Exp Econ
DOI 10.1007/s10683-007-9167-z

Coordinated voting in sequential and simultaneous elections: some experimental evidence

Sugato Dasgupta · Kirk A. Randazzo · Reginald S. Sheehan · Kenneth C. Williams

Received: 20 January 2006 / Accepted: 13 March 2007 /
Revised: 11 March 2007

Abstract This paper studies a situation wherein a set of voters choose between two alternatives in the presence of a *payoff externality*. Specifically, regardless of her intrinsic preference, a voter's payoff is maximized should she vote for the alternative that garners a majority of the votes cast. Are votes coordinated on a single alternative? Using laboratory experiments, we examine voting patterns in sequential voting and simultaneous voting elections. Across both election types, we also vary the amount of information that an individual voter has regarding the intrinsic preferences of the other voters. Our main findings are as follows. In the "low" information treatment, sequential voting elections facilitate coordinated voting. However, in the "high" information treatment, voting patterns are not dependent on how the election is structured.

Keywords Payoff externality · Coordinated votes · Sequential election · Simultaneous election · Information

JEL Classification D72 · D82

Electronic Supplementary Material The online version of this article (http://dx.doi.org/10.1007/s10683-007-9167-z) contains supplementary material, which is available to authorized users.

S. Dasgupta
Centre for Economic Studies and Planning, Jawaharlal Nehru University, New Delhi, India

K.A. Randazzo
Department of Political Science, University of Kentucky, Lexington, USA

R.S. Sheehan · K.C. Williams (✉)
Department of Political Science, Michigan State University, East Lansing, MI 48824, USA
e-mail: willia59@msu.edu

1 Introduction

Our paper studies situations wherein a set of voters choose between two alternatives in the presence of *a payoff externality*. This payoff externality assumes a specific form: regardless of her intrinsic preference, a voter's payoff is maximized should she vote for the alternative that garners a majority of the votes cast.

Before proceeding further, we provide three examples of the payoff externality highlighted in our paper. First, consider justices of the US Supreme Court having to decide between two alternatives: *Green* and *Red*. Some of the justices intrinsically prefer alternative *Green* to alternative *Red*; others intrinsically prefer alternative *Red* to alternative *Green*. Yet, regardless of *what* the majority coalition represents, it is frequently in the private interest of justice i to forecast the election winner and vote with the majority. Why? The language of the majority opinion serves as the future rule of law and policy statement of the Supreme Court (Epstein and Knight 1998). Therefore, if justice i is not a member of the majority coalition, she will not be able to impact the language of the decision. In contrast, as a member of the majority coalition, justice i is in a position to potentially influence the majority opinion. Second, consider mass elections where voter i chooses between two political parties. An extensive literature shows that voters engage in conformity voting. Regardless of her intrinsic preference, voter i derives pleasure simply by being on the winning side (see, e.g., Bartels 1985, 1988). This motivates voter i to "go with the party most likely to win" (Coleman 2004, p. 79). Third, consider roll call voting on omnibus packages in the US Congress. It is difficult for legislator i to get her ideal pork project passed individually. So, it is critical for legislator i to be part of the majority coalition and bargain for a lesser pork project in an omnibus bill that will surely pass (Krutz and Patterson 2001).

With the payoff externality in place, we use laboratory methods to explore some of the factors that likely facilitate coordinated voting. Our experiments study voting patterns under two different voting mechanisms. In *sequential voting elections* with a *fixed* ordering rule, subjects vote one at a time; thus, when casting her ballot, subject i knows how those preceding her have voted. The ordering rule specifies which subject votes first, second, and so on.[1] In *simultaneous voting* elections, all subjects vote at the same time; thus, when casting her ballot, subject i knows nothing about how the other subjects have voted. Across both election types, we also varied the amount of information that an individual voter has regarding the intrinsic preferences of the other voters. In *own-type information* elections, subject i was apprised of her own intrinsic preference; the intrinsic preferences of the remaining subjects were not revealed. By contrast, in *full-type information* elections, subject i was cognizant of the intrinsic preferences of all subjects.

What did we observe in the laboratory? Our principal conclusions are threefold. *First*, in sequential voting elections, the *standard* game-theoretic prediction is that

[1] Perhaps contrary to popular perception, sequential voting elections have wide real-world usage; this voting mechanism is used, for example, in some aspects of deliberation in the US Senate, the US Supreme Court, a majority of the State Supreme Courts, some city councils, the International Court of Justice, the UN Security Council, the Finnish Parliament, and some corporate boardrooms (see, respectively, Oleszek 1984, Epstein and Knight 1998, Hall 1990, www.ci.atherton.ca.us, Rosenne 1995, www.un.org, and www.vnk.fi).

independently of voter information, votes cast should be coordinated on a single alternative. However, when voter information is of the own-type variety (that is, each voter only knows her own intrinsic preference), coordinated voting is *not* guaranteed in the laboratory. We conjecture that subjects located near the top of the voting queue are uncertain about the identity of the election winner; this uncertainty begets conservative behavior (that is, sincere voting).[2] As the game unfolds and the sequence of votes cast is recorded, it becomes progressively easy to predict the election winner. Therefore, near the end of the voting queue, there is a sharp increase in the incidence of strategic voting when the election winner is different from a subject's intrinsically-favored alternative.

Second, voter behavior in a simultaneous voting election depends *critically* on what voters know to begin with. When voter information is of the full-type variety (that is, each voter's intrinsic preference is common knowledge), voters readily coordinate their votes on a single alternative. This coordination breaks down dramatically when voter information is own-type in nature.

Third, the contrasts between sequential voting and simultaneous voting elections hinge *crucially* on the information that voters possess. Under the full-type information condition, voter welfare is not dependent on whether the election is structured to be sequential or simultaneous. However, under the own-type information condition, voter welfare is unambiguously higher when the election entails sequential voting rather than simultaneous voting. Summing up, absent knowledge of voter information, our experiments *suggest* that decision making via sequential voting is (at least weakly) superior to decision making via simultaneous voting.

How is our paper related to the extant theoretical literature on decision making in sequential and simultaneous voting environments with binary choices? In a seminal contribution, Dekel and Piccione (2000) show that when voter preferences are private information, informative symmetric equilibria of a simultaneous voting game remain equilibria in a sequential voting game. Thus, for example, the information aggregation results of Feddersen and Pesendorfer (1997, 1998), obtained for simultaneous voting elections, extend immediately to any sequential voting environment.[3] Given this informational equivalence, is there *any* theoretical rationale for contrasting the two voting environments? Battaglini (2005) shows that when there is even a slight cost of voting and voters are allowed to abstain, the set of equilibria of simultaneous and sequential voting games are generally disjoint. Callander (2004) obtains non-equivalence through a different assumption: in his model, voters wish to elect the better candidate but possess a desire as well to be part of the majority coalition. We

[2]Our conjecture that subjects near the top of the voting queue are unable to fully predict the behavior of subsequent voters resonates with the findings in Wilson and Herzberg (1988). In their experimental study of agenda games, subjects relied on *limited* sophisticated strategies as the size of the agenda grew in length. Eckel and Holt (1989) experimentally examined very simple agenda games (nine voters, two stages, and three outcomes). Even in this simple set-up, strategic voting emerges only under especially propitious circumstances (e.g., stationary preference profiles, repeated play, and so on). More generally, *standard* game-theoretic predictions are based on unlimited voter rationality. Of course, subjects participating in experiments, as behavioral game theory emphasizes, make mistakes and have limited foresight.

[3]It was believed (see, e.g., Bikhchandani et al. 1992) that a combination of private information and sequential voting would give rise to cascades. The error in this intuition was exposed as well by the results in Dekel and Piccione (2000).

too obtain non-equivalence (contrast propositions 2 and 4b) by assuming that voters derive some utility from voting with the majority.[4] However, our theoretical set-up differs from that of Callander. Callander explores a framework with *common values à la* Austen-Smith and Banks (1996); we study a situation with *independent private values*.

Our paper is linked to two experimental studies that contrast voter behavior in sequential voting and simultaneous voting elections. Morton and Williams (1999, 2001) analyze coordination problems in elections with three alternatives: they show that later voters in sequential voting elections sometimes use the alternative-specific information implicit in early voting outcomes to make more informed choices than voters in simultaneous voting elections. Battaglini et al. (2005) focus on binary choice elections wherein voters have common values, voting is costly, and voter abstention is permitted. They identify a tradeoff: while sequential voting aggregates information better compared to simultaneous voting, sequential voting also leads to significant inequities, with later voters being better off than early voters.

The rest of this paper is structured as follows. In Sect. 2, we describe the various election models that were analyzed in the experiments. The standard game-theoretic predictions for these models are outlined in Sect. 3. Section 4 presents our experimental design. Section 5 contains the experimental results while Sect. 6 concludes.

2 Description of the experimental models

We study different one-period models of elections in which a set of five voters, denoted $N \equiv \{1, \ldots, 5\}$, choose between two alternatives, denoted $K \equiv \{G, R\}$.[5] We present the various models in three stages. In stage one, we introduce the basic structures that are shared by all of the models and we describe the characteristics of voters. In stage two, we describe the two voting mechanisms that specify the sequence in which votes are cast. In stage three, we outline the two information conditions under which voting takes place.

2.1 Basic structures and voter payoffs

In a single election, each voter $i \in N$ casts a vote for either alternative G or alternative R; $v_i \in K$ identifies voter i's choice. For a fixed *vote profile* $v \equiv (v_1, \ldots, v_5)$, the alternative with a majority of the votes is determined to be the election winner.

Given v, voter i's payoff depends only on her own vote choice, v_i, and the identity of the election winner. The *type* of voter i, denoted t_i, broadly represents her preferences. Let $t_i = g$ if voter i has an *intrinsic preference* for alternative G; let $t_i = r$ if voter i favors alternative R instead.

[4] Consider the statement of proposition 4b. Under the own-type information condition, the sequential voting mechanism has a *unique* equilibrium outcome: the first voter votes sincerely and the remaining voters opt for the alternative picked by the first voter. Notice that voters' equilibrium behavior is *history dependent*. Hence, no informative and symmetric equilibrium of the simultaneous voting mechanism can remain an equilibrium in the sequential voting mechanism.

[5] In the experiments that were run (see Sect. 4 for details), voters chose between two alternatives that were color-coded and given names: *Green* and *Red*. Thus, read "G" as *Green* and "R" as *Red*.

Table 1 Payoff schedule for voters

	Voter's type, t_i, is g		Voter's type, t_i, is r	
	G wins election	R wins election	G wins election	R wins election
vote G	1.50	0.0	1.0	0.25
vote R	0.25	1.0	0.0	1.50

Notes: The left panel shows voter payoffs when the voter's type is g; the right panel shows voter payoffs when the voter's type is r. Note that a voter's payoff depends on her type (left or right panel), the vote that she casts (first or second row), and the identity of the election winner (first or second column within each panel)

Table 1 shows the payoff schedule for voters.[6] The left panel of Table 1 is read as follows. Here, voter i's type, t_i, is g. Voter i receives a payoff of 1.50 (0.00) if she votes for alternative G and alternative $G(R)$ is the election winner. On the other hand, voter i receives a payoff of 0.25 (1.00) if she votes for alternative R and alternative $G(R)$ is the election winner. The right panel of Table 1 shows that symmetric conditions apply when voter i's type is r.

Two considerations are implicit in the payoff schedule for voters. First, assume that voter i casts a vote that does *not* conform to the majority choice. Given that voter i is therefore not a member of the majority coalition, observe that voter i is better off should her intrinsically-favored alternative be the election winner (see the footnote for details).[7]

Second, notice also that the optimal behavior of voter i depends critically on her conjecture of how other voters are voting. To see this, let t_i equal g and assume that voter i conjectures, correctly or otherwise, that all other voters have chosen alternative R. In other words, alternative R is viewed as the election winner independently of the vote v_i by voter i. If voter i votes *sincerely* and picks alternative G, her payoff is 0. If instead voter i joins the majority by casting a *strategic* vote for alternative R, her payoff is 1.00.[8] Thus, voter i's optimal action is to vote for alternative R. Consider, now, another scenario in which voter i believes that the remaining four voters are evenly split between alternatives G and R. Here, voter i's optimal action is to vote sincerely for alternative G (see the footnote for details).[9]

2.2 Voting mechanisms

Our models vary the formal procedures under which voting takes place. In a *simultaneous voting* election, all voters vote at the same time. Before voting, voter i therefore

---

[6] We thank an anonymous referee for suggesting this schedule and for providing an interpretation of the payoffs involved.

[7] To fix ideas, let t_i equal g. When voter i is not in the majority coalition, the payoff received by voter i is 0.25(0.00) when the election winner is alternative $G(R)$.

[8] A vote is called *sincere* if voter i votes for the alternative that she intrinsically prefers. Thus, voter i casts a sincere vote if (1) her type is g and her vote is for alternative G, or if (2) her type is r and her vote is for alternative R. If a vote is not sincere, we refer to it as *strategic*.

[9] Given voter i's beliefs, a vote for alternative G ensures that alternative G is the election winner; this yields a payoff of 1.50. A vote for alternative R ensures that alternative R is the election winner; this yields a payoff of 1.00. Therefore, voter i maximizes her payoff by voting for alternative G.

has no information on the choice of voter j ($j \neq i$). In a *sequential voting* election, votes are cast one at a time: voter 1 votes first, followed by voter 2, and so on till voter 5. Before voting, voter i is therefore aware of the choices made by voters 1 through $(i-1)$.

2.3 Voter information conditions

At the time that votes are cast in an election, each voter i knows her own type/preference, t_i. However, what is the procedure by which the election-specific *type profile* $t \equiv (t_1, \dots, t_5)$ is determined? A random draw determines whether t_i is g or r; the prior probability that t_i equals $g(r)$ is $\frac{1}{2}$. Voter types, furthermore, are assigned independently across voters (see the footnote for details).[10]

Our models vary the amount of information voters have about the election-specific type profile t. In a *own-type information* election, each voter i simply knows her own t_i and the procedure by which t is generated. By contrast, in a *full-type information* election, each voter i knows the entire type profile t.

3 Theoretical predictions

This section provides the standard game-theoretic predictions for the models described in Sect. 2. These models are admittedly stylized (for example, number of voters fixed at five) but our theoretical predictions remain approximately valid in far more general settings (see the footnote for details).[11] For brevity, we provide explanations for the theoretical predictions and omit formal proofs, which are available upon request.

3.1 Simultaneous voting elections

3.1.1 The full-type information case

Consider an election that takes place under type profile t, where t is common knowledge. The election situation is a static game with complete information, and we make predictions by computing the pure strategy Nash equilibria of this game.

[10]The *type set* for voter i is $T_i \equiv \{g, r\}$. Let T be the set of type profiles; that is, $T = \{g, r\}^5$. Fix a type profile $t \equiv (t_1, \dots, t_5) \in T$ and let $p(t)$ be the probability that this type profile is generated in the election. Then, $p(t) = (\frac{1}{2})^5$, $\forall t \in T$.

[11]We briefly discuss the robustness of the four propositions to two perturbations in the Sect. 2 models. First, none of the propositions require the number of voters to be fixed at five; any odd integer suffices. Second, consider changes in the payoff schedule for voters. Suppose the payoff schedule satisfies the following two properties: (1) voter i prefers to be in a majority coalition than in a minority coalition, regardless of what the majority coalition represents, and (2) conditional on being in the majority coalition, voter i is better off if this coalition votes for the alternative that voter i intrinsically favors rather than the other alternative. Then, propositions 1, 2, and 3 are unchanged. On the other hand, while proposition 4 needs to be somewhat restated, the possibility of voter herding, which is the main thrust of this proposition, remains unaltered. A full description of more general models and the game-theoretic predictions that follow are omitted for brevity but available upon request.

Proposition 1 Regardless of the type profile $t \in T$, there are *two* equilibrium vote profiles: $v_G \equiv (G, G, G, G, G)$ and $v_R \equiv (R, R, R, R, R)$.

Proposition 1 maintains that there are *multiple* (two) equilibrium vote profiles. In one, all voters vote for alternative G, thereby generating v_G; in the other, all voters vote for alternative R, thereby generating v_R. The intuition for proposition 1 is transparent. Consider a vote profile in which the five votes are not coordinated on a single alternative; for example, let $v = (G, G, G, G, R)$. Can this v be an equilibrium vote profile? The answer is "no." To see this, note that (1) given v, alternative G is the election winner, and (2) voter 5 is not in the majority coalition. Since it pays to be part of the majority coalition regardless of what it represents, voter 5 is strictly better off by switching her vote from alternative R to alternative G. Summing up, in an equilibrium vote profile, there can be no divergence in the five vote choices. Therefore, only vote profiles v_G and v_R are candidates for equilibrium. Why, then, is v_G an equilibrium vote profile (an identical argument applies for v_R)? If voter i deviates relative to v_G and votes for alternative R instead of alternative G, the outcome of the election is unaltered since alternative G wins with four out of five votes. On the other hand, voter i now finds herself excluded from the majority coalition. Since this unilateral deviation is strictly unprofitable for voter i, v_G constitutes an equilibrium.

3.1.2 The own-type information case

When an election takes place, voter i knows her own type, t_i. However, she does not know the types of the other four voters. The election situation is a static game with incomplete information, and we make predictions by computing the Bayesian–Nash equilibria of this game.

Proposition 2 The election game has *three* Bayesian–Nash equilibria. These are as follows. (1) In the first case, each voter i, regardless of her type, t_i, votes for alternative G. (2) In the second case, each voter i, regardless of her type, t_i, votes for alternative R. (3) In the third case, each voter i votes sincerely (that is, voter i votes for alternative G if t_i is g, and votes for alternative R if t_i is r).

An election takes place under a fixed type profile $t \in T$. Given t, proposition 2 says that *three* vote profiles can be rationalized as equilibrium outcomes: these vote profiles are v_G, v_R, and that corresponding to sincere voting by all voters.

We now outline the intuition for proposition 2. Why is "everyone votes for alternative G (R) regardless of intrinsic preferences" an equilibrium? Should all voters behave as above, the ensuing vote profile is v_G (v_R). Notice now that a unilateral deviation by voter i is unprofitable because the election outcome remains unaffected whilst voter i simply finds herself excluded from the majority coalition. Why is "everyone votes sincerely" an equilibrium strategy profile? To fix ideas, let g be voter i's type. We need to argue that in this case, voter i's expected payoff is larger if she votes for alternative G rather than alternative R. Since voter preferences have been ex ante randomly assigned with 50–50 odds and all voters other than (possibly) voter i are voting sincerely, voter i realizes that the probability of being a member of the majority coalition does not depend on her vote choice.[12] Given this, it is optimal for voter i to vote sincerely and choose the alternative that she intrinsically prefers, namely, alternative G.

3.2 Sequential voting elections

3.2.1 The full-type information case

Consider an election that takes place under type profile t, where t is common knowledge. Since voters cast their ballots in a fixed order, the election situation is a dynamic game with complete information. We make predictions by computing the subgame perfect equilibrium of this game.

For expositional ease, some notation is required. For $i \in N$, let S_i denote the set consisting of voter i and all the voters following her in the voting queue.[13] Given the election-specific type profile t and set S_i, let $N_g(S_i; t)$ ($N_r(S_i; t)$) count the number of voters in S_i with type g (r). Also, when voter i gets to cast her vote, let B^i_G (B^i_R) denote the number of votes already garnered by alternative G (R). Proposition 3a predicts the behavior of *all* voters. Given predicted voter behavior, proposition 3b identifies the sequence of votes that constitutes the equilibrium outcome.

Proposition 3a Voter i first observes (B^i_G, B^i_R) and computes the number of votes that each of the two alternatives eventually receives *if* she and all the voters following her vote sincerely. This number is $B^i_G + N_g(S_i; t)$ for alternative G while it is $B^i_R + N_r(S_i; t)$ for alternative R. Voter i opts for alternative G if $B^i_G + N_g(S_i; t)$ exceeds $B^i_R + N_r(S_i; t)$; otherwise, she opts for alternative R.

Proposition 3b Since voters behave as above, the equilibrium sequence of votes is unique: the vote choices of the five voters are coordinated on the alternative that is majority-preferred. In other words, if the type of three or more voters is g (r), the equilibrium vote profile is v_G (v_R).

Instead of providing some intuition for the above propositions, a task that would consume too much space, we simply analyze the behavior of voter 5. At the time of her voting, two cases can arise. First, one of the alternatives (R, say) could already have obtained majority support (that is, $B^5_R \geq 3$). Subgame perfection requires voter 5 to join the R-majority; notice that this is what proposition 3a predicts as well. Second, suppose $B^5_G = B^5_R = 2$. Now, subgame perfection requires voter 5 to break the 2–2 tie by voting for her intrinsically-favored alternative; notice that proposition 3a makes the same prediction.[14]

[12] To see this, note that if voter i votes for alternative $G(R)$, she is a member of the majority coalition if at least two out of the remaining four voters are of type $g(r)$. Hence, voter i is in the majority coalition with probability equal to $\sum_{k=2}^{4}(\frac{1}{2})^4 \times (\frac{4!}{k!(4-k)!})$.

[13] For example, let $i = 3$. Then, $S_3 = \{3, 4, 5\}$.

[14] Without loss of generality, assume that t_5 is g. Then, $S_5 = \{5\}$, $N_g(S_5; t) = 1$ and $N_r(S_5; t) = 0$. Thus, $B^5_G + N_g(S_5; t)$ exceeds $B^5_R + N_r(S_5; t)$ and voter 5 is predicted to select alternative G.

3.2.2 *The own-type information case*

An election takes place under a fixed type profile $t \in T$, where voter i knows only her own type, t_i. Since voters cast their ballots in a fixed order, the election situation is a dynamic game with incomplete information. We make predictions by computing the perfect Bayesian equilibrium of this game. Proposition 4a predicts the behavior of *all* voters. Given predicted voter behavior, proposition 4b identifies the sequence of votes that constitutes the equilibrium outcome.

Proposition 4a Voter i first observes (B_G^i, B_R^i). Suppose that one of the two alternatives is ahead by one or more votes. Then, regardless of her own type, t_i, voter i votes for the alternative that is ahead in the vote count. On the other hand, suppose that B_G^i is equal to B_R^i (this is the case for voter 1 and *may* be the case for voters 3 and 5). Then, voter i casts a sincere vote.

Proposition 4b Since voters behave as above, the equilibrium sequence of votes is unique: voter 1 casts a sincere vote, and the remaining four voters opt for the alternative picked by voter 1. In other words, if the type of voter 1 is g (r), the equilibrium vote profile is v_G (v_R).

To get some intuition for the above propositions, consider voter 4. Assume, without loss of generality, that t_4 is g (symmetric arguments apply when t_4 is r). Also, let $B_G^4 = 1$ and $B_R^4 = 2$ (that is, alternative R is ahead in the vote count by one). What should voter 4 do? If she votes for alternative R, alternative R wins for sure and yields voter 4 a payoff of 1. Suppose she votes for alternative G instead. Then, voter 5 sees a 2–2 tie that voter 5 breaks by casting a sincere vote. Hence, the election winner is alternative G with probability $\frac{1}{2}$ and alternative R with probability $\frac{1}{2}$ (the probabilities are assigned this way because t_5 is ex ante equally likely to be g or r). Voter 4's expected payoff from this lottery is $[\frac{1}{2} \times 1.50 + \frac{1}{2} \times 0] = 0.75$. Since 0.75 is less than 1, voter 4 should vote for alternative R. This herding on alternative R is precisely what proposition 4a predicts.

4 Experimental design

In this section, we indicate how the various models outlined in Sect. 2 were implemented in the laboratory. Our experiment comprised a total of four sessions and 10 subjects participated in each session. Subjects were recruited from the undergraduate population at a large public university and had no prior experience with the experiment.

A session proceeded as follows. The experiment was entirely computerized and once all 10 subjects had logged onto their computers, two equal-sized groups were randomly formed. While the composition of each group was held *fixed* for the duration of the session, no subject was apprised of the identity of her group members.

Our experiment consists of four treatments (2 voting mechanisms × 2 voter information conditions). Subsequent to group formation, the two groups were assigned to *different* treatments of the experiment. The assignment done, the experimental program displayed the instructions to each subject. Subjects read the instructions at their leisure and were permitted to ask questions about the procedures. The instructions took between five to ten minutes to read.

When the session ended, subjects were paid in cash the amount that they had earned. The average payment was 20 dollars per subject for the hour that the session lasted.

4.1 Voter payoffs

Subjects were informed that they would participate in a *series* of elections in which they were required to choose between two alternatives, *Green* and *Red*. They were also told that the payoff they would receive from a particular election depended on which alternative they voted for and which alternative actually won that election. On each subject's display was a payoff schedule corresponding to Table 1.

4.2 Voting mechanism treatments

How were sequential voting elections implemented in the laboratory? Consider the five subjects in a certain group. At the start of an election round, the numbers 1 through 5 were randomly assigned to the five group members. Of course, each subject was only apprised of her *own* round-specific subject number.

On the display of each subject was a row of five boxes. Associated with each box was a subject number and, hence, a specific subject. The position of the boxes determined when a subject was required to vote. The subject assigned to the first box voted first, followed by the subject assigned to the second box, and so on to the last subject. Before a subject cast her vote, the votes of subjects prior to her in the voting queue were revealed (*after* a subject had voted, the corresponding box assumed the color of the alternative chosen).

Once the five votes had been cast and the election decided, the election results were revealed and a new round began. This required subjects to be randomly reshuffled to new box positions (that is, locations in the voting queue of an election).

When simultaneous voting elections were implemented in the laboratory, all voters effectively voted at the same time. Although each subject was assigned to a box, the position of the box (in the row of five boxes) did not matter. This was because subjects voted when they wanted to. At the time that a subject cast her vote, she did not know how other subjects had voted. The vote margin corresponding to an election was revealed only after all five votes were recorded.

4.3 Voter information treatments

We have indicated that subjects in an election round were represented as numbered boxes. In the *full-type information* treatment, each subject knew the round-specific intrinsic preferences of all the other subjects in the election. This was because *prior* to voting, the box corresponding to each subject was entirely filled with the color of that subject's intrinsically-preferred alternative. In the *own-type information* treatment, a subject could not determine the round-specific intrinsic preferences of the other subjects in the election. This was because *prior* to voting, the boxes of the other subjects were colored 50% green and 50% red (that is, subject i should believe that subject j's intrinsically-favored alternative is equally likely to be *Green* or *Red*).

4.4 Other design issues

Our experiment consisted of four sessions. Aggregated over these sessions, eight groups formed. The pairing of treatments and groups was such that two groups were assigned to each of the four treatments. A session consisted of 24 separate election rounds (subjects were not informed of the number of elections rounds in a session); hence, for each subject our experiment generates 24 vote observations corresponding to a single treatment.[15]

5 Experimental results

5.1 Simultaneous voting elections

We present the empirical results for simultaneous voting elections in two stages. First, we report our findings for the own-type information treatment; then, we do the same for the full-type information treatment.

5.1.1 The own-type information case

For this set-up, recall that proposition 2 says that there are three distinct equilibria: (1) each voter i votes for alternative G regardless of her type, t_i; (2) each voter i votes for alternative R regardless of her type, t_i; and (3) each voter i votes sincerely. What did we see in the laboratory? The first row of Table 2 summarizes the data. We conducted 48 separate elections and, hence, observed $5 \times 48 = 240$ vote decisions. Out of these 240 votes, 92.5% (222 votes) were classified as sincere. Our conclusion, albeit reached somewhat informally, is straightforward: the strategy profile "everyone votes sincerely" best accounts for the experimental data.

When voters are exclusively sincere in their vote behavior, a *unanimous election* (that is, an election in which one alternative gets all of the votes) occurs only if the election-specific type profile t has the same type for all five voters. Given the procedure by which types are assigned in our experiment, the probability of generating such a type profile is only $\frac{1}{16}$. In other words, unanimous elections are predicted to be rare occurrences. Our data bear this out – only two out of the 48 observed elections were unanimous (refer to row 1 of Table 2). Exclusively sincere voting has yet another implication: in any election, the majority-preferred alternative is predicted to

[15] We recognize that some readers may find the small sample size of our experiment somewhat disconcerting: indeed, with just two groups of five subjects per treatment, our experiment generates only two independent observations per treatment. Nonetheless, we think that the conclusions of this paper are quite robust: we obtained *very* similar findings in earlier and unreported experiments (our first submission to this journal) that used a *slightly* different payoff schedule for voters (refer to Table 1); an analysis of these earlier experiments is available upon request.

Table 2 Summary of voter behavior

Voting mechanism	Information condition	No. of votes	Percent sincere votes	No. of unanimous elections	No. of of maj-pref. winners	Treatment efficiency
simultaneous	own-type	240	92.5	2 (48)	44 (48)	74.53
simultaneous	full-type	240	64.2	43 (48)	45 (48)	97.31
sequential	own-type	240	70.0	25 (48)	37 (48)	88.47
sequential	full-type	240	62.9	42 (48)	48 (48)	97.52

Notes: Corresponding to a treatment condition, "No. of votes" is the total number of votes observed (each election yields five vote observations). "Percent sincere votes" is the percentage of votes in which the voter voted sincerely (that is, selected her intrinsically-favored alternative). "No. of unanimous elections" is the number of elections in which all five voters voted for the same alternative; the number within parenthesis is the total number of elections. "No. of maj-pref. winners" is the number of elections in which the election winner was the intrinsically-favored alternative of at least three voters; the number in parenthesis is the total number of elections. "Treatment efficiency" is 100×([the sum total of payoffs subjects received in the experiment, aggregated over all treatment-specific elections]÷[the sum total of payoffs subjects would have received had they coordinated perfectly on the majority-preferred alternative in each of the treatment-specific elections])

be the election winner.[16] In the laboratory, a bit of deviation from sincere voting was observed. Nonetheless, in 44 out of the 48 observed elections, the winner happened to be the majority-preferred alternative.

Finally, we compute *treatment efficiency* as follows. Let $t^j \equiv (t_1^j, \ldots, t_5^j)$ denote the type profile under which election j was conducted (j ranges from 1 to 48), where t_i^j is the type of voter i in election j. Given t^j, recall that the aggregate of voter payoffs in election j is maximized if all five voters coordinate their votes on the majority-preferred alternative. Let $\bar{P}_j$ denote this maximum aggregate payoff. It follows that the total voter earnings for the entire set of 48 elections cannot exceed $\sum_{j=1}^{48} \bar{P}_j$. In the laboratory, let P_j denote the aggregate of voter payoffs *actually* received in the j'th election. Hence, total voter earnings for the entire set of 48 elections is $\sum_{j=1}^{48} P_j$. We define treatment efficiency as $[\frac{\sum_{j=1}^{48} P_j}{\sum_{j=1}^{48} \bar{P}_j}] \times 100$. Row 1 of Table 2 says that the treatment efficiency in our experiment was 74.53. Note that the treatment efficiency is less than 100 for two reasons. First, voters sometimes failed to elect the majority-preferred alternative (this occurred in four elections). Second, voters rarely managed to coordinate their votes on a single alternative (coordination occurred in two elections). Conclusion 1 summarizes our discussion.

Conclusion 1 In simultaneous voting elections under the own-type information condition, the strategy profile "everyone votes sincerely" best accounts for the data. This has two implications. First, the majority-preferred alternative is frequently the elec-

[16] We say that an alternative is majority-preferred if it is *intrinsically* favored by at least three out of the five voters.

tion winner. Second, voters rarely manage to coordinate their votes on a single alternative, G or R.

5.1.2 *The full-type information case*

For this set-up, recall that proposition 1 says that there are two distinct equilibrium vote profiles: v_G and v_R. What did we see in the laboratory? The second row of Table 2 summarizes the data. We conducted 48 separate elections and, hence, observed $5 \times 48 = 240$ vote decisions. For the most part, subjects in election j (j ranges from 1 to 48) took note of the election-specific type profile t^j and coordinated their votes on the majority-preferred alternative. Indeed, out of the 240 recorded votes, the precept of voting for the majority-preferred alternative was violated in only 22 instances![17]

Since subjects were mostly successful in coordinating their votes on the majority-preferred alternative, three features of our data can be explained at once. First, in 45 out of the 48 elections, the majority-preferred alternative was the election winner. Second, in 43 out of the 48 elections, the outcome was unanimous (that is, the theoretically predicted vote profile, v_G or v_R, was observed). Third, the treatment efficiency recorded an impressive 97.31. Conclusion 2 summarizes our discussion.

Conclusion 2 In simultaneous voting elections under the full-type information condition, voters observe the election-specific type profile and, for the most part, coordinate their votes on the majority-preferred alternative. The majority-preferred alternative is frequently the election winner, unanimous outcomes are common, and the treatment efficiency is high.

5.2 Sequential voting elections

We present the empirical results for sequential voting elections in two stages. First, we report our findings for the full-type information treatment; then, we do the same for the own-type information treatment.

5.2.1 *The full-type information case*

For this set-up, recall that proposition 3b says that in the unique equilibrium, all votes are coordinated on the majority-preferred alternative. Row 4 of Table 2 summarizes our data.

[17] We should further note that 15 out of these 22 cases occur in three *consecutive* "anomalous" elections. What happened in these elections? In election round 16 of an experimental session, three voters were of type r while two voters were of type g: predictably, all five votes were cast for the majority-preferred alternative, R. In election round 17, the type profile switched to three type g voters and two type r voters. However, a clear break in voters' behavioral pattern is now observed: all five votes in election round 17 were cast for the alternative that is *not* majority-preferred (that is, alternative R). We conjecture that in election round 17, for *some* reason, the observed outcome of election round 16 and not the current period type profile coordinated voter expectations at the time that votes were cast. The use of the previous period outcome as a focal point for voter expectations in the current period also accounts for voters' behavior in election rounds 18 and 19. In both these election rounds, all five votes were cast for alternative R even though the type profiles had three type g voters and two type r voters. The string of three "anomalous" elections snaps in election round 21 when the type profile had *four* type g voters and one type r voter; here, all five votes were cast for the majority-preferred alternative, G.

We conducted 48 separate elections and, hence, observed $5 \times 48 = 240$ vote decisions. Except in just seven instances, subjects in election j (j ranges from 1 to 48) took note of the election-specific type profile t^j and voted for the majority-preferred alternative. Since votes are virtually always cast for the majority-preferred alternative, three features of our data are readily explained. First, in all 48 elections, the majority-preferred alternative was the election winner. Second, in 42 out of the 48 elections, the outcome was unanimous (that is, the theoretically predicted vote profile was observed). Third, the treatment efficiency recorded an impressive 97.52. Conclusion 3 summarizes our discussion.

Conclusion 3 In sequential voting elections under the full-type information condition, voters observe the election-specific type profile and almost always coordinate their votes on the majority-preferred alternative. The majority-preferred alternative is always the election winner, unanimous outcomes are common, and the treatment efficiency is high.

5.2.2 The own-type information case

For this set-up, recall that proposition 4b says that in the unique equilibrium, all votes are coordinated on the alternative that is intrinsically-preferred by the first voter. This means, of course, that the majority-preferred alternative is *not* guaranteed to be the election winner. Row 3 of Table 2 summarizes our data.

We conducted 48 separate elections and, hence, observed $5 \times 48 = 240$ vote decisions. In *rough* agreement with proposition 4b, notice that majority-preferred alternatives win out in only 37 out of the 48 elections (this is the lowest proportion across the four treatment conditions).

Observe also that another aspect of proposition 4b is clearly violated in the laboratory: voters are frequently *unable* to coordinate their votes on a single alternative. In fact, unanimous outcomes crop up in only 25 out of the 48 elections. We study the nature of this violation later. For now, we note that it is precisely because votes are uncoordinated that location in the voting queue *may* be a critical determinant of whether a voter succeeds in being a member of the majority coalition. This possibility is explored below.

Let $J \equiv \{1, 2, \ldots, 48\}$ index the set of sequential elections conducted under the own-type information condition. 10 subjects participated in these elections. Let $J(i) \subset J$ index the set of elections in which subject i (i ranges from 1 to 10) was a voter.[18] Two variables—*Coord* and *Queue*—are now created as follows. For $j \in J(i)$, $Coord_{ij}$ is equal to 1 if subject i's vote in election j places her in the majority coalition (that is, subject i voted for the election-j winner), and is 0 otherwise; $Queue_{ij}$ is equal to 1 if subject i is located somewhere in positions three to five of the voting queue in election j, and is 0 otherwise. Is *Queue* a determinant of *Coord*? To answer this question, we use the random effects probit model to estimate the *coordination equation* given below:

$$Coord_{ij} = 1\{\beta_0 + \beta_1 Queue_{ij} + \alpha_i + \epsilon_{ij} \geq 0\}, \tag{1}$$

[18] Consider, for example, subject 1. Then, $J(1) \subset J$ identifies the 24 elections (one experimental session) in which subject 1 participated.

where 1{.} is an indicator function that takes value 1 if the inequality within brackets is valid and 0 otherwise, α_i is the subject error component, and ϵ_{ij} is the idiosyncratic error term.[19]

The estimated coefficient of $Queue_{ij}$ turns out to be positive (1.25) and statistically significant at the 1 percent level.[20] In other words, voters located in positions three to five of the voting queue are more successful in being part of the majority coalition than are voters located in the top two positions of the voting queue.

Why is *Queue* a determinant of *Coord*? Our *conjecture* is as follows. In a situation where coordinated voting is not guaranteed, voters located in the top two positions of the voting queue find it difficult to predict the election winner. This prediction uncertainty provides an incentive to just vote sincerely (see the footnote for details of our argument).[21] On the other hand, as the game unfolds, it becomes progressively simpler to predict the election winner. This, in turn, makes a late voter cast a strategic vote should the likely election winner not be her intrinsically-favored alternative. If our conjecture is valid, location in the voting queue *should* predict the incidence of strategic voting. This is indeed the case. For each voter position, we aggregate over the 48 elections and compute the proportion of votes cast that are strategic. Corresponding to voter positions one through five, these proportions are, respectively, 0.02, 0.02, 0.23, 0.56 and 0.67.

Conclusion 4 In sequential voting elections under the own-type information condition, location in the voting queue matters. Voters further down the voting queue have an advantage: they are more likely to vote for the election winner.

Finally, to get some added perspective on why the *standard* game-theoretic prediction of coordinated voting fails in the laboratory, we simply *document* the discrepancies between actual voter behavior and predicted voter behavior by voter position.

Voters in positions three to five of the voting queue sometimes encounter situations wherein choosing a particular alternative is a dominant strategy (that is, predictions

[19] The random effects probit model imposes structure on α_i and ϵ_{ij}; for brevity, we refer the reader to Wooldridge (2002) for details. Here, we alert the reader to an attractive feature of Eq. 1. Subjects differ in their abilities to vote with the majority. This heterogeneity is accommodated by allowing α_i to vary across subjects.

[20] The relationship between *Queue* and *Coord* is reasonably robust to how *Queue* is coded. For example, the estimated coefficient of $Queue_{ij}$ in Eq. 1 remains positive and statistically significant at the 1 percent level when $Queue_{ij}$ is coded as follows: $Queue_{ij}$ equals 1 if subject i is located in positions four or five of the voting queue in election j, and is 0 otherwise.

[21] To fix ideas, let voter i's type, t_i, be g. Suppose voter i casts a sincere vote. Two cases arise: If voter i finds herself in the majority coalition (alternative G wins the election), her payoff is 1.5; if voter i is excluded from the majority coalition (alternative R wins the election), her payoff is 0. Given uncertainty about the identity of the election winner, a sincere vote is a gamble over payoffs of 1.5 and 0. Suppose, now, that voter i casts a strategic vote for alternative R. Once again, two cases arise: If voter i finds herself in the majority coalition (alternative R wins the election), her payoff is 1.0; if voter i is excluded from the majority coalition (alternative G wins the election), her payoff is 0.25. Given uncertainty about the identity of the election winner, a strategic vote is a gamble over payoffs of 1.0 and 0.25. Observe that when prediction uncertainty is substantial (say, voter i believes that each alternative can win the election with probability $\frac{1}{2}$), risk-neutrality or "mild" risk aversion implies that the gamble associated with a vote for alternative G is preferred to the gamble associated with a vote for alternative R.

Table 3 Voter behavior—sequential voting elections and own-type information

Voter no.	Predicted vote	Circumstances involved	No. of obs.	No. of sincere votes
1	sincere	$t_1 = g, r;\ (B^1_G, B^1_R) = (0, 0)$	48	47
2	sincere	$t_2 = g$ and $(B^2_G, B^2_R) = (1, 0)$,	30	30
		or $t_2 = r$ and $(B^2_G, B^2_R) = (0, 1)$		
2	strategic	$t_2 = g$ and $(B^2_G, B^2_R) = (0, 1)$,	18	17
		or $t_2 = r$ and $(B^2_G, B^2_R) = (1, 0)$		
3	sincere	$t_3 = g, r;\ (B^3_G, B^3_R) = (1, 1)$	18	18
3	strategic	$t_3 = g$ and $(B^3_G, B^3_R) = (0, 2)$,	17	6
		or $t_3 = r$ and $(B^3_G, B^3_R) = (2, 0)$		
4	strategic	$t_4 = g$ and $(B^4_G, B^4_R) = (1, 2)$,	13	7
		or $t_4 = r$ and $(B^4_G, B^4_R) = (2, 1)$		

Notes: Proposition 4a is used to determine "Predicted vote." Fix voter number i $(i = 1, \ldots, 4)$. "Circumstances involved" shows what is theoretically required—that is, the voter type, t_i, and the (B^i_G, B^i_R)-vector—to elicit the "Predicted vote" from voter i. "No. of obs." records the number of times in the experiment that we observe the conditions specified in "Circumstances involved." "No. of sincere votes" records the number of times in these situations that the vote cast is sincere

about how other subjects vote are irrelevant).[22] Aggregated over the 48 elections, voters 3, 4 and 5 faced such situations on, respectively, 13, 35 and 48 occasions. In accord with theory, the dominant strategy was played 13, 35 and 46 times. How do voters behave in situations where a dominant strategy is *not* available? Table 3 summarizes our evidence.

Consider voter 1. Proposition 4b predicts that voter 1 will cast a sincere vote. In conformity with theory, a sincere vote was elicited in all but one case (refer to row 1 of Table 3). The behavior of voter 2, on the other hand, identifies a circumstance wherein our game-theoretic analysis is dramatically off the mark. We had predicted that voter 2, regardless of her type, would mimic the choice of voter 1. This means that a strategic vote should be forthcoming under two conditions: "$t_2 = g$ and $v_1 = R$" *or* "$t_2 = r$ and $v_1 = G$." Row 3 of Table 3 shows that voter 2 encountered these situations

[22]When do such situations arise? Consider voter 3 and let her type, t_3, be g. At the time of her voting, alternative G may have obtained two votes. Notice that if voter 3 votes for alternative G, she obtains the maximal payoff of 1.5. In this case, voter 3's dominant strategy is to vote for alternative G. Consider voter 4 and let her type, t_4, be g. At the time of her voting, two cases may arise. First, one of the alternatives, G or R, could have obtained three votes. In this case, voter 4's dominant strategy is to vote with the formed majority. Second, in the vote count, alternative G may be ahead of alternative R by one vote. Since a vote for alternative G guarantees voter 4 the maximal payoff of 1.5, her dominant strategy is to opt for alternative G. Finally, consider voter 5. At the time of her voting, two cases are possible. First, one of the alternatives, G or R, could have obtained at least three votes. In this case, voter 5's dominant strategy is to vote with the formed majority. Second, voter 5 may observe a 2–2 tie. In this case, the dominant strategy for voter 5 is to break the tie by casting a sincere vote.

18 times; yet a sincere vote was cast on all but one occasion! A similar, if less striking, pattern in our theory's predictive failure occurs as well for voters 3 and 4. Consider voter 3. Our theory has two implications for voter 3. First, a sincere vote is predicted when voter 3 faces a 1–1 tie. In conformity with theory, a tie always elicited a sincere vote (refer to row 4 of Table 3). Second, a strategic vote is predicted when the initial two voters choose the alternative that voter 3 does not intrinsically favor (that is, "$t_3 = g$ and $(B_G^3, B_R^3) = (0, 2)$" *or* "$t_3 = r$ and $(B_G^3, B_R^3) = (2, 0)$"). Voter 3 was placed in such situations 17 times and cast a strategic vote on 11 occasions only (refer to row 5 of Table 3). Finally, consider the behavior of voter 4. Voter 4 has a nontrivial vote choice only when the scenario is of the following kind: the alternative that is ahead in the vote count by one vote is not the alternative that voter 4 intrinsically favors (that is, "$t_4 = g$ and $(B_G^4, B_R^4) = (1, 2)$" *or* "$t_4 = r$ and $(B_G^4, B_R^4) = (2, 1)$"). In this case, our theory predicts a strategic vote. Voter 4 encountered these situations 13 times; yet a strategic vote was forthcoming in 6 instances only (refer to row 6 of Table 3).

The central message of Table 3 is clear. In the experiment, our game-theoretic analysis breaks down, strikingly in the case of voter 2, when a strategic vote is predicted. Regardless of location in the queue, voters often prefer the more conservative sincere vote option. This frequent unwillingness to herd on the alternative that is ahead in the vote count also explains why, in violation of proposition 4b, coordinated voting is frequently not observed in the laboratory.

Conclusion 5 Consider voter behavior in sequential voting elections under the own-type information condition. In circumstances where a dominant strategy is not available, voters often favor the sincere vote option. The unwillingness of voters to herd on the alternative that is ahead in the vote count results in uncoordinated voting in the laboratory.

5.3 Comparing voting mechanisms

In this subsection, we compare simultaneous voting elections with sequential voting elections. We provide two perspectives on this contrast. First, we hold voter information fixed (that is, own-type information *or* full-type information) and ask: does the choice of a voting mechanism affect the extent to which votes are coordinated? Second, we hold the voting mechanism fixed (that is, simultaneous voting election *or* sequential voting election) and vary voter information. Here we ask: does the performance of a voting mechanism hinge critically on what voters know?

Using a total of 40 subjects, our experiment generates data on voter behavior in $4 \times 48 = 192$ elections. Let $J \equiv \{1, 2, \ldots, 192\}$ index the set of all elections in the experiment. Let $J(i) \subset J$ index the set of elections in which subject i (i ranges from 1 to 40) was a voter. We now proceed in two steps. First, we create three variables—*Coord*, *Seqdum*, and *Informdum*—as follows. For $j \in J(i)$, $Coord_{ij}$ is equal to 1 if subject i's vote in election j places her in the majority coalition, and is 0 otherwise; $Seqdum_j$ is equal to 1 if election j uses sequential voting, and is 0 otherwise; $Informdum_j$ is equal to 1 if voter information in election j is full-type, and is 0 otherwise. Second, we pool *all* the experimental data and use the random effects probit

Table 4 Comparison of voting mechanisms

Coordination equation	
Constant	0.496^a
	(0.144)
Seqdum	0.670^a
	(0.212)
Seqdum × *Informdum*	0.839^a
	(0.263)
(1 − *Seqdum*) × *Informdum*	1.560^a
	(0.260)
Observations	960
Subjects	40

Notes: The "Coordination equation" refers to Eq. 2 of Sect. 5.3. "Seqdum" is a dummy variable that equals 1 if the vote being considered comes from an election with sequential voting, and is 0 otherwise. "Informdum" is a dummy variable that equals 1 if the vote being considered comes from an election conducted under the full-type information condition, and is 0 otherwise. "Observations" indicates the total number of vote decisions used in estimating the equation. "Subjects" indicates the total number of subjects whose vote decisions were used in estimating the equation. The standard errors of the estimated coefficients are in parentheses; a = statistical significance at the 1 percent level

model to estimate the following *coordination equation*:

$$Coord_{ij} = 1\{\beta_0 + \beta_1 Seqdum_j + \beta_2 Seqdum_j \times Informdum_j + \beta_3(1 - Seqdum_j) \times Informdum_j + \alpha_i + \epsilon_{ij} \geq 0\}. \tag{2}$$

The Eq. 2 estimates are given in Table 4.

5.3.1 Comparing voting mechanisms: voter information fixed

We conducted 96 elections under the own-type information condition and 96 elections under the full-type information condition. Within each information condition, 48 elections were sequential in nature while the rest used simultaneous voting. We ask: *given* an information condition, does the choice of a voting mechanism affect the ease with which a voter votes with the majority?

We consider first the own-type information condition. There are three explanatory dummy variables in Eq. 2: *Seqdum*, *Seqdum* × *Informdum*, and (1 − *Seqdum*) × *Informdum*. With the information treatment *fixed*, observe that sequential voting elections ensure that only *Seqdum* takes the value 1 while simultaneous voting elections ensure that all three dummy variables assume the value 0. Now, Table 4 shows that the estimated coefficient of *Seqdum* (that is, $\hat{\beta}_1$) is positive and statistically significant at the one percent level. In other words, under the own-type information condition, the incidence of coordinated voting is higher in sequential voting elections than in simultaneous voting elections.

Consider the full-type information condition. With the information treatment *fixed*, sequential voting elections ensure that two dummy variables in Eq. 2—*Seqdum* and *Seqdum* × *Informdum*—take the value 1 while simultaneous voting elections ensure that only (1 − *Seqdum*) × *Informdum* assumes the value 1. Now, Table 4 shows that $(\hat{\beta}_1 + \hat{\beta}_2)$, the sum of the estimated coefficients of *Seqdum* and *Seqdum* × *Informdum*, is 1.509 while $\hat{\beta}_3$, the estimated coefficient of (1 − *Seqdum*) × *Informdum*, is 1.560. Furthermore, a standard chi-squared test reveals that the null hypothesis, $(\beta_1 + \beta_2) - \beta_3 = 0$, cannot be rejected at conventional levels of significance. In other words, under the full-type information condition, the incidence of coordinated voting is independent of the voting mechanism in place.

Conclusion 6 Under the own-type information condition, voters in sequential voting elections are more likely to be part of the majority coalition than are voters in simultaneous voting elections. On the other hand, under the full-type information condition, a voter's probability of being in the majority coalition is not dependent on the nature of the voting mechanism.

5.3.2 Comparing voting mechanisms: voter information varied

We conducted 96 elections using the simultaneous voting mechanism and 96 elections using the sequential voting mechanism. For each voting mechanism, 48 elections were of the own-type information variety while the rest had full-type information. We ask: *given* a voting mechanism, does the quality of voter information affect the ease with which a voter votes with the majority?

Table 4 shows that the estimated coefficients of *Seqdum* × *Informdum* and (1 − *Seqdum*) × *Informdum* are positive and statistically significant at the one percent level. In other words, regardless of the voting mechanism being considered, voters are more likely to be part of the majority coalition if voter information is full-type rather than own-type.

The *quantitative* impact of voter information however varies considerably across voting mechanisms. Consider simultaneous voting elections. Given $\hat{\beta}_3$ equal to 1.560, a voter's probability of being part of the majority coalition jumps from 0.69 to 0.98 when voter information switches from own-type to full-type (see footnote for details).[23] By contrast, in sequential voting elections, with $\hat{\beta}_2$ equal to 0.670, the corresponding jump in probability is from 0.88 to 0.98 (see footnote for details).[24]

[23] Consider the three explanatory dummy variables in Eq. 2: *Seqdum*, *Seqdum* × *Informdum*, and (1 − *Seqdum*) × *Informdum*. Under the own-type information condition, simultaneous voting elections ensure that all three dummy variables assume the value 0. Now, set $\alpha_i = 0$. Thus, the probability of a voter being part of the majority coalition is $\Phi(0.496) = 0.69$, where $\Phi(.)$ is the cumulative standard normal distribution. Under the full-type information condition, simultaneous voting elections ensure that only (1 − *Seqdum*) × *Informdum* takes the value 1. Thus, the probability of a voter being part of the majority coalition is $\Phi(0.496 + 1.560) = 0.98$.

[24] Consider the three explanatory dummy variables in Eq. 2: *Seqdum*, *Seqdum* × *Informdum*, and (1 − *Seqdum*) × *Informdum*. Under the own-type information condition, sequential voting elections ensure that only *Seqdum* takes the value 1. Now, set $\alpha_i = 0$. Thus, the probability of a voter being part of the majority coalition is $\Phi(0.496+0.670) = 0.88$, where $\Phi(.)$ is the cumulative standard normal distribution. Under the full-type information condition, sequential voting elections ensure that *Seqdum* and *Seqdum* × *Informdum* take the value 1. Thus, the probability of a voter being part of the majority coalition is $\Phi(0.496 + 0.670 + 0.839) = 0.98$.

Conclusion 7 Regardless of the voting mechanism being considered, voter information matters. Specifically, voters are more likely to be part of the majority coalition when voter information is full-type rather than own-type. However, the quantitative impact of voter information is far greater in simultaneous voting elections than in sequential voting elections.

6 Conclusion

This paper has used experimental methods to study voter behavior in different settings. In the experiment, we varied the information possessed by voters (own-type information or full-type information) and the voting mechanism employed (simultaneous voting election or sequential voting election). Our main conclusions are listed below.

Consider, first, simultaneous voting elections. Under the own-type information condition, voting in the laboratory was mostly sincere. Therefore, while the majority-preferred alternative was frequently elected, voters seldom coordinated their votes on a single alternative, G or R. In contrast, under the full-type information condition, voters, for the most part, coordinated their votes on the majority-preferred alternative.

Consider, now, sequential voting elections. Regardless of the voter information condition, we had predicted that votes would be coordinated on a single alternative. In the laboratory, coordinated voting was however *far* from guaranteed when voter information was of the own-type variety. Given uncoordinated voting in the laboratory, location in the voting queue became a valuable asset. Once the game unfolds and the sequence of votes recorded, voters lower down in the voting queue were better able to vote with the majority.

We should also point out that two policy implications follow directly from our experimental results. First, suppose that a social planner is entrusted with the task of choosing a voting mechanism for a fixed set of voters. When voter information approximates the own-type situation, we have shown that the incidence of coordinated voting is higher when the social planner selects the sequential voting mechanism rather than the simultaneous voting mechanism. On the other hand, when voter information approximates the full-type situation, the social planner becomes irrelevant: voter behavior does not depend on whether the election is simultaneous or sequential. Second, suppose that the social planner must choose the voting mechanism *without* knowing anything about the information that voters possess. In this context, we have shown that the sequential voting mechanism has the attractive property of being more robust than the simultaneous voting mechanism. In other words, the link between coordinated voting and voter information quality is less pronounced in the sequential voting mechanism than in the simultaneous voting mechanism.

Acknowledgements We would like to acknowledge financial support from the National Science Foundation. We thank Terence Conklin and Conklin Systems for developing the software used in our experiment. Finally, we are grateful to our reviewers, Stephen Haptonstahl, and seminar participants at the University of Chicago and Washington University for very helpful comments. Of course, the usual disclaimer applies.

References

Austen-Smith, D., & Banks, J. (1996). Information aggregation, rationality, and the Condorcet jury theorem. *American Political Science Review*, *90*, 34–45.

Bartels, L. (1985). Expectations and preferences in presidential nomination campaigns. *American Political Science Review*, *79*, 804–815.

Bartels, L. (1988). *Presidential Primaries and the Dynamics of Public Choice*. Princeton: Princeton University Press.

Battaglini, M. (2005). Sequential voting with abstention. *Games and Economic Behavior*, *51*, 445–463.

Battaglini, M., Morton, R., & Palfrey, T. (2005). Efficiency, equity, and timing in voting mechanisms. Princeton University and New York University, mimeo.

Bikhchandani, S., Hirshleifer, D., & Welch, I. (1992). A theory of fads, fashion, custom, and cultural change as informational cascades. *Journal of Political Economy*, *100*, 992–1026.

Callander, S. (2004). Bandwagons and momentum in sequential voting. Northwestern University, mimeo.

Coleman, S. (2004). The effects of social conformity on collective voting behavior. *Political Analysis*, *12*, 76–96.

Dekel, E., & Piccione, M. (2000). Sequential voting procedures in symmetric binary elections. *Journal of Political Economy*, *108*, 34–55.

Eckel, C., & Holt, C. (1989). Strategic voting in agenda-controlled committee experiments. *American Economic Review*, *79*, 763–773.

Epstein, L., & Knight, J. (1998). *The Choices Justices Make*. Washington: Congressional Quarterly Press.

Feddersen, T., & Pesendorfer, W. (1997). Voting behavior and information aggregation in elections with private information. *Econometrica*, *65*, 1029–1058.

Feddersen, T., & Pesendorfer, W. (1998). Convicting the innocent: the inferiority of unanimous jury verdicts. *American Political Science Review*, *92*, 23–35.

Hall, M. (1990). Opinion assignment procedures and conference practices in state supreme courts. *Judicature*, *73*, 209–214.

Krutz, G., & Patterson, S. (2001). *Hitching a Ride: Omnibus Legislating in the US Congress (Parliaments and Legislatures)*. Columbus: Ohio State University Press.

Morton, R., & Williams, K. (1999). Informational asymmetries and simultaneous versus sequential voting. *American Political Science Review*, *93*, 51–67.

Morton, R., & Williams, K. (2001). *Learning by Voting: Sequential Choice in Presidential Primaries and other Elections*. Ann Arbor: University of Michigan Press.

Oleszek, W. (1984). *Congressional Procedures and the Policy Process*. Washington: Congressional Quarterly Press.

Rosenne, S. (1995). *The World Court: What It is and How It Works*. London: Martinus Nijhoff.

Wilson, R., & Herzberg, R. (1988). Results on sophisticated voting in an experimental setting. *The Journal of Politics*, *50*, 471–486.

Wooldridge, J. (2002). *Econometric Analysis of Cross Section and Panel Data*. Cambridge: MIT Press.