1993; Forsythe et al., 1996; Myerson, 2002).

Forsythe et al. (1993, 1996) are closest to our paper. There are few other papers comparing plurality to AV: for instance, Rapoport et al. (1991), Van der Straeten et al. (2010), Dellis et al. (2011) or Bassi (2015) study whether voters behave more or less strategically under plurality and/or whether Duverger's Law applies in each system. These papers focus on the case of private values and perfect information (see also Rietz, 2008; Palfrey, forthcoming for detailed reviews of that literature). By contrast, our majority voters have common values and they are uncertain about their preferred alternative. Our paper also relates to the experimental literature on the Condorcet jury theorem, with the difference that we consider three alternatives; see e.g., Guarnaschelli et al. (2000), Battaglini et al. (2008, 2010), Goeree and Yariv (2011), and Bhattacharya et al. (2014).

## 2. The model

While the literature typically focuses on results valid for arbitrarily large electorates, we want to identify theoretical results that are valid for any population size. This is necessary to test the results in the laboratory. We thus consider a voting game with an electorate of fixed and finite size who must elect one alternative $P$ out of three: $A$, $B$ and $C$.

[3] Under AV, voters can "approve" of as many candidates as they want. Each approval counts as one point and the candidate obtaining the largest number of points wins.

[4] In a large Poisson game setup, Bouton and Castanheira (2012) show that the theoretical properties of AV remain the same when majority voters are also divided by heterogeneous preferences. We can thus focus on the simpler case of pure common values without losing the insights from the more general setup.

[5] In a different setup, the pioneering work by Myatt (2007) already identified aggregate uncertainty as key to understand the properties of plurality. Before his work, the literature typically assumed that voters know the distribution of preferences in the electorate. In this case, only Duverger's Law equilibria should be stable (Riker, 1982; Palfrey, 1989; Bouton et al., forthcoming).