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Media Systems and Voter Knowledge:
An Agent-Based Model

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Abstract

This paper presents an agent-based model explaining voter knowledge in the context of electoral competition. It shows that a set of simple behavioral rules implemented by voters, parties and media outlets generates novel (and testable) predictions regarding the mass-mediated underpinnings of aggregated voter knowledge and party representativeness. More specifically, it finds that increasing competition among media outlets has a positive effect on the political knowledge of the electorate at large. It also finds that increasing media competition leads to parties that are more accountable to the median voter, but only when voters care about the quality of the news alone.

Keywords

Voter knowledge, party competition, incomplete information, media reporting, agent-based modeling.

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What explains a citizen's political knowledge? Answers to this question have varied considerably over time. Early behavioral work emphasizes individual characteristics such as education, income and political interest. These studies tend to be rather pessimistic about the potential of the typical individual to learn about politics. For example, *The American Voter* (Campbell et al. 1960) argues that a majority of voters hold so-called 'non-attitudes' which are unconstrained by ideological content. Most voters do not care about issues—all that informs their vote is identification with the party they grew up with. With the advent of more sophisticated multilevel modeling techniques in political science came an *interactive* approach, which models political knowledge as a function of both individual characteristics and the institutional environment. This approach opens the door to understanding political knowledge not just as a capability or cognitive trait (like the earlier behavioral studies) but instead as a choice. That is, citizens may become better informed about politics if the institutional environment makes it less costly for them to be so (Gordon and Segura 1997). In line with this, one would also expect variation in political content in media outlets to affect the electorate's political knowledge. After all, it is through the mass media that most citizens learn about politics. There is some evidence for this. Jerit, Barabas and Bolsen (2006) find that the volume of newspaper reporting moderates the impact of socioeconomic status in explaining political knowledge: an increased volume of newspaper reporting is positively related with larger information differences between highly and poorly educated voters. De Vreese and Boomgaarden (2006: p. 317) find that "exposure to news outlets with high levels of political content (such as public television news and broadsheet newspapers) contributes the most to knowledge gains and increases the propensity to turn out to vote. Exposure to news outlets with less political content has either no effects or slightly positive effects, depending on the type of content."

However, if voter knowledge increases with a greater supply of useful political news, what exactly explains this supply? For this, we need to understand what motivates media outlets

in their reporting. Nevertheless, despite their importance to voter knowledge, much public opinion research in political science—both theoretical and empirical—has not *systematically* studied the mass media. Instead, media reports are often taken as the exogenous starting point for study. An assumption that is implicit in this approach is that the mass media are “a conveyor belt that passively transports elite views—particularly the views of the most powerful elites—to the public” (Baum and Potter 2008: p.40). However, this is only one possible model. One could also think of media outlets as producers of political news that respond to market incentives. Gentzkow and Shapiro (2008: p. 108) note, “For free markets to provide accurate information requires three things: that consumers want to hear the truth, that markets provide incentives to give consumers what they want, and that firms respond to these incentives. None of these is a given.” To put it another way, media outlets may enhance political knowledge if there is enough *demand* for good information and if its *production* is cheap enough. For example, Snyder Jr and Strömberg (2010) find that a poor fit between newspaper markets and political districts (i.e., less demand) reduces the press coverage of politics in the United States. In turn, voters in areas with less coverage of their U.S. House Representative are less likely to recall their Representative’s name, and less able to describe and rate them. Thus, increased demand for political information increases the supply of political information and, consequently, political knowledge.

In order to develop a model of the underpinnings of citizen’s political knowledge, the model that is presented in this paper treats media outlets as producers of political news that respond to market incentives.¹ The model is particularly interested in how the degree of competition among media outlets—as measured by a survival threshold that varies exogenously—affects both electoral competition and citizen knowledge about party locations. In other words, it explores how the competitiveness of a media system relates to citizens’

¹The model—which was programmed in R— can be found on my website. Replication data for the analysis presented in this paper are available there too

political knowledge and electoral representation (Hallin and Mancini 2004).

The following observations inform the most important modeling assumptions. First, many voters depend for their (political) information on traditional mass media outlets.² Second, the quality of political content varies wildly across these outlets, which in turn affects what readers can learn from attending to that outlet.³ Third, this variation in quality is not exogenous, as media outlets respond—some more than others—to reader demand. With these assumptions in place, the model shows that a set of simple behavioral rules implemented by voters, parties and media outlets can generate novel (and testable) predictions regarding the mass-mediated underpinnings of aggregated voter knowledge and party representativeness. At the heart of the model are the (simplified) interactions between voters, parties and media outlets that occur over the course of several political campaigns, within the context of media systems. In particular, parties adjust their platforms in response to voter beliefs. Voters, in turn, adjust their beliefs about party platforms and inclinations to buy news in response to media content. And media outlets adjust the quality of their reporting in response to demand from voters. In addition, these interactions are shaped by the competitiveness of the media system in which they occur. Figure 1 displays these interactions graphically. The solid lines represent the endogenous supply and demand for information between mass media outlets, parties and citizens during an electoral campaign. The dotted lines denote how media systems at large shape these micro-level interactions. In other words, the dotted lines represent how the characteristics of media systems shape the ‘information environment’ that citizens find themselves in (Jerit 2009; Kuklinski et al.

²Even in this day and age of new media, most voters learn about politics from traditional mass media outlets. For example, a 2010 news consumption survey from the Pew Research Center for the People and the Press found that of the 70 minutes that Americans spend on consuming (political) news, about 57 minutes is spent on traditional mass media, like watching television, listening to the radio or reading a newspaper (see: <http://people-press.org/report/652/>).

³For example, a typical write-up from the presidential campaign trail in the *New York Times* will contain more information than a similar article in the *New York Post*, and, all else equal, this will differentially affect political knowledge of the readers of both articles. That is, with varying degrees of success media outlets help voters overcome their rational ignorance (Downs 1957).

2001; Jerit, Barabas and Bolsen 2006). In turn, the ‘information environment’ interacts with voter characteristics in affecting their political knowledge and their ability to keep their representatives accountable.

—Figure 1 about here—

The paper proceeds as follows. In the next section, I will pit the model against a set of seminal agent-based models of electoral competition. After that, I present the model and discuss the results it generates. I then conclude.

Agent-Based Models of Political Competition

Following a seminal paper by Kollman, Miller and Page (1992), computational models of political competition have seen their popularity rise in political science. Dissatisfied with some of the theoretical results of the post-Downsian spatial political competition literature, these authors develop a theory of party competition “as a complex and evolving system where key actors hold very incomplete and imperfect information” (Laver 2005). Kollman, Miller and Page find that different behavioral search algorithms systematically converge to positions that are centrist yet distinct. Interestingly enough, this occurs regardless of the exact spatial distribution of voter preferences, although more “rugged” or “less smooth” preferences slow down the process of convergence (Kollman, Miller and Page 1998). An important extension to these seminal papers comes from De Marchi (1999) in the form of incomplete information. De Marchi also studies a two-party political system with either vote-seeking or policy-seeking parties, but unlike Kollman, Miller and Page, he lets go of the assumption of perfectly informed voters. In his model, voters are “information misers”, meaning that they try to minimize paying costly attention to politics. Voters do this retroactively by only focusing attention on specific policy issues if they are dissatisfied with the last election outcome. When voters are satisfied with the last election, they will reduce the amount of attention

they spend on politics. With these information constraints in place, De Marchi finds that voter attention and party victories may occur in cycles, findings that are mainly driven by how much parties are vote-seeking and the ‘intelligence’ of voters: “The frequency of both cycles depends on the parameter for ideological fervor of the candidates and voter sophistication (i.e., their mutation rate of attention). Ambitious incumbents result in lower frequency cycles than ideological incumbents. More responsive and aware voters, in turn, cause more party turnover, particularly when the incumbents are ideological” (De Marchi 1999: p. 411). In other words, if candidates are only in search of votes and voters have good information, electoral cycles are less frequent. In more recent years, Laver (2005) has extended these earlier models to a setting of multiparty competition in a two-dimensional space, and inclusion of valence issues, party birth, party death, and the evolution of party strategies (Laver and Sergenti 2011; Laver and Schilperoord 2007; Schreiber 2014). In all these extensions, voters hold perfect information about the policy positions of all parties.

Thus, agent-based models of electoral competition exogenously vary the level of information (complete versus incomplete). Nevertheless, from the perspective of the interactive “knowledge-as-choice” approach to political sophistication information is an endogenous phenomenon, resulting from goal-oriented decision-making by individual citizens. Moreover, as noted above, individuals obtain much of their political information from mass media outlets. This implies that one way to model voter knowledge is by modeling electoral competition in the presence of (market-based) media outlets, a viewpoint that is reflected by Strömbäck (2008: p. 234), who notes: “What is thus required is a conceptualization of media influence that is sensitive to and recognizes the interactions and interdependencies of media systems, institutions and actors, political systems, culture, and sense making.” The model that is presented here does exactly that. By using a set of simple behavioral rules implemented by voters, parties and media outlets, it generates novel (and testable) predictions regarding the mass-mediated underpinnings of aggregated voter knowledge and party representativeness.

The Model

Before I lay out its specifics, I should first mention that this is a behavioral model. The actors in the model do not maximize an objective function but instead follow predetermined (‘trial-and-error’) behavioral rules to search through such a function. Implicit in this approach is that all actors have bounded knowledge and that they use this knowledge and this knowledge alone to inform their decision-making. With this in mind, the model is specified as follows.

There are two parties competing in elections with V sincere voters and N media outlets in T rounds. Each period t in the model denotes an election cycle consisting of a campaign plus an election between an incumbent and a challenger party. Each period begins with an incumbent and a challenger party campaigning for office. Both parties are office-motivated and represented by an ideal point $I_p \sim N(0, 1)$. After the election, the losing party changes its platform in response to its loss. It does so using an updating rule that requires just one piece of information: the ideological position of the winning party. That is, the losing party moves ideologically in the direction of the winning party. This strategy is a one-dimensional equivalent of the Predator strategy in the work of Michael Laver and colleagues (Laver 2005; Laver and Schilperoord 2007; Laver and Sergenti 2011).⁴

$$I_{p,t+1} = \begin{cases} I_{p,t} + \delta & \text{if } I_{inc,t} > I_{p,t} \\ I_{p,t} - \delta & \text{if } I_{inc,t} < I_{p,t} \end{cases} \quad (1)$$

Both Equation 1 and Figure 2 represent this updating rule. The learning parameter δ is fixed—but theoretically ranges between zero and the ideological distance between the two parties. It represents a party’s responsiveness to loss.

⁴Of course, there are many decision rules possible for office-motivated parties competing in a one-dimensional issue space. For example, in a tournament of party competition in a two-dimensional issue space, Fowler and Laver (2008) explore the electoral effectiveness of as many as 29 decision rules. However, to keep things relatively simple this paper explores this Predator strategy as it (i) does not assume much information on the part of either party, and (ii) makes intuitive sense.

—Figure 2 about here—

Like the incumbents, voters have ideal points on this scale, which are denoted with $I_v \sim N(0, 1)$. Other things being equal, voters prefer parties for which the absolute distance between I_v and I_p is smallest, yet in each period the voters' payoff depends equally much on an exogenous policy shock $a_t \sim N(0, 1)$. This is intended to reflect that implementation of policy is not just a function of the incumbent's policy platform but also of factors that lie outside of the control of the incumbent (e.g., Ferejohn 1986).⁵ At the same time, this policy shock represents the source of uncertainty that may motivate voters to seek out news reports from the media to learn more about party platforms. At the end of each period, a voter's payoff is thus a function of a policy outcome $s = I_p + a_t$, where this policy outcome is simply the sum of the ideological platform of the incumbent and the policy shock. After each period t , voter v receives utility:

$$U_{v,t} = -|I_v - s| - c_v \tag{2}$$

where c is the cost of media consumption. Here, I am assuming there are two types of voters who differ on what constitutes this cost. First, there are *quality-minded* voters, who only care about the quality of the news: for them, the cost of the media consumption is simply a function of the information content of a news report; the higher the level of news content, the higher the cost of the news (more on this below, when I discuss the modeling of the media outlets). Then there are *ideology-minded* voters, for whom the cost of media consumption stems from the ideological distance between themselves and the media outlets whose content they consume; the larger this distance is the higher the cost of media consumption. The idea here is that *quality-minded* voters are content-orientated whereas *ideology-minded* voters are, in essence, motivated reasoners who prefer—regardless of content—news reports from news

⁵This linear loss function implies that voters are *risk neutral* (for a discussion, see Laver and Sergenti 2011).

outlets that are ideologically close to reports from outlets that are ideologically distant.^{6,7}

All the voters have incomplete information on I_p since they observe policy outcome s , not ideology. Because of this incomplete information, the voters hold beliefs about I_p , which are represented by a probability distribution, $\pi(I_p) \sim N(\mu, \sigma_0^2)$. The voter beliefs about the challenger are distributed normally too. The voters may decide to learn about both parties by buying news from the media. From this, it follows that in each time period there are two groups of voters: news-buying voters and news-ignoring voters. Both groups of voters update their beliefs about the incumbent in response to information: news-ignoring voters learn from incumbent performance whereas news-buying voters directly learn about the policy platform of the incumbent through media content. News-buying voters also learn about the policy platform of the challenger, whereas news-ignoring voters do not, since the challenger has not yet had a chance to implement policy.

Learning takes place as follows. From the perspective of news-ignoring voters, the information that is contained in performance can be represented by a draw from a normal distribution $N(s, \sigma_1^2)$ with mean equal to the policy outcome and variance equal to 2.⁸ Therefore, not only is the signal noisy, it is also potentially biased (with the degree of bias a function of the exogenous policy shock). News-buying voters, on the other hand, learn about ideology directly from media content, which is also represented by a normal distribution $N(I_p, \sigma_1^2)$ but with mean equal to the platform of the candidate and variance equal to the inverse of the quality of the news.⁹ In other words, the better the quality of the news, the more informative it is from the perspective of the news-buying voter. Voters update their beliefs using Bayes' rule (Gerber and Green 1999). Assuming that news (either policy results or media reports)

⁶For seminal studies on motivated reasoning in political science, see the work of Milton Lodge and Charles Taber on this topic (e.g., Lodge and Taber 2000; Taber and Lodge 2006; Kim, Taber and Lodge 2010)

⁷In the analysis, the models are populated with either *quality-minded* or *ideology-minded* voters. Investigation of mixed populations is left for later work.

⁸The variance is equal to 2 because policy is the sum of two standard normal variables that are independent and identically distributed (i.i.d.).

⁹The variance of the signal varies between zero and one.

is represented by a draw $x \sim N(\mu_1, \sigma_1^2)$, Bayes' rule implies that voters' posterior beliefs are distributed $\pi(I_p|x) \sim N(\mu(x), \rho)$, where

$$\mu(x) = \mu + (x - \mu) \frac{\sigma_0^2}{\sigma_0^2 + \sigma_1^2} \quad (3)$$

$$\rho = \frac{\sigma_0^2 \sigma_1^2}{\sigma_0^2 + \sigma_1^2} \quad (4)$$

That is, voters' beliefs after observing 'news' have mean $\mu(x)$. The strength of that belief is represented by ρ . The smaller ρ , the more 'crystallized' the belief is.

A voter's decision to purchase news occurs through a simple form of reinforcement learning. That is, voters increase (decrease) their likelihood of buying news if doing so has benefited (cost) them in the past (De Marchi 1999). This setup thus recognizes 4 groups of voters: (i) news-buying voters who have performed beyond expectation, (ii) news-buying voters who have performed short of expectation, (iii) news-ignoring voters who have performed beyond expectation, and (iv) news-ignoring voters who have performed short of expectation. Here I assume that voters initially have an idiosyncratic interest (denoted as a probability q_v) in buying news from the media. Voters update this probability—which is initially distributed uniformly across voters—dynamically over periods using the adaptive rules below (Fowler 2006). For voters who bought news in round t , the probability of buying news in round $t + 1$ equals:

$$q_{v,t+1} = \begin{cases} \min(1, q_{v,t} + \kappa) & \text{if } U_{v,t} > \frac{1}{t-1} \sum_1^{t-1} U_v \\ \max(0, q_{v,t} - \kappa) & \text{if } U_{v,t} \leq \frac{1}{t-1} \sum_1^{t-1} U_v \end{cases} \quad (5)$$

For news-ignoring voters in round t , the probability of buying news in round $t + 1$ equals:

$$q_{v,t+1} = \begin{cases} \max(0, q_{v,t} - \kappa) & \text{if } U_{v,t} > \frac{1}{t-1} \sum_1^{t-1} U_v \\ \min(1, q_{v,t} + \kappa) & \text{if } U_{v,t} \leq \frac{1}{t-1} \sum_1^{t-1} U_v \end{cases} \quad (6)$$

That is, voters compare their current utility to their average utility across all previous periods. News-ignoring voters who have done better (worse) than before decrease (increase) their likelihood of buying a newspaper. News-buying voters who have done better (worse) than before increase (decrease) their likelihood of buying a newspaper. The learning parameter κ is fixed—but ranges between zero and one. It reflects voters' responsiveness to new information.¹⁰

There are N media outlets. Just like voters and parties, media outlets have ideological ideal points I_n . These ideal points are fixed over time. In the model, media outlets are motivated by audience share alone. In each period t , media outlet n receives utility:

$$U_{n,t} = M \quad (7)$$

where M is the audience share of the outlet. Since their ideological ideal points are fixed, all that media outlets can do to catch a larger share of the audience is to vary c , the quality of their reporting. The strategy media outlets employ to search through their utility function is a Hunter strategy in which the media outlet compares its current performance to its past performance. That is, if the quality of reporting and utility at time t are both larger or are both smaller than the quality of reporting and utility at time $t-1$, then the media outlet will increase its quality by increment μ . Otherwise, the media outlet will decrease the quality of its reporting. More formally:

¹⁰This decision rule implicitly assumes that voters do not interact with each other. All that matters to voters is their performance in round t when compared to performance in round $t-1$. Voters are thus a-social and myopic. For a model party competition, voter learning and media where voters are connected in a network, see work by Smirnov and Woodson.

$$c_{n,t+1} = \begin{cases} c_{n,t} + \mu & \text{if } c_{n,t} > c_{n,t-1} \wedge U_{n,t} > U_{n,t-1} \\ c_{n,t} + \mu & \text{if } c_{n,t} < c_{n,t-1} \wedge U_{n,t} < U_{n,t-1} \\ c_{n,t} - \mu & \text{if } c_{n,t} > c_{n,t-1} \wedge U_{n,t} < U_{n,t-1} \\ c_{n,t} - \mu & \text{if } c_{n,t} < c_{n,t-1} \wedge U_{n,t} > U_{n,t-1} \end{cases} \quad (8)$$

The learning parameter μ is fixed—but theoretically ranges between zero and one. It represents a media outlet’s responsiveness to small audience shares.

To study how variation in the media landscape may affect the political knowledge of the electorate and political competition, I systematically vary one media parameter: *Survival Threshold*. The *Survival Threshold* denotes the minimum average audience share that an outlet requires in order to survive. Following Laver and Schilperoord (2007), I set the number of time periods t over which this threshold is calculated at 10.¹¹ The *Survival Threshold* parameter follows a discrete uniform distribution with a minimum of zero (no survival threshold), a maximum of 0.15, and step size 0.025. All else equal, a media system with a higher *Survival Threshold* is considered to be more competitive than a media system with a lower threshold, since in the former media outlets need a larger share of the audience to survive.

After the campaign is over, elections take place. Voters vote for the incumbent or the challenger based on the information they have.¹² After the elections, voters receive utility, update their willingness to buy news, and a new campaign period starts. The losing party updates its platform to compete in the campaign that starts in the next period. Table 1 displays the timing of the model. Together, steps 1 through 7 represent one time (campaign) period.

—Table 1 about here—

¹¹For example, say the *Survival Threshold* is set at 0.15. This means that at time t all media outlets which from time periods $t - 10$ to $t - 1$ had an average audience share below this threshold, will disappear.

¹²There is no abstention.

Analyzing the Model

Although there are many possible outcome variables to consider, I will zoom in on two in particular: i) the knowledge levels of voters as a function of exogenous variation in media systems, and (ii) the ‘representativeness’ of the evolved party systems.

Model Input

To investigate how *Threshold* and voter type may affect voter knowledge and party competition, I conduct a large number of Monte Carlo simulations randomly varying the values of these parameters. In particular, I conduct 1400 Monte Carlo simulations and since I have specified two possible voter types and seven possible thresholds (between 0 and 0.15, with increments of 0.025) this boils down to 100 simulations of each individual ‘media system’ or combination of threshold and voter type. A single Monte Carlo simulation consists of 2000 time periods (with each denoting a campaign and election; see Table 1). Table 2 contains the starting values and distributions of all the parameters in a single Monte Carlo run. Because randomness in the starting values of the random parameters in the model may affect the output variables, I discard the first 1000 time periods in each simulation (treating them as ‘burn-in’) and collect the output variables from the last 1000 observations alone.¹³

—Table 2 about here—

Model Output

The main dependent variables in the model are the representativeness of the evolved party system and voter knowledge. *Representativeness* at time T is measured as $\sum_{p=1}^P |I_{p,T} - I_{mv}|$. That is, the representativeness of a party system that has evolved after T time periods in

¹³I should note that each of these random parameters is drawn from identical distributions for each Monte Carlo run, so their expected values are identical across different values of *threshold* and voter type.

the model equals the sum of the absolute distances between the platforms of all parties P and the ideological location of the median voter. More representative party systems are thus represented by smaller values of *representativeness*.¹⁴ *Voter knowledge* is measured as the average distance of voter beliefs from actual party platforms averaged across the last 1000 time periods in the model (after burn-in) and across all V voters: $\frac{1}{1000*V} \sum_{v=1}^V \sum_{t=1001}^T \frac{1}{2} (|\pi(I_1) - I_1| + |\pi(I_2) - I_2|)$.¹⁵ As such, smaller values of *voter knowledge* represent higher levels of knowledge. In addition to the main dependent variables, I measure the average quality of the news from surviving media outlets as follows: $\frac{1}{1000*N} \sum_{t=1001}^T \sum_{n=1}^N c_N$. *Total audience share* is the average percentage of news-buying voters during the last 1000 time periods. Finally, *party turnover* is measured as the number of alternations in office during the last 1000 time periods of each Monte Carlo run.

Results

The reader may have noticed that I have not specified any hypotheses regarding the model results. The reason for this is that I do not have clear expectations about the directions of any of the effects, mostly because media content, voter knowledge and party competition are all intertwined and difficult to disentangle. In fact, I am treating the model as a tool to generate such (exploratory) hypotheses, which in future work could be tested with (comparative) data. In essence, formally modeling these processes is one way get around potential endogeneity problems that plague empirical hypotheses on the mass-mediated underpinnings of voter knowledge and party competition.

—Table 3 about here—

¹⁴A representativeness score of zero denotes a perfectly representative political system with all parties located at the ideal point of the median voter.

¹⁵Each run of the model consists of 2000 time periods. When analyzing the data the first 1000 time periods are considered burn-in and thus discarded.

Knowledge

Do *threshold* and voter type affect aggregate voter knowledge? To answer this question I calculate the average voter knowledge across each of the 14 possible media systems. The results of the analysis can be found in Table 3, which presents average political knowledge across media systems and two standard errors above and below these means.¹⁶ This figure shows that at high levels of media competition (e.g., *threshold* > 0.10) voter knowledge is highest: as it becomes more difficult for media outlets to survive, voters become better able to locate the parties in their polity, regardless of whether they are *quality-minded* or *ideology-minded*. However, if the survival threshold is smaller than 0.05, the average political knowledge diverges between types of voters, with *quality-minded* having better knowledge than *ideology-minded* voters. An explanation for this pattern of low-competition divergence and high-competition convergence is offered in Figure 4, which displays the average cost of media consumption across the media systems.¹⁷ It shows that at low levels of media competition, the average cost of media consumption is much lower in media systems populated with *quality-minded* voters than in media systems populated with *ideology-minded* voters. In contrast, at high levels of media competition the average cost of media consumption is relatively low for both *ideology-minded* and *quality-minded* voters. It thus appears that the observed patterns of voter knowledge correlate negatively with the aggregate cost of news consumption: as the cost of news consumption goes down, voter knowledge goes up, and vice versa.

—Table 4 about here—

¹⁶In the discussion that follows, *voter knowledge* will be recoded to vary between zero and one and with larger scores denoting higher levels of knowledge as this makes more intuitive sense.

¹⁷Remember, the average cost of news consumption means different things for different people: for an *ideology-minded* population it represents the average distance of voters to their nearest media outlet; for a *quality-minded* population it represents the average quality of the news reports of the surviving media outlets.

Furthermore, Figure 5 shows that political knowledge is not evenly distributed among the electorate but correlates with the ideological leanings of individual voters.¹⁸ Interestingly enough, the sign of this correlation depends on whether voters are *quality-minded* or *ideology-minded*. In particular, for *quality-minded* voters this correlation tends to be slightly positive, indicating that political moderates tend to be a little less informed about politics than those at the ideological extremes. In contrast, when voters are *ideology-minded* voters this correlation tends to be negative across low levels of political competition, suggesting that ideological moderates are better able to locate the parties in their polity in these types of media systems. Motivated reasoners are able to inform themselves but only if they are ideologically moderate.

—Table 5 about here—

Representativeness and Turnover

How do *threshold* and voter type relate to the nature of political competition? In addressing this question I first calculate the average representativeness of the evolved political system—measured as the average distance of between all parties and the median voter in the last 1000 time periods of each run of the model—for each media system. The results are displayed in Table 6. Again, patterns emerge that are different for *quality-minded* and *ideology-minded* electorates, although they are qualitatively different from what was observed with respect to voter information. For *ideology-minded* voters, representativeness does not differ all that much across levels of media competition: from the lowest level of political competition to the highest the overall difference in aggregated representativeness is not larger than 0.15 (averages move between about 0.50 and 0.35). In other words, varying the level of competition among media outlets does not make it more or less difficult for parties to find the location of the median voter if voters are motivated reasoners. For *quality-minded* voters, the pattern

¹⁸Ideology is measured as the absolute distance from the median voter.

is different: media competition does affect the representativeness of political competition considerably. As it becomes more difficult for media outlets to survive, political competition becomes increasingly more representative of the median voter (averages move between about 0.65 and 0.15). In fact, a combination of a high survival threshold with *quality-minded* voters leads to competition that is most representative of the median voter, whereas at low levels of media competition *quality-minded* voters are least capable of keeping their parties in check.

—Table 6 about here—

A similar pattern can be observed for the number of alternations in office (see Table 7).¹⁹ Again, not much difference can be observed for *ideology-minded* voters: the number of alternations fluctuates between 25 and 38 across the values of the survival threshold. However, when a media system is populated with *quality-minded* voters fluctuations are much more pronounced: between a *threshold* of 0.02 and 0.15 the number of alternations falls from about 50 to about 15 on average, a much larger difference. In other words, political competition is predicted to be more volatile and less representative in case voters are *quality-minded* and media competition is low. In contrast, political competition is predicted to be less volatile and more representative if voters are *quality-minded* and media competition is high. If voters are *ideology-minded*, then political competition is predicted to be moderately volatile and representative of the median voter. All of this of this goes to show that the nature of political competition is shaped by the media environment and the characteristics of the electorate at large.

—Table 7 about here—

¹⁹The number of alternations refers to the total number of alternations in office in the last 1000 time periods of one run of the model.

Conclusion

This paper has presented an agent-based model in which aggregate voter knowledge and electoral representativeness emerge as a function of competitiveness of the media system and characteristics of the electorate. Using Monte Carlo analyses, it has shown that a set of simple behavioral rules implemented by voters, parties and media outlets could generate novel (and testable) predictions regarding the mass-mediated underpinnings of aggregated voter knowledge and the nature of political competition. For example, the model predicts that increased competition among media outlets has a positive effect on the political knowledge of the electorate. The model also predicts that ideological extremity has a positive association with voter knowledge if voters only care about the quality of the news. In contrast, ideological extremity has a negative association with voter knowledge if the electorate cares about media ideology. Furthermore, it also finds that increased media competition leads to better accountability and less political volatility, but only if voters only care about the quality of the news. Voters who only care about the ideology of their media outlets of choice and not so much about their news content are less successful in keeping their representatives at bay, especially at high levels of media competition.

The model has both its strengths and its weaknesses. To begin with the latter, I should start by emphasizing that, without doubt, the behavioral assumptions make this model very abstract. For example, voters have no stable individual characteristics but their ideology. In reality of course, citizens are anything but homogeneous and behavioral research has shown time and again that stable individual-level characteristics other than ideology are important when it comes to explaining citizens' political behavior and attitudes. Furthermore, electorates are likely to consist of both *ideology-minded* and *quality-minded* voters. Lastly, the model is located in a one-dimensional polity where it is easy to come up with behavioral rules that are different from those that were under study.

That being said, the results the model generates help our understanding of, for example, the institutional underpinnings of voter knowledge in the context of political competition. For decades, behavioral research has emphasized the importance of stable voter characteristics in explaining voter knowledge.²⁰ It is only in recent years with the advent of more sophisticated multilevel modeling techniques that political science has witnessed a *neo-institutional* approach that models voter knowledge as a function of both individual characteristics and institutional factors (e.g., Fraile 2013). But although this contextual approach is exciting, intuitive and opens up many possibilities of empirically testing, with it comes the risk of observing more false positives and false negatives. After all, because of their mutual interdependence, the causal mechanisms underlying voter knowledge, mass media reports and electoral competition are hard to disentangle with empirical data alone. To counter this risk, what is needed—in addition to empirical work—is further development of theoretical models of public opinion research. The model that has been presented in this paper aims to contribute to this mission.

²⁰For example, Jennifer Jerit, Jason Barabas and colleagues refer to socioeconomic type covariates as the “usual suspects” of public opinion research (Jerit, Barabas and Bolsen 2006; Jerit 2009; Barabas and Jerit 2009).

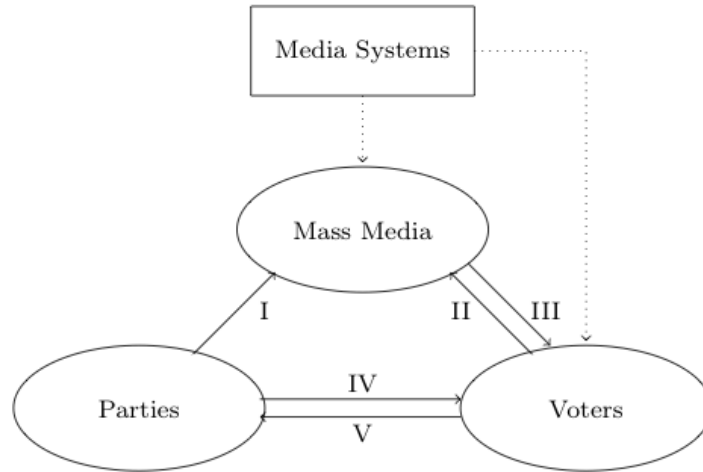
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Tables & Graphs

Figure 1: A Model of Media Systems, Information and Political Competition



Note:

- I—parties change platforms, which affects media content
- II—voters demand news, which affects the quality of media content
- III—the quality of media content affects voter beliefs
- IV—changes in party platforms affect voter beliefs
- V—voters vote based on beliefs, which affects party platforms

Figure 2: Party Updating Algorithm

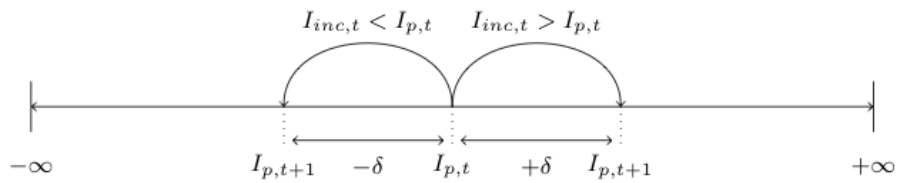


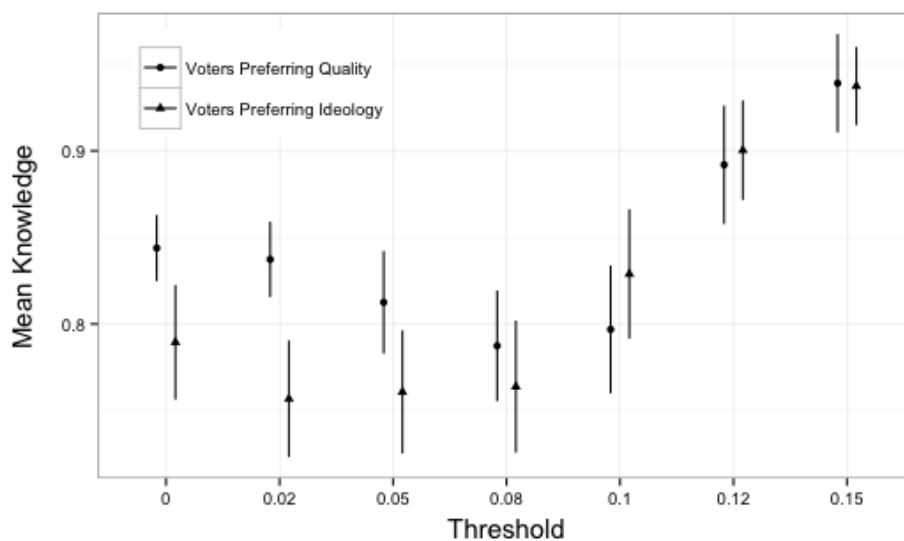
Table 1: Timing of One Time Period of the Model

- 1) Incumbent and challenger party campaign for office.
- 2) Exogenous policy shock.
- 3) Media outlets report on party platforms with quality c_n .
- 4) Voters decide to buy news reports.
- 5) Voters update beliefs about party platforms.
- 6) Elections take place. Losing party updates platform.
- 7) Voters update willingness to buy news. Return to step 1.

Table 2: Parameter Settings for Monte Carlo Simulation

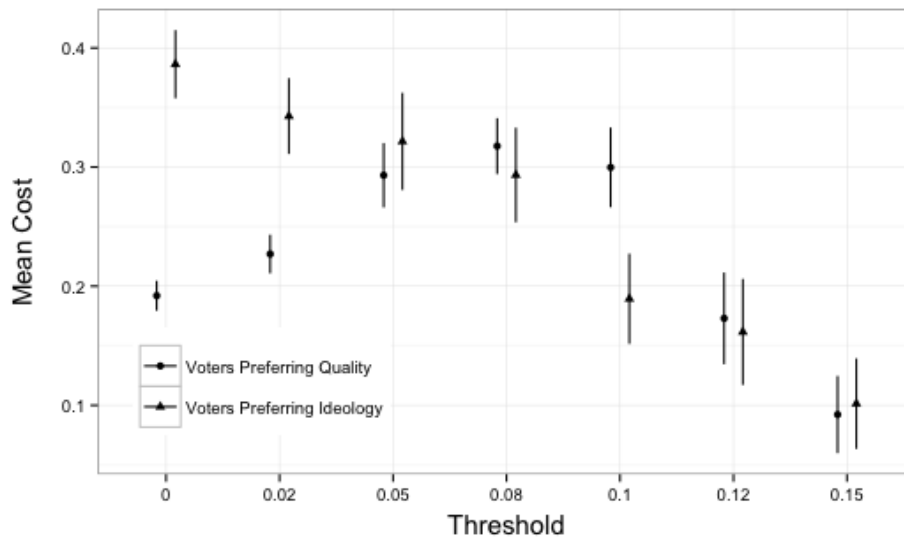
Parameter	Description	Default Value
<i>Random Parameters</i>		
Threshold	Survival Threshold	$\sim DU(7, 0, 0.025)$
Strategy	Media Outlet Strategy	$\sim DU(3, 0, 1)$
a	Policy Shock	$\sim N(I_{inc}, 1)$
I_p	Party Ideology	$\sim N(0, 1)$
I_v	Voter Ideology	$\sim N(0, 1)$
I_n	Media Outlet Ideology	$\sim N(0, 1)$
C	Initial Quality of Reporting	$\sim U(0, 1)$
Q	Pr(Voter Purchases News)	$\sim U(0, 1)$
<i>Fixed Parameters</i>		
V	Number of Voters	101
P	Number of Parties	2
T	Number of Time Periods	2000
R	Number of Monte Carlo Runs	2100
δ	Party Learning Parameter	.01
ϵ	Voter Learning Parameter	.01
γ	Media Learning Parameter	.01

Figure 3: Knowledge as a Function of Voter Type and Survival Threshold



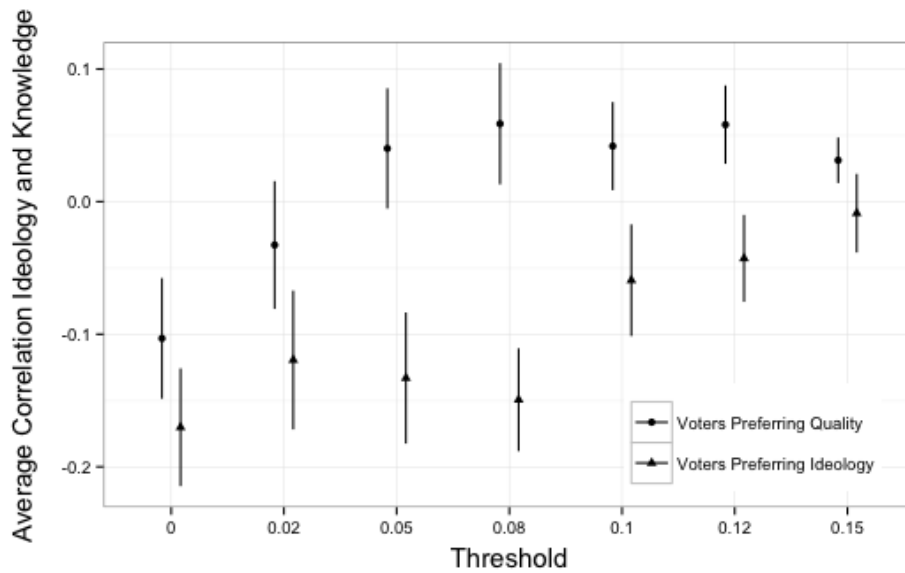
Note: The dots and the squares represent the average knowledge of the electorate in media systems populated by two types of voters: those who care about media quality and those who care about media ideology. The lines represent two standard errors above and below the estimated means. The figure shows that as media systems become more competitive, this has a positive effect on average voter knowledge. If the survival threshold is smaller than 0.05, average political knowledge diverges between types of voters with *quality-minded* voters having better knowledge than *ideology-minded* ones.

Figure 4: Cost of News Consumption as a Function of Voter Type and Survival Threshold



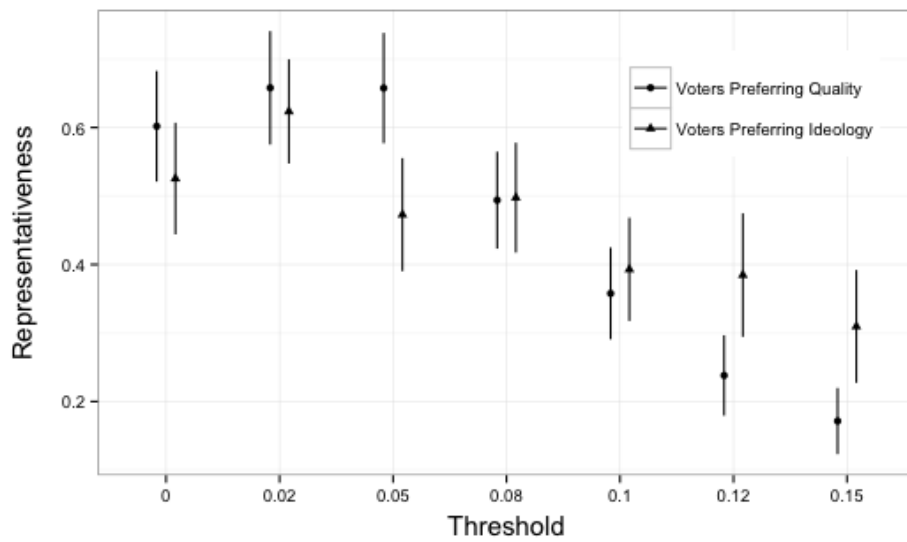
Note: The dots and the squares represent the average cost of media consumption to voters in media systems populated by two types of voters: those who care about media quality (with cost determined by media content) and those who care about media ideology (with cost determined by ideological divergence). The lines represent two standard errors above and below the estimated averages. The figure shows that at low levels of media competition, the average cost of media consumption is much lower in media systems populated with *quality-minded* voters than in media systems populated by *ideology-minded* voters. In contrast, at high levels of media competition, the average cost of media consumption is relatively low for both *ideology-minded* and *quality-minded* voters.

Figure 5: Correlation Between Ideology and Knowledge as a Function of Voter Type and Survival Threshold



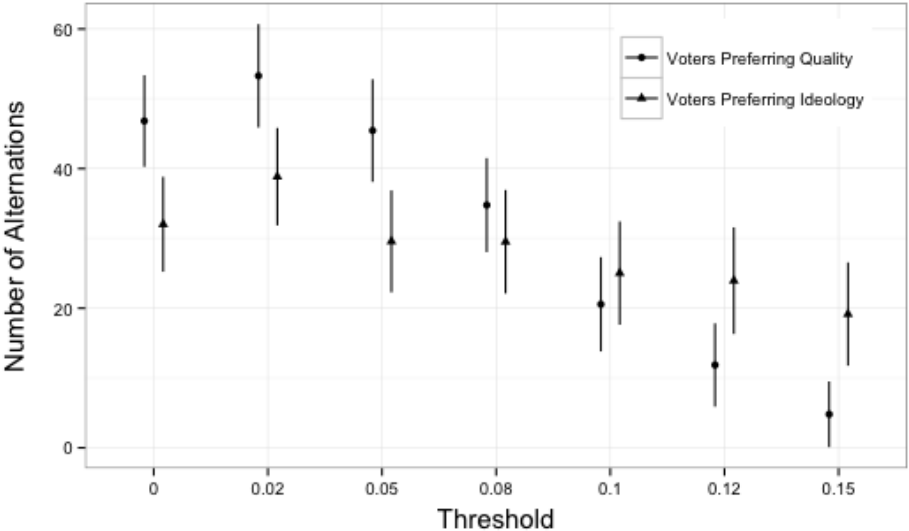
Note: The dots and the squares represent the average correlation between ideology and knowledge among voters in different media systems. The lines represent two standard errors above and below the estimated averages. The figure shows that for *quality-minded* voters this correlation tends to be slightly positive, whereas for *ideology-minded* voters this correlation tends to be slightly negative. This means that ideological moderates tend to have more knowledge of politics than political extremists if they are *quality-minded* but less if they are *ideology-minded*.

Figure 6: Representativeness as a Function of Media Strategy and Survival Threshold



Note: The dots and the squares represent the representativeness of political competition in media systems populated by two types of voters: those who care about media quality and those who care about media ideology. The lines represent two standard errors above and below the estimated averages. The figure shows that as media systems become more competitive, political parties become more responsive to the median voter.

Figure 7: Number of Alternations in Office as a Function of Media Strategy and Survival Threshold



Note: The dots and the squares represent the turnover in office through political competition in media systems populated by two types of voters: those who care about media quality and those who care about media ideology. The lines represent two standard errors above and below the estimated averages. The figure shows that as media systems become more competitive, political parties become more responsive to the median voter.