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Title: "Voting rules and voter behavior: a comparative perspective using laboratory and field experiments"

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Abstract: In this talk, we report on several experiments, designed to compare aggregate results and individual voting behavior in winner-take-all elections under four different voting rules: plurality, run-off elections, single transferable vote (alternative vote) and approval voting.

First, in laboratory experiments with an abstract framing where subjects have single-peaked preferences over a set of candidates, we find that the voting rule makes important differences in determining who gets elected: the Condorcet winner is always elected under single transferable vote and never elected under the Alternative vote. At the individual level, we find that the rational choice theory provides very good predictions of actual individual behavior in plurality and approval voting elections, but fares poorly in explaining vote choice under two-round run-off elections. We conclude that voters behave strategically as far as strategic computations are not too demanding, in which case they rely on simple heuristics (in two-round elections) or they just vote sincerely (in single transferable vote elections).

Second, we report on an internet-based quasi-experiment which took place during the French 2012 presidential election. We designed a website where French voters were offered the opportunity to cast a "mock vote" (for the real candidates) under the same four voting rules. Based on the observation of over 8,000 participants, we find that a substantial minority (10 to 15%) vote differently under the different systems, with 17% of the voters not voting for their preferred candidate in the plurality election, this percentage dropping to 12% in the alternative vote (first choice). After voting under the four different rules, participants were invited to report which rule they preferred. We explore the determinants of these preferences for the voting rules, and undercover a strong self-serving bias. Ideology and whether the respondent casts or not a sincere vote in the experiment also significantly explain these preferences.

References:

- "Strategic, Sincere and Heuristic Voting under Four Election Rules: An Experimental Study", *Social Choice and Welfare*, vol. 35, n°3, 2010, p. 435-472 (with A. Blais, J.-F Laslier and N. Sauger)
- "Vote Au Pluriel: How People Vote When Offered to Vote Under Different Rules?", *PS: Political Science & Politics*, vol. 46, n°2, 2013, p. 324-328 (with A. Blais and J.-F Laslier)
- "Why Voters Like Voting Rules: Self-Interest, Ideology, or Sincerity", Mimeo (with A. Blais, J.-F Laslier and F. Poinas

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ORIGINAL PAPER

Strategic, sincere, and heuristic voting under four election rules: an experimental study

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Abstract We report on laboratory experiments on voting. In a setting where subjects have single-peaked preferences, we find that the rational choice theory provides very good predictions of actual individual behavior in one-round and approval voting elections but fares poorly in explaining vote choice under two-round elections. We conclude that voters behave strategically as far as strategic computations are not too demanding, in which case they rely on simple heuristics (under two-round voting) or they just vote sincerely (under single transferable vote).

1 Introduction

One of the most celebrated pieces of work in political science is due to Maurice Duverger whose comparison of electoral systems in the 1950s showed that proportional representation creates conditions favorable to foster multi-party development, while the plurality system tends to favor a two-party pattern (Duverger 1951). To

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explain these differences, Duverger drew a distinction between mechanical and psychological effects. The mechanical effect corresponds to the transformation of votes into seats. The psychological effect can be viewed as the anticipation of the mechanical effect: voters are aware that there is a threshold of representation (Lijphart 1994), and they decide not to support parties that are likely to be excluded because of the mechanical effect.

Since then, strategic voting has been considered as the central explanation of the psychological effect (Cox 1997). The assumption of rational individuals voting strategically has been intensively used as a tool in formal models, which inspire most of the contemporary works on electoral systems (Taagerera 2007). In this vein, Myerson and Weber (1993) and Cox (1997) have provided models of elections using the assumption of strategic voters which yield results compatible with Duverger's observations.

These models have had widespread appeal but are simultaneously extensively debated (Green and Shapiro 1994). In particular, the assumption of rational forward-looking voters seems to be at odd with a number of empirical studies of voters' behavior. Following the lines of the pessimistic view of the nineteenth century elitist theories, decades of survey research have concluded to the limited capacities of the electorate to behave rationally, lacking coherence of preferences (Lazarfeld et al. 1948), basic information about political facts (Delli Carpini and Keeter 1991), and cognitive skills to elaborate strategies (for comprehensive and critical review, see Kinder 1983; Sniderman 1993; Kuklinski and Quirk 2000). In his survey of strategic voting in the U.K., Fisher (2004, p. 163) posits that "no one fulfils the abstract conception of a short-term instrumentally rational voter in real life." Yet, Riker claims that "the evidence renders it undeniable that a large amount of sophisticated voting occurs—mostly to the disadvantage of the third parties nationally—so that the force of Duverger's psychological factor must be considerable" (Riker (1982, p. 764)).

There is an obvious contradiction between these two streams of literature. Yet, testing the existence of rational strategic behavior at the individual level with survey data is fraught with difficulties. Indeed, rational choice theory postulates that voters cast their vote to maximize some expected utility function, given their beliefs on how other voters will behave in the election. Testing for this kind of behavior requires measuring voters' preferences among the various candidates as well as their beliefs on how their own vote will affect the outcome of the election.

One route to test for rational strategic behavior from electoral survey data has been to use proxies for voters' relevant beliefs such as the viability of candidates (Alvarez and Nagler 2000; Blais and Bodet 2006). The basic approach is to determine whether the so-called viability of candidates (the likelihood that they win the election) is significant when modelling individual vote choice. This is generally considered as an approximation of the core idea of the rational choice theory of voting, i.e., that voters try to maximize the utility of their vote. However, these proxies are a "far cry" from the concept of a pivotal vote, which is central in the rational choice model (Aldricht 1993).

To overcome these difficulties, this article proposes to study strategic voting in the laboratory. We have conducted a series of experiments where subjects are voters, asked to vote to elect a candidate from a fixed set of five candidates. This experimental setting allows us to control for individual preferences for the various candidates (which are

monetary induced) and for the information they have regarding the respective chances of the various candidates (thanks to repeated elections).

The aim of this article is to test whether the behavior of individuals, in such a favorable context, complies with expectations built on rational choice theory. Our hypothesis is that it all depends on the complexity of the strategic reasoning entailed by the voting rule. Four different electoral systems are used as treatments. Besides the one-round plurality (labeled 1R in the sequel) and two-round majority (2R) voting rules we were primarily interested in, we also run some experiments under approval voting (AV) and the single transferable vote (STV) with Hare transfers, also known as the alternative vote,[1] to add additional evidence about the importance of the level of complexity—the idea being that strategic calculi are quite easy under AV and extremely difficult under STV.

The choice of these four voting rules was driven by the following considerations. First, we wanted to study 1R plurality and 2R majority voting because these are the two rules used almost exclusively for uninominal direct elections for main political offices and especially for presidential elections throughout the world (Lijphart 1994; Farrell 2001). These two rules differ with regard to the complexity of the voter calculus entailed by rational theory. Under 1R plurality voting rule, the recommendations of the strategic theory at the individual level are quite simple. The voter should vote for the candidate yielding the highest utility among the viable candidates. In 2R elections also, there is no point in voting for a non-viable candidate, but the reasoning is more complex. For example, there is no point in voting for a candidate which is sure to make it to the second round. Indeed, one might consider that if her vote is pivotal, this is more likely between the second- and third-ranked candidates. Besides, if one is sure that a candidate that she likes will make it to the second round, it might be in her interest to vote for a candidate that she does not like if this candidate will more surely be defeated in the second round, thus fostering the chances of her favored candidate. Such complex and counter-intuitive considerations may be beyond the cognitive skills of ordinary voters, or may simply not convince them.

Beside these two main rules, we also investigated two other rules, AV and STV under which the theoretical rational behavior is, respectively, particularly simple and particularly intricated. Under AV, the strategic recommendation (Myerson and Weber 1993; Laslier 2009; Dellis 2010) is essentially to approve or not a candidate depending on whether or not you prefer this candidate to the most likely winner of the election. Under STV, the strategic recommendation is to solve backward a decision tree (which has as many levels as there are candidates) iterating for each branch the same kind of reasoning as in 2R voting.[2]

The assumption we want to test with this large spectrum of voting rules is that when strategic considerations are simple to compute and formulate, strategic voting provides accurate predictions of actual individual behavior, but that this theory fails

[1] Although the latter label is more common in political science, we use in the text the label "single transferable vote". It is the label we used in the experiment, because we thought it might help subjects understand the mechanism of vote transfers.

[2] Up to our knowledge, the solution to this problem has never been published, but a similar pattern arises in sequential voting rules considered by Moulin (1979) or Bag et al. (2009).

to account for individual choices when it implies too demanding computations. Furthermore, in situations where the rational choice model performs poorly, we want to know if voters vote sincerely or have made reasoned choices, following simpler rules of thumb or heuristics.

Closely related to our study are a series of experiments on voting rules in three candidate elections, which examine under which conditions the minority-preferred candidate wins in elections, where a majority of voters is split between two majority-preferred candidates. Felsenthal et al. (1988), Forstythe et al. (1993, 1996), under the plurality voting rule, study various public coordinating signals, such as pre-election polls or repeated elections, making it certain that majority voters successfully coordinate on one of the majority-preferred candidates. Morton and Rietz (2008) study the effects of run-off elections in these split-majority electorates, showing that under 2R voting rules, a minority-preferred candidate has much fewer chances of winning the election that under plurality (even with public coordinating signals). Forstythe et al. (1996) study AV and the Borda rule as well; again, the minority candidate is more often defeated than under plurality.[3]

Again with three candidates, Lepelley et al. (2009) demonstrate that the notion of "manipulation" or "strategic voting" must be defined as a dynamic concept, as voters react to new information. Under the Borda rule, Kube and Puppe (2009) show that voters tend to vote strategically if they have information about the other voters' votes.

Contrary to those experiments, we are interested in a symmetrically distributed electorate and a more fragmented set of options from which to select (five candidates instead of three), and we have a larger electorate (21 or 63 voters compared to 14 in most of those experiments). The preference profile we use does not stem from the literature on voting paradoxes but mimics a simple one-dimensional political landscape. It turns out that, in this familiar setting, strategic behavior may be more complex than in the three-way races previously studied.[4] And indeed, our conclusion sharply differs from that of Rietz (2008) when summarizing the main lessons to be drawn from those experiments, namely that "Again, in the experimental tests, voters' actions appear largely rational and equilibria appear consistent with rational modelling" (p. 895). We will rather conclude that, indeed, when strategic recommendations are simple, as in 1R elections, voters' behavior is satisfactorily explained by rational choice theory, but this result does not hold under 2R elections with a preference profile and a set of candidates generating more complex computations.

Also related to our study are experiments exploring voters' strategic decisions in other voting settings, such as strategic participation and voter turnout, or strategic voting and information aggregation in committees. For a survey on these experiments, see Palfrey (2006). Seminal experiments by Plott and Levine (1978) concluded that in a fixed agenda, single meeting committee, myopic-voting rules yielded accurate description of voters' behavior. Eckel and Holt (1989) design an experiment to evaluate the effect of voters' knowledge about other voters' preferences and experience on

[3] See Rietz (2008) for a survey of those experiments.

[4] For example, in Morton and Rietz (2008) analysis of 2R elections, voting sincerely at the first round for one's preferred candidate is a dominant strategy for minority voters, but such is not the case in the one-dimensional setting.

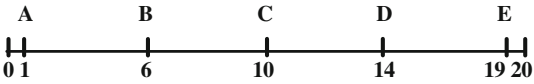

Fig. 1 Positions of the five candidates

the emergence of strategic voting in a fixed-agenda committee voting game. As anticipated, repetition and public information about preferences contribute to the emergence of strategic voting. The authors report nonetheless having had expected a higher level of strategic voting than actually observed.

More closely related to our project is an experiment focussing on the impact of complexity on the prevalence of strategic behavior in the context of agenda-controlled committee decisions. Herzberg and Wilson (1988) explicitly test whether complexity affects individuals' strategic choices by varying the length of the agenda, starting with the hypothesis that the longer the agenda, the more difficult strategic computations are. Their principal finding is "that sophisticated behavior is relatively uncommon. (. . .) Instead, we conclude that decision making is most often characterized by sincere behavior" (p. 484). Besides, unexpectedly, they find little evidence supporting their conjecture about the impact of complexity on strategic choices. Rather, it seems that the frequency of sophisticated choices by voters is bell-shaped in the level of complexity. In our experiment also we are interested in varying the level of complexity of the strategic decisions, but rather than using the length of an agenda in a sequential voting game, we use various voting rules.

The rest of the article is structured as follows. Section 2 describes the experiments. Section 3 presents the aggregate results. Section 4 contains the core of the analysis: it presents our models of individual voting for 1R and 2R elections. Section 5 tests the models with the individual data and presents a cognitive explanation to our findings. Section 6 corroborates the findings using evidence from AV and STV elections, and Sect. 7 concludes. A technical appendix presents details on the models and some additional findings.

2 The experimental protocol

The basic protocol is as follows.[5] 21 (63, in six sessions) subjects vote among five alternative candidates, labeled A, B, C, D, and E, symmetrically located at five distinct points on an axis, presented as going from left to right, from 0 to 20: an extreme left candidate (A, in position 1), a moderate left (B, in position 6), a centrist (C, in position 10), a moderate right (D, in position 14), and an extreme right (E, in position 19) (see Fig. 1).

Each subject is randomly assigned a position on this axis (see below for a description of this assignment). The monetary incentive for a subject is that the elected candidate be as close as possible to her position. Subjects are informed that they will be paid 20 euros (or Canadian dollars) minus the distance between the elected candidate's position and their own position. For instance (this is the example given in the instructions), a voter whose assigned position is 11 will receive 10 euros if candidate A wins,

[5] The full instructions (slides) that were delivered to subjects are available upon request.

12 if E wins, 15 if B, 17 if D, and 19 if C. When candidate C is elected, payoffs range between 20 euros (for the voter in position 10) and 10 euros (for the voters located in position 0 and 20); average payoff is 14.8 euros. When candidate B is elected, payoffs range between 20 euros (for the voter in position 6) and 6 euros (for the voter located in position 14); average payoff is 14 euros. The case of candidate D is symmetric. Given the winning frequencies of the various candidates, average payoff in the experiment was 14.5 euros.

The set of options and the payoff scheme are identical for all elections. The main treatment is to vary the electoral system. In each group, the first two series of four elections are alternatively held under 1R and 2R voting rules. In some sessions, one more series is held under AV or STV. The four elections in each series are held with the same voting rule, this being explained at the beginning of each series. For each series, participants are assigned a randomly drawn position on the 0 to 20 axis. There are a total of 21 positions, and each participant has a different position. (For large groups three subjects have the same position.) The participants are informed about the distribution of positions: they know their own position, they know that each possible position is filled exactly once (or thrice in sessions with 63 students) but they do not know by whom. Voting is anonymous. After each election, ballots are counted and the results (the five candidates' scores) are publicly announced.[6]

After the initial series of four elections, the participants are assigned new positions and the group moves to the second set of four elections, held under a different rule and, in some sessions, to a third series of four elections. The participants are informed from the beginning that one of the eight or twelve elections will be randomly drawn as the "decisive" election, the one which will actually determine payoffs.[7] Cooperation and communication among voters are banned.

Since the objective of the experiment had to do with the ability of the voters to cope with different voting rules, one might fear that the outcomes could be affected by voters' familiarity with some voting rules. For that reason, we split geographically the experiment, part of it being run in Canada characterized by 1R voting rule, the other part being run in France characterized by 2R. We found no statistically significant difference between the Canadian and French sessions.

We performed a total of 23 sessions: four in Lille, France (of which two featuring 63 subjects,[8]) eight in Montreal, Canada (of which four featuring 63 subjects), and eleven in Paris, France (of which six sessions include a third series under AV, and four sessions include a third series under STV), with a total of 734 participants. In Montreal and Paris, subjects are students (from all fields) recruited from subject pools (from the CIRANO experimental economics laboratory in Montreal, and from the *Laboratoire d'économie expérimentale de Paris*). In Lille, they were first year law students enrolled in a political science course. All experiments took place in classrooms. Information

[6] In STV elections, the whole counting process occurs publicly in front of the subjects, eliminating the candidate with the lowest score and transferring ballots from one candidate to the others.

[7] This is customary in experimental economics; this has the advantage of keeping the subjects equally interested in all elections and of avoiding insurance effects; see Davis and Holt (1993).

[8] In fact, large groups in Lille were composed of 61 and 64 students, because of technical problems. This does not seem to have any effect on the quality of the data.

Table 1 The sessions

	Place	Date	Group size	Electoral systems
1	Paris	06/13/2006	21	2R/1R
2	Paris	12/11/2006	21	2R/1R/AV
3	Paris	12/11/2006	21	1R/2R/AV
4	Paris	12/13/2006	21	2R/1R/AV
5	Paris	12/13/2006	21	1R/2R/AV
6	Paris	12/18/2006	21	2R/1R/STV
7	Paris	12/18/2006	21	1R/2R/STV
8	Paris	12/19/2006	21	2R/1R/STV
9	Paris	12/19/2006	21	1R/2R/STV
10	Paris	1/15/2007	21	2R/1R/AV
11	Paris	1/15/2007	21	1R/2R/AV
12	Lille	12/18/2006	21	2R/1R
13	Lille	12/18/2006	21	1R/2R
14	Lille	12/18/2006	61	2R/1R
15	Lille	12/18/2006	64	1R/2R
16	Montreal	2/19/2007	21	1R/2R
17	Montreal	2/19/2007	21	2R/1R
18	Montreal	2/20/2007	21	1R/2R
19	Montreal	2/20/2007	21	2R/1R
20	Montreal	2/21/2007	63	1R/2R
21	Montreal	2/21/2007	63	2R/1R
22	Montreal	2/22/2007	63	1R/2R
23	Montreal	2/22/2007	63	2R/1R

about each experiment (date, location, number of subjects, treatments) is provided in Table 1.[9]

Before turning to the individual level analysis of the data, which is the main focus of this article, we briefly present the aggregate electoral outcomes.

3 Aggregate electoral outcomes

Table 2 shows how many of the elections were won by the various candidates. Whatever the voting rule, the extremist candidates (A and E) are never elected. In 1R and 2R

[9] We gathered some basic information on the sociodemographic background of this sample. Males represent 46% of the sample (information is missing for 5% of the sample). The average age of the sample is 24 years, ranging from 19 to 61 (information is missing for 5% of the sample). If the sample is split in accordance with its location, males represent 31% of the sample in Lille (information missing for 2% of the sample), 41% in Paris (information missing for 12%), 52% in Montreal (information missing for 2%). Regarding age, the average is 20 years in Lille, 22 in Paris, 28 in Montreal.

Table 2 Winning candidates (all)

	1R	2R	AV	STV
C (%)	49	54	79	0
B or *D* (%)	51	45	21	100
A or *E* (%)	0	0	0	0
Total	92	92	24	16

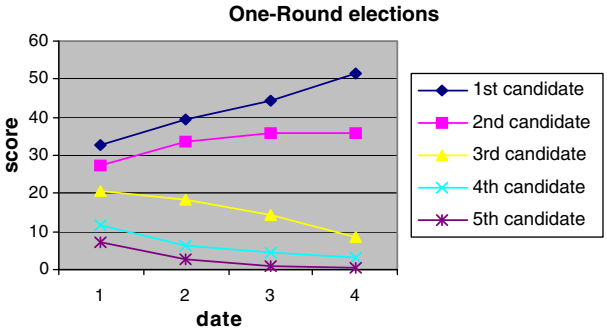

Fig. 2 Evolution of the scores of ranked candidates (1R)

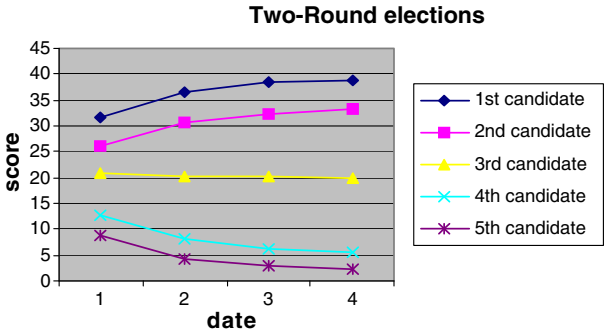

Fig. 3 Evolution of the scores of ranked candidates (2R)

elections, candidate *C* (the centrist candidate, a Condorcet winner in our case) is elected in about half of the elections. Things are quite different in AV and STV elections. In AV elections, *C* is almost always elected (79% of the elections), and in STV elections, *C* is never elected.[10]

Figures 2, 3, 4, and 5 indicate the percentage of votes (averaged over our 23 sessions) obtained by the candidates ranked first, second, third, fourth, and last over the course of the four elections held under the same voting rule (from first to last), for each electoral system. In the case of 2R elections, we consider only the first round. For AV, the figures represent the percentage of voters who vote for the candidate (these

[10] Tables 9–12 in the appendix present the winners of elections date by date.

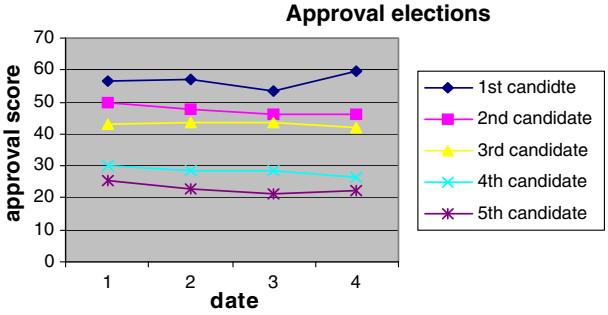

Fig. 4 Evolution of the scores of ranked candidates (AV)

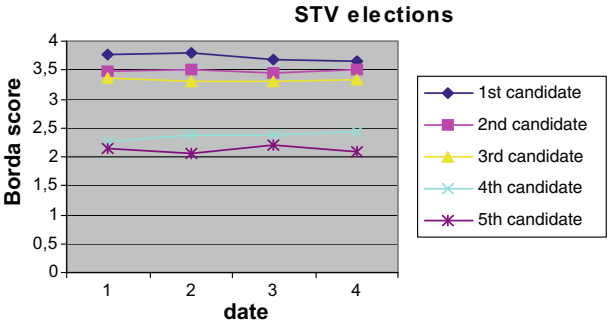

Fig. 5 Evolution of the scores of ranked candidates (STV)

percentages do not sum to 100). STV is not a score method, but one can compute the Borda scores of the candidates in the STV ballots and this is how Fig. 5 is constructed.

One can see that as time goes, votes gather on two (for 1R elections) or three (for 2R elections) candidates. The three viable candidates are always the same for 2R elections (candidates B, C, and D), but for 1R elections the pair of viable candidates is not the same in all elections (the pairs of viable candidates are always composed of two candidates among the set B, C, and D). The pictures for AV and STV do not show any time-dependence effect.

These aggregate results show that our protocol is able to implement in the laboratory several of the theoretical issues about voting rules: with the same preference profile, voting rules designate the Condorcet winner (AV), or not (STV), or designate a candidate which depends on history (1R and 2R). For additional analyses of those aggregate results see Blais et al. (2007, 2010).

4 Strategic, sincere, and heuristics voting in 1R and 2R elections

We start with an analysis of individual behavior for 1R and 2R elections. We first describe our model of strategic voting; a more detailed and technical presentation of the model is presented in the appendix. As a benchmark to which compare the

performance of the strategic model, we also describe the sincere voting model. We also introduce another model of individual behavior combining properties from the first two models, labelled heuristics voting. Section 5 tests the models with the individual data coming from the experiments, and ascertain their relative performance.

Note that in a second round of a 2R election, the choice faced by voters is very simple: they have to vote for one candidate among the two run-off candidates. In particular, voting for the candidate associated with the highest monetary payoff is a dominant action and a "sincere" vote. In second round, the percentage of voters who take a correct decision is as follows: out of $734 \times 4 = 2936$ votes, we have 2,761 correct ones (=94%), 142 (=5%) unpredicted votes, and 33 spoiled ballots (=1%). The few abnormal votes do not seem to follow any clear pattern and they are not concentrated on some specific voters. It is therefore reasonable to treat them as a random noise, and we shall not attempt to analyze them further.[11] Therefore, the models we propose below are intended to describe behavior in the first round of 2R elections; in the sequel, when we talk about behavior and scores in 2R elections, unless otherwise specified, we mean behavior and scores in the first round.

4.1 Strategic voting

By strategic behavior we mean that an individual, at a given date t, chooses an action (a vote) which maximizes her expected utility given her belief about how the other voters will vote in the same election. Strategic voting is understood, in this article, in the strict rational choice perspective (see Downs 1957; Myerson and Weber 1993).[12] We assume that voters are purely instrumental and that there is no expressive voting, so that the only outcome that matters is who wins the election. Besides, the utility of a voter is her monetary payoff.

For each candidate v, voters evaluate the likelihood of the potential outcomes of the election (who wins the election) *if they vote for candidate* v, and they compute the associated expected utility. They vote for the candidate yielding the highest expected utility.

To be more specific, we introduce the following notation: there are I voters, $i = 1, 2, \ldots, I$, and 5 candidates, $c = A, B, C, D, E$. The monetary payoff received by voter i if candidate c wins the election is denoted by $u_i(c)$. Let us denote by $p_i(c, v)$ the subjective probability that voter i assigns to the event "candidate c wins the election," conditional on her casting her ballot for candidate v.[13] Given these beliefs, if voter i votes for candidate v, she gets the expected utility

[11] Notice that this "noise" being quite small is an indication that the participants performed the task seriously. In many instances, the outcome of the second round is indeed very clearly predictable and would not depend upon a single vote; nevertheless, the participants did not vote randomly.

[12] Note that the definition of strategic voting we use here does not coincide with that which is sometimes given in the literature in political science. Indeed, this literature has traditionally opposed a sincere and a strategic (or sophisticated) voter, where a voter is said to be strategic only when she deserts her preferred option (Alvarez and Nagler 2000). Such strategic voting needs not be utility maximizing.

[13] Thus $\sum_c p_i(c, v) = 1$, for all v.

$$W_i(v) = \sum_c p_i(c, v) u_i(c).$$

Voter i votes for a candidate v^* such that:

$$W_i(v^*) = \max_{v \in \{A,B,C,D,E\}} W_i(v).$$

For example, if candidate c is perceived to be a sure winner, then whatever the vote decision v of voter i, $p_i(c, v) = 1$ and $p_i(c', v) = 0$, for all c' other that c. In such a case, voter i gets the same expected utility whoever she votes for, since candidate c will be elected no matter what she does. In that case, $W_i(v) = u_i(c)$, for all $v \in \{A, B, C, D, E\}$. Any vote is compatible with the strategic model in that case. That is why the empirical analysis will be restricted to unique predictions (see below).

This model leaves open the question of the form of the probabilities $p_i(c, v)$, which reflect the predictions that voter i makes regarding other voters' behavior. We have to make assumptions regarding these probabilities. A first possibility, that we call the "rational expectation" assumption, is simply to assume that voters' beliefs about other voters' behavior are correct. This assumption is common in economic theory. It lacks realism because it amounts to postulate that the voter "knows" something which has not taken place yet. But it is theoretically attractive because it avoids the difficult question of the belief formation process.

A second possibility that we call the "myopic" assumption is to assume that each voter forms her beliefs about how other voters will behave in the current election based on the results of the previous election, and thinks that other voters will behave in the current election just as they did in the previous election. A "myopic" theory only makes prediction for the second, third, and fourth elections in each series ($t = 2$, 3, or 4). It does not predict how voters behave before they observe any results. On the contrary, the rational expectation hypothesis makes predictions even for the first date. This discussion applies to 1R elections and to the first round of 2R elections. In 2R elections, these $p_i(c, v)$ involve both beliefs as to how voters will behave at the first round, and beliefs as to how voters will behave at the second round (if any). We assume that each voter anticipates that at the second round (if any), each voter will vote for the candidate closest to her position, and will toss a coin if the two run-off candidates are equally close to her position.

Myopic beliefs, as well as rational expectations or any other kind of beliefs, can be precise or approximate. The former will be labelled "noiseless" and the latter "noisy". Under the "noiseless myopic" assumption, the voter believes that at the current election, all voters but herself will vote exactly as they did in the previous election. Under the "noisy myopic" assumption the voter believes that the other voters' current vote will be approximately the same as their previous vote; each voter considers that with a small probability ε, one voter exactly is going to make a "mistake" by deviating from her past action and voting with an equal probability for any of the remaining four candidates. These noisy models draw on the refinement literature in game theory and consider "trembled" beliefs (Selten 1975; Myerson 1991, Chap. 5).

The noisy assumption is preferable from a methodological point of view because it yields more unique predictions. Indeed, note that under the noiseless assumption, the

only case where a voter is pivotal in 1R elections—and thus where she is not indifferent—is when the vote gap between the first two candidates (not taking into account her own vote) is strictly less that 2 (either 1 or 0). The introduction of a small noise increases the chances that any voter becomes pivotal: under this assumption, a voter can be pivotal when the vote gap between the first two candidates in strictly less than 4. When there is a unique best response for the voter under the noiseless assumption, this action is still the unique best response when there are very small "trembles" in other voters' votes (ε small); but when the best response under the noiseless assumption is not unique, considering small trembles may break ties among the candidates in this set.

The appendix describes how to derive the $p_i(c, v)$ probabilities under the various assumptions (rational or myopic, noiseless or noisy) and for the different voting rules. We performed analyses based on these four different assumptions. Analyses under the rational and the myopic expectations turn out to yield very similar results (see appendix). For ease of exposition, we report in the main text only the findings based on the "noisy rational expectation" assumption.

4.2 Sincere voting

For 1R and 2R elections, the simplest behavior that can be postulated is "sincere" voting, which means that the individual votes for the candidate whose position is closest to her own position. With our notation, in plurality 1R and majority 2R elections, individual i votes for a candidate v^* such that:

$$u_i(v^*) = \max_{v \in \{A,B,C,D,E\}} u_i(v).$$

This model makes a unique prediction as to how a voter should vote, except if the voter's position is equally distant from two adjacent candidates, which is the case of voters on the 8th and 12th position on our axis. The sincere prediction does not depend on history.

4.3 Heuristics voting

Over the past two decades, several authors have examined the implications of citizens' limited competence and widespread political ignorance, and discussed the possible use of heuristics. Building on advances in cognitive psychology (Nibset and Ross 1980), Sniderman et al. (1991), Popkin (1991), and Lupia et al. (2000) have argued it is possible for people to reason about politics without a large amount of knowledge, thanks to heuristics. Heuristics, in this context, are defined as "judgemental shortcuts, efficient ways to organize and simplify political choice, efficient in the double sense of requiring relatively little information to execute, and yielding dependable answers even to complex problems of choice" (Sniderman et al. 1991, p. 19). This perspective is thus closely linked to the idea of a "bounded rationality."

In their review of how political science has considered heuristics employed by citizens in their vote choices, Lau and Redlawsk (2001, pp. 953–954) distinguish five major categories. The first heuristics are candidates' appearance. Visual images of candidates have particularly been considered as potentially triggering emotions, stereotypes and finally determining the "likableness" of candidates (Marcus 1988). The three following heuristics are cognitive shortcuts about policy positions. These heuristics are candidates' party affiliation and ideology, as well as endorsements by interest groups. The fifth heuristics are polls results. According to Lau and Redlawsk (2001, p. 954), "information [provided by polls] can produce tremendous reduction in cognitive efforts" because they make it possible to reduce the size of the choice set. It is easier for voters to collect adequate information on candidates once the choice set has been restricted to a few "relevant" options. Polls may even motivate voters to pay closer attention to candidates otherwise neglected because of their leading position (Mutz 1992).

This fifth category of heuristics is the kind of shortcut we consider in this article. Beyond the results of polls, it is generalized to the structure of the electoral competition. (In the same perspective, see Patty 2007; Lago 2008; Laslier 2009.) The general idea of the heuristic voting model we propose is that voters vote sincerely in the set of "viable" candidates.

The viability of candidates is defined as a binary characteristic for each candidate (viable or non viable). In this perspective, vote choice is sincere (as previously) within the limits of the restricted set of candidates that are considered viable. Viability is directly dependent on the result of the election. (It may be either the result of the previous election under the "myopic" assumption or the current election under "rational expectations".) Only leading candidates are viable. This corresponds to the idea that information on preference and vote distribution contributes to the elimination of the weakest alternatives (McKelvey and Ordershook 2008).

Given our assumption that heuristics based on the viability of the candidates defines a restricted menu for attention and our experimental setup which involves five candidates for each election, we consider two versions of such heuristics: "Top-Two heuristics" and "Top-Three heuristics".[14] "Top-Two heuristics" posit that voters choose the candidate they feel closest to among the candidates who obtained the two highest scores, either in the previous election (under the "myopic" assumption) or in the current election (under the "rational expectations"assumption). "Top-Three heuristics" (either myopic or rational) posit that voters choose the candidate they feel closest to among the top three candidates.

We expect that these two versions of heuristic voting will perform differently under each electoral system since viability is generally considered as dependent on the electoral rule. Building on Cox' (1997) results that there are $M + 1$ viable candidates, M being the district magnitude, we hypothesize that "Top-Two" heuristics should apply to 1R electoral systems whereas "Top-Three" heuristics should apply to 2R electoral

[14] We might have consider a "Top-Four heuristics" as well. Given the overall symmetry of our set-up and the closeness of this heuristics to the "sincere model," it is not surprising that this heuristics does not render any significant result. It is therefore not considered here.

Table 3 Model performance for 1R elections, by date

1R: correct predictions	Sincere	Strategic	Top-Two	Top-Three
$t = 1$ (%)	68.7	53.8	49.7	67.5
$t = 2$ (%)	54.8	64.2	60.7	71.2
$t = 3$ (%)	48.7	74.6	75.3	69.5
$t = 4$ (%)	44.7	86.7	80.1	66.8
All dates	54.2	66.7	66.5	68.5
(Testable, all dates)	2647	1968	2775	2667

systems because the first round of a 2R system can be viewed as having a magnitude of two, two candidates moving to the second round.

Note that in 1R elections, the strategic and Top-Two models are almost identical, both in principle and in practice; the difference is that the strategic theory (in the version we use) does not provide a unique recommendation when the first-ranked candidate is four or more votes ahead of the second-ranked one, whereas the top-two theory does.

5 Test of the models

The general approach is to compare the predictions of the theoretical models with the observations. It consists in computing for each theory the predictions in terms of individual voting behavior and to determine how many times these predictions coincide with observations (Hildebrand et al. 1977).

5.1 Results for 1R elections

The columns of Table 3 indicate the percentage[15] of correct predictions, at different dates, for the various models with respect to 1R elections. Each percentage is computed with respect to the cases where the theory makes a unique and testable prediction. The last line of the table indicates the total number of testable predictions.[16]

Sincere voting makes a unique prediction except if the voter's position is precisely in between two adjacent candidates (case of voters on the 8th and 12th position of our axis). If we restrict attention to the cases of unique predictions, we observe that the sincere voting theory is performing rather poorly: the theory explains about 69% of the votes in the initial election of the series of four, but this percentage is decreasing to 45 in the last elections. Except for the initial elections, sincere voting is not a good model.

[15] We do not indicate confidence intervals for these proportions. When we estimate proportions on samples of several hundreds participants, percentages are all very accurate.

[16] Non unique predictions are not testable. A prediction, even unique, is not testable in the case of a missing or spoiled ballot. There are very few missing or spoiled ballots (0.3%).

Table 4 Model performance for 2R elections, by date

2R: correct predictions	Sincere	Strategic	Top-Two	Top-Three
$t = 1$ (%)	74.3	53.8	43.4	64.2
$t = 2$ (%)	61.2	53.5	55.9	70.6
$t = 3$ (%)	58.1	61.0	61.1	72.0
$t = 4$ (%)	54.9	63.2	67.1	75.6
All dates	62.1	57.3	56.9	70.6
(Testable, all dates)	2646	574	2760	2646

The strategic model performs very well when elections are repeated. This is in line with previous experiments by Forstythe et al. (1993, 1996) on plurality elections, showing that repeated elections allow convergence on two main candidates, as predicted by Duverger's law.

The Top-Two model also performs very well. As already noted, the strategic and Top-Two models yield almost identical predictions. Maybe surprisingly, the Top-Three model works quite well too, especially in early rounds where it outperforms the Top-Two model. To explain this fact, note that the Top-Two and Top-Three models very often make the same recommendations. They differ when the voter's preferred candidate among candidates B, C, and D (which were in most sessions the three candidates gathering the most votes) is ranked third. This is for instance the case for an extreme-right voter when D is ranked third after B and C. In such a case, the Top-Two model recommends voting for C, whereas the Top-Three model recommends voting for D. If in such a situation a voter deserts her sincere choice E but moves to support moderate candidate D, instead of C, the Top-Three theory will better explain her behavior than the Top-Two theory. It seems that in early rounds, this behavior was more frequent; in the last rounds, extreme voters were ready to move further away from their preferred candidates and vote for farther candidates, in line with the prescriptions of the Top-Two theory (which successfully explains 80% of the decisions in case of unique predictions against 67% for the Top-Three theory).

In repeated 1R elections, then, the strategic and heuristic models clearly outperform the sincere model. The heuristic model is satisfactory, even if it does not improve over the better theoretically anchored strategic model.

5.2 Results for 2R elections

Table 4 indicates the percentage of correct predictions for 2R elections, at different dates, for the same models.[17] Again, sincere voting is not satisfactory, except for the initial election. But, contrary to 1R elections, the strategic model does not perform well either. In this case, the Top-Three heuristic model is clearly the most appropriate. Why?

One point is in common to strategic behavior in 1R and 2R elections: a voter should not vote for a candidate who has no chance to play a role in the election. In 1R elections, the strategic recommendation almost coincides with voting for one's preferred

[17] The smallest sample is for the strategic theory. In that case, with 574 observations, the 95% confidence interval for the proportion 57.3% is [54%, 59%].

Table 5 Strategic choice in front of a dilemma

	1R	2R
Extremists (0–3, 17–20)	392/439 = 80%	32/43 = 74%
Moderates (4–7, 13–16)	79/147 = 54%	17/91 = 19%
Centrists (8–12)	28/56 = 50%	7/13 = 54%

candidate among the two strongest candidates. But much more complex computations, including anticipations about the second round of the election, are involved for strategic reasoning in 2R elections. This reasoning is different depending on the voter's position, a point that will allow us, in the next section, to better understand how voters reason when they vote.

5.3 Conclusion for 1R and 2R voting

The first result is that the sincere voting theory is not able to explain much of what we observed in 1R and 2R elections. In 1R elections the "explanatory power" of this theory decreases over time, from 69% in the initial election to 45% in the fourth (Table 3). In 2R elections, figures are similar, but slightly higher (Table 4).

Strategic theory explains well the data in 1R elections (increasing from 54 to 87%) but not so well in 2R elections (from 54 to 63%). In this case, the most compelling model is a heuristics one: voters simply support the candidate they prefer among the top three.

In order to understand better why individual behavior is deviating from strict rationality in 2R elections, we restrict our attention to the cases when sincere voting is unique but is not "rational": strategic voting (in the noisy rational version) makes a unique prediction and sincere voting makes another, different, one. These are the cases where the individual is facing a dilemma. Table 5 reports how she is resolving this dilemma, depending on her position; the numbers in this table indicate the percentage of dilemmas which are resolved by a strategic choice.

One can see that, in 2R elections, moderate voters whose strategic recommendation (following our noisy model) would contradict their sincere vote prefer not to follow the strategic recommendation (only 19% do so).[18] Most of these individuals are located at positions 7 and 13. Consider for instance a voter at position 7, in an election where she perceives the extreme candidates A and E as having no chance of making it to the second round (as was indeed the case in all our elections). Such a voter should therefore vote either for B, or C, or D. She earns 19, 17, or 13 euros, respectively, depending on whether candidate B, C, or D is elected. According to our strategic model, she anticipates that she will earn 17 euros if C goes to the second round because C will then be elected. If the second round is B against D, each candidate wins with probability one half, and her expected utility is: $(19 + 13)/2 = 16$. Such a voter should rationally vote for C because promoting C to the second round is the best way to avoid the election of the worst candidate D. It seems that this kind

[18] Sample sizes are here much smaller; there are only 147 and 91 observations in the case of moderate voters. Still the difference in proportions (54 vs. 19%) is highly significant.

of reasoning leading to "inverse strategic voting" (Blais 2004) is not followed by our subjects.

On the other hand, extremist voters in 1R election massively follow the strategic recommendation rather than the sincere one, under both the voting rules. In short, in the case of the 2R rule, the Top-Three model outperforms the sincere voting model because the latter performs poorly among extremist voters and the strategic voting model because the latter performs poorly among moderates.

6 Additional evidence in AV and STV elections

Results of the previous section suggest that our subjects vote strategically when the strategic recommendation is simply to desert a candidate who is performing poorly, but they do not vote strategically when strategic reasoning asks for a more sophisticated or counter-intuitive calculus. A brief review of the individual behavior in AV and STV elections lends support to this conclusion.

6.1 Results for AV

In order to make strategic predictions at the individual level for AV, we use a slightly different scheme from the one used for 1R and 2R elections. The reason is that, with this voting rule, the voter is asked to provide a vote (positive or negative) about *all* candidates, including those who have virtually no chance of winning according to the voter's own beliefs. When a candidate is perceived as having no chance of winning, a strategic voter is indifferent between approving and not approving such a candidate. In 1R and 2R elections, under the noisy assumption as we defined it, the level of noise was limited: a voter assumed that with a small probability, *one voter* exactly would make a mistake (from the reference situation). The probability of higher "orders of mistakes" (two voters exactly make a mistake, three voters exactly make a mistake, …) was zero. This left lowest-score candidates with a zero probability of being elected.[19] Under AV, such a model does not produce unique predictions as to how a voter should fill her ballot.

This is why we use in the case of AV a model with higher levels of uncertainty, by ascribing some positive probabilities to all possible events (although the probability is exponentially decreasing with the number of "mistakes"). Contrary to what we have done for 1R and 2R elections, we do not compute the probabilities of the various outcomes, and instead borrow from the literature on strategic voting under AV (Laslier 2009[20]). It turns out that the maximization of expected utility with such a belief is easy to perform and often provides a unique strategic recommendation. This

[19] Yet the model yielded unique predictions because what mattered to the voter was being pivotal with regards to high-score candidates.

[20] Laslier considers the following voter beliefs: the voter anticipates the result of the election, i.e., the number of approvals that she thinks candidates are to receive, not including her own approval(s) and she tells herself : "If my vote is to break a tie, that will be between two (and only two) candidates, and that might occur because any other voter, with respect to any candidate, can independently make a mistake with some small probability ε."

Table 6 AV: approbations predicted by the"strategic" model

	Approval = 1	Approval = 0	Total
Prediction=1	**773**	199	972
Prediction=0	105	**1309**	1414
Total	878	1508	2386

Table 7 Strategic voting in AV elections, by date

AV: correct predictions	Strategic
$t = 1$ (%)	86.7
$t = 2$ (%)	88.3
$t = 3$ (%)	86.7
$t = 4$ (%)	87.4
All dates (%)	87.3
(Testable, all dates)	2,386

prediction can be described as follows. The voter focuses on the candidate who is obtaining the largest number of votes, say c_1. All other candidates are evaluated with respect to this leading candidate c_1: the voter approves all candidates she prefers to c_1 and disapproves all candidates she finds worse than c_1. The leading candidate is evaluated by comparison with the second-ranked candidate (the "main challenger"): the voter approves the leading candidate if and only if she prefers this candidate to the main challenger. The voter therefore places her "approval threshold" either just above or just below the main candidate.

Details of this "leading candidate" model are provided in the appendix. Again it can be defined using myopic or rational anticipations. We use the rational anticipation variant. This produces 2,386 unique predictions for $21 \times 6 \times 5 \times 4 = 2520$ votes (21 voters in 6 sessions, approving or not of 5 candidates, in 4 elections).

Table 6 (bold face figures) shows that the unique predictions are correct in $773 + 1309 = 2082$ cases out of 2, 386, that is 87.3%. The theory tends to slightly overestimate the number of approved candidates (972 predicted approvals compared to 878 observed approvals). These figures are stable over time, as can be seen from Table 7.

The predictive power of the strategic voting theory is thus very high in this instance. Note that the strategic model described above leads to behavioral recommendations which are very simple: the "Approval threshold" is defined by the main candidate. Therefore, we suspect that any simple heuristic based on the viability of candidates (as are the Top-Two or Top-Three heuristics used for 1R and 2R elections) would yield similar recommendations.[21]

In the AV case, the notion of "sincere voting" does not provide a predictive theory. Indeed, the definition of "sincere" voting under AV is that a voting ballot is sincere if and only if there do not exist two candidates c and c' such that the voter strictly

[21] Such an adaptation of the "Top-Two" heuristic to AV would be the following. Consider the two candidates that get the highest number of votes in the reference election (not taking into account the voter's own ballot). The voter should approve of the candidate she likes best among these two candidates, as well as all the candidates that she ranks higher.

Table 8 Sincere voting in STV elections, by date

STV: correct predictions	Sincere
$t = 1$ (%)	95.7
$t = 2$ (%)	90.9
$t = 3$ (%)	88.3
$t = 4$ (%)	88.5
All dates	90.9
(Testable, all dates)	2,986

prefers c to c' and nevertheless approves of c' and not of c. This definition of sincere voting therefore leaves one degree of freedom to the voter since it does not specify at which level, given her own ranking of the candidates, the voter should place her threshold of approval. With five candidates most voters have six sincere ballots (including the equivalent "full" and the "empty" ballots). Consequently, the notion of "sincere voting" does not provide clear predictions.

Nevertheless, with this definition we can count in our data, at each election and for each voter, the number of pairs (c, c') of candidates such as a violation of sincere voting is observed. Such violation of sincere voting is very rare in our data: 78 observed pairs out of 5,040 (10, 20, 22, and 26 observed pairs at $t = 1, 2, 3, 4$), i.e., 1.5% on average. As noticed above, this does not mean that the predictive power of sincere voting is 98.5%.

6.2 Results for the STV

Under STV, voters have many different ballots at their disposal since they are asked to submit a complete ranking of candidates. For five candidates, there are 121 possible ballots. We look for violations of sincere voting by counting the number of pairs of candidates (c, c') with $c \prec c'$ such that a voter strictly prefers c to c' but nevertheless ranks c' higher than c in her ballot. There are 10 such pairs for each ballot. Overall, we observe 2,986 pairs, of which only 300, i.e., 9%, violate sincerity. (See the bottom part of Table 8.) We therefore find that sincerity is satisfied at 91% for this voting rule.

This simple observation enables us to understand what went on in STV elections. Since voters vote (approximately) sincerely, given our preference profile, A, E, or C are eliminated first and second. If C is not eliminated at the second round, then for the third round of the vote transfers the two moderate candidates have more votes than the centrist candidate, who has received no transferred votes. Therefore, the centrist candidate, despite being a Condorcet winner, is always eliminated before the fourth round.

Sincere voting is clearly a satisfactory theory here. Note that the published literature on this voting rule does not propose, to our knowledge, a practical solution to the question of individual strategic voting under STV with five candidates. We have not attempted to compute the rational strategic recommendation at the individual level for this voting rule, as we have done for the other rules. These computations would be similar to, but much more complex than, those for 2R elections. In particular, the

computations would entail specifying each voter's beliefs regarding how other voters will rank all the candidates (in order to be able to proceed to the successive elimination of candidates). The assumption of fully rational expectations in this case seems particularly implausible. The myopic version would entail specifying voters' beliefs about each individual's rank ordering of the candidates, a point they did not fully learn in previous counts (indeed, although the whole counting process occurs in front of the subjects, only small parts of the relevant information necessary to compute an optimal response are made available). Therefore, we did not attempt to test the strategic model for this voting rule.

Our conclusion regarding the STV is that the sincere model is satisfactory. This is in line with the actual practice in countries where parties recommend a whole ranking of the candidates, therefore, and relieving voters from having to elaborate some strategic reasoning (see Farrell and McAllister 2006).

7 Conclusion

Reporting on a series of laboratory experiments, this article has ascertained the performance of the strategic voting theory in explaining individual behavior under different voting rules. Strategic voting is defined following the rational choice paradigm as the maximization of expected utility, given a utility function and a subjective probability distribution ("belief") on the possible consequences of actions. Utilities are controlled as monetary payoffs. Beliefs are endogenous to the history of elections.

We showed that the strategic model performs very well in explaining individual vote choice in 1R plurality elections, but that it fails to account for individual behavior in 2R majority elections.

How can we explain voting decisions in 2R elections? We first observe that un-viable candidates are massively deserted, a fact which invalidates sincere voting. Rather, voters rely on a simple heuristics; their behavior is well accounted for by a "Top-Three heuristics," whereby voters vote for their preferred candidate among the three candidates who are perceived as the most likely to win.[22]

We therefore conclude that voters tend to vote strategically if and only if the strategic reasoning is not too complex, in which case they rely on simple heuristics. Our observations on AV and STV confirm this hypothesis. In the case of AV, strategic voting is simple and produces no paradoxical recommendations; we observe that our subjects vote strategically under this system. On the contrary, voting strategically under STV is a mathematical puzzle, and we observe that voters vote sincerely.

These findings have to be compared to those based on survey analysis. Rather than estimating the role of different factors in the econometric "vote equation" as is usual in this strand of literature, we have proposed to compute predictions of individual behavior according to three models (sincere voting, strategic voting, and voting according to behavioral heuristics). The amount of "insincere" voting observed in our experiments

[22] Note that strategic voting under 1R elections is almost equivalent, both in principle and in practice, to the recommendations of a "Top-two heuristics," whereby voters vote for their preferred candidate among the two candidates who are perceived as the most likely to win.

appears to be higher than that reported in studies based on surveys (see, especially, the summary table provided by Alvarez and Nagler (2000)), though such comparisons are difficult to make because sincere and strategic choices are not defined the same way.

Why is this amount of insincere voting so high in our set-up? We would suggest three possibilities. First, the amount of insincere voting may depend on the number of candidates. We had five candidates in our set-up. Further work is needed, both experimental and survey-based, to determine how the propensity to vote sincerely is affected by the number of candidates.

Second, our findings show that the amount of sincere voting declines over time in 1R and 2R elections, which indicates that some of our participants learn that they may be better off voting insincerely. This raises the question whether voters in real life manage to learn over time. On one hand, a real election is not immediately followed by another identical one, as was the case in our experiments. On the other hand, a real election is one element of a stream of political events about which voters have some time to learn whereas our subjects were put in a completely new environment.

Third, in our set-up participants had a clear rank order of preferences among the five candidates. Blais (2002) has speculated that many voters may have a clear preference for one candidate or party and are rather indifferent among the other options, which weakens any incentive to think strategically. We need better survey evidence on that matter, and also other experiments in which some voters are placed in such contexts.

The properties of electoral systems crucially depend on voters' behavior. Electoral outcomes critically hinge on whether people vote sincerely, strategically, or follow another behavioral rule. Our experiments show that the appropriate assumption about voters' behavior is likely to depend on the voting rule. We conclude that the sincere model works best for very complex voting systems where strategic computations appear to be insurmountable that the strategic model performs well in simple systems, and that the heuristic perspective is most relevant in situations of moderate complexity.

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Technical appendix

A Complements on aggregate results

Tables 9, 10, 11, and 12 provide further information about the outcomes of the elections, with regards to the electoral rule.

Table 9 Elections won by date, one-round

	$t = 1$	$t = 2$	$t = 3$	$t = 4$
B	4	9	10	8
C	13	8	12	12
D	6	6	1	3
Total	23	23	23	23

Table 10 Elections won by date, two-round

	$t=1$	$t=2$	$t=3$	$t=4$
B	5	5	7	6
C	15	12	13	11
D	3	6	3	6
Total	23	23	23	23

Table 11 Elections won by date, AV

	$t=1$	$t=2$	$t=3$	$t=4$
B	3	2	0	0
C	3	4	6	6
D	0	0	0	0
Total	6	6	6	6

Table 12 Elections won by date, STV

	$t=1$	$t=2$	$t=3$	$t=4$
B	4	2	3	2
C	0	0	0	0
D	0	2	1	2
Total	4	4	4	4

B 1R elections

B.1 Sincere voting theory (1R)

B.1.1 Description

Individuals vote for any candidate that yields the highest payoff if elected. Individual i votes for a candidate v^* such that:

$$u_i(v^*) = \max_{v \in \{A,B,C,D,E\}} u_i(v).$$

B.1.2 Predictions

Sincere voting is independent of time. For all voters except those in positions 8 and 12, this theory makes a unique prediction. Voters in position 8 are indifferent between B and C and voters in position 12 are indifferent between D and C.

Table 13 Sincere voting for one-round elections

(1R)	$t = 1$	$t = 2$	$t = 3$	$t = 4$	Total
Testable predictions	662	662	661	662	2647
Correct predictions	455 = 69%	363 = 55%	322 = 49%	296 = 45%	1436 =54%

B.1.3 Test

When we restrict ourselves to unique testable predictions,[23] this theory correctly predicts behavior on 54% of the observations, but this figure hides an important time-dependency: the predictive quality of the theory is decreasing from 69% at the first election to 45% at the fourth one (see Table 13).

B.2 Strategic models in 1R elections

B.2.1 Strategic behavior under the noiseless assumption (1R)

Description with rational anticipations

Assumption 1 (*Noiseless, rational anticipations*) Each individual has a correct, precise anticipation of other individuals' votes at the current election.

In that case, the subjective probabilities $p_i(c, v)$ are constructed as follows.

Consider voter i at tth election in a series ($t = 1, 2, 3, 4$). Voter i correctly anticipates the scores of the candidates in election t, net of her own vote. The subjective probabilities $p_i(c, v)$ are then easily derived. Let us denote by C_i^1 the set of first-ranked candidates (the leading candidates), and by C_i^2 the set of closest followers (considering only other voters' votes). (i) If the follower(s) is (are) at least two votes away from the leading candidate(s), if voter i votes for (one of) the leading candidate(s), this candidate is elected with probability 1, if she votes for any other candidate, there is a tie between the leading candidates (if there is only one leading candidate, he is elected for sure).[24] (ii) If now the two sets of candidates C_i^1 and C_i^2 are exactly one vote away: if voter i votes for (one of) the leading candigate(s), this candidate is elected for sure; if she votes for (one of) the followers, there is a tie between this candidate

[23] A prediction, even unique, is not testable in the case of a missing or spoiled ballot, which explains why the denominators in Table 13 are not exactly the same. We should have 664 sincere predictions at each date, i.e., 2656 on the whole. There are very few missing or spoiled ballots (about 0.3%).

[24] Formally,
if $v \in C_i^1$: $p_i(v, v) = 1$ and $p_i(c, v) = 1 \quad$ for all $c \neq v$,
if $v \notin C_i^1$: $p_i(c, v) = \frac{1}{\left|C_i^1\right|}$ if $c \in C_i^1$ and $p_i(c, v) = 0 \quad$ for all $c \notin C_i^1$,
where $\left|C_i^1\right|$ is the number of leading candidates.

Table 14 Multiple predictions, noiseless rational anticipations, 1R

1	**2**	**3**	**4**	**5**	Total
823	18	30	343	1722	2936
28.0%	0.6%	1.0%	11.7%	58.7%	100%

Table 15 Testing strategic noiseless theory, rational anticipations, 1R

(1R)	$t = 2$	$t = 3$	$t = 4$	Total
Testable predictions	212	269	157	638
Correct predictions	149 = 70%	211 = 78%	139 = 89%	499 = 78%

and the leading candidates; if she votes for any other candidate, there is a tie between the leading candidates.[25]

Predictions Under these assumptions regarding the $p_i(c, v)$, we compute (using *Mathematica* software) for each election (starting from the second election in each session) and for each individual, her expected utility when she votes for candidate $v \in \{A, B, C, D, E\}$, i.e., $\sum_c p_i(c, v)u_i(c)$. We then take the maximum of these five values. If this maximum is reached for only one candidate, we say that for this voter at that time, the theory makes a unique prediction regarding how she should vote. If this maximum is reached for several candidates, the theory only predicts a subset (which might be the whole set) of candidates from which the voter should choose.

Table 14 gives the statistics regarding the number of candidates in this subset. These figures are obtained considering all four dates 1—4. The total number of observations is thus $734 \times 4 = 2936$.

In 823 cases, the theory makes a unique prediction as to vote behavior and in 1,722 cases any observation is compatible with the theory. Note that in 343 cases, it recommends not to vote for a given candidate.

Test We restrict attention to the last three elections of each series, since we are interested in comparing the performance of the rational anticipations and myopic anticipations assumptions, the latter making predictions only for the last three elections. This theory makes unique predictions in 638 testable cases, of which 499 are correct, i.e., 78% (see Table 15).

[25] Formally,
if $v \in C_i^1$: $p_i(v, v) = 1$ and $p_i(c, v) = 1$ for all $c \neq v$,
if $v \in C_i^2$: $p_i(c, v) = \frac{1}{\left|C_i^1\right|+1}$ if $c \in C_i^1 \cup \{v\}$ and $p_i(c, v) = 0$ for all $c \notin C_i^1 \cup \{v\}$,
if $v \notin C_i^1 \cup C_i^2$: $p_i(c, v) = \frac{1}{\left|C_i^1\right|}$ if $c \in C_i^1$ and $p_i(c, v) = 0$ for all $c \notin C_i^1$.

Table 16 Testing strategic noiseless theory, myopic anticipations, 1R

(1R)	$t = 2$	$t = 3$	$t = 4$	Total
Testable predictions	181	212	270	663
Correct predictions	125 = 69%	167 = 79%	235 = 87%	527 = 79%

Comparison with myopic anticipations The "Myopic" version of the theory is very similar to the "Rational Anticipations" but Assumption 1 becomes:

Assumption 1bis (*Noiseless, myopic anticipations*) Each individual assumes that during the current election, all voters but herself will vote exactly as they did in the previous election.

Comparing Tables 15 and 16 one can see that the qualitative conclusions to be drawn from these two variants will be identical.

B.2.2 Strategic behavior under the noisy assumption (1R)

Description with rational anticipation

Assumption 2 (*Noisy, rational anticipations*) Each individual belief is a small perturbation of the actual votes of the other individuals at the current election.

More precisely, consider voter i. Her belief is a probability distribution over the set of possible behavior of the other voters. With probability ε (small), one voter exactly (taken at random among the $I - 1$ remaining voters) makes a mistake and does not vote for the intended candidate, but instead, with equal probability, votes for one of the other four candidates.

Note that the number of unique predictions is higher in the noisy case than in the noiseless case. Indeed, we take ε extremely close to zero, so that each time the strategic theory yields a unique prediction under the noiseless assumption, the noisy theory yields the same unique prediction. To see why the noisy assumptions yields unique predictions in many other cases, consider for example voter i in the following situation: in the current election, not taking into account her own vote, she is sure that a candidate will be alone ahead leading by two votes (with the rational noiseless assumption). With this noiseless assumption, voter i is not pivotal: whoever she votes for, this leading candidate wins with probability 1, and therefore voter i is indifferent between voting for any candidate. Now, with the noisy assumption, this voter also assigns a small but positive probability to other events. If ε is small enough, the most likely event is still by far the situation where this leading candidate is still two votes ahead. But there is now a small probability that voter i might be pivotal. Indeed, for example, if one of the voters who is supposed to vote for the leading candidate rather votes for the second-ranked candidate, then these two candidates will receive exactly the same number of votes, and in this event, voter i becomes pivotal.

Table 17 Multiple predictions, noisy rational anticipations, 1R

1	**2**	**3**	**4**	**5**	Total
1977	28	12	153	766	2936
67.3%	1.0%	0.4%	5.2%	26.1%	100%

Table 18 Testing strategic noisy theory, rational anticipations, 1R

(1R)	$t = 2$	$t = 3$	$t = 4$	Total
Testable predictions	583	512	263	1358
Correct predictions	374 = 64.2%	382 = 74.6%	228 = 86.7%	984 = 72.5%

Predictions In that case, the probabilities $p_i(c, v)$ are harder to write down in an explicit way. But they can easily be computed using *Mathematica* software. Under these assumptions regarding the $p_i(c, v)$, we compute for each election (starting from the second election in each session) and each individual, here expected utility when she votes for candidate $v \in \{A, B, C, D, E\}$, i.e., $\sum_c p_i(c, v)u_i(c)$. We then take the maximum of these five values. If this maximum is reached for only one candidate, we say that for this voter at that time, the theory makes a unique prediction regarding how she should vote. If this maximum is reached for several candidates, the theory only predicts a subset of candidates from which the voter should choose.

Table 17 gives the statistics regarding the number of candidates in this subset. These figures are obtained considering all four dates 1–4. The total number of observations is thus $734 \times 4 = 2936$.

In 1,977 cases, i.e., 67.3%, the theory makes a unique prediction as to vote behavior. This is much more than what we had with the no-noise assumption (28.0%).

Test We restrict attention to the last three elections of each series. This theory makes unique predictions in 1,358 testable cases, of which 984 are correct, i.e., 72.5% (see Table 18).

Comparison with the myopic version The "Myopic" version of the theory is very similar to the "Rational Anticipations" but the assumption 2 becomes:

Assumption 3 (*Noisy, myopic anticipations*) Each individual belief is a small perturbation of the actual the vote of the other individuals at the previous election. We use exactly the same model for the perturbation as before, but the reference scores are now the scores obtained at the previous election, instead of the current one.

Table 19 Testing strategic noisy theory, myopic anticipations, 1R

(1R)	$t = 2$	$t = 3$	$t = 4$	Total
Testable predictions	610	582	513	1705
Correct predictions	390 = 63.9%	431 = 74.1%	426 = 83.0%	1247 = 73.1%

Table 20 Testing Top-Two theory, rational anticipations, 1R

(1R)	$t = 2$	$t = 3$	$t = 4$	Total
Testable predictions	695	695	693	2083
Correct predictions	422 = 60.7%	523 = 75.3%	555 = 80.1%	1500 = 72.0%

Comparing Tables 18 and 19, one can see that the qualitative conclusions to be drawn from these two variants will be identical.

B.3 "Top-two" theory (1R)

B.3.1 Description

Individuals vote for their preferred candidate among the two candidates that get the highest two numbers of votes in the current ("Rational Anticipation" version) or the previous ("Myopic" version) election.

More precisely, consider individual i and denote by $s_i(c)$ is the score (number of votes) that candidate c obtains in the reference election (the current or the previous one), taking into account the ballots of all voters but i. Voter i ranks the five candidates according to those scores. If two candidates at least rank in the first place, then individual i votes for her preferred candidate among them. If only one candidate ranks first, she votes for her preferred candidate among the set constituted of this first-ranked candidate and the candidate(s) getting the second highest score.

B.3.2 Predictions

This theory makes unique predictions in almost all cases, double predictions may occur when a voter's position is just between two candidates.

B.3.3 Test

This theory correctly predicts behavior on approximately 70% of the observations. Tables 20 and 21 show the time-evolution, and show again that the two versions "rational anticipations" and "myopic anticipations" are similar.

Table 21 Testing Top-Two theory, myopic anticipations, 1R

(1R)	$t = 2$	$t = 3$	$t = 4$	Total
Testable predictions	692	694	696	2082
Correct predictions	412 = 59.5%	494 = 71.2%	573 = 82.3%	1479 = 71.0%

Table 22 Testing Top-Three theory, rational anticipations, 1R

(1R)	$t = 2$	$t = 3$	$t = 4$	Total
Testable predictions	664	668	668	2000
Correct predictions	473 = 71.2%	464 = 69.5%	446 = 66.8%	1383 = 69.1%

B.4 "Top-three" theory (1R)

B.4.1 Description

Individuals vote for their preferred candidate among the three candidates that got the highest three numbers of votes in the reference (current or previous) election. More precisely,

- if three candidates at least rank in the first place, the individual votes for her preferred candidate among them,
- if two candidates exactly rank in the first place, the individual votes for her preferred candidate among the set constituted of those two first-ranked candidates and the candidate(s) getting the second highest score,
- if one candidate exactly ranks in the first place, and at least two candidates rank second, the individual votes for her preferred candidate among the set constituted of this first-ranked candidate and the candidate(s) getting the second highest score,
- if one candidate exactly ranks in the first place and one candidate exactly ranks second, the individual votes for her preferred candidate among the set constituted of this first-ranked candidate, this second-ranked candidate and the candidate(s) getting the third highest score.

B.4.2 Predictions

This theory makes unique predictions in almost all cases, double predictions may occur when a voter's position is just between two candidates.

B.4.3 Test

In 1R elections, this theory correctly predicts behavior on about 70% of the observations. Tables 22 and 23 show the time-evolution, and show again that the two versions "rational anticipations" and "myopic anticipations" are similar.

Table 23 Testing Top-Three theory, myopic anticipations, 1R

(1R)	$t = 2$	$t = 3$	$t = 4$	Total
Testable predictions	667	663	669	1999
Correct predictions	491 = 73.6%	455 = 68.6%	453 = 67.7%	1399 = 70.0%

Table 24 Sincere voting for single-name elections

(2R)	$t = 1$	$t = 2$	$t = 3$	$t = 4$	Total
Testable predictions	657	663	663	663	2646
Correct predictions	489 = 74%	406 = 61%	385 = 58%	363 = 55%	1643 = 62%

C 2R elections

C.1 Sincere voting theory in 2R elections

C.1.1 Description

Exactly the same as for 1R elections. Individuals vote for any candidate that yields the highest payoff if elected. Individual i votes for a candidate v^* such that:

$$u(v^*) = \max_{v \in \{A,B,C,D,E\}} u_i(v).$$

C.1.2 Predictions

Sincere Voting is independent of time. For all voters except those in positions 8 and 12, this theory makes a unique prediction. Voters in position 8 are indifferent between B and C, and voters in position 12 are indifferent between D and C (Table 24).

C.1.3 Test

See Table 13. At the first date, this theory correctly predicts behavior for 74% of the observation. This percentage decreases to 55 for fourth elections.[26]

C.2 Strategic models in 2R elections

Note first that in 2R elections, in the second round with two run-off candidates, voting for the candidate associated with the highest monetary payoff is a dominant strategy. Therefore, we only study strategic behavior at the first round.

[26] To compare with the other tables, the figures in the main text are computed for dates 2 to 4, i.e., 1154/1989 = 58.0% for 2R.

As in the 1R elections, we assume that voters are purely instrumental and that they select a candidate v^* such that:

$$v^* \in \text{argmax}_{v \in \{A,B,C,D,E\}} \sum_c p_i(c, v) u_i(c),$$

where $p_i(c, v)$ is the subjective probability that voter i assigns to the event "candidate c wins the election," conditional on her casting a ballot for candidate v at the first round.

Note that these $p_i(c, v)$ involve both beliefs as to how voters will behave at the second round (if any), and beliefs as to how voters will behave at the first round. We can decompose this probability $p_i(c, v)$ into a sum of two probabilities: the probability that c wins at the first round (i.e., c gets an absolute majority at the first round) plus the probability of the event "c makes it to the second round *and* wins the second round". Formally, this can be decomposed as:

$$p_i(c, v) = \sum_{c'} \pi_i(\{c, c'\}, v) r(c, \{c, c'\}),$$

where for $c' \neq c$, $\pi_i(\{c, c'\}, v)$ is the probability that the unordered pair $\{c, c'\}$ will make it to the second round, conditional on voter i voting for candidate v and $r(c, \{c, c'\})$ is voter i's subjective probability that candidate c wins the run-off election when the pair $\{c, c'\}$ is vying at the second round.[27] To save on notation, we define $\pi_i(\{c, c\}, v)$ as the probability that c wins at the first round if i votes for v and $r(c, \{c, c\}) = 1$.

Let us first describe the $r(c, \{c, c'\})$ when $c' \neq c$. In all that follows, we assume that each voter anticipates that at the second round (if any), each voter will vote for the candidate closest to her position, and will toss a coin if the two run-off candidates are equally close to her position:

- the centrist candidate C defeats any other candidate in the second round: $r(C, \{C, c\}) = 1$ for $c \neq C$,
- a moderate candidate (B or D) defeats any extremist candidate (A or E) in the second round: $r(B, \{B, c\}) = r(D, \{D, c\}) = 1$ for $c \in \{A, E\}$,
- a second round between either the two moderate candidates or the two extremist candidates results in a tie: $r(B, \{B, D\}) = r(D, \{B, D\}) = r(A, \{A, E\}) = r(E, \{A, E\}) = 1/2$.

In all that follows, we assume that to compute the $\pi_i(\{c, c'\}, v)$, each voter forms some beliefs about how other voters will behave in the current election, based on the results of the reference (previous or current) election. Just as we proceeded in 1R elections, we assume that each voter simply thinks that other voters will behave at the first round in the current election either exactly as they did at the first round of the reference election, or approximately so.

We now describe more precisely how we compute the $p_i(c, v)$ probabilities under these alternative assumptions, and test this theory.

[27] There is no subcript i because all voters have the same beliefs regarding the secund round (see below).

C.2.1 Strategic behavior under the noiseless assumption (2R)

Description with rational anticipations

Assumption 1 (*Noiseless, rational anticipations*) Each individual has a correct, precise anticipation of the vote of the other individuals at the current election.

In that case, the subjective probabilities $p_i(c, v)$ are more difficult to write down explicitly than they were in 1R elections. Given the scores $s_i(c)$ (number of votes) that candidate c obtains in the first round of the current election, taking into account the ballots of all voters but i, with $\sum_c s_i(c) = I - 1$, what is the probability $\pi_i(\{c_1, c_2\}, v)$ that the unordered pair $\{c_1, c_2\}$ will make it to the second round, conditional on voter i voting for candidate v?

We introduce some further notation. Let us denote by $s_i(c, v)$ is the score (number of votes) that candidate c obtains in the reference election, if voter i votes for candidate v and all other voters vote exactly as they do in the reference election. Let us denote by $s_i^k(v)$, $k = 1, 2, \ldots, 5$ the kth largest number in the vector $(s_i(c, v), c \in \{A, B, C, D, E\})$. For example, if $s_i(A, v) = 3$, $s_i(B, v) = 5$, $s_i(C, v) = 6$, $s_i(D, v) = 5$, $s_i(E, v) = 2$, then $s_i^1(v) = 6$, $s_i^2(v) = 5$, $s_i^3(v) = 5$, $s_i^4(v) = 3$, $s_i^5(v) = 2$.

Definition of the probability that candidate c_1 wins in the first round, $\pi_i(\{c_1, c_2\}, v)$, $c_1 = c_2$,

- if $s_i(c_1, v) > E[I/2]$ then $\pi_i(\{c_1, c_2\}, v) = 1$,
- in all other cases, $\pi_i(\{c_1, c_2\}, v) = 0$.

Definition of the $\pi_i(\{c_1, c_2\}, v)$, $c_1 \neq c_2$, $s_i^1(v) < E[I/2]$

- if $s_i(c_1, v) > s_i^3(v)$ and $s_i(c_2, v) > s_i^3(v)$, then $\pi_i(\{c_1, c_2\}, v) = 1$
- if $s_i(c_1, v) = s_i(c_2, v) = s_i^1(v) = s_i^3(v) > s_i^4(v)$, then $\pi_i(\{c_1, c_2\}, v) = 1/3$
- if $s_i(c_1, v) = s_i(c_2, v) = s_i^1(v) = s_i^4(v) > s_i^5(v)$, then $\pi_i(\{c_1, c_2\}, v) = 1/6$
- if $s_i(c_1, v) = s_i(c_2, v) = s_i^1(v) = s_i^5(v)$, then $\pi_i(\{c_1, c_2\}, v) = 1/10$
- if $s_i(c_1, v) = s_i^1(v) > s_i(c_2, v) = s_i^2(v) = s_i^3(v) > s_i^4(v)$, or $s_i(c_2, v) = s_i^1(v) > s_i(c_1, v) = s_i^2(v) = s_i^3(v) > s_i^4(v)$, then $\pi_i(\{c_1, c_2\}, v) = 1/2$,
- if $s_i(c_1, v) = s_i^1(v) > s_i(c_2, v) = s_i^2(v) = s_i^4(v) > s_i^5(v)$, or $s_i(c_2, v) = s_i^1(v) > s_i(c_1, v) = s_i^2(v) = s_i^4(v) > s_i^5(v)$, then $\pi_i(\{c_1, c_2\}, v) = 1/3$,
- if $s_i(c_1, v) = s_i^1(v) > s_i(c_2, v) = s_i^2(v) = s_i^5(v)$, or $s_i(c_2, v) = s_i^1(v) > s_i(c_1, v) = s_i^2(v) = s_i^5(v)$, then $\pi_i(\{c_1, c_2\}, v) = 1/4$,
- in all other cases, $\pi_i(\{c_1, c_2\}, v) = 0$.

Now for each pair, a voter can anticipate the outcome of the second round, see above. And thus this fully describes the $p_i(c, v)$.

Predictions Under these assumptions, we can compute $p_i(c, v)$. We compute (using *Mathematica* software) for each election and each individual, her expected utility when she votes for candidate $v \in \{A, B, C, D, E\}$, i.e., $\sum_c p_i(c, v)u_i(c)$. We then take the maximum of these five values. If this maximum is reached for only one candidate, we say that for this voter at that time, the theory makes a unique prediction regarding how she should vote. If this maximum is reached for several candidates, the theory only predicts a subset of candidates from which the voter should choose.

Table 25 Multiple predictions, Noiseless rational anticipations, 2R

1	**2**	**3**	**4**	**5**	Total
194	2	4	160	2576	2936
6.6%	0.1%	0.1%	5.4%	87.7%	100%

Table 26 Testing strategic noiseless theory, rational anticipations, 2R

(2R)	$t = 2$	$t = 3$	$t = 4$	Total
Testable predictions	31	47	37	115
Correct predictions	10 = 32.2%	34 = 72.3%	18 = 48.6%	62 = 53.9%

Table 27 Testing strategic noiseless theory, myopic anticipations, 2R

(2R)	$t = 2$	$t = 3$	$t = 4$	Total
Testable predictions	77	31	48	156
Correct predictions	47 = 61.0%	12 = 38.7%	31 = 64.6%	90 = 57.7%

Table 25 provides statistics regarding the number of candidates in this subset. These figures are obtained considering all dates 1–4. The total number of observations is thus $734 \times 4 = 2936$.

One can see that this theory is of little use since it only make a sharp prediction for 6.6% of the observations.

Test For the sake of completeness, Tables 26 and 27 provide the tests of this theory in the two versions (rational and myopic anticipations) for the last three dates.

C.2.2 Strategic behavior under the noisy assumption (2R)

Description with rational anticipation

Assumption 2 (*Noisy, rational anticipations*) Each individual belief is a small perturbation of the actual vote of the other individuals at the current election. The perturbations are introduced in the model exactly as for 1R elections (see above).

Predictions Table 28 provides statistics regarding the number of multiple predictions. These figures are obtained considering all four dates 1–4. The total number of observations is thus $734 \times 4 = 2936$.

In 576 cases, i.e., 19.6%, the theory makes a unique prediction as to vote behavior. This is much more than what we had with the no-noise assumption (194, i.e., 6.6%).

Test See Table 29. We restrict attention to the last three elections of each series. This theory makes unique predictions in 375 testable cases, of which 222 are correct, i.e., 59.2%, and this figure is increasing with time.

Table 28 Multiple predictions, noisy rational anticipations, 2R

1	**2**	**3**	**4**	**5**	Total
576	60	36	196	2068	2936
19.6%	2.0%	1.2%	6.7%	70.4%	100%

Table 29 Testing strategic noisy theory, rational anticipations, 2R

(2R)	$t = 2$	$t = 3$	$t = 4$	Total
Testable predictions	127	123	125	375
Correct predictions	68 = 53.5%	75 = 61.0%	79 = 63.2%	222 = 59.2%

Table 30 Testing strategic noisy theory, myopic anticipations, 2R

(2R)	$t = 2$	$t = 3$	$t = 4$	Total
Testable predictions	199	126	124	449
Correct predictions	106 = 53.3%	66 = 52.4%	72 = 58.1%	244 = 54.3%

Comparison withe the "Myopic" version Assumption 2 becomes:

Assumption 2bis (*Small noise, myopic anticipations*) Each individual belief is a small perturbation of the actual the vote of the other individuals at the previous election. More precisely, we use exactly the same model for the perturbation as before, but the reference scores are now the scores obtained at the previous election not the current one.

Comparing Tables 29 and 30 one can see that the qualitative conclusions to be drawn from these two variants will be identical.

C.3 "Top-Two" theory (2R)

C.3.1 Description

Same theory as for 1R elections. Individuals vote for their preferred candidate among the
two candidates that obtain the highest two numbers of votes in the reference election. The reference election is the current one (in the "rational anticipations" version) or the first round of the previous one (in the "myopic anticipations" version).

C.3.2 Predictions

This theory makes unique predictions in almost all cases, double predictions may occur when a voter's position is just between two candidates.

Table 31 Testing the Top-Two theory, rational anticipations, 2R

(2R)	$t = 2$	$t = 3$	$t = 4$	Total
Testable predictions	691	694	695	2080
Correct predictions	386 = 55.9%	424 = 61.1%	466 = 67.1%	1276 = 61.1%

Table 32 Testing the Top-Two theory, myopic anticipations, 2R

(2R)	$t = 2$	$t = 3$	$t = 4$	Total
Testable predictions	685	690	695	2070
Correct predictions	370 = 54.0%	438 = 63.5%	447 = 64.3%	1255 = 60.6%

C.3.3 Test

This theory correctly predicts behavior on approximately 60% of the observations. Tables 31 and 32 show the time-evolution: the percentage of correct predictions increases. One can verify again again that the two versions "rational anticipations" and "myopic anticipations" are similar.

C.4 "Top-Three" theory (2R)

C.4.1 Description

Same theory as for 1R elections. Individuals vote for their preferred candidate among the three candidates that get the highest two numbers of votes in the reference election. The reference election is the current one (in the "rational anticipations" version) or the first round of the previous one (in the "myopic anticipations" version).

C.4.2 Predictions

This theory makes unique predictions in almost all cases, double predictions may occur when a voter's position is just between two candidates.

C.4.3 Test

This theory correctly predicts behavior on approximately 73% of the observations. Tables 33 and 34 show the time-evolution: the percentage of correct predictions increases. One can verify again that the two versions "rational anticipations" and "myopic anticipations" are similar.

Table 33 Testing the Top-Three theory, rational anticipations, 2R

(2R)	$t = 2$	$t = 3$	$t = 4$	Total
Testable predictions	663	661	663	1987
Correct predictions	468 = 70.6%	476 = 72.0%	501 = 75.6%	1445 = 72.7%

Table 34 Testing the Top-Three theory, myopic anticipations, 2R

(2R)	$t = 2$	$t = 3$	$t = 4$	Total
Testable predictions	664	663	661	1988
Correct predictions	467 = 70.3%	483 = 72.9%	494 = 74.7%	1444 = 72.6%

D Approval voting

The strategic behavior in that case is derived from the theory by Laslier (2009), slightly adapted to take care of ties. If there are no ties the behavior is easily described: the voter has in mind a reference election (the current election or the previous one). She compares the leading candidate to the second-ranked one, and she approves all candidates she prefers to the leader, and no candidate she finds worse than the leader.

Here is a complete description of this theory. Like in the case of 1R or 2R elections, $s_i(c)$ is the total number of votes obtained by candidate c in the reference election, from voters other than i herself. Denote by

$$C_i^1 = \arg\max s_i$$

the set of candidates who tie at the first place in the score vector s_i and by $\left|C_i^1\right|$ their number. If i decides to approve of no candidate and the other voters vote like in the reference election then the winner of the election will be chosen at random in C_i^1. Likewise, denote by C_i^2 the set of second-ranked candidates in s_i.

First case: If a single candidate, say c^1, has the highest score in the vector s_i then i considers the utility she attaches to this candidate

$$u_i^1 = u_i(c^1).$$

For the other candidates $c \neq c^1$, if $u_i(c) > u_i^1$, i approves c, and if $u_i(c) < u_i^1$, i disapproves of c. For candidate $c = c^1$ himself, as well as for any other candidate c such that $u_i(c) = u_i^1$, i compares c with the second-ranked candidates: let

$$u_i^2 = \frac{1}{\left|C_i^2\right|} \sum_{c \in C_i^2} u_i(c),$$

if $u_i^1 > u_i^2$, i approves c^1, if $u_i^1 < u_i^2$, i disapproves c^1, and if c is such that $u_i(c) = u_i^2$, i can either approve c^* or not (no unique prediction).

Second case: If two or more candidates have the same highest score in the vector s_i then i considers the average utility she attaches to these candidates

$$u_i^1 = \frac{1}{|C_i^1|} \sum_{c \in C_i^1} u_i(c).$$

Then if $u_i(c) > u_i^1$, i approves c, if $u_i(c) < u_i^1$, i disapproves of c, and if c is such that $u_i(c) = u_i^1$, i can either approve c or not (no unique prediction).

With this definition one makes one or several prediction for each vote of a voter about a candidate. An individual ballot is made of the five votes for the five candidates.

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Vote Au Pluriel: How People Vote When Offered to Vote Under Different Rules?

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ABSTRACT This article reports on an Internet-based quasi-experiment that took place during the French 2012 presidential election. We designed a website where French voters could vote under different voting rules. Based on the observation of more than 8,000 participants, we find that a substantial minority (10% to 15%) vote differently under the different systems, with 17% of the voters not voting for their preferred candidate in the one-round election, this percentage dropped to 12% in the alternative vote (first choice). Compared to the two-rounds election, at the aggregate level, the top two candidates get slightly more votes under one round, while the small candidates obtain more first choices under the alternative vote. These findings are consistent with what the literature suggests about the impact of these voting systems on voters' choice.

When people vote in an election they do so under a given voting system. One obvious question that political scientists struggle with is whether people would make different choices if the voting systems were different. Most of the time, this question has been addressed indirectly. Researchers compare voting patterns under different rules, and they infer that observed differences in the votes result from differences in the rules (Blais and Carty 1991; Clark and Golder 2006). It is difficult to tell whether the correlation is spurious or not; causal inferences are always tricky in observational studies.

We propose a different approach: inviting people to vote under different systems and comparing their vote choice under these various systems. This quasi-experiment occurred during the first round of the French 2012 presidential elections. As done in a previous study conducted during the 2011 election in Ontario, Canada (Blais et al. forthcoming), we created a website with sections providing information about four voting systems (one round, two rounds, alternative, and approval) and another section where people were invited to vote according to each of the four rules and to complete a short questionnaire (see www.voteaupluriel.org).

Three weeks before the election the website was open to the public. The website was advertised through many different routes: after a first phase of direct mailing to the academic world, the general media got involved and the website was widely advertised in the main French newspapers, on the Internet, and the radio. More than 20,000 people visited the website. A total of 11,000 did cast their vote under each of the four rules and answered the short questionnaire at the end.[1] Among those participants, 8,044 had the right to vote in the election. Our analysis deals with these 8,044 voters.

The participants are not a representative sample of French voters. Those participants who are interested in politics, elections, and voting rules are probably overrepresented. Besides, we observed a strong Left bias. We correct this bias by weighting the participants so that the reported votes in the first round of the two-rounds election corresponds to the actual votes.

Our goal is to determine how many people vote differently from one system to the other, how many come to support a candidate who is not their preferred one, and who are these voters. "Sincere preference" is tapped in the short questionnaire through a simple and direct question: "Which presidential candidate do you prefer?" (See table 1, column 1.)

In 2012, 10 candidates were running for the presidency. The official results are presented in table 1, column 2. The top two candidates in the first round were François Hollande, with 29% of the vote, and Nicolas Sarkozy, with 27%. Hollande was elected in the second round, with 52% of the vote. A short description of the candidates follows.

- Nicolas Sarkozy (UMP, *Union pour la Majorité Présidentielle*), moderate conservative, was the incumbent. According to the preelection polls Sarkozy was very likely to go to the runoff.
- François Hollande (*Parti Socialiste*) was the main challenger and likely winner (after a runoff) according to the polls.

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Table 1

Preferences and Votes under the Four Voting Rules (%)

CANDIDATE	PREFERENCE	2R (OFFICIAL)	1R	AV FIRST RANK	APPROVAL
F. Hollande	23	29	31	25	46
N. Sarkozy	25	27	28	27	36
M. Le Pen	15	18	16	15	23
J.-L. Mélenchon	15	11	10	12	36
F. Bayrou	11	9	9	11	41
E. Joly	6	2	2	6	33
N. Dupont-Aignan	3	2	2	3	15
P. Poutou	1	1	1	1	11
N. Arthaud	0	1	0	1	7
J. Cheminade	0	0	0	0	4
Total	100	100	100	100	254

Note: The approval scores are the percentages of voters who approve the candidates, therefore they do not sum to 100. 1R = first round, 2R =second round; AV = alternative vote.

- Marine Le Pen (FN, *Front National*), extreme Right, was ranked third, according to the polls, and it would have been a big surprise if she had made it to the second round. UMP and FN had proscribed any kind of alliance.
- Jean-Luc Mélenchon (*Front de Gauche*) led a coalition of extreme Left parties. According to the polls it was nearly impossible for Mélenchon to go to the second round. As expected, Mélenchon invited his supporters to vote for Hollande at the second round although he maintained that he would not accept a position in a Hollande government.
- François Bayrou (*Mouvement pour la Démocratie*), a centrist candidate, tried to maintain an independent position between the Left and the Right. According to the polls he had no serious chance of being one of the top two candidates.
- Eva Joly (*Europe Ecologie Les Verts*), the Green candidate, was allied with the socialist party and had signed an agreement for the coming legislative elections. She had very little support in the polls.
- Nicolas Dupont-Aignan, a dissident from the UMP, had no chance to go to the second round.
- Philippe Poutou and Nathalie Arthaud were two Trotskyist candidates
- Jacques Cheminade was an autonomous candidate.

Poutou, Arthaud, and Cheminade obtained very few votes.

In table 1, columns 3 and 5 give the candidates' scores under the first round (1R) and approval voting respectively.[2] As explained previously, the participants have been weighted so that the votes in the first round of the two-rounds election correspond to the actual outcome. Column 4 gives the percentage of first rank obtained by the various candidates under the Alternative Vote (AV) (again weighted). Table 2 provides the complete AV counting.

PREFERENCES AND VOTE CHOICE

First, we look at the relationship between preferences and vote choice. This review allows us to estimate how many people vote sincerely for their preferred candidate. In this section we leave aside approval voting because the concept of "sincere voting" with this rule is unclear and, for AV, we consider only the first-ranked candidate.

Column 2 of table 1 shows, for each candidate, the (weighted) percentage of respondents who report this candidate as their preferred candidate. In terms of first preferences, Sarkozy comes first, with 25%, followed by Hollande with 23%, then Le Pen and Mélenchon with 15%, and Bayrou with 11%.

For each voting rule, we compute how many people voted for the person who they indicated in the questionnaire as their preferred candidate.[3] A vote is deemed to be sincere when it is cast for the preferred candidate. The proportion of sincere votes is 83% for one round (1R), 87% for two rounds (2R), and 88% for the alternative vote (AV). These results make sense. Studies of presidential elections in the United States and Mexico and direct prime ministerial elections in Israel suggest that about 10% of voters do not vote for their preferred candidate (see Abramson et al. 2010). More desertion from sincere voting is indicated here which is not surprising given the high number of candidates, many of whom are not viable (Cox 1997). In the questionnaire, we also asked the question: "Do you always vote for the candidate you prefer?" The answer was "No" for 30% of the respondents.

Note that the amount of insincere votes is 13% for the first round in the 2R system. This may be surprising because it is often thought that the first round of a two-rounds election allows people to vote sincerely according to their heart, with the understanding that they will have the opportunity to choose among the top two candidates in the second round. These results align with recent research that suggests that strategic voting exists in both two-rounds elections and in one-round elections (see Blais 2003).

As expected, the proportion of sincere votes is also high under the AV (88%). In principle, AV allows people to express their first preference for an unviable candidate because their second or third preferences will be considered if necessary (see Tideman 2006). Still, the proportion of insincere first votes is far from being

Table 2

Vote Count under the Alternative Vote (%)

	FH	NS	MLP	JLM	FB	EJ	NDA	PP	NA	JC
Count 1	25	27	15	12	11	6	3	1	1	0
Count 2	25	27	15	12	11	6	3	1	1	
Count 3	25	27	15	12	11	6	3	2		
Count 4	25	27	15	13	11	6	3			
Count 5	25	28	16	14	11	6				
Count 6	28	28	17	16	12					
Count 7	33	32	17	18						
Count 8	36	42		21						
Count 9	55	45								

Note: FN = François Hollande; NS = Nicolas Sarkozy; MLP = Marine Le Pen; JLM = Jean-Luc Mélenchon; FB = François Bayrou; EV = Eva Joly; NDA = Nicolas Dupont-Aignan; PP = Philippe Poutou; NA = Nathalie Arthaud; JC = Jacques Cheminade

Table 3

Votes in the One Round Election (%) by Vote in the First Round of the Two Rounds Election

	TWO ROUND										
One Round	FH	NS	MLP	JLM	FB	EJ	NDA	PP	NA	JC	Total
F. Hollande	94	0	2	19	9	29	4	18	7	5	31
N. Sarkozy	0	96	5	0	5	1	8	2	4	14	28
M. Le Pen	0	1	88	0	0	0	1	0	0	5	16
J.-L. Mélenchon	3	1	1	78	0	3	2	3	0	10	10
F. Bayrou	1	2	2	1	85	1	4	1	0	19	9
E. Joly	2	0	0	1	1	66	0	0	0	0	2
N. Dupont-Aignan	0	0	3	0	0	0	80	0	0	0	2
P. Poutou	0	0	0	0	0	0	0	75	7	5	1
N. Arthaud	0	0	0	0	0	0	1	0	81	0	1
J. Cheminade	0	0	0	0	0	0	0	0	0	43	0
Total	100	100	100	100	100	100	100	100	100	100	100

Note: FN = François Hollande; NS = Nicolas Sarkozy; MLP = Marine Le Pen; JLM = Jean-Luc Mélenchon; FB = François Bayrou; EV = Eva Joly; NDA = Nicolas Dupont-Aignan; PP = Philippe Poutou; NA = Nathalie Arthaud; JC = Jacques Cheminade

negligible, which suggests that strategic considerations come into play in alternative vote as well (see Laslier 2012).

The proportion of deserters is the highest among those who prefer Joly, the Green candidate: almost two-thirds (65%) under 1R and 2R, and 39% under AV. Desertion may occur toward nonviable candidates: 11.5% of Joly supporters voted for Mélenchon under 2R and, conversely, Joly received votes from voters who declared to prefer other candidates. Desertion is substantial among Mélenchon supporters (37% under 1R, 31% under 2R, and 24% under AV) and Bayrou supporters (28% under 1R and 2R and 16% with AV). Desertion is less than 5% for each of the top three candidates under 2R and for the top two candidates under 1R (6% of Le Pen supporters desert her under 1R). Some desertion of Sarkozy (4%) and Le Pen (8%) is seen under AV.

Hence, the phenomenon of insincere voting (as defined earlier: not voting for the preferred candidate) does not reduce to desertion of nonviable candidates. Nevertheless, as we would expect, the top three candidates get more votes under 1R, 2R, and AV than first preferences, especially with the first two voting rules, and all the other candidates obtain fewer votes than first preferences. This effect is stronger on the Left, because there are several nonviable left candidates. Indeed, the main beneficiary is the socialist Hollande, who has 23% of first preferences and 31% of the vote under 1R, and the main losers are Mélenchon (from 15% of first preferences to 10% of 1R votes) and Joly (from 6% to 2%).

COMPARING THE VOTES

Let us look at the relationship between the three votes. As the reference, we use the two-rounds system, which is actually used in the election. Globally, 89% of the voters vote for the same candidate under 1R and 2R. We see in table 3 that among Hollande and Sarkozy voters (under 2R), only about 5% would vote differently under 1R. The percentage of switchers increases to 12% among Le Pen voters (most go to Sarkozy) and to 15%, 22%, and 34% respectively among Bayrou, Mélenchon, and Joly voters (most go to Hollande). The overall outcome is that the top two candidates get more votes with 1R (Hollande goes from 29% with 2R to 31% with 1R and Sarkozy from 27% to 28%) and that the third and fourth candidates lose (from 18% to 16% in the case of Le Pen and from 11% to 10% for Mélenchon).

Table 4 indicates the link between vote choice in the AV and 2R elections. Globally, 86% vote for the same candidate in the two elections and 14% switch. Hollande voters in the 2R election are the most likely (20%) to switch in the AV election, mostly for Mélenchon and Joly. Interestingly, Le Pen also loses 19% of those who vote for her under 2R, mostly to the benefit of Sarkozy.[4] Sarkozy is the candidate who keeps the greatest proportion (93%) of his voters. All in all, Hollande's share of first votes under AV is four points lower than under 2R (25% versus 29%); Le Pen also loses three points (15% versus 18%) and the minor candidates do better, most especially Joly. Sarkozy remains with the same score (27%), which allows him to have more first choices than Hollande.

THE STRUCTURE OF INDIVIDUAL AV BALLOTS

Under AV, voters can rank order all the candidates from first to last. The participants were asked to indicate at least their top three choices. Table 2 shows the vote count under AV, leading, just like 2R, to the election of Francois Hollande against Nicolas Sarkozy.

We first consider the relationship between the first and the second rank. Table 5 shows the relationship. We can see that 40% of second choices among those whose first choice is Hollande go to Mélenchon, 28% to Bayrou and 26% to Joly. In the case of Sarkozy, 53% of second choices are for Bayrou and 16% for Le Pen and Hollande. Note that many more Sarkozy supporters are willing to cast their second vote for Hollande than the reverse. The most popular second choice among Le Pen's supporters is, tellingly, not Sarkozy (who gets only 31%) but rather Dupont-Aignan (38%), who gets only 3% of first votes. Mélenchon supporters, as expected, give their second vote to either Hollande (41%) or Joly (32%). Those whose first choice is Bayrou give their second vote to the top two candidates, 39% to Hollande and 30% to Sarkozy. And finally Joly's supporters split their second votes between Hollande and Mélenchon.

We determine which combinations of first, second, and third choices are the most frequent. Table 6 lists the 10 most frequent combinations. These 10 most frequent combinations together account for only 35% of all cases, a testimony of the great variety of preference orders among the participants.

The most popular combination (6%) is Sarkozy-Bayrou-Hollande, indicating support for the status quo first, for the center second, and the moderate Left third. The second most frequent is Hollande-Mélenchon-Joly, representing the moderate Left, followed by the extreme Left and the Greens.

Table 4

First Votes in the Alternative Vote Election (%) by Vote in the First Round of the Two Rounds Election

	TWO ROUND										
AV	**FH**	**NS**	**MLP**	**JLM**	**FB**	**EJ**	**NDA**	**PP**	**NA**	**JC**	**Total**
F. Hollande	80	0	1	6	5	8	1	5	11	0	25
N. Sarkozy	0	93	7	0	2	1	3	2	4	10	27
M. Le Pen	0	1	81	0	0	0	3	0	0	0	15
J.-L. Mélenchon	7	0	1	86	1	1	2	3	4	10	12
F. Bayrou	3	3	3	1	90	1	5	1	4	14	11
E. Joly	8	1	0	5	2	89	1	5	0	0	6
N. Dupont-Aignan	0	1	5	0	0	0	84	0	0	0	3
P. Poutou	0	0	0	0	0	0	0	82	0	10	1
N. Arthaud	0	0	0	2	0	0	0	1	78	0	1
J. Cheminade	0	0	0	0	0	0	1	0	0	57	0
Total	100	100	100	100	100	100	100	100	100	100	100

Note: FN = François Hollande; NS = Nicolas Sarkozy; MLP = Marine Le Pen; JLM = Jean-Luc Mélenchon; FB = François Bayrou; EV = Eva Joly; NDA = Nicolas Dupont-Aignan; PP = Philippe Poutou; NA = Nathalie Arthaud; JC = Jacques Cheminade

Table 5

Second-ranked Candidates (%) by First-ranked Candidate in the Alternative Vote Election

	1ST-RANKED CANDIDATE										
2nd-ranked Candidate	**FH**	**NS**	**MLP**	**JLM**	**FB**	**EJ**	**NDA**	**PP**	**NA**	**JC**	**Total**
F. Hollande	*0*	16	1	41	39	43	3	8	2	8	25
N. Sarkozy	4	*0*	31	1	30	2	20	4	0	4	27
M. Le Pen	0	16	*0*	2	3	1	40	0	0	42	15
J.-L. Mélenchon	40	5	7	*0*	6	37	10	45	25	22	12
F. Bayrou	28	53	15	6	*0*	10	15	1	2	4	11
E. Joly	26	1	3	32	13	*0*	5	14	6	0	6
N. Dupont-Aignan	0	9	38	2	6	1	*0*	2	0	13	3
P. Poutou	1	0	1	13	1	5	1	*0*	61	7	1
N. Arthaud	0	0	1	3	0	3	1	25	*0*	0	1
J. Cheminade	0	0	3	1	1	1	6	2	4	*0*	0
Total	100	100	100	100	100	100	100	100	100	100	100

Note: FN = François Hollande; NS = Nicolas Sarkozy; MLP = Marine Le Pen; JLM = Jean-Luc Mélenchon; FB = François Bayrou; EV = Eva Joly; NDA = Nicolas Dupont-Aignan; PP = Philippe Poutou; NA = Nathalie Arthaud; JC = Jacques Cheminade

What is perhaps more striking in this list is that Sarkozy is either first or nonpresent, an indication that he was a polarizing candidate. The same is true for Le Pen who, despite being third on the first ballot, appears only in one of the combinations. At the opposite end, we find the centrist candidate Bayrou, who receives only 9% of the votes under 2R but is present in seven of the 10 most popular combinations.

Although Bayrou is often ranked quite high in the participants' AV ballots, when we look at the details of the vote transfers along the alternative-vote elimination path we observe that Bayrou is quickly eliminated (5th elimination) because, even if he is highly ranked, he is often behind one of the top two candidates. This pattern is the phenomenon of "squeezing of the center" often described for two-round voting and that works in a similar way under AV.

COULD THE RESULTS HAVE BEEN DIFFERENT?

From what we have seen so far, it seems that, for this election, voters' behavior under the three rules (1R, 2R, AV) is not so different. Moreover, the outcome is always the same, that is, Hollande is elected. Thus this question: would the result of the election have been the same under any voting rule?

In the vote section of the survey, we asked voters how they would vote at the second round of the election in the 10 hypothetical cases where the five main candidates (Hollande, Sarkozy, Le Pen, Mélenchon, and Bayrou) are present in the runoff.[5] It turns out that Bayrou wins against any opponent (with 53% of the votes against Hollande, 66% against Sarkozy, 65% against Mélenchon, and 79% against Le Pen).

If we trust this observation we might conclude that Bayrou would be elected under voting rules that elect the Condorcet candidate when there is one. We did not propose such voting rules, but we invited people to vote according to approval voting. Under this rule people can vote for as many candidates as they want. The approval scores are as follows: Hollande 46% and Bayrou 41%, ahead of Sarkozy 36% (see the last column of table 1). Compared with the previous rules, these results strengthen the centrist candidate (Bayrou).

CONCLUSION

We offered French voters the opportunity to vote under different voting rules. Most people vote for the same candidate that they support under the first vote of a two-rounds election, under a one-round system, or under alternative voting (first choice). But a substantial minority (respectively 11% and 14%) vote differently. The top two candidates get slightly more votes in a one-round election while the less-popular candidates obtain slightly more first choices under AV, compared to the two rounds election. We also

Table 6

The Ten Most Popular Combinations under AV

FIRST-RANKED CANDIDATE	SECOND-RANKED CANDIDATE	THIRD-RANKED CANDIDATE	PROPORTION (%)
Sarkozy	Bayrou	Hollande	6
Hollande	Mélenchon	Joly	5
Hollande	Joly	Mélenchon	4
Sarkozy	Bayrou	Dupont-Aignan	4
Hollande	Mélenchon	Bayrou	3
Sarkozy	Le Pen	Bayrou	3
Hollande	Bayrou	Joly	3
Hollande	Bayrou	Mélenchon	3
Mélenchon	Hollande	Joly	3
Sarkozy	Hollande	Bayrou	2

find that, respectively, 12%, 13%, and 17% of the voters do not vote for their preferred candidate under AV, at the first round of the two-round election, and under one-round voting. All these results are consistent with what the literature suggests about the impact of these voting systems on voters' choice.

Finally, an inherent limit of this kind of quasi-experiment is that the political offer (the set of candidates) might be different under different voting rules. This study only deals with the voters' behavior, which is only one aspect of the impact of voting systems.

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We thank Sri Sikandan for his handling of the web-site and a referee for his or her useful comments. ■

NOTES

1. Voting under the four rules and filling the questionnaire took about 20 minutes.
2. As explained on the web site, under approval voting, "Each voter indicates, for each candidate, if he or she approves the candidate. The candidate who is approved by the largest number of voters is elected."
3. For the sake of brevity we do not report the full tables of votes and preference transfers among all candidates.
4. This phenomenon may be due to "inverse strategic voting" (Blais 2003). Right-wing voters who prefer Sarkozy to LePen as a president nevertheless vote for Le Pen in the first round to "pull" Sarkozy toward the more right-wing positions.
5. Recall that the data was collected before the first round of the election.

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Why Voters Like Voting Rules: Self-Interest, Ideology, or Sincerity?

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VERY PRELIMINARY. Please do not quote.

Abstract:

The paper studies the determinants of citizens' preferences for different electoral systems. We use data collected through a large internet-based quasi-experiment during the 2012 French presidential election. A website provided information about four voting rules (one round, two rounds, alternative and approval) and people were invited to vote, for the real candidates, according to each of the four rules (see www.voteaupluriel.org). Once they had experimentally voted with the four voting rules, the participants were asked to answer a short questionnaire, including a question asking them to report which system they liked the most. The first hypothesis that we test is that people like systems that are beneficial to the candidate/party they prefer. The second hypothesis is that people's preferences for the official two round system also depend on how they actually vote under this system. Our expectation was that people who cast a non-sincere vote under the official two-round system are less likely to like this system. Both hypotheses are confirmed by our data. Interestingly, we also discover another important determinant of preferences over voting systems, which is of an ideological nature. Right-wing voters tend to be much more supportive of voting rules in which one can vote for only one candidate (1R and 2R).

1. Introduction

There is a vast literature in comparative political science on how voters vote under different electoral systems (Cox, 1997; Blais and Carty 1991; Clark and Golder 2006, ...). The question of how they like/evaluate the different voting systems has been much less addressed. This paper intends to help fill this gap, using data collected during a large internet-based quasi-experiment which took place at the time of the first round of the French 2012 presidential elections. We created a website with:

- *An information section* providing detailed information about four voting systems: one-round, two-round (the official system currently used in France), alternative vote and approval voting. For each system, visitors were provided with information about how the system works (format of the ballot and details of the vote count), as well as an example of a country where the system is used in practice for presidential elections (Mexico for the one-round system, France for the two-round system, Ireland for the alternative vote. No example was given for approval voting, since no country uses this system for presidential elections).
- *An experiment section* where people were invited to vote, for the real candidates running for the presidency, according to each of the four rules. They were then invited to answer a short questionnaire (see www.voteaupluriel.org). In particular, in the short questionnaire, they were asked to report which system they liked the most, among the four systems they experimentally voted with.

The first hypothesis to be tested is that people like systems that are beneficial to the candidate/party they prefer. In particular, our expectation is that participants who declare preferring a candidate from one of the two largest parties (the two viable candidates under the current two-round system) are more likely to report preferences for the status quo.

A secondary hypothesis is that preferences for the status quo (the two-round system used in France) are affected by how people actually vote under this system. In particular, we wanted to test whether people who cast a non sincere vote in the experiment under the two-round system are less likely to like this system (controlling for other factors, such as their preferred candidate). Our expectation is that those who cast a strategic vote (and thus do not vote for their preferred candidate) are more likely to dislike the 2R system.

Both hypotheses are confirmed by our data. First, controlling for socio-demographic variables, participants whose preferred candidate is one of the top two candidates (the most likely winners in the French 2R system) are 18 percentage points more likely to prefer the status quo. Second, participants who cast a non sincere vote in the experiment under the two-round system are 9 percentage points less likely to prefer the status quo.

Interestingly, we also discover another important determinant of preferences over voting systems, which is of an ideological nature. Compared to other voters, right-wing voters tend to be much more supportive of voting systems in which voters have a single vote (1R and 2R).

As mentioned above, related literature is scarce. One reason which may explain this scarcity is that voting rules and electoral systems may be perceived as unfamiliar objects to citizens, over which it is probably difficult for them to have definite views and preferences. Indeed, instances where voters are invited to directly express their views about electoral reforms, for instance through referenda about reforms of institutions, are scare. The most important related studies have been done at the occasion of potential electoral reforms and during citizen assemblies. Fournier et al. (2011) examines the decisions made by Citizen Assemblies on Electoral Reform in British Columbia, Ontario and the Netherlands and voters' rejection of their proposals in referenda in BC and Ontario. In these three unprecedented large-scale democratic experiments, randomly selected citizens (forming the Citizen assemblies) were asked to design the next electoral system. In each case, the participants spent almost a year learning about electoral systems, consulting the public, deliberating, debating, and ultimately deciding what specific institution should be adopted. These are examples of situations where citizens where provided with sufficient information to form judgements about electoral systems.

Given the fact that it might be difficult to form preferences about electoral systems in the abstract, that is, without being given a first-hand experience with these systems, we believe that experiments are a well-suited tool to study these preferences. Building on this idea, Weber (2014), distinguishing among various formulas for proportional representation, experimentally studies preferences for different apportionment rules. He finds support for rules of the Shapley-Shubick type, versus the Banzhaf type. Distinguishing among various formulas for proportional representation is not at stake in our study, but we share the same view that having subjects experiment with different electoral systems helps them form preferences about these systems.

Contrary to voters, politicians certainly have a much better knowledge of electoral systems. In a paper entitled "Why Politicians Like Electoral Institutions: Self-Interest, Values, or Ideology?"[1], Bowler et al. (2006) explore the determinants of politicians' preferences for different electoral institutions. They survey national level politicians (both candidates and MPs) at the time of general elections in Australia, the Netherlands and New Zealand. The survey includes questions about specific electoral reforms (e.g. a question about the introduction of referendum and initiative), as well as questions measuring values, ideology, and attitudes toward each country's current electoral systems. They show that self-interest (tapped by coding whether a candidate – and his/her party- won or lose in the general elections) is a key determinant in explaining whether he/she approves of electoral reforms. But that "there are sizeable independent effects of values and ideology and that the substantive magnitude of

[1] Our title echoes theirs.

these effects rivals the effect of electoral self-interest" (page 443). In particular, candidates on the right are more supportive of status quo electoral systems, and less supportive of direct democracy. Our results echo several of their findings in an interesting way: we discover that voters' preferences over the electoral system have similar determinants: self-interest plays a key role, but ideology is an equally strong determinant.

Section 2 describes the "Vote Au Pluriel" experiment. Section 3 presents the test of our first hypothesis about self-serving preferences. Section 4 presents the test of our second hypothesis about non-sincere voting. Section 5 discusses the relationship between ideology and evaluation of the voting rules, and proposes some mechanisms to account for this relationship. Section 6 concludes.

2. The "Vote Au Pluriel" experiment

Protocol

This quasi-experiment took place at the time of the first round of the 2012 French presidential election. In the same fashion as in a previous study conducted at the time of the 2011 election in the province of Ontario Canada (Blais et al.2012), we created a website with sections providing information about four voting systems (one-round, two-round, alternative and approval) and another section where people were invited to vote according to each of the four rules for the "real" candidates running for the Presidency (see www.voteaupluriel.org). Once they had experimentally voted with the four voting rules, the participants were asked to answer a short questionnaire, including a question asking them to report which system they liked the most. Voting under the four rules and filling the questionnaire took about 20 minutes.

The website was open to the public three weeks before the election. It was advertised through many different routes: after a first phase of direct mailing in the academic world, the general media got involved and the web site was widely advertised in the main French newspapers, on the internet and the radio. More than 20,000 people visited the website during this period.

Elections results

Although our interest lies in studying preferences for the voting rules, we briefly present here the electoral results under the different voting rules (This subsection borrows from Van der Straeten *et al.* (2013)). Among the 20,000 visitors, 11,000 did cast their vote under each of the four rules. Among those participants, 8,044 had the right to vote in the election. The experimental results below are based

on these respondents (those 8,044 respondents constitute the sample used in Van der Straeten *et al.* (2013). In the next paragraphs, we will further restrict the sample when studying preferences for the voting rules, since some of these respondents did not fill the short questionnaire where the question about preferences for the voting rules was asked). These 8,044 participants are not a representative sample of French voters. Those who are interested in politics, elections, and voting rules are probably over-represented. Besides, we observed a strong left bias. We correct the latter bias by weighting the participants so that the reported votes in the first round of the two rounds election in the experiment corresponds to the actual votes observed in the official election nationwide. All the results presented in the sequel will use this weighting.

There were 10 candidates running for the presidency (see in the Appendix a short description of each candidate). The official results at the first round are presented in column 2 of Table A1 in the appendix. The top two candidates in the first round were François Hollande, with 29 % of the vote, and Nicolas Sarkozy, with 27%. In the official election, Hollande was elected in the second round, with 52% of the vote.

In our experiment, Column 2 in Table A1 gives the candidates' scores under 2R. As explained above, observations are weighted so that the first round results in the experiment exactly match the official results. As to the second round: in the vote section, we asked the voters how they would vote at the second round of the election in the ten hypothetical cases where the five main candidates (Hollande, Sarkozy, Le Pen, Mélenchon and Bayrou) are present in the runoff.[2] In case of a run-off between Hollande and Sarkozy, 56% of our respondents vote for Hollande.[3]

Column 3 in Table A1 gives the candidates' scores under 1R.

Results under alternative vote are a bit more complex to describe since several steps of elimination can be necessary to get a candidate elected. In the experiment, nine steps were actually required to elect the President, the vote count is detailed under the column "Alternative vote" (Column 4).

The candidates' scores under approval[4] voting are shown in the last column.

All these results, as explained above, have been computed with weighting the observations in such a way that the votes in the first round of the two rounds election in the election correspond to the actual official outcome.

[2] Recall that the data was collected before the first round of the election.

[3] The number in the official election is 52%, indicating that even after weighting our observations to match first-round scores, we still have a small bias in favour of the left in our sample.

[4] As explained on the web site, under approval voting, "Each voter indicates, for each candidate, if he or she approves the candidate. The candidate who is approved by the largest number of voters is elected." The approval scores in Table A1 are the percentages of voters who approve the candidates, therefore they do not sum to 100.

From Table A1, it seems that, for this election, aggregate results under 1R, 2R and alternative vote are not so different. Moreover the outcome is always the same, that is, François Hollande is elected. Under approval voting, François Hollande is elected too, but the results go in the direction of strengthening the centrist candidate (Bayrou: 41% under approval voting vs. 9% in the official system).

Preferences for the voting rules

Preferences for the voting rules are tapped in the questionnaire respondents were asked to fill, once they have experimentally voted with the four voting rules. They were asked to answer the following question*: "What is your favorite voting rule?"*, with four possible answers corresponding to the four voting rules they had just tested in practice.

Since in Section 4, we will study whether voting non-sincerely in the official 2R system affects one's own evaluation of this system (hypothesis 2), it is important to distinguish whether an individual votes for a candidate in the 2R system (which we observe in the experimental vote) and whether this candidate is her preferred candidate. This preference among the candidates will be tapped in the short questionnaire through a simple and direct question: *"Which presidential candidate do you prefer?"* Because for some of the candidates, especially those who gathered less than 2% of the votes in the official election, we have very few observations (few participants report having these candidates as their preferred candidates), we restrict attention to the six candidates who gathered the most votes.

Dropping respondents who did not answer the question about their preferred voting rules, as well as respondents who did not respond to the question about their preferred candidate or reported preferring one of the last four candidates, we are left with 6,309 individuals. The remaining of our analysis will deal with these 6,309 individuals.

Table A2 in the appendix provides some summary statistics about these participants, first in the whole sample (column 2) and then by preferred candidate.

First of all, looking at our whole sample (column 2 in Table A2), one observes a clear ranking of the voting rules: 41% of the sample prefer the Alternative vote, 28% prefer Approval voting, 22.5% the official two round system, and last only 8% prefer the one-round system.

Graph 1 depicts the preferred voting rule, by preferred candidate (Figures in the top part of Table A2).

[Insert Graph 1 about here]

It shows that some patterns are shared across the different groups of voters. In particular, whatever the preferred candidate, the one-round system is the least preferred, and except for Sarkozy supporters, the alternative vote is the most preferred rule.

But it also shows some differences. One observes that the supporters of Hollande and Sarkozy are much more favourable to the two-round system than other participants. This lends support to our hypothesis of self-serving preferences (Hypothesis 1). Interestingly, support for the 2R system approximately follows the actual 2R scores with one exception: one swap between Hollande and Sarkozy. Further scrutiny of the graph also reveals some interesting differences within supporters of the viable candidates: Supporters of Sarkozy prefer the uninomimal systems (1R or 2R) more often than those of Hollande; and similarly, among supporters of non-viable candidates, supporters of Le Pen prefer the uni-nomimal systems (1R or 2R) more often than those of Mélenchon, Bayrou and Joly (who have quite similar preferences). These observations suggest that these preferences for the voting rule are also affected by ideology: independently of whether they prefer a viable or a non-viable candidate, right-wing participants (supporters of Sarkozy and Le Pen) seem to like the alternative vote and approval voting less than left wing participants. This finding will be discussed in section 5.

Table A3 in the appendix (columns (1), (3), (5), (7)) shows the results (marginal effects) of a multinomial logistic regression, where the independent variables are dummy variables indicating the respondent's preferred candidates. The table confirms some significant differences across supporters of the various candidates. One also checks (columns (2), (4), (6), (8)) that the impact of political preferences remains significant and strong even after controlling for socio-demographic variables.

Once these basic description statistics have been shown, we now proceed to testing our main two hypotheses.

3. Hypothesis 1: Preferences for voting rules and self-interest

Hypothesis 1

Our hypothesis is that preferences for voting rules are (at least partly) instrumentally based, that is, people like systems which give the best chance to the candidate/party they prefer.

In the context of this election, François Hollande and Nicolas Sarkozy, the candidates of the main two French parties, are the most likely winners in the two-round run-off system. At the time of the election, they were clearly perceived as the almost certain contenders in the run-off (see the short description of the candidates in the Appendix). Since also both had some chance to win the second round, we expect supporters of Hollande and Sarkozy to be more favourable to the two-round system than other

participants, and less favourable to the more open systems such as the alternative vote and approval voting.

Test of Hypothesis 1

To test this hypothesis, we estimate a multinomial logit model (See Table 1) where the dependent variable is the preferred voting rule and explanatory variables are:

- one dummy indicate whether the subject prefers a Viable candidate (Hollande or Sarkozy) or not (the omitted category in Table 1)
- one set of dummy if the subject prefers a left-wing candidate (Hollade, Mélenchon or Joly), a centrist candidate (Bayrou) or a right-wing candidate (Sarkozy or Le Pen, the omitted category in Table 1)
- socio-demographic controls including education, age, and gender.

[Insert Table 1 about here]

Table 1 reports the marginal effects of the explanatory variables on the probabilities of preferring each voting rule, without the socio-demographic controls in Columns (1), (3), (5), (7), and with these controls in Columns (2), (4), (6), (8). Note that for a given voting rule A, the marginal effect of a specific variable X should be interpreted as the marginal impact of X on the probability of preferring voting rule A, compared to all other voting rules.[5]

The first two columns show that Hypothesis 1 is strongly supported by our data: Subjects preferring one of the two viable candidates are almost 20 percentage points more likely to prefer the status quo two-round system (whether one controls or not for socio-demographic characteristics) than subjects preferring any other candidates. They are also less likely to prefer the alternative vote (about 13 percentage point) and approval voting (about 5 percentage point).

This impact of self-interest is quite large, if one compares it to the impact of other variables.

Looking at the socio-demographic controls, we expect those socio-demographic variables to have an independent effect on preferences for the voting rules. More specifically, we expect higher levels of education to be correlated with higher evaluations of systems such as the Alternative Vote or Approval Voting, which have the characteristics to be new to the voters, and presumably more complicated than the 1R or 2R systems. Similarly, if age is negatively correlated with the taste for new experience or

[5] Indeed, the multinomial Logit model relies on the Independence of Irrelevant Alternative Hypotheses.

status quo bias, we might expect older participants to like the two-round system more than younger participants. We indeed observe that compared to subjects with no educational diploma, subjects with an elite school degree or a PhD are 20 percentage point less likely to prefer the two-round system (column 2), and 24 percentage point most likely to prefer the alternative vote (column 6). The size of the effect is similar to that estimated for self-interest. We observe small or insignificant effect of age and gender.

Descriptive statistics in Section 2 seemed to suggest that ideology is also an important determinant of preferences for the voting rules. Table 1 confirms that subjects preferring a left wing or a centrist candidate about 10 percentage points less likely to prefer the two-round system, and about 8 percentage points less likely to prefer the one-round system than subjects preferring a right-wing candidate. This point will be further discussed in Section 5.

4. Hypothesis 2: Preferences for voting rules and non-sincere voting

We have seen that individuals whose preferred candidate is a potential winner with the 2R system tend to like the status quo more than others. It is also likely that how voters "use" this system in practice also affects their preferences for the 2R system. In particular, it might not always be easy for voters to figure out how they should cast their vote in the two-round system. Indeed, even if they have clear preferences over the candidates, it is not always in the voter's best interest to vote for their preferred candidate. We test the hypothesis according to which voters who vote non-sincerely in the 2R system like this system less than those we simply vote for their preferred candidate.

Before turning to the data, let us first review some of the arguments which may lead a voter to cast a non-sincere vote under the 2R system. Consider for instance a voter, whose preferred candidate has obviously no chance to be part of the run-off. This voter may choose to desert this preferred (non-viable) candidate and instead vote for a candidate who has a serious chance to be elected. This is "standard strategic voting" (Cox 1997). But even a voter who prefers a viable candidate may have some incentives to vote for another candidate. Indeed, if her candidate is sure to be part of the run-off, this voter may choose to use the first-round to send this candidate some kind of "signal". For example, consider a voter whose preferred candidate is Nicolas Sarkozy (center-right), but who would like this candidate to move his platform slightly to the right, or to care more about issues which are perceived to be central in the Extreme-right manifesto (e.g. immigration or security). Then this voter may choose to vote for Marine Le Pen rather than for Nicolas Sarkozy, since the electoral risk of Nicolas Sarkozy

being eliminated at the first round is basically zero, and thus the cost of sending this kind of message is basically zero. This type of behavior has been called "inverse strategic voting"[6] by Blais (2003).

Under the 2R system, voters may therefore vote non-sincerely, whatever their political preferences. Indeed, Van der Straeten et al. (2013) show that in the Vote au Pluriel experience, over 15% of the voters cast non-sincere votes under the 2R system, and that both "standard" and "inverse" strategic voting is observed.

Hypothesis 2

How does this non-sincere voting relate to preferences for the voting rules? Our hypothesis is that voters who vote non-sincerely in the (official) 2R system dislike this system more than those who cast a sincere vote. The hypothesis derives naturally from the ideas that individuals avec an intrinsic preference for honesty (voting non sincerely implies a sort of lie) or for simplicity (voting strategically implies some cognitively costly computation).

Test of hypothesis 2

In order to test for this hypothesis, we construct a dummy indicating whether the subject, in our experimental two-round election, voted for the candidate she declared preferring in the questionnaire. We estimate the same multinomial logit model as in Table 1 (with the socio-demographic controls), but adding as a supplementary variable the dummy "Sincere voting", indicating whether the subject did cast a since vote in the two-round experimental election.

Table 2 reports the marginal effects of the explanatory variables on the probabilities of preferring each voting rule. Again, note that for a given voting rule A, the marginal effect of a specific variable X should be interpreted as the marginal impact of X on the probability of preferring voting rule A, compared to all other voting rules.

[Insert Table 2 about here]

Table 2 (column 2) shows that hypothesis 2 is supported by our data. Individuals who cast a non-sincere vote in the experiment under the 2R system are 9 percentage points less likely to report

[6] "Standard strategic voting" refers to situations where the voters desert a non-viable candidate for a viable candidate, whereas "inverse strategic voting" refers to situations where a voter deserts a viable candidate for a non-viable candidate, for instance in order to send a message to the former.

preferring the 2R system, compared to voters who cast a sincere vote (controlling for political preferences and for socio-demographic variables).

5. Discussion: Preferences for voting rules and ideology

Table 1 has shown a strong left-wing bias in favor of approval voting and the alternative vote, besides the strong effect of self-serving preferences (which is robust to the inclusion of the "sincere voting" dummy, as shown by Table 2). Subjects preferring a left wing or a centrist candidate are about 10 percentage points less likely to prefer the two-round sytem, and about 8 percentage points less likely to prefer the one-round system than subjects preferring a right-wing candidate.

What are the potential mechanisms under this relationship?

First, it might be the case that the alternative vote and approval voting are perceived to be less immune to coordination problems than uninominal 1R or 2R system. In the French political landscape, the political supply is much more fragmented on the left-wing than on the right-wing of the political spectrum. For example, in this election, there were six left wing candidates, and only three right-wing candidates (plus one centrist) (See the short description of the candidates in the appendix). With single vote ballots (such as 1R or 2R), coordination among left-wing voters can be difficult. A focal example was the 2002 Presidential election where the Moderate-left candidate Lionel Jospin was eliminated at the first round.[7] This elimination was perceived as the result of the large number of left-wing candidates in this election, inducing complicated coordination among left-wing voters.[8] With the alternative vote, coordination problems are less severe: a voter can rank her preferred candidate first on her ballot even if he is non-viable, without the fear of causing the defeat of her second or third-best (viable) preferred candidate, provided she also ranks him high on her ballot. This explanation, centered on *the number of candidates* on each side, is not fully convincing though. Indeed, right-wing voters who hesitate between voting for Sarkozy or for Le Pen (the third ranked candidate in this election according to the poll) must also have suffered strong coordination problems, even if their choice was mostly between two candidates.

An alternative explanation for this relationship is that this correlation between left-wing political ideology and liking the alternative vote or approval voting might be driven by unobservable characteristics of

[7] This led to a run-off between the Moderate -Right candidate Jacques Chirac and the National Front candidate Jean-Marie Le Pen (father of the current candidate Marine Le Pen). Even if defeated, the presence of Jean-Marie Le Pen at the second run off was a major political event.

[8] Indeed, according to Cautrès and Mayer (2004), a substantial fraction of the left-wing voters who did not vote for Lionel Jospin in the first round said they regretted their choice

the subjects, such as different tastes or psychological traits differentiating left-wing and right-wing voters (remember we already control for some observable socio-demographic variables, such as education or age). Indeed, the literature in political psychology has pointed to differences between left-wing and right-wing voters reading their scores on "the big five" (Camey et al. 2008, Gerber et al. 2010),; left-wing voters in particular show higher scores on "openness", which may explain why they have more positive attitudes towards new systems. Unfortunately, we do not have data on psychological traits and cannot test for a direct relationship between these traits and preferences for the voting rules. Note nevertheless that the bias for status quo observed in right-wing subjects would be consistent with observations of Bowler et al. (2006), who, as mentioned in the introduction, when exploring the determinants of politicians' preferences for different electoral institutions, found that politicians on the right are more supportive of status quo electoral systems

They also observed that politicians on the right are less supportive of direct democracy. Our finding is also reminiscent of theirs. Indeed, note that another distinctive feature between 1R and 2R system on one hand and alternative vote and approval voting on the other hand is that the former are single-vote ballots, whereas the latter allow voters to express more detailed preferences. In a sense, we can defend the view that alternative vote and approval voting increase the citizens' ability to express their view.

Let us mention a last channel which may explain this relationship between right-wing ideology and support for uni-nominal systems? It might be explained by the fact that traditionally, right-wing political ideology emphasizes the importance of the leader: if elections are about choosing one leader, single-vote ballots may be more in line with this conception of elections. As a test of this idea, we use the following question in the questionnaire: *"Which is more important: the leader or the party?"*. We expect respondents who answer that the candidate is more important to prefer single-vote ballots more often than those who answer than the party is more important. Table A4 in the appendix shows the results of multinomial logit regressions which include such a variable (dropping respondents who did not answer the question about whether the party or the candidate is more important, we are left with 5,519 observations). Respondents who report being party-centered (candidate-centered respondents being the reference) indeed tend to like less the 1R system. The effect, however, is only significant at the 10% level and the size is small (3 percentage points). Besides, contrary to expectations, we do not observe such an effect with respect to 2R. We therefore conclude that this specific channel is weak at best.

6. Conclusion

This paper is a first step towards eliciting citizens' preferences for different electoral institutions, in an experimental context where they have been given the opportunity to try in practice the different voting

rules on “real candidates”.

There are only very few situations where citizens are actually directly questioned about their preferences. One recent example is the United Kingdom alternative vote referendum held on Thursday 5 May 2011. The referendum was about a proposal to replace the present one-round (simple plurality) system with the alternative vote. The proposal to introduce AV was rejected by the electorate (67.9% against the reform).

The scarcity of real life examples of such consultations makes the experimental approach particularly appealing to study such issues. In particular, subjects were given the opportunity to read about them and to actually use them, which made it easier to understand how they work. Still, since the results of the experimental votes were not made public until the election was over, they were not given the opportunity to observe the electoral consequences of the different systems. Their preferences for the different systems might have been different, should they have had this additional information.

In this study, we confirmed our hypothesis that citizens’ preferences are party self-serving: Subjects preferring one of the two viable candidates are about 20 percentage points more likely to prefer the status quo (the two-round system) than subjects supporting non-viable candidates.

But we also uncovered other determinants of these preferences. Individuals who cast a non-sincere vote in the experiment under the 2R system are 9 percentage points less likely to report preferring the 2R system, compared to voters who cast a sincere vote. These results shed light on the fact that the way individuals “use” the system in practice may also shape their preferences for the different systems. There is a large literature on whether voters cast strategically or not, but much less on the potential psychological costs associated to strategic voting. Our results suggest that strategic voting might be psychologically costly. Some people do not like not being able to support their preferred party/candidate, and as a consequence they dislike systems that induce them to do so.

Last, we found a strong left-wing bias in favor of more open systems, but still lack a definitive explanation for this effect. We leave to future research the task to check whether this effect is observed in other contexts or types of elections, and to elucidate the mechanism underlying it.

Comparing with the results by Bowler *et al.* (2006) on politicians’ preferences for voting rules, we find that citizens’ and politicians’ preferences share striking similarities. Self-interest is indeed a key determinant, but ideology also strongly shapes these preferences.

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APPENDIX :

A short description of the candidates[9]

- François Hollande (*Parti Socialiste*), was the main challenger to the incumbent Nicolas Sarkozy, and likely winner (after a runoff) according to the polls.
- Nicolas Sarkozy (UMP, *Union pour la Majorité Présidentielle*), moderate conservative, was the incumbent. According to the pre-election polls Sarkozy was very likely to go to the runoff.
- Marine Le Pen (FN, *Front National*), extreme right. According to the polls, she was ranked third, and it would have been a big surprise if she had made it to the second round. UMP and FN had proscribed any kind of alliance.
- Jean-Luc Mélenchon (*Front de Gauche*) led a coalition of extreme left parties. According to the polls it was close to impossible for Mélenchon to go to the runoff. As expected, Mélenchon invited his supporters to vote for Hollande at the second round even if he always maintained that he would not accept a position in a Hollande government.
- François Bayrou (*Mouvement pour la Démocratie*). This centrist candidate tried to maintain an independent position between the Left and the Right. According to the polls he had no serious chance of being one of the top two candidates. Before the second round, he declared that he would personally vote for Holland in the second round, but did not give any explicit recommendations to his first round voters regarding how theu should vote in the run-off.
- Eva Joly (*Europe Ecologie Les Verts*). The Green candidate was allied with the socialist party and had signed an agreement for the coming legislative elections. She had very little support in the polls.
- Nicolas Dupont-Aignan is a dissident from the UMP. He had no chance to go to the runoff.
- Philippe Poutou and Nathalie Arthaud were two Trotskyist candidates, and Jacques Cheminade was an autonomous candidate. These last three candidates obtained very few votes.

[9] Borrowed from Van der Straeten *et al.* (2013).

Graph 1: Preferred voting rule, by preferred candidate.

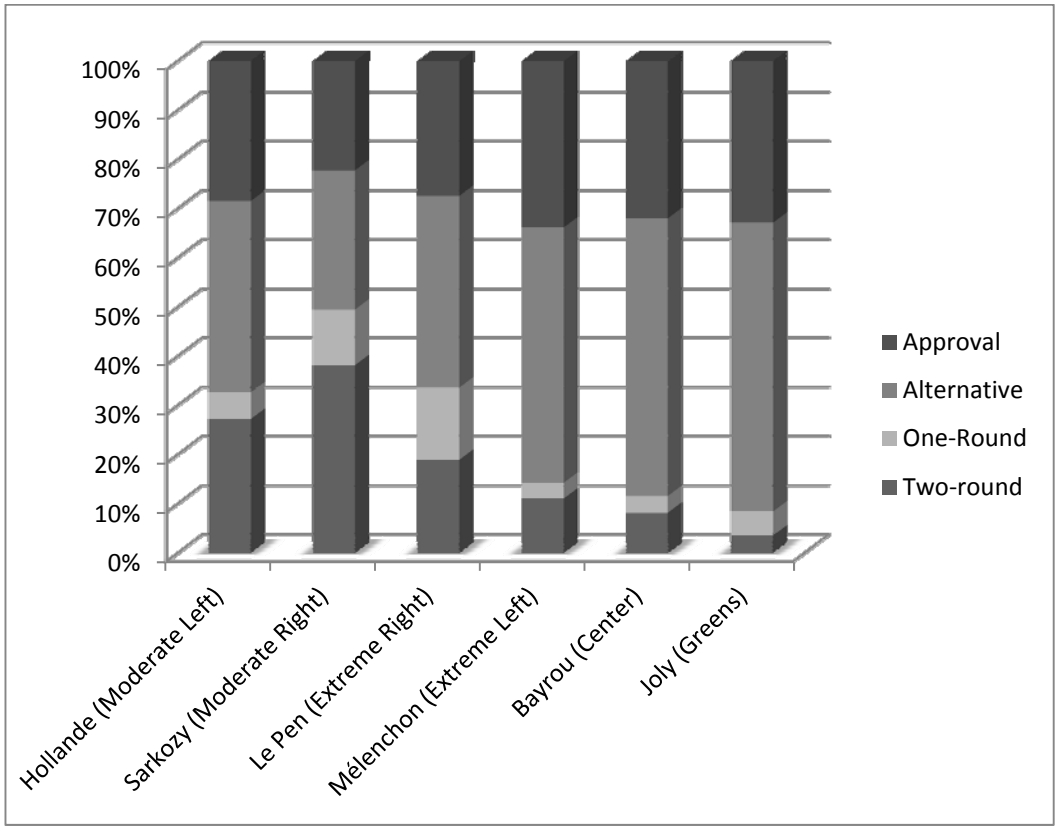

Table 1: Preferred Voting Rule and Self-interest (Marginal Effects)

	(1) 2-round	(2) 2-round	(3) 1-round	(4) 1-round	(5) Alt	(6) Alt	(7) Appr	(8) Appr
Prefers viable Candidate	0.1825***	0.1921***	-0.0063	-0.0009	-0.1276***	-0.1378***	-0.0486**	-0.0534**
	(0.022)	(0.021)	(0.016)	(0.015)	(0.025)	(0.025)	(0.023)	(0.023)
Ideology:								
Left	-0.1012***	-0.1009***	-0.0822***	-0.0772***	0.1237***	0.1197***	0.0597***	0.0584**
	(0.021)	(0.021)	(0.017)	(0.015)	(0.025)	(0.025)	(0.023)	(0.023)
Center	-0.1317***	-0.1102***	-0.0932***	-0.0780***	0.1677***	0.1315***	0.0572	0.0568
	(0.032)	(0.033)	(0.020)	(0.020)	(0.039)	(0.039)	(0.035)	(0.035)
Right	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Education:								
No diploma		Ref.		Ref.		Ref.		Ref.
Secondary education		-0.1322		0.0115		0.0767		0.0440(
		(0.085)		(0.058)		(0.082)		0.093)
Bachelor		-0.1214		-0.0253		0.1351*		0.0115
		(0.082)		(0.053)		(0.076)		(0.087)
University graduate		-0.1384*		-0.0383		0.1670**		0.0097
		(0.081)		(0.051)		(0.075)		(0.086)
Elite school, PhD		-0.2024**		-0.0668		0.2372***		0.0320
		(0.079)		(0.050)		(0.075)		(0.085)
Age		0.0015***		0.0025***		-0.0041***		0.0001
		(0.001)		(0.000)		(0.001)		(0.001)
Female		**0.0115**		**-0.0229***		**-0.0272**		**0.0386***
		(0.020)		(0.014)		(0.022)		(0.022)
Obs.	6309	6309	6309	6309	6309	6309	6309	6309

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 2: Preferred Voting Rule and Non Sincere voting (Marginal Effects)

	(1) 2 rounds	(2) 1 round	(3) Alt	(4) Appr
Non sincere voting	-0.0928***	0.0240	0.0218	0.0471
	(0.025)	(0.026)	(0.034)	(0.034)
Prefers viable Candidate	0.1776***	0.0008	-0.1342***	-0.0442*
	(0.022)	(0.016)	(0.027)	(0.026)
Ideology:				
Left	-0.0905***	-0.0807***	0.1189***	0.0523**
	(0.019)	(0.016)	(0.025)	(0.024)
Center	-0.0968***	-0.0823***	0.1285***	0.0506
	(0.032)	(0.020)	(0.038)	(0.035)
Right	Ref.	Ref.	Ref.	Ref.
Education:				
No diploma	Ref.	Ref.	Ref.	Ref.
Secondary education	-0.1224	0.0089	0.0740	0.0396
	(0.085)	(0.058)	(0.082)	(0.095)
Bachelor	-0.1141	-0.0273	0.1334*	0.0080
	(0.082)	(0.053)	(0.076)	(0.088)
University graduate	-0.1317	-0.0404	0.1656**	0.0065
	(0.081)	(0.052)	(0.075)	(0.087)
Elite school, PhD	-0.1926**	-0.0699	0.2352***	0.0274
	(0.079)	(0.051)	(0.075)	(0.086)
Age	0.0015***	0.0025***	-0.0041***	0.0001
	(0.001)	(0.000)	(0.001)	(0.001)
Female	0.0088	-0.0224	-0.0263	0.0400*
	(0.020)	(0.014)	(0.022)	(0.022)
Obs.	6309	6309	6309	6309

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A1: Aggregate results under the four voting rules (%)

	2-R		1-R	Alternative Vote									Approval
Candidate	Round 1	Round 2		Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Step 8	Step 9	
F. Hollande	29	56	31	25	25	25	25	25	28	33	36	55	46
N. Sarkozy	27	44	28	27	27	27	27	28	28	32	42	45	36
M. Le Pen	18	/	16	15	15	15	15	16	17	17	/	/	23
J.-L. Mélenchon	11	/	10	12	12	12	13	14	16	18	21	/	36
F. Bayrou	9	/	9	11	11	11	11	11	12	/	/	/	41
E. Joly	2	/	2	6	6	6	6	6	/	/	/	/	33
N. Dupont-Aignan	2	/	2	3	3	3	3	/	/	/	/	/	15
P. Poutou	1	/	1	1	1	2	/	/	/	/	/	/	11
N. Arthaud	1	/	0	1	1	/	/	/	/	/	/	/	7
J. Cheminade	2	/	0	0	/	/	/	/	/	/	/	/	4
Total	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*254*

Note: Total number of observations: 8,044.

The approval scores are the percentages of voters who approve the candidates, therefore they do not sum to 100.

Table A2: Summary Statistics

	All	François **Hollande**	Nicolas **Sarkozy**	Marine **Le Pen**	J.-L. **Mélenchon**	François **Bayrou**	Eva **Joly**
	(mean)	*(mean)*	*(mean)*	*(mean)*	*(mean)*	*(mean)*	*(mean)*
Preferred Voting Rule:							
Two-round	0.225	0.273	0.382	0.190	0.111	0.082	0.036
One-round	0.079	0.054	0.113	0.147	0.032	0.034	0.049
Alternative vote	0.414	0.389	0.283	0.390	0.519	0.565	0.587
Approval vote	0.281	0.284	0.222	0.274	0.338	0.320	0.328
Socio-demographic:							
No diploma	0.023	0.019	0.016	0.059	0.022	0.006	0.010
Secondary education	0.097	0.058	0.113	0.175	0.099	0.060	0.042
Bachelor	0.226	0.190	0.221	0.284	0.264	0.177	0.232
University graduate	0.293	0.337	0.247	0.281	0.311	0.300	0.307
Elite school graduate, PhD	0.359	0.395	0.403	0.200	0.304	0.458	0.409
Age	36.485	39.953	35.550	36.066	35.297	34.265	36.014
Female	0.262	0.313	0.250	0.193	0.274	0.245	0.320
Observations	6309	1634	436	143	1957	980	1159

Table A3: Preferred Voting Rule and Preferred Candidate (Marginal Effects)

	(1) 2 rounds	(2) 2 rounds	(3) 1 round	(4) 1 round	(5) Alt	(6) Alt	(7) Appr	(8) Appr
Preferred candidate:								
F. Hollande	-0.1090***	-0.1195***	-0.0592***	-0.0662***	0.1062***	0.1219***	0.0620**	0.0638**
	(0.027)	(0.027)	(0.018)	(0.017)	(0.026)	(0.026)	(0.026)	(0.025)
N. Sarkozy	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
M. Le Pen	-0.1922***	-0.2130***	0.0336	0.0133	0.1068**	0.1401***	0.0518	0.0596
	(0.041)	(0.040)	(0.034)	(0.032)	(0.047)	(0.047)	(0.044)	(0.044)
Mélenchon	-0.2711***	-0.2798***	-0.0809***	-0.0828***	0.2362***	0.2438***	0.1158***	0.1187***
	(0.026)	(0.026)	(0.018)	(0.018)	(0.030)	(0.030)	(0.029)	(0.029)
F. Bayrou	-0.3002***	-0.2994***	-0.0794***	-0.0743***	0.2818***	0.2671***	0.0977***	0.1066***
	(0.026)	(0.027)	(0.018)	(0.018)	(0.034)	(0.034)	(0.032)	(0.032)
E. Joly	-0.3458***	-0.3517***	-0.0645***	-0.0587**	0.3042***	0.3010***	0.1061***	0.1095***
	(0.027)	(0.027)	(0.023)	(0.024)	(0.041)	(0.040)	(0.036)	(0.036)
Education:								
No diploma		Ref.		Ref.		Ref.		Ref.
Secondary education		-0.1279		0.0112		0.0754		0.0413
		(0.084)		(0.058)		(0.082)		(0.094)
Bachelor		-0.1148		-0.0260		0.1324*		0.0084
		(0.081)		(0.053)		(0.076)		(0.088)
University graduate		-0.1316*		-0.0393		0.1642**		0.0067
		(0.080)		(0.051)		(0.076)		(0.086)
Elite school, PhD		-0.1939**		-0.0675		0.2328***		0.0285
		(0.078)		(0.050)		(0.076)		(0.086)
Age		0.0015***		0.0025***		-0.0041***		0.0001
		(0.001)		(0.000)		(0.001)		(0.001)
Female		0.0128		-0.0230*		-0.0282		0.0385*
		(0.020)		(0.014)		(0.022)		(0.022)
Obs.	6309	6309	6309	6309	6309	6309	6309	6309

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A4: Preferred Voting Rule and Candidate-Centered attitudes (Marginal Effects)

	(1) 2-round	(2) 2-round	(3) 1 round	(4) 1 round	(5) Alt	(6) Alt	(7) Appr	(8) Appr
Party-centered	-0.0254	0.0040	-0.0455***	-0.0277*	0.0513**	0.0241	0.0195	-0.0004
	(0.020)	(0.021)	(0.014)	(0.015)	(0.023)	(0.024)	(0.021)	(0.022)
Prefers viable Candidate	0.2170***	0.1923***	0.0096	-0.0038	-0.175***	-0.1432***	-0.0517**	-0.0453*
	(0.020)	(0.023)	(0.015)	(0.017)	(0.023)	(0.027)	(0.021)	(0.025)
Education								
No diploma	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Secondary education	-0.1345	-0.1228	0.0239	0.0230	0.0888	0.0820	0.0218	0.0177
	(0.092)	(0.089)	(0.066)	(0.058)	(0.083)	(0.086)	(0.091)	(0.097)
Bachelor	-0.1443	-0.1231	-0.0277	-0.0138	0.1634**	0.1437*	0.0086	-0.0067
	(0.089)	(0.085)	(0.060)	(0.052)	(0.077)	(0.080)	(0.085)	(0.090)
University graduate	-0.1673*	-0.1374	-0.0466	-0.0278	0.1981***	0.1685**	0.0158	-0.0034
	(0.087)	(0.084)	(0.058)	(0.051)	(0.076)	(0.079)	(0.084)	(0.089)
Elite school, PhD	-0.2352***	-0.2053**	-0.0803	-0.0607	0.2781***	0.2454***	0.0375	0.0206
	(0.086)	(0.083)	(0.056)	(0.049)	(0.076)	(0.079)	(0.084)	(0.089)
Age	0.0011*	0.0015**	0.0024***	0.0026***	-0.0039***	-0.0042***	0.0004	0.0002
	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Female	0.0025	0.0111	-0.0258*	-0.0212	-0.0151	-0.0246	0.0384*	0.0348
	(0.022)	(0.022)	(0.015)	(0.015)	(0.024)	(0.024)	(0.023)	(0.023)
Ideology								
Left		-0.0988***		-0.0688***		0.1070***		0.0606**
		(0.023)		(0.016)		(0.027)		(0.025)
Center		-0.1077***		-0.0749***		0.1425***		0.0401
		(0.036)		(0.020)		(0.040)		(0.035)
Right		Ref.		Ref.		Ref.		Ref.
Obs.	5519	5519	5519	5519	5519	5519	5519	5519

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$