# The Role of Communication in Voting with Multi-dimensional Platforms

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**Abstract**
This work analyzes a voting model with multi-dimensional platform space in a situation of incomplete information. Voters rationally compare platforms given the available information and so they formulate an intention of vote. Then an imitation mechanism due to talking comes into place. Parties decision are exogenous, in particular their platforms are deterministic with some stochastic components regarding communication. Results of interest are about platforms divergence, segregation, the role of communication and volatility of electoral results.

# 1 Introduction

## 1.1 Voting models: between political economics and ABMs

Over the last century, the economic theory has developed many models aimed at formalizing, and possibly explaining voting mechanisms. This work, which belongs to the field of Political Economy, relies on some assumptions about individual preferences and their behavior. The simplest model has to take into account different set of agents: candidates, who announce platforms, and voters, which vote a platform according to their preferences. In general we have preferences relations over a specific space of platforms, which are defined according to the classical approach used in microeconomic theory. Indeed, preferences are assumed to be complete and transitive, meaning rational. If we look at the structure we might use to model candidates, there are several ways to do it. For instance candidates may be endogenously or exogenously determined, or they might have or not their own preferences over the space of platforms. A common feature to all of this model is the assumption about candidates' strategic behavior. These kind of models have had lot of success because of the simplicity and the elasticity they own. However, they has also many limits, both regarding the assumption they make and the conclusion they reach. If we look at the assumptions, they simply suffer the same problems of the classic microeconomic assumptions: even if they are reasonable and necessary in a mathematical model, they do not always represent well the way individuals take their decision. If we look at the results, the theory in the field of political economics is scared by many paradoxes and empirical evidences which is not able to explain. Just to give an example, rational individual should not vote as the probability that their vote matters is close to zero. That is that given standard assumptions about rationality voters behavior and the empirical level of social turnout is not that easy to be explained (Mackie and Rose 1997). An alternative may be found in ABMs. Like analytical models, ABMs are built on formal assumptions about agents and how they interact. Similar to the standard analytical models, the assumptions are clearly defined, the results are stated in precise terms, and they are, typically, easy to replicate (Gilbert and Troitzsch 1999). These models, being less formalized, allow to simpler and less restrictive assumptions. Note that these simpler assumptions, as they are less formalized and more general, could not be part of a mathematical model, and allows for instance for irrational or bounded rational agents. Moreover, using Monte Carlo methods, it is possible to endow such models with high degrees of randomization and heterogeneity, achieving results different by the ones obtained by the theory.

## 1.2 Some fundamental assumptions in political economics

Let consider models from the theory and the related assumptions on voters' behavior. There are two assumptions that we want to focus on, made respectively on the structure of preference relations and on the decision rule applied by voters.

**Definition:** *A binary relation* $\geq$ *over a set* $X$ *is a linear order if it is :* $(a)$ *transitive,* $(b)$ *complete, and* $(c)$ *anti* $-$ *symmetric* $[x \geq y$ *and* $y \geq x \Rightarrow x = y]$.

**Definition:** *A preference relation* $R$ *is single peaked with respect to a linear order* $\geq$ *if there exists* $x$ *such that :* $z \geq w \geq x \Rightarrow wRz$ *and* $x \geq w \geq z \Rightarrow wRz.Wesaythat$ *x is the bliss point.*

A result that follows is that, if we assume that the preference relation R is single peaked with respect to a linear order $\geq$, there always exists a median voter (Gans and Smart 1996). Indeed, those two conditions are sufficient to prove the well-known Median Voter Theorem, which shows how, in some situations, it always wins the party which announces the preferred policy of the median voter. In particular this result always applies to situations in which there are two candidates exogenously determined. If we consider the decision rule used by voters, it relies on rational (in particular optimizing) behaviors, which are perfectly implementable if the previous conditions that ensure the existence of the median voter apply. Note that there are many ways to introduce uncertainty in these models, in order to let them be less deterministic.

## 1.3 About the good sense of the assumptions and possible alternatives

Let consider preferences which are single-peaked with respect to a linear order $\geq$. To keep the sense of this formulation let consider a simple example: it means for instance that is possible to order all political parties in terms of left-wing and right-wing, and that this is the only thing that matters for voters. If this assumptions might seem obvious few decades ago, recent facts suggest how it could be useful to go through it again. For instance consider the progressive decreasing of differences between right-wing and left-wing parties, and the rise of populism and of anti-system parties. Moreover, it is possible that a party announces right-wing platform about education and left-wing platform regarding ethics, and it is also an anti-system party for policies regarding taxation. This overview of recent political events offers some interesting suggestions about how we could modify the traditional assumptions on the structure of preferences. Let think for instance that parties may announce many platforms regarding different themes, and that voters' preferences are single-peaked with respect to a linear order $\geq$ for each theme. At this point it is not reasonable that voters do some kind of linear combinations between the announced platform to get the "average platform of each party" and decide with respect to it, as well it is not reasonable to have utility functions of many variables. Indeed, consider that preference relation is also in this case an ordinal concept, so it would not be possible to combine all together in a function platforms which belongs to different spaces and which are ordered by not necessary the same linear order. A more realistic way is given by the following assumption: because of asymmetric information, voters take into account few platforms, according to parties' communication strategy, and vote according to the information they have.

## 1.4 Purpose of this work

The modified assumptions that have been already proposed can be seen at the same time as a more detailed specification and as a simplification of the traditional assumptions. On the one hand, by enlarging the space of proposal to a multidimensional one the result is a much complicated problem, in which it has also been introduced a new decision problem due to the choice of the communication strategy of parties. On the other hand it has been relaxed the assumption of fully rational individual that, so that after the first step, the model has been simplified by saying that agents are able to consider only a couple of platforms at a time. To implement a voting model with the presented features it has been chosen to work with Agent-Based simulation methods, as their features well match with our needs. Indeed ABMs, using Monte-Carlo methods, allow to introduce strong elements of randomization in the model, giving the possibility to study decisions and interactions under heterogeneity. Moreover, given that it is not a pure mathematical model, but a computational one, it possible to endow agents with simple, non necessary analytic and even heuristic rules. The purpose of this work is to construct a model and see whether the theoretical results predicted using the traditional assumptions of the political economics are verified also with the specification of the assumption that has been proposed. In particular many features of voting model will be introduced and observed in this model, like the role of uncertainty, cost of voting, local communication and medias. For this purpose the model will be made with the help of NetLogo, which is a multi-agent programmable modeling environment.

# 2 The Model

## 2.1 Elements of the model

We introduce the model by presenting first the way we modelled voters and candidates. For simplicity, candidates have not been modelled explicitly as agents.

**Candidates**
To keep the model simple and to focus on results as general as possible, there are only two candidates exogenously determined, which are named A and B. As they are not modelled as agents, they do not own specific and randomized features. Note that this choice allow to exogenously determine their own features, and to set them depending on what is the purpose of our investigation. Candidates have to announce platforms at each period and then they are communicated to voters. For this purpose each candidates is defined in each period by two lists, which are global variable, called `platform-a` and `strategy-a` for candidate a, `platform-b` and `strategy-b` for candidate b. The vector named platform has a length equal to the number of themes candidates may do some proposal. The vector named strategy has a length equal to the number of groups of voters, and each element returns the message that is received by each group. At this point can be argued that it is unrealistic that a party send a different message to each agent from one election to the other. Moreover this would introduce a huge variance in electoral results from one period to the other. To contain this volatility and to have to allow for some degrees of platform consistency over time, it has been introduced imperfect communication. This has been done by saying that not all messages sent by candidates actually arrive to voters, but once that parties have chosen the platform that will be communicated for that period to each group, with a certain probability $p$ voters will take their voting decision on the basis of the communicated platforms, while with probability $1 - p$ they will vote as they have voted in the previous period. This quantity $p$ is called in the model `ProbOfInformation` which stands for "probability of information" and can be set using the correspondent slider.

**Voters**
Voters are the only agents of the model. The number of voters in the model can be set using a slider between zero and two thousands. Each of theme belongs to a group, and the number of group for the simulation can be chosen as well using a slider from zero to twenty. For the moment let introduce features of voters, meaning the characteristics they own:

- `peak-theme`: this is a numerical variable between 0 and 10. For each theme, each voters own a peak. This follows the assumption of single-peaked preferences, but extending it to many different space of platforms (that is one for each theme). In particular voters do have preferences over three different space of platforms which are called themes. For simplicity themes have been called as follows: health, edu (education), ethics.

- `w-theme`: this is a numerical variable between 0 and 10. For each theme, each voters own a weight, meaning that different voters may give different importance to different theme.
- `vote`: this is a numerical binary variable which takes value 0 or 1. It indicates which candidates the voter will vote for that period. If it takes value 0, the vote will go to candidate A, otherwise it will go to B.
- `abst`: this is a numerical binary variable which takes value 0 or 1 and allows for abstension. If it takes value 0, the voter will actually vote, otherwise he will not.
- `talks`: this is a numerical variable which counts with how many agents a voter has already talked.

Further specification of these features will be introduced later, while explaining the mode of operation of the model.

### 2.2 Structure of the model

**Setup button – create the environment**
The setup button allows to initialize the model and to create the environment for the simulation. At the beginning we "create" candidates by initializing the vector by which they are identified as zero vectors of the right size:

```
set platform-a [0 0 0]
set platform-b [0 0 0]
set strategy-a []
set strategy-b []
let i 0
while [i < nGroups] [
set strategy-a fput 0 strategy-a
set strategy-b fput 0 strategy-b
set i i + 1]
```

The next step is to setup voters, by initializing random values for their features:

```
ask voters [
set shape "person"
```

```
set size 1
set pick-health random 11
set pick-edu random 11
set pick-ethics random 11
set w-health random 11
set w-edu random 11
set w-ethics random 11
set group random nGroups
set vote random 2
]
```

Note that all of these variables are set once at the beginning and are not allowed to change. The only one that will change is vote.
Now let introduce all the other commands which will be run sequentially at each step by running the model through the go button.

**Platform announcement**
At the beginning of each period candidates are asked to set values for the two lists: platform and strategy. The elements of platform will be fixed through the simulation, even though they could also be assigned randomly. In particular the values of `platform-a` have been set equals to 5 for each theme, meaning that candidate A always announce the preferred policy of the median voter. The values of `platform-b` can be assigned using the appropriate sliders in the interface. The elements of strategy are integers between 0 and 2 and indicates the element of platform that will be communicated to the group. So if the i-th element of strategy is j, it means that to the i-th group will be communicated the j-th element of platform.

```
set platform-a replace-item 0 platform-a 5
set platform-a replace-item 1 platform-a 5
set platform-a replace-item 2 platform-a 5
set platform-b replace-item 0 platform-b plat-b-0
set platform-b replace-item 1 platform-b plat-b-1
set platform-b replace-item 2 platform-b plat-b-2
let i 0
while [i < nGroups] [
set strategy-a replace-item i strategy-a random 3
set i i + 1]
set i 0
while [i < nGroups] [
set strategy-b replace-item i strategy-b random 3
set i i + 1]
```

**Voting decision**
Once that elements of platform and strategy have been defined, it has been defined which platform will be announced to each voter, depending on the group she belongs to. The code of this command is quite complex, but it can be summarized as follows. Say that the i-th element of `strategy-a` is j and that the i-th element of `strategy-b` is k. Then a voter which belongs to group i will vote for the candidate who has announced a policy closer to his bliss-point, and will randomize if the two platforms are identical, that is:

```
if (item j weights) * (((item j platform-a) - (item j picks))^2) > (item
k weights)* (((item k platform-b) - (item k picks))^2) [set vote 1]
if (item j weights) * (((item j platform-a) - (item j picks))^2) < (item
k weights) * (((item k platform-b) - (item k picks))^2) [set vote 0]
if (item j weights) * (((item j platform-a) - (item j picks))^2) = (item
k weights) * (((item k platform-b) - (item k picks))^2) [ifelse random
2 > 0 [set vote 0] [set vote 1]]
```

**Talking**
At this point each agent has decided which candidates she would like to vote, so everyone has an intention of voting. Now it is possible to allow for talking, meaning that voters within the same group may talk to each other saying whether they would vote for candidate b or not. At each period each voter may have n possible interactions, and in each of them she may talk to m other agents per time. Call this number n nInteractions and m nTalksPerInteraction, and they can be set using sliders from the user interface. After each interaction a voter may change idea about the candidate he is going to vote, and he would so if a large fraction of the agents she talks to will vote a candidate different from the one he has planned to vote for.

```
let p 0
while [p < nInteractions] [
if Talking [ ask voters [
set talks 0
set oppTalks 0 ]
let i 0
let j 0
while [i < nGroups] [
ask voters with [group = i] [
set j 0
while [j < nTalksPerIntercation] [
let talker one-of voters with [group = i]
```

```
if [vote] of talker != vote [set oppTalks oppTalks + 1]
set talks talks + 1
set j j + 1
]
]
set i i + 1
]
ask voters [
if random 100 < talks [set abst 0]
if (oppTalks) > 0.6 * talks [
if-else vote = 1 [set vote 0] [set vote 1]
]
]
]
set p p + 1]
end
```

**Count vote**
This last command has the simple purpose of counting votes of individuals and computing the following quantities:

- How many voters actually vote
- How many voters vote for each candidate
- What is the vote share of each candidate

## 2.3 On/Off Buttons

In the interface there are some fundamental on/off buttons that simply allow to change some element of the model to isolate their effect by comparing the results. Let introduce them.

**Multiscale**
This button allows to switch from a multi-scale model of voting, in which there are many themes –actually three- to the classical theoretical situation in which candidates announce only a platform. In particular what happens in the model when we turn this button off is that the relevant policy is the first one –the one indexed by zero- and so voters automatically take their voting decision on the basis of the announced platform, without taking into account the element of strategy.

**Talking**

This switch simply allows to turn off the command Talking, which has been already introduced and explained

**Abstension**
This button gives the possibility to allow for abstension, meaning that if it is turned off everyone will vote, while if it is turned on someone may decide not to vote. Let introduce how individuals decide whether to vote or not. While the model execute the running command Voting, agents take into account the platforms that have been communicated to them and decide which of the two is their preferred one. Then, if the Abstension button is turned on, voters actually vote for their preferred candidates only if its platform is not too far from their bliss point. This concept of distance is expressed by the squared distance between the preferred platform and the voter's bliss point, and the threshold above which one decide not to vote can be set using the slider ToleranceForVoting. The intuition is that if the announced platforms are not what a voter wants, even if one is slightly better than the other, there is no incentive to vote. However there is another future, that is that if an individual who has decided not to vote start talking with other individuals within its group, with a certain probability he can decide to vote.

**ChangeGroup**
This button, when it is turned on, gives agents the possibility to change group if the weights of other individuals within the same group are on average too distant from their own. This concept of distance is expressed by the sum of the squared distance, computed separately for each theme, between the weights of the individual and the average weights of the group. The threshold for this distance above which one decide to change group can be set using the slider ToleranceForVoting. It can argued that linking the possibility of changing group with weights instead of bliss points is not an obvious decision. The reason why weights have been chosen is that, recalling that they are relevant for voting decision, it introduces some randomization in the decision of changing group with respect to the announced platforms, but it does not yet turn out to be a random decision as it is driven by the willing of finding more similar agents. Note that in the developing of the model it has been introduced another version of this button based on bliss-points instead of weights, but results were almost the same.

**HomogeneousGroup**
This button changes the way the model is set up, so to sort some effects must be turned on before creating the world. It creates homogeneous groups, meaning that in each group voters' peaks will be similar. Recall that without this button voters' peaks are chosen randomly from a uniform distribution between 0 and 10. Now what happens is that the average peaks of each groups are randomly chosen from the same uniform distribution, and then the peaks of each voter in that group are

drawn from normal distributions with unit variance and centered in the average peaks of the group.

### 2.4 Summary: endogenous and exogenous variables

Let the following be a quick summary of the main variables of the model.

- Endogenous variables: `vote, abstension`
- Exogenous deterministic variables: `platform, nGroups, nVoters, nInteractions, nTalksPerInteraction, ToleranceforVoting, ToleranceforChangingGroup`
- Exogenous randomly assigned variables (source of heterogeneity): `peack, weights, group`
- Exogenous stochastic variables: `strategy`

Legend of variables:

- `vote`: if it is one the agent will vote for B, otherwise she will vote for A
- `abstension`: if it is one the agent will not, otherwise she will
- `platform-i`: it is the list of platforms announced by candidate i, made of three elements
- `nGroups`: it sets the number of groups
- `nVoters`: it sets the number of voters
- `nInteractions`: it sets the number of interactions an agent has before voting
- `nTalksPerInteraction`: it sets the number of agents a voter talk to in each interaction
- `ToleranceForVoting`: it sets the threshold above which an agent decide not to vote
- `ToleranceForChangingGroup`: it sets the threshold above which an agent changes group
- `peack-theme`: it returns the bliss point of each agent for theme
- `w-theme`: it is the weight an agent has for theme
- `group`: it returns the group to which an agent belongs
- `strategy-i`: it is a list of lengths nGroups which returns for each group the platform that will be communicated to each group.

# 3 Results

## 3.1 Main observables and basic results

Let show the basic results of this model using charts made with 1000 runs of the model for a initial randomization. The chosen charts are usually representetive, meaning they are not the result of a particular randomization of initial conditions.

**Multi-scale**

If the simplest model is run, meaning with all botton turned off, the result is a deterministic Downsian model, in which the median candidate always gets the same largest share of vote. As the mulsti-scale button is switched on, uncertainty comes into the model and candidate b gets a larger vote share. These are consequences of the fact that the comunication strategy of b can be interpreted as if he is choosing a mixed strategy centered in the median platform, so that more agents decide to vote for him.

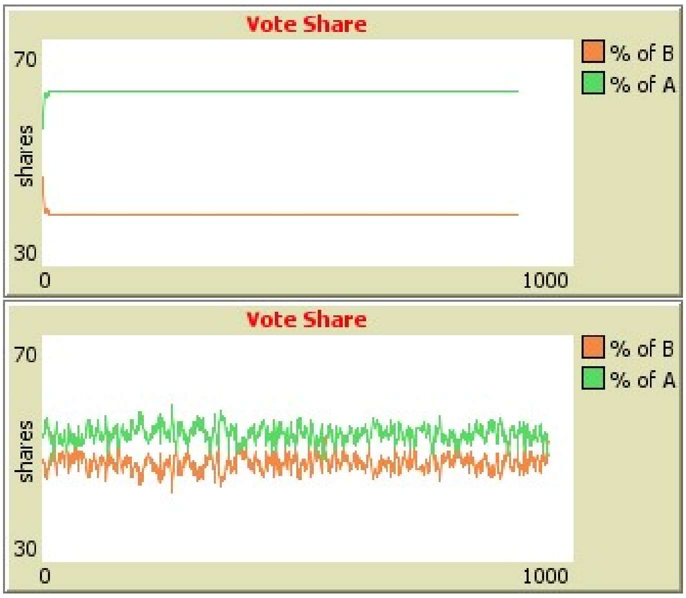


Figure 1: The left chart shows the deterministic result, the other one represents the multi-scale voting model

**Segregation**

A key element of this model is the possibility of segregation that has been introduced by allowing individual to talk between each other. This means that agents belonging to the same group, because of imitation, tends to take the same voting decision, that is almost all agents belonging to the i-th group will vote for the same candidate. Note that this is a very powerful result as very weak conditions are needed. Results in Figure 2 has been obtained by setting the probability of voters to get the actual correct information about platform equal to 0.3 and by letting each agents having two interactions within the group, each of one with two agents. Let emphasize a key property of this group segregation which is stability: it occurs that the vote shares of the two parties become perfectly stable and almost constant after few periods of talking. Note that this is not properly an intuitive and obvious result, as there is still candidate B who is announcing different policies from one period to the other, and at least one agent over three has receiving a message different from the one of the previous period.

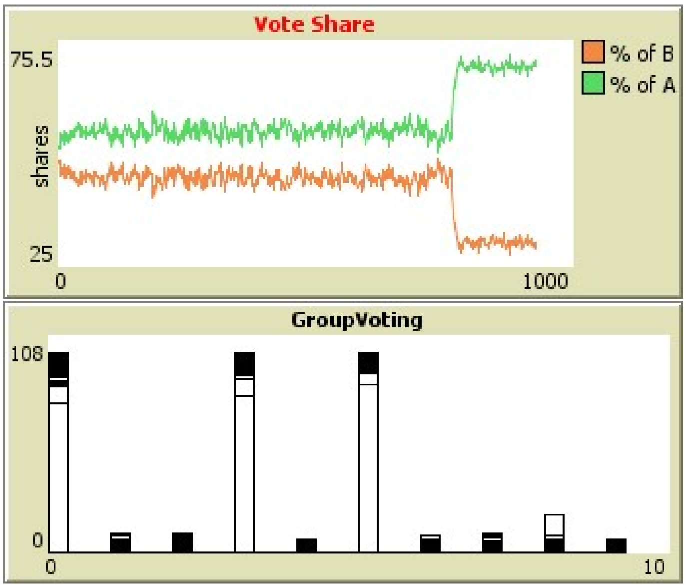


Figure 2: Results on segregation obtained with multi-scale voting. Bars show how each group has voted after switching on the talk button

**Robustness of median voter theorem**
By running the model many times, by switching on different buttons, the main regularity is that candidate A almost always wins -at least on average-. There are features that reduces the gap between the two parties, as allowing for multi-scale or for abstension, but there is no way to give to candidate b a significant advantage. The best that can be done is, by switching on both multi-scale and abstention, is to put theme on the same level, so that sometime a wins on average, and other times b wins on average.

## 3.2 The role of abstention

It can be seen how the level of abstention (and so of social turnout) is stable within a range for all simulations. This stability is easily explainable as in this model ab-

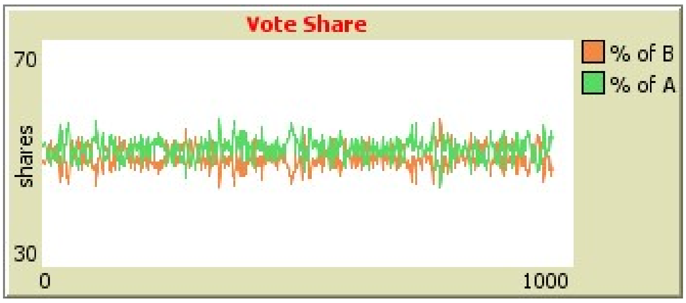


Figure 3: Results obtained with multi-scale voting and abstention

stention is a platform-related decision, so there would not be a reason for that to explode. Moreover, even if with mixed strategies, platform are kept constant through each simulation, so it is reasonable that the level of turnout is stable in a range, as platforms are. Notice that the length of this range depends on the way abstention has been defined. In particular two different characterization has been used. The first one, that is the one which has been presented earlier, is the more stable, and this is why it has been chosen for the model. Under this characterization, the abstained is a voter who does not feel to be represented by candidates. The alternative refers to distance between platforms: the decision between voting or not depends on the distances between the announced – or communicated-platforms of different candidates, so that social turnout depends on the stake of the election. This alternative source of abstention is realistic and reasonable, it is also coherent with the literature (Edlin, Gelman and Kaplan 2007) about the cost of voting and the social turnout.However, once allowing for multi-scale voting, the first source of abstention must be taken into account. This not only for its significant stability, but also for its capability of explaining electoral results. In a non-multi-scale world, a non-represented voter would not matter, as they would be divided in two halves between the "influence-areas" of the two parties, so there would not be the possibility to get a larger vote share by getting closer to them, because of the symmetry of the problem. In a multi-scale world with weights and segmented communication – even if in the presented model they have only the role of introducing uncertainty and offering a decision-driver different from platforms-it would be possible to increase its vote share by getting non-represented voters from different scales.

### 3.3 Further results from talking

As it has been said before, the possibility of talking is a key part of this model. For the moment it has been presented only the segregation induced by local communication. Now let consider also the effect that the possibility of talking has on the aggregate electoral result. A simple evidence is that it enlarge the gap between the two parties, so that segregation seems to favor the winning candidate. This intuition comes from a simple suggestion, that is talking may work like a majoritarian voting system. However, by further investigation, it looks like talking works like a true-revealing mechanism. This suggestion comes from results obtained by allowing for talking in simulations with multi-scale voting and abstention, so in a context in which also candidate B wins with a significant probability. In such situations talking turns to favor almost always candidate A. Note that there is already some literature about the the efficiency of imitation under incomplete information, for instance about how imitation, if interactions are neither global nor limited to the immediate neighbors, payoff-efficient equilibria can be uniquely selected (Alós-Ferrer and Weidenholzer 2006) .

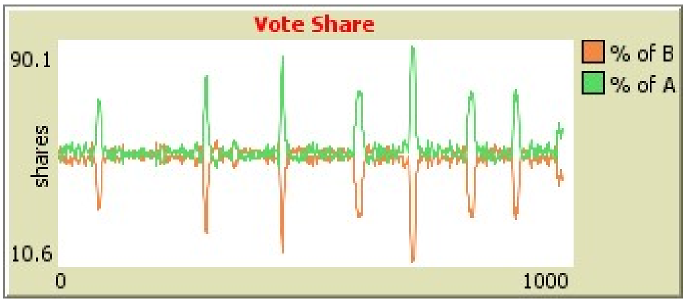


Figure 4: In this simulation the winning probability of B is 0.3. However, by turning on talking eight times, the result is that it always favors candidate A

## 3.4 Changing group and the effect of shocks

In presence of segregation (talking on), this button favors the winning candidates if a sufficient number of voters are allowed to change their group (in general at least 25-30 percent). Note that the decision of changing group is based on weights, so in same sense it still is a rational decision, but it introduces some random movements with respect to other elements as peaks. This is not a simple and intuitive result, and there are many possible interpretations. It can be due to the fact that supporters of A, by changing group, may randomly enter groups made of supporters of B and gradually reduce segregation, or it may occur because of the heterogeneity of groups which support B, so that some voters leave them. Another possible explanation could be just a matter of numbers, meaning that if many voters change their group, it means that it is like reassigning group. Then because the supporters of A are significantly more than supporters of B, the result is straightforward. If we look at simulations' results, this last explanation seems to be the most reasonable. Indeed it occurs that, if B is winning, the possibility of changing group favors B; while if A is winning the possibility of changing group favors A. This symmetry is justified only by the last explanation.

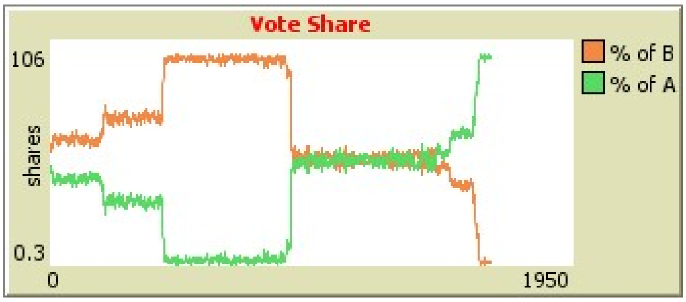


Figure 5: In this simulation two different reshuffling of groups are made by switching on changing group, letting each time move at least 30 percent of agents.

### 3.5 Homogeneous groups and stability

An interesting result is the one that is obtained by creating a world with homogeneous groups using the corresponding button before the setup of the model. The basic result is that talking is significantly less effective in stabilizing the result of electoral competitions over time. Indeed it occurs that the segregation between groups induced by local communication and imitation is less effective, so that it is not removed the volatility in vote shares due to the changes in the policy communicated by candidate B. In particular it is shown how, allowing for talking, homogeneous groups, once segregated, may easily switch from A to B, which occurs because a segregated group is more sensitive to a change in the policy communicated by B. Those evidence confirms a kind of counterintuitive result that is presented in the literature: local homogeneity of voters makes them more sensitive to changes in announced platforms. This is an argument that, under some assumptions, yields to party polarization as a consequence of self-segregation.

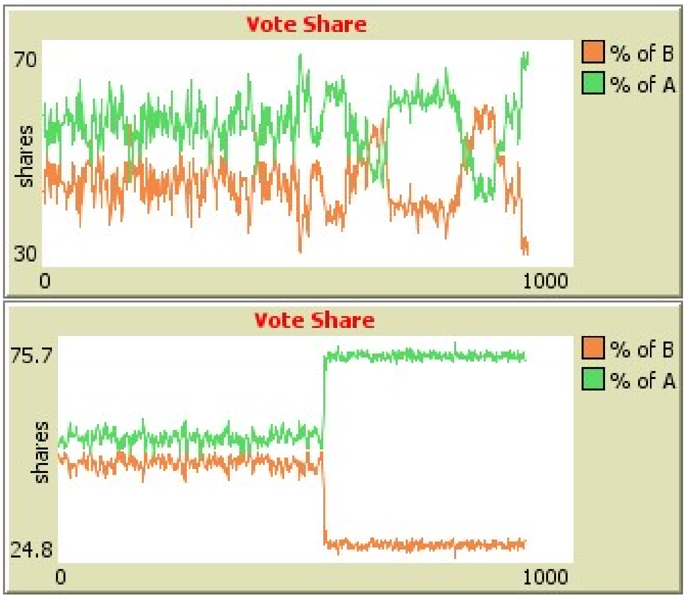


Figure 6: Results come from simulations with same parameters except for group heterogeneity. In the left picture groups are homogeneous, with a standard deviation around the average bliss points equal to one. In the right picture groups are heterogeneous, meaning there is the same expected variance of within group bliss points then the variance of between group bliss points that there is in the left picture

## 4 Conclusions

One of the main result of this model is the robustness of median voter theorem: the way multi-scale preferences of voters have been modeled are not a sufficient incentive for parties to announce platforms far from that of the median voter. Indeed candidate B would increase its probability of winning by getting closer to the bliss point of the median voter. At this point the only explanation -or at least a necessary condition- for the empirical evidence of platform divergence is related to policy-motivated parties under uncertainty (Fowler and Smirnov 2005): in the case of multi-scale voting with abstention, for candidate B would not be profitable to converge towards the median platform only if he gets a larger payoff by implementing policies far from the median once he is in charge. About platform divergence recall the importance of abstention that has been discussed previously in the results. Note that these "weak" results about the importance of multi-scale voting can be a consequence of the lack of strategic behavior by parties. If candidates would be able to decide strategically which theme to communicate to each group on the basis of past results, some interesting result may occur in explaining platform divergence.
The second important result from this model is the importance of communication and the way it affects local decision and the aggregate electoral result. It occurs that if "weak" local communication takes place after platform announcement, that is what actually happens, it originates local segregation regarding voting decision and stabilization over time of the electoral outcome. Some results also suggest that local communication and imitation may work as a true-reviling mechanism, which would be saying something more that it only leads to the efficient outcome.

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