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KIEL WORKING PAPER

**Opportunistic Candidates
and Knowledgeable
Voters – A Recipe
for Extreme Views**



No. 2047 August 2016

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ABSTRACT

OPPORTUNISTIC CANDIDATES AND KNOWLEDGEABLE VOTERS – A RECIPE FOR EXTREME VIEWS

David Benček

In recent years, a number of Western industrialized nations have experienced a notable polarization of political ideologies, and growing numbers of individuals seemingly support extreme positions. As a result, established political parties have moved to the left or right and new parties have appeared on the fringes. But why are people with extreme political views this visible in the public debate, and how are they able to move party positions further to the margins when they should be outnumbered by a moderate majority? Contradictory to the classic literature that focuses on collective action problems, this paper studies emerging effects from informational asymmetries. It extends a spatial voting model to include incompletely informed candidates and knowledgeable voters. Agent-based simulations suggest that only fringe voters benefit from distorting their opinions and dominating political discourse. At the same time, better informed candidates have a competitive advantage in elections no matter how strongly voters distort their positions.

Keywords: spatial voting, heterogeneous actors, extreme opinions, agent-based modelling

JEL classification: C63, D02, D72

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1 Introduction

Recently, a number of Western industrialized nations have experienced a notable polarization of political ideologies and growing numbers of individuals seemingly support extreme views on the left or right. Survey data among US American adults, for instance, show a “growing ideological distance” between parties as well as along educational and generational lines (Pew Research Center, 2014; Pew Research Center, 2016). Reacting to such shifts in preferences, established political parties have moved considerably to the left or right, and new political parties have emerged – and succeeded – on the fringes of policy space. The impact of Bernie Sanders and his supporters on the US Democratic Party’s platform with regard to issues such as the minimum wage or Wall Street reform, the rise of Donald Trump as the Republican Party’s presidential candidate, but also the widespread emergence of anti-immigration parties in Western Europe or the electoral successes of left-wing parties in Greece, Portugal, or Spain are examples of these trends. It seems as if extreme political views have become more prevalent in public discourse, have moved “from the margins to the mainstream” (Lowles, 2015), and have considerably influenced the face of party systems for years to come. But why are people with extreme political views this visible in the public debate, and how are fringe voters able to move party positions to the extremes when they should be outnumbered by a moderate majority?

This paper develops a spatial voting model built upon a classic Downsian framework extended by incomplete information, heterogeneous candidates and knowledgeable voters to show why fringe political views influence the political discourse to the extent observed today. The motivation underlying this approach is twofold: With such departures from the standard model this paper contributes to the theoretical literature by accounting for empirical observations in the model’s assumptions. As recent studies have highlighted, notable discrepancies exist between voter preferences and candidate assessment of their constituency due to ideology or political commitments (e.g. Enos and Hersh, 2015; Broockman and Skovron, 2015) and cognitive heuristics (Miler, 2009).

Additionally, adopting an extended spatial voting model in order to comprehend widespread shifts in our political discourse can help trace the mechanisms responsible for them. Of course, a common theoretical explanation of differences between individual preferences and social outcomes is based on collective action problems among the large majority of people holding moderate views (cf. Olson, 1965). What extremists lack in numbers they make up for by dominating public discourse, while the moderate majority is trapped in a situation where no one feels urged to proclaim their views. However, we live in a time of instantaneous unlimited communication and a real-time feedback loop between politicians and their constituency; opinion polls are being conducted constantly and statistical models have become sophisticated and relatively accurate tools for predicting election outcomes. In this environment, society is conspicuously aware of the interplay of politics and political interests; and voters have an adequate understanding of democratic processes. So if there were a collective action problem inhibiting moderate views to challenge extreme opinions in public discourse,

it would be identified and internalized almost immediately. By incorporating knowledgeable voters in a spatial voting framework the potential causes of discourse shifts are thus not subsumed under the umbrella of collective action but can instead be traced along the mechanisms at work.

Focusing on the combination of incompletely informed candidates and voters' interest in affecting policy, this paper argues that only voters holding fringe political views should have a justifiable interest in signalling their preferences distorted towards even more extreme positions. Voters with moderate political opinions do not benefit from similar signalling behavior due to the complex interplay of electoral competition, multiple attempts at influence, and opportunistic candidate behavior under incomplete information. Simulations of the model support this proposition and further show that better informed candidates as well as stronger electoral competition both mitigate such disparate behavioral incentives.

The remainder of this paper proceeds as follows: Section 2 briefly reviews the relevant literature on the interplay between voter preferences and candidate perceptions and behavior. Subsequently, section 3 presents a spatial voting model with informational and behavioral frictions. The formal model is used to derive the proposition that only fringe voters with preferred policies sufficiently far from the center in an n -dimensional issue space benefit from signalling distorted opinions, because only they can influence candidate platforms in the desired way. This proposition is then examined in section 4 using an agent-based simulation implemented in NetLogo. The simulation enables us to fully consider the implications of heterogeneous agents and investigate different parameter constellations regarding the informational capacity of candidates, electoral competition, and voter influence. The final section concludes and identifies avenues for future research.

2 Background

The concept of spatial competition, starting out with Hotelling (1929) and Black (1948), and popularized by Downs (1957), has produced a vast and diverse literature within the social sciences (e.g. Stokes, 1963; Eaton and Lipsey, 1975; Aoyagi and Okabe, 1993). It has especially influenced theoretical research on party policy strategies as well as empirical studies of voting behavior (cf. Adams and Merrill III, 2000). Most of this literature has focused on two particular issues: First, the existence of stable or unstable equilibria in policy space under various circumstances and model assumptions has been the topic of numerous studies. For instance, Lin, Enelow, and Dorussen (1999) demonstrate that differences in equilibria exist between deterministic and probabilistic multicandidate spatial voting models; Schofield (2006) develops a spatial model with valence, in order to explain the gap between theory and empirical observations regarding equilibria in voting models, and derives general conditions under which local Nash equilibria exist in a multi-party setting; and Banks and Duggan (2005) set up a basic and common framework to unify large parts of

the existing literature on probabilistic voting with two candidates. They prove the existence of equilibria in pure and mixed strategies and relate them to social optima.

Second, the spatial voting framework has also been applied to the explanation of variance in voter turnout: Plane and Gershtenson (2004) study voter alienation in US mid-term elections and find that voter indifference and alienations explain why voters abstain from casting their vote; and Geys (2006), in a meta-analysis of 83 studies on voter turnout, highlights in particular population size and election closeness as explanations for why people turn out in elections.

A very common simplifying assumption in these studies is that of perfect information of either candidates, voters or both (see e.g. Shepsle and Weingast, 1984). For instance, McKelvey and Patty (2006) use a Bayesian framework that includes game-theoretic considerations for voters in order to model strategic voting – but this implicitly assumes voters to have the capabilities to process lots of information. Stimson, Mackuen, and Erikson (1995, p. 559) are also optimistic about politicians’ ability to correctly assess preferences of their constituency and describe them as “keen to pick up the faintest signals”. When testing the predictions of such spatial voting models, the empirical literature takes these assumptions as given (see e.g. Schofield, Sened, and Nixon, 1998).

But empirical studies have shown noteworthy discrepancies between the assumptions underlying standard spatial voting models and actual candidate behavior: Candidates have widespread and lasting misperceptions about their constituencies. Miller and Stokes (1963, p. 56) were the first to show empirically that representatives have “very imperfect information about the issue preferences of [their] constituency”. Several studies have also shown that politicians are more likely to consider information coming from specific interest groups (Bartels, 2009; Hacker and Pierson, 2010; DeCanio, 2005; Gilens, 2012). Similarly, Miler (2007) finds that candidates do not assess information from all constituents, nor from the largest constituencies, but rather from the most active and resource-rich constituents. Therefore it is not surprising that according to Page, Bartels, and Seawright (2013) the top 1 percent of US wealth-holders, which tends to be both more conservative and more politically active than the rest of the population, has a higher impact on government policies than the majority of US citizens. Miler (2009) also studies the role of incomplete or unrepresentative information in politicians’ judgement and suggests the widespread use of cognitive heuristics by decision-makers. Their effects can be found in Enos and Hersh’s (2015) research who find political campaign staff overly confident and note how this limits the benefits of electoral competition.

So while there is abundant evidence of bounded rationality and the resulting systematic or incidental misperceptions, it is mostly the empirical literature accounting for them. As a result, formal theoretical models neglect the complex properties of established political systems which consist of a constant interplay of actors and can thus exhibit emerging dynamics. This paper therefore develops a formal spatial voting model that expands the standard framework with respect to three essential aspects: First, candidates do not possess complete information about voter preferences. They can only consider a subset of opin-

ions when choosing their policy platform for elections. Second, candidates are heterogeneous with respect to the scope of information they are able to take into account. As in real elections, some candidates are more experienced, have higher quality information or more resources at their disposal, or are simply more interested in the preference structure of the electorate. Some candidates thus choose their platform based on more voter information than others. Lastly, voters in the proposed model are knowledgeable in the sense that they are aware of how the democratic process functions. Voters know that candidates try to win elections and do so by appealing to as large a share of the electorate as possible. Consequently, voters are able to signal their preferences but do not necessarily need to signal them truthfully. The underlying rationale is to influence the candidates' perceptions and arrive at more favorable policy outcomes.

With these built-in informational and behavioral imperfections, the proposed model is detached from the focus on equilibria and instead illustrates the complex system dynamics of interdependent political behavior. The model allows for candidates to be influenced by voters to varying degrees and conditional on the underlying preferences. The following section describes the properties and dynamics of the model in more detail.

3 Model

The spatial voting model depicts the interaction of candidates and voters and the ensuing dynamics in discrete time. For reasons of clarity and legibility, the time subscript t is omitted in this exposition.

3.1 Basic Structure

Actors The proposed model accommodates two types of actors, candidates and voters, who are scattered randomly across an n -dimensional, bounded policy space $Y \subseteq \mathbb{R}^n$ according to some density function $f_n^c(\cdot)$ and $f_n^v(\cdot)$, respectively.

Each candidate $j = 1, \dots, M$ has a unique policy platform $p_j \in Y$, represented by her position in policy space and $\mathbf{p} = (p_1, \dots, p_M)$ is the vector of all candidate platforms. Candidates attempt to win elections by choosing their platform in policy space.

Each voter $i = 1, \dots, N$ has a stationary but not necessarily unique bliss point $b_i \in Y$. Voters have single-peaked, symmetric preferences according to some function $u_i(p_j)$ and their utility strictly decreases in the distance between a given policy and their ideal point. For simplicity, utility is determined by their Euclidean distance¹

$$u_i(p_j) = -\|b_i - p_j\|. \tag{1}$$

¹A common alternative to this linear utility model is the quadratic utility $u_{ij} = -\|b_i - p_j\|^2$. The main difference between both is the stronger relative penalty that the quadratic utility places on distance. This paper follows Singh (2013), who argues that the linear formulation more accurately reflects actual election outcomes.

Since voters are assumed to be utility maximizing, they will always cast their ballot in favor of the candidate closest to their bliss point. In case two or more candidates have chosen their platform at the exact same distance, he is indifferent and chooses randomly between them.

Incomplete and Unreliable Information Candidates do not possess complete information about voter preferences. In particular, they do not know the distribution of bliss points across policy space. In order to estimate the aggregate preference structure, they depend on voters signalling their ideal points. Candidates remain, however, incompletely informed for two reasons: First, candidates are not able to take into account signals from the entire population of voters. Instead each candidate j is only able to consider c_j voters in each election cycle. Heterogeneity of candidates with respect to c_j may be interpreted as differences in financial endowments, infrastructure and political experience – generally, necessary prerequisites to develop and implement balanced and inclusive policies based on voter preferences.

The second reason for the persistently incomplete knowledge lies in a behavioral trait of voters: They are solely interested in policy outcomes, no matter which candidate ends up implementing them. As voters try to maximize their personal utility, they therefore always prefer a candidate to be closer to them than further away. They are furthermore aware that candidates use their signals to assess voter preferences when choosing a platform. Consequently, voters do not necessarily signal their true bliss points, but may instead distort their preferences strategically so as to pull the respective candidate closer to them. In a similar fashion as Buechel, Hellmann, and Klößner (2012) model the misrepresentation of individual opinions by non-conformists in consensus-seeking discussions, voters tend to overstate their preferences subject to the current platform the targeted candidate occupies. In particular, each voter has an innate propensity s_i by which they misrepresent their signalled bliss point. So the opinion o_{ij} signalled by voter i to candidate j is given by

$$o_{ij} = b_i + s_i (b_i - p_j). \quad (2)$$

Candidates receive a random sample \mathcal{S}_j of voter signals each period. The signal sent by a specific voter always depends on the current platform taken up by the candidate it is intended for and will not be the same for two candidates unless $p_j = p_k$. Candidates therefore receive skewed information that depends on their current platform, as well as the voters' unobserved position and propensity to misrepresent their preferences.

In each period, this randomly drawn sample of size c_j provides a candidate with a temporary set of opinions $\omega_j = \{o_{ij}\}_{i \in \mathcal{S}_j}$, which serves as a basis for assessing the preference structure of the voter population.

Candidate Behavior Candidates seek to be elected and therefore try to maximize their expected vote share. But they cannot be sure about exact voter preferences (especially since they estimate them using a sample of voters). This

would, however, be required to model candidates' estimates of voting probabilities as a discontinuous step function that only takes the values $\{0, 1\}$, depending on whether or not the candidate is closest to a particular voter's bliss point. Furthermore, voters might not necessarily be perfectly informed about candidate positions and thus perceive them within a margin of error. Therefore even perfect knowledge of voter preferences would not enable candidates to clearly demarcate regions of winning platforms.

In light of this, it is more realistic to base candidate decisions on a probabilistic voting model, in which their likelihood of receiving a vote increases as their platform approaches a voter's ideal point. In order to preserve the generality of the model, utility and not simply distance is considered in the likelihood function, because there may be additional factors such as loyalty or ideology that influence voter decisions. For simplicity, however, the utility function is reduced to distance in this exposition. As explained above, candidates are imperfectly informed about voter preferences and use o_{ij} as a proxy for b_i , which may or may not coincide. The utility function of any voter i in a candidate's maximization rationale is thus

$$v_i^j(p_k) = u_i(p_k | b_i = o_{ij}) = -\|o_{ij} - p_k\|. \quad (3)$$

This denotes candidate j 's estimate of voter i 's expected utility given candidate k 's platform. The fact that voters may communicate different bliss points to different candidates, i.e. $p_j \neq p_k \iff o_{ij} \neq o_{ik}$ if $s_i > 0$, makes this superscript necessary to indicate whose estimate is being considered.

In order to determine voting probabilities, a standard contest success function is used and from the perspective of candidate j , the probability of receiving a vote from voter i is

$$\pi_{ij}(\mathbf{p}) = \frac{e^{\alpha v_{ij}^j}}{\sum_{k=1}^m e^{\alpha v_{ik}^j}} \quad \text{with } \alpha > 0. \quad (4)$$

This way of modelling the probabilistic voting scheme in conditional logit form goes back to a difference-based contest success function (Tullock, 1967; Tullock, 1980; Hirshleifer, 1989; Coughlin, 1992) and has been applied in empirical studies on voting (e.g. Adams and Merrill III, 2000; Merrill III and Adams, 2002).

Each candidate seeks to maximize her expected vote share $\frac{1}{n} \sum_{i=1}^n \pi_{ij}$. But since probabilities can only be estimated for those voters included in the candidate's own sample \mathcal{S}_j , the objective function is limited to

$$\max_{p_j} \pi_j(p_j | \mathbf{p}_{-j}) = \frac{1}{c_j} \sum_{i \in \mathcal{S}_j} \frac{e^{\alpha v_{ij}^j}}{\sum_{k=1}^m e^{\alpha v_{ik}^j}} \quad \text{s.t. } p_j \neq p_k \text{ for all } k \in P \quad (5)$$

and is conditional on all other candidate platforms $\mathbf{p}_{-j} = (p_1, \dots, p_{j-1}, p_{j+1}, \dots, p_M)$. This implies that the candidate-specific set of voter opinions is treated by each candidate as if it were representative of the entire voter population.

3.2 Model Dynamics

From an individual voter’s perspective a biased disclosure of preferences attaches a higher weight to his utility in the candidate’s decision-making process and therefore also raises the expected utility from potential future policy. It is easy to show by combining equations 2 and 3 that candidate j ’s evaluation of voter i ’s utility becomes $v_i^j(p_j) = (1 + s_i)u_i(p_j)$. Thus strategic opinion distortion should increase the weight attached to his true utility in candidate j ’s estimate by $(1 + s_i)$. But whether or not this actually increases the weight of his likelihood contribution in the candidate’s maximization rationale depends on the spatial distribution of (i) the other candidates and (ii) the other voters in the candidate’s polling sample.

Because a distorted communication of opinion $s_i > 0$ not only affects the respective candidate’s estimate of voter utility given her own policy platform, so that $v_i^j(p_j) \neq u_i(p_j)$, it also changes the candidate’s estimate of the voter’s utility given other candidates’ platforms: $v_i^j(p_k) \neq u_i(p_k)$. This affects the relevant part of candidate’s objective function in the following way:

$$\pi_{ij} = \frac{e^{-\alpha(1+s_i)\|b_i-p_j\|}}{\sum_{k=1}^m e^{-\alpha\|(1+s_i)b_i-s_i p_j-p_k\|}} \quad (6)$$

As voter i ’s opinion is distorted to pull candidate j closer to b_i , it also depends upon the relative positions of other candidates k whether this actually increases π_{ij} compared to a non-distorted signal. The relative positions of other parties, in turn, depend on the overall distribution of voters.

Proposition 1. *Whether or not a voter can benefit from distorted opinion signalling depends upon her true bliss point in policy space. Only if it is located sufficiently far from the center will the signalled opinion affect the candidate in the desired way and increase the weight of the true opinion.*

Due to the complexity created by the heterogeneity of actors in conjunction with the multi-dimensional policy space, there is no closed-form analytical solution of the model and we need to rely on numerical methods. The next section therefore describes the approach taken to simulate the spatial voting model and presents the results.

4 Simulation

In order to examine its dynamics and allow for emerging global behavior, the proposed model was implemented as an agent-based model in NetLogo (Wilensky, 1999). For this simulation the number of policy dimensions is set to 2. Other relevant parameters were varied between runs in order to be able to assess their effects and see whether observed results are stable. Table 1 summarizes the ranges used for each model parameter. Their permutations lead to 147 distinct parameter constellations used in simulating the model. Each simulation run lasted 150 elections and each parameter set was replicated 30 times. During

Table 1: Parameter ranges of simulation

Parameter	Values
Candidates	2-8
Voters	203
Sample Size	5%, 20%, 100%
Distortion	0%, 20%, 80%
Distorting Voters	1, 20, 81
Voter Distribution	$\mathcal{N}_2(0, 25)$
Policy Dimensions	2
Size of Policy Space	101×101

each run, data on voter and candidate behavior as well as on election outcomes were recorded for subsequent analysis.²

Using the simulated data, a closer look at potential differences in the utility levels of voters with and without distorted signals becomes possible. For this purpose, a simple OLS-regression of after-election utility among voters who signalled their opinions on their level of distortion can be estimated:

$$u_i(p_e) = \alpha + \beta s_i + \gamma r_i + \eta s_i r_i + \varepsilon_i, \quad (7)$$

where p_e identifies the policy platform elected by the majority of voters and r_i denotes the distance of voter i 's bliss point from the center of policy space. Since simulations were performed with normally distributed voters around the center, controlling for the voter-specific distance is necessary. The interaction between distortion and distance is of main interest here, since according to proposition 1, only voters with extreme opinions, i.e. voters whose bliss point is located further away from the center of policy space, should benefit from opinion distortion.

Estimation results of equation (7) are shown in table 2. As one would expect, a higher distance of a voter's bliss point from the center decreases utility on average. Distorting preference signals for candidates does not generally lead to higher utility levels. However, the significant and positive interaction effect of distortion and distance clearly shows benefits of distorted signals for voters with extreme opinions. On average, they seem to be able to influence candidates in a way that reduces their distance compared to other voters within the same radius around the center of policy space who do not distort their signals.

As the regression is run as a pooled model over different parameter constellations, these are average results. In order to further analyse the effects, figure 1 additionally depicts the benefits from opinion distortion conditional on the number of candidates competing in elections as well as on the informational advantage, i.e. the sample size, of one of the candidates. Since it is necessary to control for the negative linear effect of distance on utility here as well, utility is depicted in relative terms compared to voters within the same radius corridor.

²For a better understanding of the computational implementation details and in order to enable the interested reader to replicate the results, an ODD description of the model is included in the appendix (cf. Grimm et al., 2010).

Table 2: OLS estimation of voter utility

	Utility
High Distortion	-0.383*** (0.040)
Radius	-0.866*** (0.0003)
High Distortion * Radius	0.009*** (0.001)
Constant	-6.763*** (0.009)
N	7,447,400
R ²	0.542
Adjusted R ²	0.542
Residual Std. Error	10.479 (df = 7447396)
F Statistic	2,943,084.000*** (df = 3; 7447396)

*p < .1; **p < .05; ***p < .01

The upper row of figure 1 shows this relationship if all candidates use little information and receive signals from 5% of the electorate. Only voters whose true bliss point is located outside a radius around the center of more than 50% of the maximum possible distance have an incentive to distort their signalled opinion. With increasing electoral competition, these incentives are reduced and the radius beyond which benefits from distortion can be observed increases. The middle and lower rows of figure 1 furthermore highlight decreased incentives when the sample size of one of the candidates is larger and thus platforms are chosen based on better information.

Lastly, the effects of better information on the behavior of candidates and electoral competition can be seen in figure 2. The number of election wins is significantly higher if candidates can choose their platform based on a larger sample size. This advantage holds up until 5 candidates compete in elections. Beyond this threshold, choices of better informed candidates seem susceptible to randomness in the model, i.e. their maximization of expected votes may at times be too exact and thus minor deviations of anticipated behavior by voters or other candidates lead to defeat.

5 Conclusion

This paper has developed a spatial voting model that incorporates incomplete and unreliable information based on empirical research highlighting cognitive heuristics and systematic misperceptions among politicians. Furthermore, an essential property of the model concerns the behavior of voters: In an age of constant, unlimited communication and sufficient experience with the democratic process, voters can be expected to try to influence policy platforms to

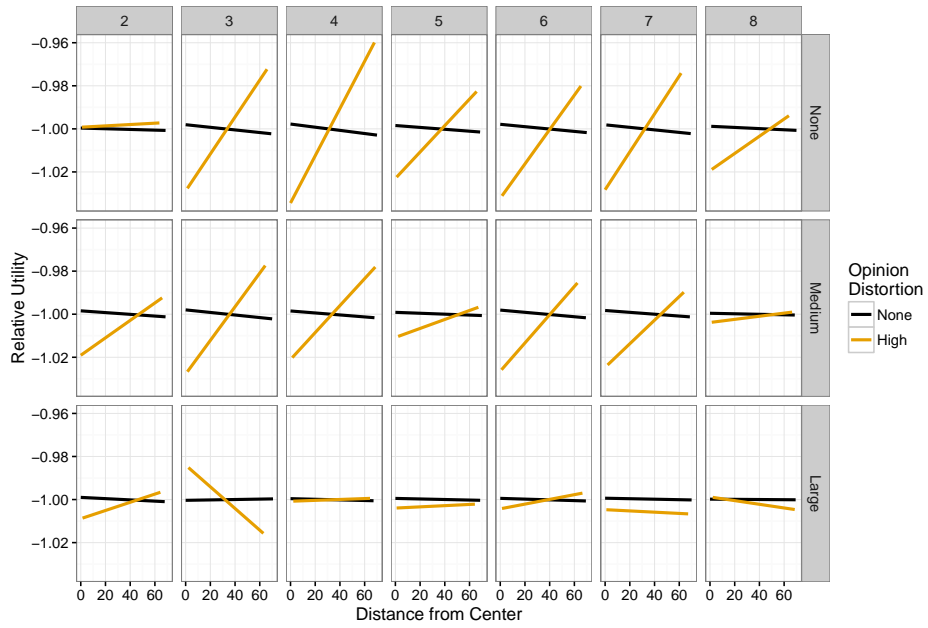


Figure 1: Benefits from opinion distortion by number of candidates and sample size

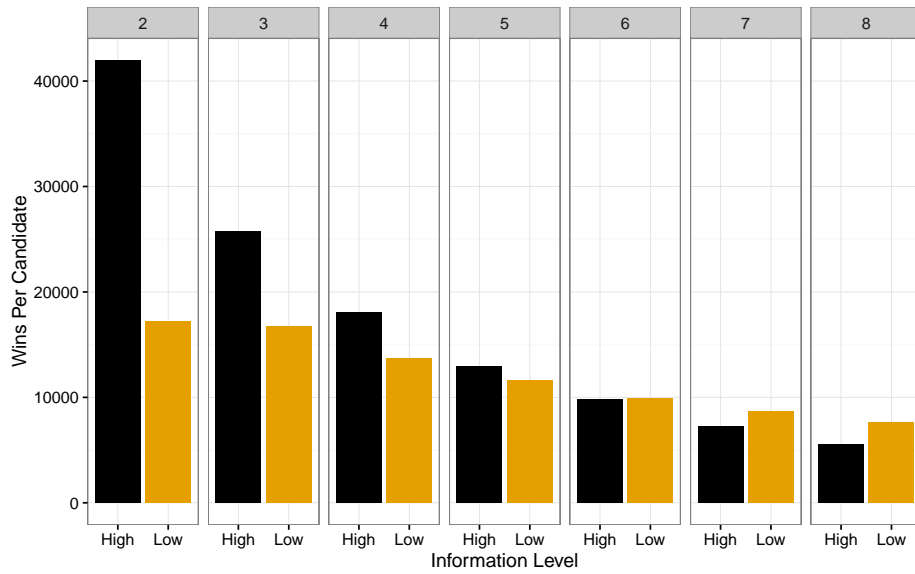


Figure 2: Benefits from more voter information by number of candidates

better suit their preferences. Internalizing this interplay of voter preferences and electoral competition has led to the proposition, that only fringe voters with extreme opinions actually have an incentive to signal their views in an attempt to influence policy platforms in elections. Agent-based simulations of the proposed model support this proposition and show that these incentives for communicating extreme views are especially strong under low electoral competition (i.e. with a small number of political candidates) and when candidates base their decisions on little information.

These results may help explain the widespread shifts in public discourse we observe in recent years. If only supporters of extreme political views have an incentive to proclaim their opinions because only they can reasonably expect to have the desired impact on eventual policy, it is not surprising that the language and topics of public discourse have gotten more extreme. With voters knowledgeable of the mechanisms underlying the democratic process and candidates prone to considering only easily attainable information, moderate views do not benefit from efforts to take over the discussion. Unfortunately, the logic of the proposed model also implies that only after extreme views have succeeded to propagate extreme policies and not only preference signals but elected platforms have shifted to extremes would the moderate majority of voters have an incentive to dominate the political discussion in an attempt to influence policy. The question is thus: How extreme a shift is necessary to jolt the majority from its lethargy?

Even though the theoretical model presented in this paper takes up behavioral properties from the empirical literature to inform its underlying assumptions, its implications require empirical testing. For one, the moderating effect of the number of candidates produces a testable hypothesis: Can we observe much more extreme opinions dominating the political discourse in two-party systems compared to multi-party systems? Does this effect, for instance, also occur in the context of simple yes or no referenda? Are presidential elections more susceptible to an extreme discourse than parliamentary elections? Furthermore, since the model shows decreasing incentives with better informed candidates, newly established democracies should exhibit a more polarized political discourse than consolidated democracies. Finally, as the feedback loop of preference communication and platform evaluation is at the center of the theorized mechanism, further research should also take into account the political discourse in social media. The role of communication bots and fake user profiles in shaping discussions or simulating support deserves further analysis if we want to trace the mechanisms by which extreme views can end up feeling familiar.

A Simulation Description – ODD-Protocol

A.1 Purpose

The simulation explores the effects of frictions in a spatial voting framework: incompletely informed candidates encounter voters that may signal their opinions

in a strategically distorted way. Is it generally beneficial for voters to distort their signals strategically or only under certain circumstances? Do effects differ between two-candidate and multi-candidate systems? Should candidates try to gain more detailed knowledge about voter preferences or is there a threshold beyond which more information is useless (or even harmful)?

A.2 Entities, state variables, and scales

There are two types of actors, voters and candidate, who both inhabit a location on a grid of 101×101 cells. For voters, this location is fixed and represents their most preferred policy (bliss point); candidates may change their location once per time step, it represents their policy platform in an election. Furthermore, candidates are heterogeneous in the number of voter signals they are able to consider per time step. In each time step, they assess the preference structure of voters based on the signals they receive. Voters, have a heterogeneous propensity to strategically distort their true bliss point. In order to perform elections, voters each have one vote that indicates one of the competing candidates. Each voter also determines after each election his personal level of satisfaction given the election winner. One time step represents one election cycle and simulations were run for 150 cycles.

A.3 Process overview and scheduling

The following actions are executed once per time step:

- Candidates receive signals from a subset of voters, the size of which depends on their respective ability to process signals. Candidates receive their signals consecutively and in a random order (see submodel *signalling*).
- Voters signal their true or distorted bliss point (see submodel *opinion*).
- The set of signals to each candidate informs their current assessment of the preference distribution in policy space.
- Candidates maximize their number of expected votes according to this estimated preference structure by changing their location (see submodel *choose platform*).
- An election takes place, in which all voters cast their vote for their preferred candidate (i.e. the one being closest to them); the candidate with a simple majority of votes wins (see submodel *election*).
- Voters determine their level of satisfaction given the elected candidates' platform.

A.4 Design concepts

The following concepts and theories were taken into account for performing the simulation:

- spatial voting in two dimensions
- bounded rationality
- strategic communication/preference distortion
- spatial tessellation

A.5 Initialization

A specified number of voters (203 in the simulation runs) and candidates (simulations were performed with 2 – 8) are initialized. Voters are scattered across the 10201 patches according to a bounded two-dimensional normal distribution with zero mean and a standard deviation equal to 25% of the range in each dimension. Candidates are placed randomly on an empty patch with uniform probability.

Each agent’s location at once defines their bliss point (voters) and current platform (candidates). For all voters except of a subset the strategic propensity s_i is set to zero. The size of the subset is user-specified and their strategic propensity is set to a chosen value between zero and one (simulations were performed with 1, 20 and 80 agents receiving a strategic propensity of either 0.2 or 0.8). Voters are chosen randomly to belong to the subset at the start of each simulation.

Candidates are assigned the number of voter signals they are able to consider per time step: In one set of simulations, all candidates were only able to consider 5% of the population in each period. Further sets of simulations were run, that had all but one candidate still relying on 5% of opinions and one randomly selected candidate having a competitive advantage. This advantage was being able to consider either 20% of opinions or even the entire voter population.

A.6 Input data

No input from external models or data files is used.

A.7 Submodels

The following submodels are employed by agents at certain points in the simulation process:

In order to create their list of bliss points for a subset of voters, candidates use the submodel *signalling* in a random sequence. This lets them choose randomly a certain number of voter signals from the entire population. Exactly how many signals a candidate receives is determined by the candidate-specific variable c_j . Each chosen voter is then asked for her bliss point, in reaction to which voters

use the submodel *opinion*. The signals are stored by the candidate as a list and used in the submodel “choose platform” as an assessment of the spatial preference distribution.

The submodel *opinion* is employed by voters to signal their (possibly distorted) bliss point. In case the voter is not currently at his preassigned bliss point, he moves to its location. If he has no strategic propensity, he then simply signals his location (x, y) . If, however, his strategic propensity s_i is positive, the voter will face the candidate targeted to receive the signal, move backwards by a fraction s_i of the Euclidean distance to the candidate and report the resulting location. Since policy space is bounded, a situation may occur in which the voter cannot move as far away from the candidate as his strategic propensity would make him wish to. In that case the voter will distort her position as much as possible, i.e. move to and signal a location on the boundary of policy space.

In the submodel *choose platform*, candidates calculate the expected share of votes for each possible platform in policy space, then move to the location with the highest share. They calculate the expected share for a single location by determining the sum of likelihoods of receiving a vote over all voters they have received signals from. The likelihood is given by a logit function that uses Euclidean distance from the respective voter at the platform being considered. This submodel is the numerical solution to the maximization problem stated in equation 5.

During the submodel *election*, the positions of all agents are fixed and voters determine, which candidate is closest to their bliss point. This is achieved by dividing up policy space into Voronoi polygons, using an algorithm by Wilensky (2006). Candidates act as generator points of the Voronoi polygon and their cells comprise their respective constituency. Voters sense whose cell they lie in and set their vote to reflect their preference for that candidate. Candidates then count the number of their votes and the election winner is determined according to a simple majority rule. A coin toss breaks potential ties.

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