Political Research Quarterly
2014, Vol. 67(1) 136–151

DOI: 10.1177/1065912913487258
prq.sagepub.com
SAGE

The Emergence of Parties: An Agent-Based Simulation

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Abstract

An agent-based computer simulation demonstrates that results from Downs, Duverger, Riker, and Sundquist can be seen as emergent consequences of five simple rules about iteratively forming coalitions and adjusting policy platforms. The model creates distributions of agents who form coalitions within a political body. By modifying and omitting the basic rules, I compare results from plurality and majority-seeking actors and from policy-seeking, office-seeking, and mixed-strategy coalitions. A set of simple rules implemented by agents with extremely bounded knowledge are sufficient to drive the classic median voter, two-party system, minimum winning coalitions, and party realignment results in a single framework.

Keywords

agent-based model, party formation, median voter, party realignment

> As in other departments of science, so in politics, the compound should always be resolved into the simple elements or at least parts of the whole.
>
> Aristotle. *The Politics*. Book 1, Section 1

The quest to understand complex political phenomena as the emergent features of basic political forces and fundamental actors reaches back to antiquity. However, most contemporary models of the interactions of parties treat them as unitary actors optimizing their power through strategic positioning in a landscape of voters. The framework in this article understands parties as merely coalitions of coalitions.

As coordinating on decisions is a prime function of political bodies, Kenneth Arrow's (1951) result that even rational voters with transitive preference rankings cannot guarantee transitive policy rankings poses a challenge to political science. The answer Thomas Schwartz (1989) provides to his question *Why Parties?* is that long and narrow coalitions can resolve inefficiencies resulting from many of the kinds of collective choices that Arrow describes. If the division of a political body into coalitions can diminish coordination problems and if a coalition itself is a political body subject to coordination problems, then I argue that we should expect politics to be characterized by nested coalitions.

However, the description of simple elements is insufficient for an understanding of the complex whole. Rules of interaction among particles govern physics and among words govern literature. With basic rules governing the formation and dissolution of coalitions and the movement of their policy platforms, this article shows that simple rules of political interaction can account for a broad range of political phenomena.

In the first section, I describe the traditional models and results in the party formation and spatial voting literatures. In the second section, I discuss the general framework for the models presented in the following four sections. Finally, I discuss the results of the investigation and propose an extended research agenda.

Traditional Approaches to Voting and Parties

Anthony Downs' (1957) classic *An Economic Theory of Democracy* presents a deductive argument about the strategy of parties and political actors in a two-party system. Downs borrowed economic assumptions of unified rational actors and spatial markets for his political analysis. The rational *homo politicus* (1) makes a decision when confronted with alternatives, (2) ranks preferences, (3) uses a transitive ranking, (4) always chooses the highest ordered preference, and (5) makes the same choice when presented with the same alternatives (Downs 1957,

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6). However, the actors in Downs' (1957, 25) model are not only individuals but they can also be teams—coalitions with members that agree on all their goals. Because of this agreement, the team can be treated as a single entity for the purposes of the model. Downs defines a political party as a team seeking to control the governing apparatus by gaining office.

Downs also adopts the notion of spatial markets from economics and applies it to the ordering of political preferences. Voters prefer some point on the policy dimension and their utility for alternatives diminishes monotonically from that point (Downs 1957, 115). One interesting result that Downs presents is the tendency of parties to move toward the median voter (Downs 1957, 117). The logic is that if a left-wing party has 30 percent of the electorate and the right-wing party has 70 percent then, under the assumptions of the spatial voting model and the definition of party, the left party will move toward the center to garner a greater share of the votes. The right party must react and will also move toward the center. Eventually, the parties will converge on the median position. Duncan Black (1958) demonstrates this result formally in one dimension as the Median Voter Theorem.

Most of Downs' theory is developed in the context of the two-party system in America. Of course, two parties are not constitutionally mandated in the American system. But, Downs and others have argued that this is the natural result of a winner-take-all plurality electoral structure. The two-party result is frequently referred to as Duverger's Law. Although statements of the tendency toward two parties had been expressed eighty years prior to Maurice Duverger's publication, he is noteworthy for having collected the historical evidence as well as for distinguishing the hypothesis that proportional representation will lead to a multiparty system (Riker 1986, 26).

The reasoning of Duverger's Law is that when only one party can be elected, one challenger to the leader can be viable, but votes for additional challengers would be "wasted" (Downs 1957, 48). Gary Cox (1997, 30) expands on this by noting that in addition to this strategic voting concern, a contributor may worry about other resources such as money and endorsements being wasted if they go to a candidate with no hope of winning. Cox's (1994) model of strategic voting shows that we would expect voters to remain with two or more challenging parties (as opposed to the leading party) only when there is a coordination problem and the challengers are expected to garner an equal number of votes. Otherwise, voters who like the challengers better than the leader improve their expected utility by switching to the party they think will come in second.

While we expect two parties in equilibrium, Downs notes that third parties occasionally arise to challenge the existing two. He cites the enfranchisement of the working class in late-nineteenth-century Britain as a cause for the rise of the Labour Party against the traditional Liberal and Conservative parties (Downs 1957, 128). The changed importance of social cleavages or the emergence of new cleavages alters the political landscape and creates opportunities for new parties. The Labour Party entered British politics to the left of the Liberals, who were unable to react to the changing times.[1]

James Sundquist's (1983) *Dynamics of the Party System* extends the discussion of what party changes might result from a change in social cleavages. His second chapter narrates the fictional tale of a town divided into the Progressive and Conservative parties. A new issue arises, whether to allow a saloon, and supporters and opponents are found in both existing parties. He describes five scenarios that might ensue (1) no major realignment, (2) realignment of the two existing parties, (3) realignment of the existing parties through absorption of a third party, (4) realignment through replacement of one major party, and (5) realignment through replacement of both existing parties. Which of the scenarios occurs depends on the salience and positioning of the new issue and the existing cleavages, party leadership, and strength of party attachments. Sundquist argues his theory by looking at historical examples of new cleavages and their results. Part of Sundquist's argument is that realignment comes about not because of forming and reforming of coalitions of groups, rather from the reordering of individual attachments (Sundquist 1983, 41).

While Sundquist's argument is based predominantly on historical evidence from the American experience, William H. Riker's *Theory of Political Coalitions* uses a formal model to describe the dynamics of coalitions. In the first half of his book, he argues that political actors will create coalitions just as large as they believe will ensure winning and no larger (Riker 1962, 47). This notion of "minimum winning coalitions" (also known as the "size principle") has been disputed on theoretic (Hardin 1976) as well as empirical grounds (Hinckley 1972). But, the notion that winning coalitions will still be constrained in size remains important (Koehler 1975).

In the second half of his book, Riker (1962, 133) modifies the *n*-person game of Von Neumann and Morgenstern (1944) into an n-set partition of the voting members. He uses this partition model to describe strategy at the step before a winning coalition is established. While the dynamics of the final step are interesting and tractable within game theory, Riker's model shares a limitation with Downs. We get little understanding of the internal dynamics of coalitions and parties. For Downs, the party is a unified team. For Riker, the partition is a divisible set, but the theory describes very little of the workings within the set.

A general theory of politics should give insights into the competition and coordination among political actors, be they individuals, factions, or coalitions. If political science concluded that the internal politics of the Democrats in the Congress had no importance, then we could treat them as a unified actor and theories in the tradition of Downs or Riker could be adequate. But, if the debates between Blue Dog Democrats and the Congressional Black Caucus interact with the debates between Republicans and Democrats as a whole, then we need a theory that can accommodate intra- as well as intergroup conflict.

One might respond that this is a straw-man conflict, that the answer to the question "Do Parties Matter?" is "No," and that having individual members of Congress as the unit of analysis would solve the problem. But, as Schattschneider (1960) contends, the organized beat the unorganized. Coalitions struggle to form a united front, using Schwartz's solution to the problems described by Arrow, precisely because there are gains from coordination. This article presents a framework for the dynamics among intra- and intercoalitional conflict and cooperation.

The Framework

To escape the limitations of the frameworks of Downs and Riker, this article proposes a view of parties as coalitions of coalitions. Empirically, political observers back to the ancients have described political bodies as factional. By iterating Riker's concept of a divisible set, we can see that the nation divides into parties, the parties divide into coalitions, and the coalitions divide into subcoalitions. Alternatively, we can say that coalition building is essential to the coordination game of politics and that voters build proto-coalitions, which form coalitions, parties, and so on.

To construct a theoretical framework for the study of nested coalitions, I propose two types of actors: voters and coalitions. The "voters" in my framework represent a unified enfranchised constituency acting in accordance with the principles of Downs' *homo politicus* as discussed above. As I am intending a generic political framework, we could imagine the voters to be a single person with a vote (e.g., a citizen, committee member, or legislator) or a Downsian "team" that is entering the voting process with a unified agenda, set of ideal points, and method for decision making (e.g., a party, coalition, or interest group).

In this framework, the voters are the enfranchised, fundamental, and indivisible unit. The "coalitions" are the aggregate unit. The coalition in this model has no vote or existence in its own right; rather it embodies the aggregate preferences of its members. Although an aggregate, the coalition also functions with the same Downsian rules of rationality that face the voter *homo politicus* described above. We could think of these coalitions as analogous to Riker's proto-coalitions, or as coalitions of parties, interest groups, or elites. When a coalition is independent (e.g., it is not a member of a larger coalition), I will describe it as a "party," following Schwartz's (1989) reasoning.

Now, imagine a committee composed of eleven voters as described above. This committee must decide on a budget for a new school that is between $0 and $100,000. Each voter has an ideal point (like the Downsian spatial model described above) and the voter's utility from an adopted policy diminishes monotonically as a function of the distance between the policy point and the voter's ideal point. Consistent with the framework described above, we can imagine that the voters will form coalitions as part of the process of arriving at a decision.

In this article, I operationalize a series of thought experiments about coalition formation and dynamics with an agent-based computer simulation. In each section, I describe the rules for the model, a run of the model, the motivation for the rules, and the results of the model. I begin with a simple, relatively static one-dimensional model and present increasingly complex models that culminate with a richer, dynamic two-dimensional model. Going step by step in this fashion illustrates the strength of computational modeling as an iterative process as well as hopefully facilitating the readers' intuition about the function of each of the pieces.

Model 1: Policy-Seeking Coalitions

Rule 1: If possible, *form a coalition* with your closest neighbor and set your ideal point at the policy space centroid of the voters in the coalition.

Rule 2: Stop forming coalitions when your coalition has *enough* votes.

The simulation for Model 1 takes the spatial voting framework described above and gives the actors two rules to apply repeatedly. I will first describe one run of the simulation and then describe the rules and the motivation for the rules. Figure 1a illustrates eleven voters (V0–V10) with ideal points distributed along a one-dimensional policy space.[2] Voter 5 prefers to spend close to $0 on the new school and Voter 9 prefers to spend close to $100,000. In this simulation, their ideal points are drawn randomly from a uniform distribution. Interested readers can follow along with this first simulation by implementing the rules with pen and paper.

As the voters know that their committee is going to make a policy, each decides to try and form coalitions with the closest other voter. If the two voters agree that they are the closest to each other, then they can form a coalition. In Figure 1b, we see the new coalitions. Voters

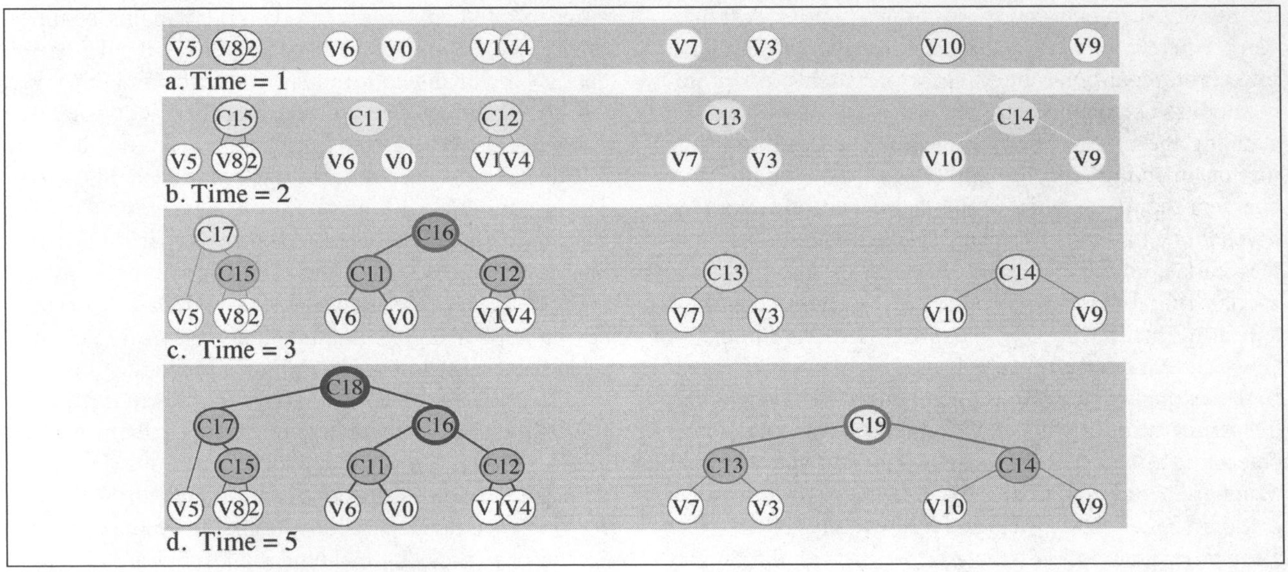

Figure 1. Model 1-a: policy-seeking coalitions.

9 and 10 agreed that the other was the closest other voter in the issue space. They have formed Coalition 14 and set its ideal point at the mean of their individual ideals. Voter 5 wanted to form a coalition with its closest neighbor, Voter 8, but Voter 8 had Voter 2 (partially hidden) as its closest neighbor. As Voters 5 and 8 did not agree about being closest neighbors, they did not form a coalition. But, Voters 2 and 8 did agree that they were closest neighbors and formed Coalition 15. As a result, Voter 5 did not join any coalitions during the first iteration of the model.

Figure 1c shows the result of another iteration of this process. Coalition 15 joins with Voter 5 to form Coalition 17. The policy point for Coalition 17 is set at the mean of the positions of Voters 2, 5, and 8 (the weighted mean of Voter 5 and Coalition 15). Coalitions 11 and 12 join to form Coalition 16. In Figure 1d, Coalitions 16 and 17 have joined to form Coalition 18. And, Coalitions 13 and 14 have joined to form Coalition 19. As Coalition 18 has seven voters supporting it, that policy point is enacted.

The preceding figures and text narrate a single run of Model 1. Each time a simulation is run in Model 1, the computer randomly distributes eleven voters' ideal points in a one-dimensional policy space. The computer then applies Rule 1 "If possible, form coalitions . . ." iteratively until, under Rule 2 "Stop forming coalitions . . .," a coalition has formed with a sufficient number of votes.[3] The threshold for the sufficient number of votes is a parameter set by the user of the software. In the example above, the threshold was set at 50 percent of the total votes and Coalition 18 stopped applying Rule 1 when it had a majority. The user can also instruct a coalition to stop the process when it has a plurality. In this article, the effect of both the majority and plurality rules will be studied.

The concept of forming coalitions in Rule 1 reflects the factional nature of politics described above. The assumption is that political actors will form coalitions with those who are most similar on the issues. A rational actor will find it is easiest to achieve policy goals by banding with those who have the most similar policy goals. This is observable by studying the relationship between coalition membership, declared values, and vote history in a political body (Laver and Budge 1992). Vote trading may appear to be an exception, but rational actors will only vote against their preference on Issue A in exchange for a vote on Issue B if they value gains from Issue B more highly. As such, vote trading can still be understood as the result of a decision based on a generalized form of the proximity model, as will be discussed below.

Setting the coalition's policy point at the mean of the voters' ideal points is a simple heuristic. If two voters know that they have the most similar ideal points and that all of the other voters will be forming coalitions to control policy, then the pair has a strong incentive to come to an agreement quickly. The mean of their ideal points is the point at which their contract curves intersect and their utility from the adoption of coalition's policy point would be equal. The next two models will allow for subsequent actions to adjust the coalition's policy point, but we are best off understanding the implications of the initial assumptions first.

The iterative process of forming coalitions of coalitions and setting the policy point of the new coalition at the centroid of the members is essentially a clustering algorithm from statistics. Cluster analysis groups entities into subsets on the basis of their similarity across a set of attributes (Lorr 1983, 11). Bernard Grofman (1982) applies this method to study parties in a multiparty framework where proximate parties are iteratively combined into proto-coalitions building a hierarchy of proto-coalitions. The method has been shown useful for understanding the role of policy preferences on coalition formation in multiparty systems (Laver and Budge 1992; chapters applying this method to Ireland, Norway, Sweden, Denmark, Germany, Luxembourg, Belgium, Denmark, Italy, Israel, and France) in the European Parliament (Laver 1997) and among interest groups appearing before the U.S. Congress (Jenkins-Smith, St. Clair, and Woods 1991).

The stopping rule (Rule 2) embodies the concept that the aggregate utility of a coalition with sufficient votes to determine policy will decrease if they add an additional member to the coalition. This is similar to arguments made by Riker (1962, 47)[4] and Schwartz (1989). To test alternative assumptions, the user of the simulation can vary the requirement for a sufficient number of votes. In the simulations presented below, I instructed the coalitions to stop forming new coalitions once they had achieved a majority (the first set of results) or a plurality (the second set of rules).

It is important to note that the majority and plurality versions of Rule 2 are not equivalent to majority rule and plurality rule in electoral systems. In all of the models in this article, the winner is the coalition with the most votes—an electoral rule known as the winner-take-all plurality rule. Versions a and b of the models differ in that coalitions are either pursuing the absolute size of a majority of the vote share or the relative size of a plurality of the vote share.

There is a debate in political science regarding the extent that political actors are policy-seeking or office-seeking. For instance, this is one of the issues studied in Laver and Budge's (1992) work using cluster analysis in European Parliaments. The coalitions in Model 1 can be described as policy-seeking coalitions in the sense that they do not move their policy point once it is established. They may form a new coalition with a new policy point, but an existent coalition will not adjust the policy point to entice additional members and increase the probability of winning. The simulation becomes static once all of the coalitions have formed, because none will move their policy points.

To examine the consequences of the policy-seeking model described above, I randomly generated one thousand initial distributions of 11 voters each and their ideal points. For each of the one thousand runs, I then instructed the computer to repeatedly implement the policy-seeking coalition rules until no new coalitions formed. I then repeated the experiment using one hundred runs that each contained 101 voters.

All coalitions other than the winning coalition will constantly want to form coalitions, because Rule 2 has not been satisfied. However, when the winning coalition satisfies Rule 2, the rest of the coalitions will quickly find that they are unable to form new coalitions and the model will appear static. The winning coalition will not agree with any other coalition to form another coalition because of Rule 2. The subordinates of the winning coalition have already formed coalitions with their nearest neighboring coalitions. And any other free coalitions (parties or coalitions that are not members of another coalition) will find that there are no other free coalitions to join with because they do not both agree that the other is nearest to them.

The first output of the model I examined was the number of parties. As I indicated above, parties in this model are coalitions that are not members of another coalition like Coalitions 18 and 19 in the figures above. However, in this simulation as in American politics, not all parties are viable contenders. Many political systems have a number of parties that make the ballot, but are unable to elect a representative or seriously affect policy (Cox 1997). To calculate the number of viable parties, I use the reciprocal of the Hirschman–Herfindahl Index: Number of viable parties $=1/\sum_{i=1}^{n} v_i^2$, as suggested by Laakso and Taagepera (1979), where v_i is the share of the votes for independent coalition i. This measure counts the parties, but weights them by their relative strength in terms of their portion of the vote. Thus, parties with small fractions of the vote only count for a small fraction of a party. For each simulation run in this article, I calculate the number of parties and the number of viable parties.

Model 1-a: One Issue Dimension—Majority

In the simulation where the stopping rule is a majority, 71.3 percent of the eleven-voter runs ended with two parties, 25.4 percent of the runs ended with three parties, 3.1 percent ended with four parties, and 0.2 percent ended with five parties. As many of the runs ended with individual voters who had not joined a coalition because they were so far from the others, we would expect the viable parties' calculation to be different. These individual voters are treated as a "party" unto themselves. Using the Laakso measure, we had one viable party 6.6 percent of the time, two parties 90.2 percent of the time, and three viable parties 3.2 percent of the time.[5] Of the one hundred runs of Model 1-a where there were 101 voters, two parties emerged 96 percent of the time (counting either using the total parties or the viable parties measure).

Model 1-b: One Issue Dimension—Plurality

When the stopping rule for coalitions is a plurality, the results differ, but there is still a strong tendency toward two parties. Counting all independent agents in the eleven-voter model, there were two parties 44.2 percent, three parties 23.3 percent, four parties 20.4 percent, five parties 7.1 percent, six parties 3.4 percent, and seven parties 1.5 percent of the time. Using the viable parties measure, I found one party in 0.9 percent, two parties in 50.9 percent, three parties in 29.5 percent, four parties in 12.7 percent, five parties in 4.6 percent, and five parties in 1.4 percent of the runs. The results when using 101 voters in the model were similar, with 57 percent of the runs yielding two, 25 percent yielding three, 11 percent yielding four, and 4 percent yielding five viable parties.

The prediction of Duverger's Law is not as convincingly supported under the plurality stopping rule, but still satisfied in around half of the cases. The coalitions in the simulation, unlike real coalitions, are not looking ahead to see the consequences of their actions. Not only is programming such artificial intelligence challenging but it is also reducing the elegance that comes from the simple assumptions presented in this simulation. Thus, coalitions in Model 1-b will stop merging if they have a plurality during that step of the simulation, which may cost them a plurality at the end of the simulation. Despite this lack of foresight, the simple iterative process of coalition formation illustrates the structural tendency toward two parties even without foresight or strategy.

One long-standing question about Duverger's Law is whether it is deterministic or probabilistic. Riker (1986) argues that this was left ambiguous because Duverger himself was uncertain. Models 1-a and 1-b suggest that in a one-dimensional issue space with actors who only seek after policy, Duverger's Law is probabilistic.

Model 2: Office-Seeking Coalitions

Rule 1: If possible, *form a coalition* with your closest neighbor and set your ideal point at the policy space centroid of the voters in the coalition.

Rule 2: Stop forming coalitions when your coalition has *enough* votes.

Rule 3: If your coalition is not the winning party, *move your policy point* closer to the closest actor who is not a member of your coalition.

Rule 4: Defect and join the closest coalition if the coalition you currently belong to is no longer closest to you. If your coalition has *enough* votes, then simply defect and become an independent party.

Initially, Model 2-a runs like Model 1-a as illustrated above. Coalitions form iteratively until one has a majority. However, in Model 2, once Coalition 18 has a majority, all of the other coalitions (including Coalition 18's subordinates) begin competing for additional voters in an attempt to gain the majority. To continue the previous narrative, we can imagine that Coalition 19 realizes its risks losing the vote. Unlike the Coalition 19 in Model 1-a, this coalition is willing/able to move its policy point to attract new voters and win the election. In Figure 2a, Coalition 19 determines which actor is closest to its policy point (Voter 4) and moves the policy point half of the distance from its original position to Voter 4's ideal point.[6] Similarly, Coalition 13 also identifies Voter 4 as the closest actor who is not a subordinate or superior and moves half the distance from its original position to Voter 4's ideal point.

Coalitions 12 and 16 move left toward Voter 0, whereas Coalitions 15 and 17 move right toward Voter 6. Initially, the subcoalitions of Coalition 18 converge from both directions on the party median (Voter 6) because that is where they can gain the closest voters that they might hope to entice. The next time period depicts that convergence on the party median is almost achieved.[7]

Figure 2b shows the result of a series of moves by Coalition 19 toward Voter 4. Voter 4 thus defects to Coalition 19 as a result of Rule 4 because it is the closest coalition. At the same time, Coalition 18 and Coalition 19's subordinates have been moving their policy points in attempts to add members. Coalition 14 is now approaching Voter 4 as well.

In Figure 2c, we see that the partially obscured Voter 1 has defected to Coalition 19. Coalition 19 now is the winning coalition and Coalition 18 has begun to move its policy point to try and regain its winning status. In Figure 2d, Coalition 18 is converging upon Voter 1 to regain its support, and its subordinates are following as they also attempt to gain additional voters. By Time Period 24 in Figure 2e, all of the coalitions have converged upon the ideal point of Voter 1, the median voter.

The assumption behind Rule 3 is that coalitions that are not winning will try and entice members from the winning coalition. Similarly, Riker (1962, 47) describes the second feature of his theory of strategy as follows: "For the proto-coalitions lacking an advantageous position when others have it, the main task is to minimize or eliminate the advantage of others." The resulting process of offer and counteroffer is also akin to the assumptions of the "bargaining set" described by Aumann and Maschler (1964). If actors are rational and value outcomes, then we would expect them to act strategically to achieve those outcomes. By moving their policy points closer to nonmembers, coalitions entice defection.

Riker's (1962, 47) initial setup, like Model 1, precludes resigning a coalition that one has joined. And, as I have done in Model 2 with Rule 4, Riker discards this assumption so that he can develop a dynamic theory of coalitions. As a Downsian *homo politicus*, an actor in this model ranks the alternatives presented by the various coalitions and chooses the coalition with the closest policy point. If the actors in Model 1 can be described as

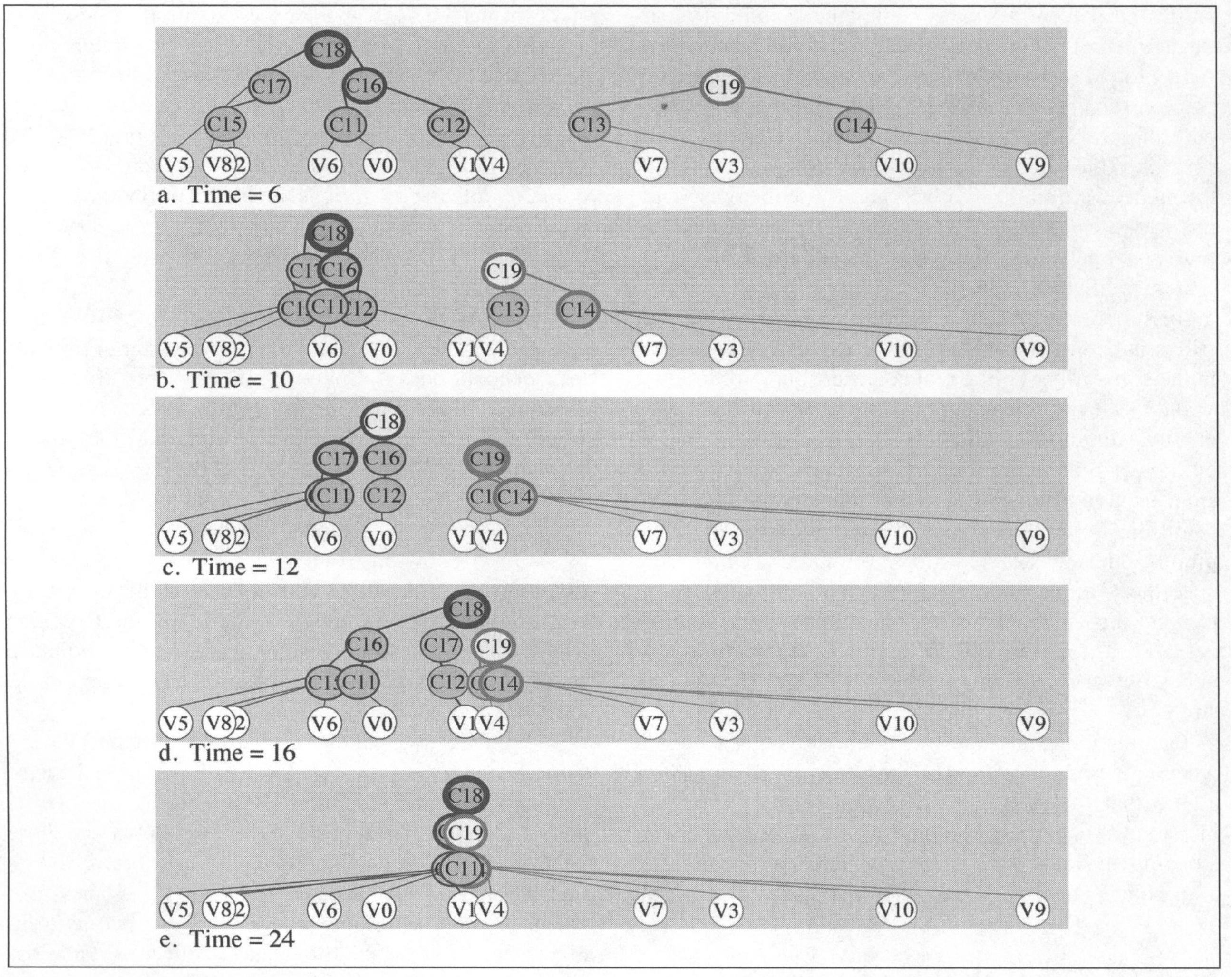

Figure 2. Model 2-a: office-seeking coalitions.

policy-seeking, we could describe the actors in Model 2 as behaving like office-seeking politicians. Rather than simply forming a coalition and sticking with it whatever the outcome, the actors in Model 2 will move their policy points in an attempt to become the winning coalition.

Riker (1962, 47) also argues, for the second part of Rule 4, that a subcoalition with sufficient votes should shed the excess voters who come with coalition membership. By defecting when a subcoalition would independently have sufficient votes to win, it can determine the policy point most advantageous to its own members without considering the other members in the larger coalition. Similarly, a real subcoalition with sufficient power may desire independence if its superior coalition is failing to bring benefits to the members of the subcoalition. Model 2-a implements this concept by allowing subcoalitions to become independent parties when they have a majority. However, as plurality is a relative rather than absolute concept, it is much more difficult for subcoalitions to estimate when their defection would be sufficient to enable them to successfully defect.[8] As such, actors in Model 2-b (plurality rule) will only defect to the closest coalitions; the subcoalitions will not become independent.

With the ability to strategically move issue positions and defect, the support for Duverger's Law becomes even stronger. After one thousand runs of Model 2-a with 11 voters and a majority stopping rule, we have two parties 93.5 percent of the time and three parties 6.4 percent of the time just by counting independent agents. With the Laakso calculation for viable parties, we have one viable party 11.2 percent, two viable parties 88.7 percent, and three viable parties 0.1 percent of the time. The third parties are typically voters who are so far on the extreme of the issue dimension that they never join a coalition. Running Model 2-a with 101 voters leads to two parties 100 percent of the time using either the total count or the viable parties count.

For Model 2-b, 11 voters and a plurality rule, the tendency toward two parties is strong, but not as strong as with a majority stopping rule. Counting independent coalitions and starting with 11 voters, we have one party 43.4 percent of the time, two parties 53.5 percent of the time, three parties 0.9 percent of the time, and 2.1 percent where there were four independent coalitions. By the viable parties measure, we have one party in 49.5 percent of the cases, two parties in 48.4 percent of the cases, and three parties in 2.1 percent of the runs. When using 101 voters, we have 51 percent of the runs leading to a single party and 49 percent leading to two parties (counting either total parties or viable parties).

In this setup, I also tabulated two additional dependent variables. First, I noted the number of times that the parties converged to one issue position. Second, I noted the frequency of convergence upon the median voter. My expectation was that the two top-level coalitions (parties) would converge on the median voter.

With Model 2-a and 11 voters, the parties converged on the issue position of the median voter in 87.1 percent of the runs. The remaining portion had one or two viable parties and one or two extreme individual voters. In such cases, the viable party or parties converged on the median of their membership ignoring the extreme individual voters. Running the model with 101 voters led to a convergence on the median voter 99 percent of the time.

In Model 2-b with 11 voters, when there were two or more parties, the two main parties converged on a single position that was the median voter 86.9 percent of the time. In the cases where all of the voters ended up in one party, competition during coalition formation still lead the party to be near the position of the median voter 79.0 percent of the time. When the simulation used 101 voters, a two-party system converged on the median voter 95.9 percent of the time and 78.4 percent of the single-party system had the parties' ideal point at the median voter.

This result fits with the expectations of the Median Voter Theorem as proven by Duncan Black. The two assumptions for that proof are (1) a single issue and (2) voters with single-peaked preferences (Hinich and Munger 1997). This simulation meets both assumptions. However, the simulation is different in that voters have bounded rationality. In the Median Voter Theorem, the voter is contemplating all of the alternative proposals. For this model, a voter is only aware of the closest coalitions.

The convergence on the median despite the bounded rationality of the actors in this simulation is an example of an "emergent property." An emergent phenomena

> (i) can be described in terms of aggregate-level constructs, without reference to the attributes of specific [micro-level agents]; (ii) persists for time periods much greater than the time scale appropriate for describing the underlying micro-interactions; and (iii) defies explanation by reduction to the superposition of "built-in" microproperties of the [system]." (Lane 1992, 3)

Here the aggregate-level construct is a convergence upon the median voter that persists longer than the micro-level decisions of the voters and coalitions to defect and to move. The convergence at the median in this model comes about by the interactions of the micro-level decisions (see Schelling 1978).

While Holland (1998, 5) correctly rejects "surprise" as a critical element of emergence, he does note that surprise often guides us to emergent phenomena. I did expect that the parties would converge on the median voter as a result of their competition. The unexpected consequence of the simulation was that *all* coalitions converge on the same point. A top-level coalition without a majority moves toward the closest agent that is not a member. The winning coalition does not move until it has lost its majority, then it reacts by moving toward the closest nonmember.

Each of the subcoalitions is also employing the same strategy. As the simulation continues, all the coalitions converge on the median voter as can be seen in Figure 2e. The result is an emergent property of this model and an interesting function of the interaction of the individual decisions (Cederman 1997, 51; Holland 1998). Also, note that because the two parties are asymptotically converging on the same position, the winning party is arbitrary and both parties will cycle as winner.

Model 3: Strategic Coalitions

Rule 1: If possible, *form a coalition* with your closest neighbor and set your ideal point at the policy space centroid of the voters in the coalition.
Rule 2: Stop forming coalitions when your coalition has *enough* votes.
Rule 3: If your coalition is not the winning party, *move your policy point* closer to the closest actor who is not a member of your coalition.
Rule 4: Defect and join the closest coalition if the coalition you currently belong to is no longer closest to you. If your coalition has *enough* votes, then simply defect and become an independent party.
Rule 5: If you are a coalition and have lost or gained a member, *recenter* the policy point in your current membership.

Model 3 adds one rule to Model 2. While losing coalitions in Model 2 will move anywhere to gain an additional voter and coalitions in Model 1 will not move from the centroid of their membership, coalitions in Model 3

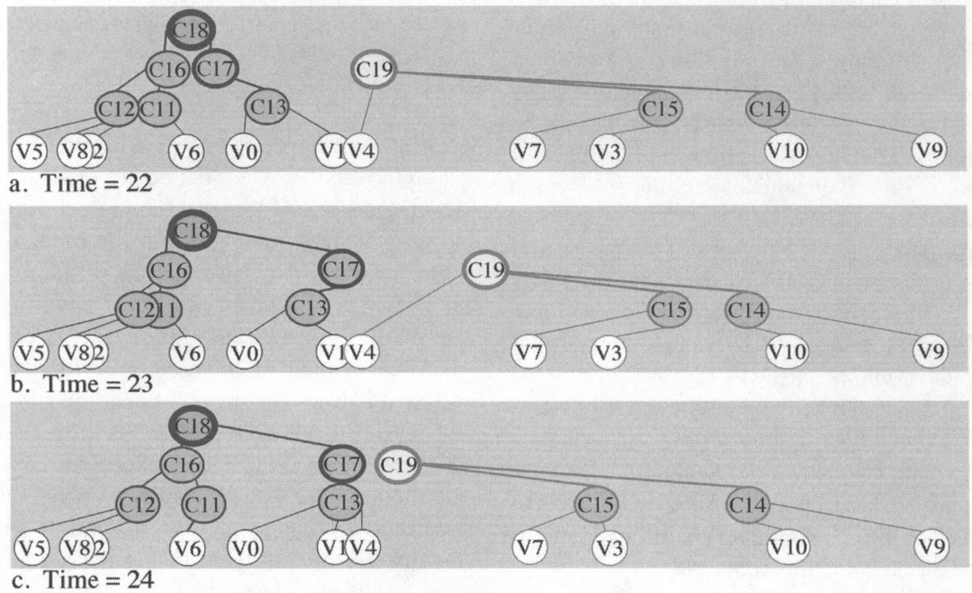

Figure 3. Model 3-a: strategic coalitions.

employ a simple strategy and retrench their positions when their membership has changed. In Figures 3a to 3c, we see the same initial setup from the illustrations of Models 1 and 2 above running with Rule 5. At Time = 22, Coalition 19 has moved to gain Voter 4. In Figure 3b, Coalition 19 obeys Rule 5 and recenters itself in its new constituency.[9] At Time = 24, having lost Voter 4, Coalition 19 again moves the policy point to gain Voter 4 back.

Rule 5 implements a simple strategy on the part of the coalition. If it is losing members, it retreats back to the center of its constituency. If it is gaining members, it consolidates the gain by returning to the center of its constituency. The strategy reduces the probability that the coalition will get so far from its members that they all defect to a competitor.

In real-world politics, candidates frequently adjust their policy to entice new members or consolidate the constituency. For instance, many analysts noted Republican Presidential Candidate George W. Bush's changes in rhetoric as he attempted to gain moderate voters with his "compassionate conservatism" or stave off defections by conservative Republicans. A politician obeying the rules of Model 1 would have to hope that public opinion supported her policies as they are unchanging. A politician obeying the rules of Model 2 would risk defections by extreme members of the coalition as she moved toward the median voter. The first model reflected policy-seeking coalitions and the second model reflected office-seeking coalitions. In Model 3, the coalitions reflect a mixture of strategies that is probably closer to the real world.

After one thousand runs with 11 voters, Model 3-a (majority rule) had 94.2 percent with two parties, 5.6 percent with three parties, and 0.2 percent with four parties. Using the viable parties measure, Model 3-a had one viable party 11.4 percent of the time, two viable parties 88.4 percent of the time, and three viable parties 0.2 percent of the time. The same model using 101 voters led to two parties 99 percent of the time (98% viable). Model 3-b, with the plurality rule, resulted in one party 31.0 percent of the time, two parties 64.4 percent of the time, three parties 2.6 percent of the time, and four parties 1.8 percent of the time. With the viable parties measure, Model 3-b had one party in 37.8 percent of the runs, two parties in 59.9 percent of the runs, and three parties in 2.2 percent of the runs. The 101 voter version of Model 3-b led to a two-party system (by total party and viable party measures) 97 percent of the time.

In both versions of Model 3, the competition for voters combined with the recentering strategy resulted in more dynamic systems. Rather than the static results of Model 1 and the asymptotic convergence of all coalitions on the median voter in Model 2, Model 3 represents a dynamic model of competition between coalitions and among subcoalitions. Thus, it escapes the flatness of models by Riker and others that represent only intercoalition competition and not intracoalition dynamics. Instead, Model 3 shows patterns of long stability in the dominant parties that can shift quickly in a manner that appears similar to the self-organized criticality described by Per Bak (1996) or reminiscent of the collapse of states in the work of Lars-Erik Cederman (1997).

I also noted the frequency of median voter and convergence results with Model 3-a. While in Model 2 the parties converged their policy points on the median, some of the runs in Model 3-a had the coalitions competing for some other voter. In 64.3 percent of the runs with eleven voters, the coalitions were competing over the median voter. The model with 101 voters was more complex as coalition would often emerge that represented a central group of voters and the two main parties would compete for this central coalition. As the central coalition shifted allegiance, ten or so voters would typically defect along with it.

These differences between the smaller and larger versions of the model led to differing positions of the policy platform relative to the median voter. With only 11 voters, the interparty competition leads the parties to have ideal points near the median voter of the electorate (30.0% within five units and 56.6% within ten units). However, with 101 voters, a mix of interparty and intraparty competition drives parties closer to the median voter of the party. The addition of new coalitions and voters causes the party to return to the center of its membership more frequently (Rule 5). Because the median voter of the electorate was often contained within a larger coalition that defected to the new winning party, the center of winning party would then be between the median voter of the electorate and the median of the original party. However, as subcoalitions with sufficient voters can defect to form their own parties, a party that ventures too far from its base will be overtaken by one of its subordinate coalitions.

The results for Model 3-b were similar with 48.6 percent of the runs with 11 voters competing over the median voter and approximately 60 percent of the runs of 101 voters competing for a coalition of 10 or fewer voters. And, similar to Model 3-a, we find that the model with only 11 voters tends to have the winning parties' policy points located closer to the median voter of the electorate, whereas the model with 101 voters tends to result in models with policy point closer to the median of the winning party.

We can see the persistence of the two-party and median voter results even with varied assumptions. In the first, second, and third sets of simulations, two parties usually emerged as a result of the rule that the coalitions would continue to form new coalitions until they had sufficient votes. The two-party result was even more likely in the second and third sets when the coalitions were allowed to compete and move their issue positions based on strategic concerns.

The importance of the median in politics is also supported in the second and third simulations. When the coalitions compete with each other for voters, they must move toward the middle of the electorate. Again, it is interesting to see that we can achieve a median voter result without the information assumptions of the Median Voter Theorem. Voters and coalitions making simple alliance decisions based on proximity can also force policy toward the median even when they are not aware of all of the possible platforms.

Model 4: Strategic Coalitions in a Changing Issue Space

Model 4-a: Two Dimensions—Varying the Salience of the Second Issue Dimension

In Models 1 to 3, the distance in the one-dimensional issue space *X* from Coalitions A to B could be evaluated as the absolute value of differences in their policy points: $x_A - x_B$. To measure the distance between A and B in a multidimensional issue space, we can use the vector form $\text{SED}(\mathbf{a},\mathbf{b}) = \sqrt{[\mathbf{a}-\mathbf{b}]'[\mathbf{a}-\mathbf{b}]}$ where **a** and **b** are vectors of A and B's positions on the issues and SED is the simple Euclidean distance. In Model 4, I represent the addition of a new issue to the political arena by using the weighted Euclidean distance (WED) formula, $\text{WED}(\mathbf{a},\mathbf{b}) = \sqrt{[\mathbf{a}-\mathbf{b}]'\,\mathbf{W}_i\,[\mathbf{a}-\mathbf{b}]}$, and changing the weight of the second dimension from zero to a new value. I run the simulations with matrix $W = \begin{bmatrix} 1 & 0 \\ 0 & 0 \end{bmatrix}$ for fifty steps and then change to $W = \begin{bmatrix} 1 & 0 \\ 0 & w \end{bmatrix}$, where *w* is a constant representing the new weight for the second issue dimension.

James Sundquist's (1983) argument in *Dynamics of the Party System* is that newly salient issues may cause the parties to realign. The logic is that the two main parties have divided the existing issue space along a line of cleavage and that a new issue that cuts across the line of cleavage can force realignment. A portion of the constituencies of both parties now finds themselves on the wrong side of the new cleavage line. If the issue is relatively minor, then the potential defections will be small and there will be no significant movement by the parties. If the issue is of greater magnitude (e.g., slavery or race), then the defections can cause far more substantial change. In some cases, the parties will realign to account for the losses and to attract new adherents. In other cases, one or both of the main parties is unable to adjust sufficiently or fails to do so rapidly enough and new parties emerge in their place. In each of the scenarios that Sundquist explores, the major variables are the importance of the new issue and ability of the parties to successfully react to the new issue.

Having constructed and tested a framework for coalition formation, I wanted to test Sundquist's argument and study how salient a new issue would need to be to cause realignment in this simulation framework. Sundquist's

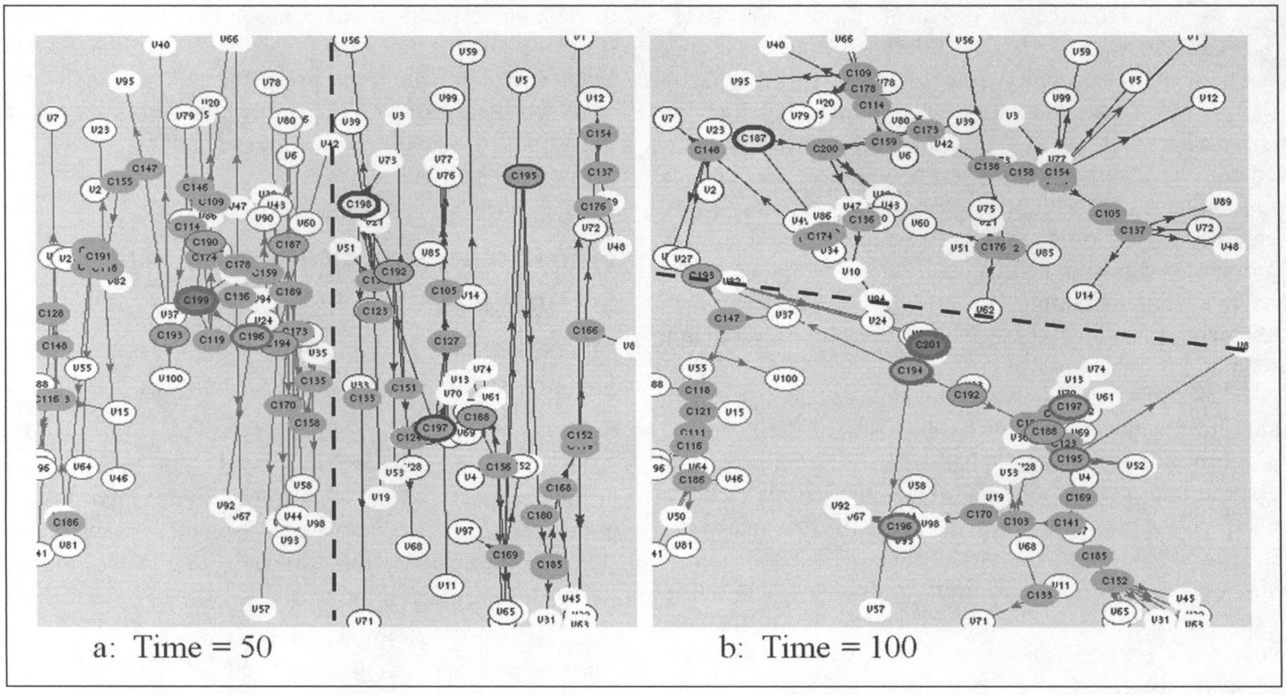

Figure 4. Model 4-a: strategic coalitions in a two-dimensional space. Salience of the second issue dimension changes from zero to one after the 50th step.

method was to analyze a number of historical cases in the United States and whether new issues caused realignment. Here, I will simulate the introduction of new issues and classify the resulting political alignments.

For the simulations in this study, I started with 101 voters. At the beginning of each run, the voters were given issue positions on two issues. The first issue had a salience of one and the second issue initially had a salience of zero. Thus, agents would build their coalitions based only upon positions on the first issue dimension. When plotted on a two-dimensional space, the coalition formation looks strange compared with the previous simulations. In Figure 4a, long lines connect actors who are close on the *x*-axis and distant on the initially irrelevant *y*-axis. This setup is akin to the initial state in Sundquist's model where the new issue is still latent and does not affect the existing divide between the two parties.

To test the realignment hypothesis, I let the coalitions form based on the single issue and then let them compete until the run had gone through fifty iterations. This was sufficient time for two major parties to emerge and compete meaningfully. At Time = 50, I noted the agent ID numbers of the two top-level coalitions (the parties). At Time = 51, I increased the second issue's salience for all agents from zero to a new value. The second issue could be half as salient, equally salient, 1.5 times as salient, or twice as salient as the existing first issue. I then let the simulation run for fifty more iterations. At Time = 100, I noted the agent ID numbers of the top-level coalitions and their division of the issue space. Figure 4b illustrates the same model in Figure 4a, but after the issue dimension on the *y*-axis has been weighted equally to the issue dimension on the *x*-axis. Model 4-a has the same rule set as Model 3-a, but runs in two dimensions and with 101 voters. I ran the model one hundred times for each of the four values of the new issue salience.

The first of Sundquist's scenarios is that the new issue will cause no major realignment. To quantify realignment, I defined the line of cleavage as a line running perpendicular to the line that connects the centroids of the membership of the two main parties. Initially, with only one salient issue, the line of cleavage is always perpendicular to the *x*-axis (note the dotted line in Figure 4a). Sundquist's second scenario is a major realignment of the two parties. I coded a major realignment as a move of the line of cleavage forty-five degrees in either direction (see Figure 4b). If the new issue did not cause the line of cleavage to change at least forty-five degrees, I considered it to not be a major realignment for this study. Thus, I was able to approximate Sundquist's first and second scenarios with a coding scheme and the model.

Sundquist's third scenario is realignment through the absorption of a third party. Although an important scenario in American politics, the computer model is unable to capture this type of realignment. In Model 4-a, the assumption is that agents defect to another coalition when the other coalition is closer than the current superior. The coalitions only become independent when they have a majority. As a result, the emergence of a new third party becomes unlikely because a potential third party needs to be able to garner a majority before it breaks away.[10] Because of the difficulties with anticipating a plurality discussed above, I was unable to test the realignment scenarios with the plurality rule.

Sundquist's fourth and fifth scenarios involve realignment through the replacement of one or two of the existing parties. In this simulation, I coded a change of a top-level coalition as the change of an existing party. Such a change occurred when a member coalition was able to command a majority and could defect from its top-level coalition. Frequently, change at the top happened when the top-level coalition had moved toward the center of the electorate and all of its member subcoalitions defected to one of the member subcoalitions.

In the simulation, a change in party was not always accompanied by a major realignment. As a result, I coded the number of parties that were different at Time = 100 than Time = 50 (either 0, 1, or 2) and whether there had been a major realignment. This meant that each run of the simulation would fall into one of six categories:

Sundquist Revisited

1. No major realignment—Sundquist's first scenario.
2. No major realignment, replacement of one party.
3. No major realignment, replacement of two parties.
4. Major realignment of the existing parties—Sundquist's second scenario.
5. Major realignment, replacement of one party—Sundquist's fourth scenario.
6. Major realignment, replacement of two parties—Sundquist's fifth scenario.

This categorization roughly matches Sundquist's theory and does a fair job of describing the patterns that emerge in the simulations. To study realignment as a function of the change in issue salience, I ran four sets of simulations with one hundred runs each. For each simulation, I noted the alignment and agent ID numbers of the parties at Time = 50 and again at Time = 100. The new issue salience from Time = 50 was 0.5, 1.0, 1.5, and 2.0 for the respective four sets of simulations. Thus, the first set of runs had a new issue that was half as important as the existing issue, and the fourth set of runs had a new issue twice as important.

As Table 1 shows, the introduction of a new issue that is only half as important as the existing issue leads to a major realignment in 10.5 percent of the runs. It also tends to leave the existing parties in power. The introduction of a new and equally important issue, however, causes realignment in 26.6 percent. A new equally important issue also caused one of the existing parties to be replaced in 59.6 percent of the runs. As we might expect, a new issue that is 1.5 or 2.0 times more important than the existing cleavage leads to a major realignment in most cases. Such dramatic shifts also undo the existing parties. When the new issue is twice as important as the existing issue, only a third of the cases result in both parties maintaining their rule.

Table 1. The Introduction of a Newly Salient Issue Causes Realignment as Predicted by James Sundquist.

	Change in issue salience (%)			
Type of realignment	0.5	1.0	1.5	2.0
1. Not realigned	49.5	25.5	15.2	8.7
2. Not realigned, one party replaced	29.5	33.0	19.2	22.8
3. Not realigned, two parties replaced	10.5	14.9	12.1	7.6
4. Realigned	6.3	14.9	21.2	25.0
5. Realigned, one party replaced	2.1	2.1	10.1	14.1
6. Realigned, two parties replaced	2.1	9.6	21.2	21.7

I also gathered data on the size of the winning coalitions from Model 4-a and the prior models to compare with Riker's prediction of a minimum winning coalition. With 101 voters, the minimum winning coalition would be fifty-one. The minimum winning coalition prediction of fifty-one was supported in 9.5 percent of the runs. Coalitions with 52 members won 9.3 percent of the runs (see Figure S1 in the online supplement—http://prq.sagepub.com). The tendency toward a minimum winning coalition is another interesting emergent feature of the models, with an intensity that varies depending on the particular model. Models 1-a and 1-b lead to minimum winning coalitions 10 percent of the time when there are 101 voters. But, Model 1-a has 51 percent and Model 1-b has 35.3 percent minimum winning coalitions if there are only 11 voters. Model 2-a ends up with minimum winning coalitions 100 percent of the time and Model 2-b 48 percent of the time with 101 voters, and 88.8 or 48.3 percent if there are only 11 voters. Like Model 1, Models 3-a and 3-b have low portions of minimum winning coalitions (12% and 13%) with 101 voters, but the portions are larger when there are only 11 voters (64.3% and 48.6%). While the portion of simulations that lead to exactly the minimum winning coalition varies, the competition with the other party drives the winning coalitions close to the minimum size possible in the vast majority of the simulations.

Discussion

As the previous sections demonstrate, the interaction of coalitions through basic rules is able to capture the essential results of the classical models of party dynamics. Although extremely simplified, this article shows that two parties can emerge from basic rules about winning and competition. The article also shows that the median voter result can be obtained in the context of bounded rationality through the micromotives of individual voters and coalitions.

Whereas the traditional models of Downs, Black, Duverger, and Riker described above assume their political actors, this model has allowed the actors to emerge as a consequence of the limited knowledge and scope of actions available to voters. Lars-Erik Cederman's (1997) model of *Emergent Actors in World Politics* was motivated in part by the failure of models that treated nation-states as indivisible units and failed to explain their dissolution. Similarly, conventional models that treat domestic political actors as unified agents fail to give us insight into the internal and local politics that drive larger organizations.

Riker (1962, 12) describes the process of making a decision in a group as a "process of forming a subgroup which, by the rules accepted by all members, can decide for the whole." This claim is a good general description of politics and the problems we face as political scientists. But, if we ignore the problems that exist in forming subgroups, we can miss much of what makes politics, politics.

Previous attempts at agent-based modeling of parties have suffered this same problem. Many models have just assumed the political entrepreneurs and had them compete in a landscape of voter preferences (Johnson 1998a, 1998b; Kollman, Miller, and Page 1992; Lomborg 1997). Another group of models employs the Tiebout (1956) mechanism that allows individuals to choose their group membership based on the public goods provided by that group (Adams 1999; Kollman, Miller, and Page 1997; McGann 1999). Both the voter landscape and Tiebout classes of models have ignored the intracoalition dynamics that are the core of the framework in this article.

The dynamics of intracoalitional politics have been posited as a driving force behind the evolution of cognition in humans and other highly social animals (Schreiber 2007). Chimpanzees (de Waal 1998), hyenas (Engh et al. 2005), and dolphins (Connor et al. 2010) demonstrate evidence of intracoalitional dynamics. This complexity is believed to force a cognitive arms race in which mental capacities must evolve to deal with the dynamic social conditions (Orbell et al. 2004).

One common feature between my framework and other agent-based models is the assumption of bounded rationality. Game theoretic models often assume complete information or at least common information and well-defined probability distributions over states of the world. The agent-based approach demonstrated in this article is able to achieve similar results with less cognitively onerous assumptions. The agents consider limited private information or information shared with those that they are considering joining in coalitions. And, they act without foresight into the consequences of their choices. While we may arrive at similar results with both types of models, assuming that all the agents share the same information (e.g., about the range of political platform choices) presents us with a less developed picture than models in which that information is generated within the system.

For instance, Riker's proof of the size principle has been criticized as being only true in the "rarified class of super-symmetric games and their asymmetric counterparts" (Hardin 1976, 1210). Part of Hardin's argument is that Riker constructs his model such that all winning coalitions have an incentive to contract down to their minimal winning size. In my framework, the competitor coalitions only know that they are not winning and that they can gain advantage by moving their platforms toward the closest nonmembers. The tendency toward the minimal winning coalition thus emerges from the competition with other agents.

While the bounded rationality and simple decision rules and actions available to the actors in this model are able to show patterns that we would expect from a political body, an easy critique of the model is that the assumptions are too simplified. However, a body of work by scholars such as Gerd Gigerenzer (2007) suggests that heuristics are often the only way to deal with highly dynamic and complex choice environments. Gigerenzer demonstrates that such simple rules will often outperform models that are more rational or that have greater levels of information available. Economists like Camerer, Ho, and Chong (2004) contend that cognitively simple models fit the empirical data far better than models of full information and rational choice. And, in previous tournaments where agent-based models competed for electoral victories, the winning algorithm used a satisficing, rather than maximizing approach (Fowler and Laver 2008).

This article presents an extremely simplistic model of the formation of political parties that is nonetheless able to capture the intuitions of a number of classical results in a single framework. The cognitive capacity of the agents is minimal and yet the emergent macrophenomena are recognizable facsimiles of the political competition described in the literature. Simple heuristics lead to complex dynamics between and within the parties.

Acknowledgment

The author would like to thank Lars-Erik Cederman, Scott Page, John H. Miller, and Paul Johnson for their help.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

Notes

1. In fact, some argue that it is the social cleavages that cause the choice of electoral system. Thus, two major factions will select a single member plurality system to protect their interest while a society with numerous powerful factions will opt for a proportional or other multimember system (Cox 1997, 14–16).
2. Note that the framework in this article follows many of the classic models in assuming a spatial model that is purely in the world of ideas rather than incorporating geography. As such, it sacrifices the many important features of political competition that emerge from the fact that politics is embedded in an actual context where political actors must attend to a geographically limited set of constituents or to constituents that have regional interests that vary due to issues of location. For an agent-based modeling approach that factors in a role for geographic constraints, consider Snyder and Ting (2002).
3. Note that this stopping rule only applies to the coalition that is winning. Even though another coalition has gained a sufficient number of voters to become the ruling party, coalitions outside the winning coalition continue to form larger coalitions until no more are possible. This feature anticipates developments in Model 2 where the second largest coalition may move its policy point to compete with the winning coalition.
4. An important difference between my framework and Riker's (1962, 108–23) is that he allows for "side payments." In my model, the coalitions simply apply their heuristic rules to try and obtain a beneficial policy.
5. While the Laakso calculation of viable parties returns a decimal value, I am rounding to the nearest integer for the purposes of this article.
6. Each time a coalition moves, it traverses half of the distance between its current position and the closest nonmember. In a series of moves similar to Zeno's paradox, a coalition starting at Position 7 and moving toward a voter at Position 0 will first move to 0.5, then to 0.75, and then to 0.875, and so on. Coalitions move only half the way toward the nearest nonmember each turn rather than moving exactly the distance needed to win over that voter due to the complex competition with the many other coalitions. The difficulty is that because the environment is highly dynamic and highly interactive, it is not clear how far to exactly move. We would expect coalitions to be adverse to moving too far because this would risk their existing coalition as they move them from the ideal point of their constituents. Furthermore, as all of the coalitions and subcoalitions in the simulation are obeying the same rules, a higher level coalition might make the gain of the nearest voter without having to move the entire distance itself. A subcoalition moving toward the nearest nonmember voter may capture that voter and thus bring it into the membership of the party well before the party reaches the point at which the party itself would have been able to convert the voter.
7. Miller and Schofield (2003) discuss similar dynamics in a two-dimensional space with activists "flanking" off of the main ideological dimension so that they can gain disaffected voters who are not being served by the current ideological divide between the two main parties. They argue that "successful American parties must be coalitions of enemies." These subcoalitions not only contest for influence within the party but may also reach outside of the traditional party boundaries if that is where the greatest opportunities for new adherents to the subcoalition are to be found. Karol (2009) gives the example of the movement of unions on immigration issues. For decades, labor led a strong anti-immigrant stance that put them in opposition to other allies of the Democrats. Having become convinced that immigration would not stop and seeing an opportunity to build a new alliance within that coalition of enemies, labor embraced amnesty and path to citizenship. This made unions more palatable to immigrant voters and increased their strength within the party. Jeong et al. (2011) also illustrate this dynamic with regard to immigration, noting that strategic minorities took advantage of vulnerability in the probusiness and social conservative elements of the Reagan coalition.
8. Solutions to this problem of building expectations are described in the "Discussion" section.
9. When a coalition recenters itself, it does so with an average of its constituent members' (coalitions and voters) current policy points weighted by the votes they represent.
10. However, third parties occasionally did emerge in the simulation despite this severe restriction. Typically, the new third parties either became one of the two major parties or were dismantled after only a few steps. While I could have coded such events under Sundquist's third scenario, the requirement that the defecting party has a majority is so different from his model that I decided it would not be sensible to twist Sundquist's conception this way.

References

Adams, Greg D. 1999. "Beyond Control: A Model of Parties As Complex Adaptive Systems." Unpublished manuscript.

Arrow, Kenneth J. 1951. *Social Choice and Individual Values*. 1st ed. New Haven: Yale University Press.

Aumann, Robert J., and Michael Maschler. 1964. "The Bargaining Set for Cooperative Games." In *Advances in Game Theory*, edited by M. Dresher, L. S. Shapley, and A. W. Tucker, 443–76. Princeton: Princeton University Press.

Bak, Per. 1996. *How Nature Works: The Science of Self-Organized Criticality*. New York: Copernicus.

Black, Duncan. 1958. *The Theory of Committees and Elections*. New York: Cambridge University Press.

Camerer, Colin F., Teck-Hua Ho, and Juin-Kuan Chong. 2004. "A Cognitive Hierarchy Model of Games." *Quarterly Journal of Economics* 119 (3): 861–98.

Cederman, Lars-Erik. 1997. *Emergent Actors in World Politics: How States and Nations Develop and Dissolve*. Princeton: Princeton University Press.

Connor, Richard C., Jana J. Watson-Capps, William B. Sherwin, and Michael Krützen. 2010. "A New Level of Complexity in the Male Alliance Networks of Indian Ocean Bottlenose Dolphins (*Tursiops* sp.)." *Biology Letters* 7 (4): 623–26.

Cox, Gary W. 1994. "Strategic Voting Equilibria under the Single Non-Transferable Vote." *American Political Science Review* 88 (3): 608–21.

Cox, Gary W. 1997. "Making Votes Count: Strategic Coordination in the World's Electoral Systems." In *Political Economy of Institutions and Decisions*, edited by J. E. Alt and D. C. North, 340 pp. New York: Cambridge University Press.

de Waal, Frans B. M. 1998. *Chimpanzee Politics: Power and Sex among Apes*. Rev. ed. Baltimore: Johns Hopkins University Press.

Downs, Anthony. 1957. *An Economic Theory of Democracy*. New York: HarperCollins.

Engh, Anne L., Erin R. Siebert, David A. Greenberg, and Kay E. Holekamp. 2005. "Patterns of Alliance Formation and Postconflict Aggression Indicate Spotted Hyaenas Recognize Third Party Relationships." *Animal Behavior* 69 (1): 209–17.

Fowler, James H., and Michael Laver. 2008. "A Tournament of Party Decision Rules." *Journal of Conflict Resolution* 52 (1): 68–92.

Gigerenzer, Gerd. 2007. *Gut Feelings: The Intelligence of the Unconscious*. New York: Viking.

Grofman, Bernard. 1982. "A Dynamic Model of Protocoalition Formation in Ideological *N*-Space." *Behavioral Science* 27:77–90.

Hardin, Russell. 1976. "Hollow Victory: The Minimum Winning Coalition." *American Political Science Review* 70 (4): 1202–14.

Hinckley, Barbara. 1972. "Coalitions in Congress: Size and Ideological Distance." *Midwest Journal of Political Science* 16 (2): 197–207.

Hinich, Melvin J., and Michael C. Munger. 1997. *Analytical Politics*. New York: Cambridge University Press.

Holland, John H. 1998. *Emergence: From Chaos to Order*. Reading: Perseus Books.

Jenkins-Smith, Hank, Gilbert St. Clair, and Brian Woods. 1991. "Explaining Change in Policy Subsystems: Analysis of Coalition Stability and Defection over Time." *American Journal of Political Science* 35 (4): 851–80.

Jeong, Gyung-Ho, Gary J. Miller, Camilla Schofield, and Itai Sened. 2011. "Cracks in the Opposition: Immigration As a Wedge Issue for the Reagan Coalition." *American Journal of Political Science* 55 (3): 511–25.

Johnson, Paul. 1998a. "An Agent-Based Model of the Exchange Theory of Interest Groups." Paper presented at the American Political Science Association, Boston.

Johnson, Paul. 1998b. "Rational Actors versus Adaptive Agents: Social Science Implications." Paper presented at the American Political Science Association, Boston.

Karol, David. 2009. *Party Position Change in American Politics: Coalition Management*. New York City: Cambridge University Press.

Koehler, David. 1975. "Legislative Coalition Formation: The Meaning of Minimum Winning Size with Uncertain Participation." *American Journal of Political Science* 19 (1): 27–39.

Kollman, Ken, John H. Miller, and Scott E. Page. 1992. "Adaptive Parties in Spatial Elections." *American Political Science Review* 86 (4): 929–37.

Kollman, Ken, John H. Miller, and Scott E. Page. 1997. "Political Institutions and Sorting in a Tiebout Model." *American Economic Review* 87:977–92.

Laakso, Marku, and Rein Taagepera. 1979. "Effective Number of Parties: A Measure with Application to West Europe." *Comparative Political Studies* 12:3–27.

Lane, David A. 1992. "Artificial Worlds and Economics." Working Paper. Santa Fe Institute, New Mexico.

Laver, Michael. 1997. "Government Formation in the European Parliament." *Aussenwirschaft* 52:223–48.

Laver, Michael, and Ian Budge, eds. 1992. *Party Policy and Government Coalitions*. London: Macmillan Press.

Lomborg, Bjorn. 1997. "Simulating Multiparty Systems." In *Simulating Social Phenomena*, edited by R. Conte, R. Hegselmann, and P. Terna, 335–41. Berlin: Springer-Verlag.

Lorr, Maurice. 1983. *Cluster Analysis for Social Scientists: Techniques for Analyzing and Simplifying Complex Blocks of Data*. San Francisco: Jossey-Bass.

McGann, Anthony J. 1999. "Why Unidimensionality: How Party Systems Produce Ideological Coherence." Paper presented at the American Political Science Association, Atlanta.

Miller, Gary, and Norman Schofield. 2003. "Activists and Partisan Realignment in the United States." *American Political Science Review* 97 (2): 245–60.

Orbell, John, Tomonori Morikawa, Jason Hartwig, James Hanley, and Nicholas Allen. 2004. "'Machiavellian' Intelligence As a Basis for the Evolution of Cooperative Dispositions." *American Political Science Review* 98 (1): 1–15.

Riker, William H. 1962. *The Theory of Political Coalitions*. New Haven: Yale University Press.

Riker, William H. 1986. "Duverger's Law Revisited." In *Electoral Laws and Their Political Consequences*, edited by B. Grofman and A. Lijphard, 19–42. New York: Agathon Press.

Schattschneider, Elmer Eric. 1960. *The Semisovereign People: A Realist's View of Democracy in America*. Hinsdale, IL: Dryden Press.

Schelling, Thomas C. 1978. *Micromotives and Macrobehaviors*. New York: W. W. Norton.

Schreiber, Darren. 2007. "Political Cognition As Social Cognition: Are We All Political Sophisticates?" In *The Affect Effect: Dynamics of Emotion in Political Thinking and Behavior*, edited by A. Crigler, M. MacKuen, G. E. Marcus, and W. R. Neuman, 48–70. Chicago: University of Chicago Press.

Schwartz, Thomas. 1989. *Why Parties?* Research Memorandum, Department of Political Science, University of California at Los Angeles, 1–17.

Snyder, James M., Jr., and Michael M. Ting. 2002. “An Informational Rationale for Political Parties.” *American Journal of Political Science* 46 (1): 90–110.

Sundquist, James L. 1983. *Dynamics of the Party System: Alignment and Realignment of Political Parties in the United States*. Rev. ed. Washington, DC: The Brookings Institution.

Tiebout, Charles. 1956. “A Pure Theory of Local Expenditures.” *Journal of Political Economy* 64 (3): 416–24.

Von Neumann, John, and Oskar Morgenstern. 1944. *The Theory of Games and Economic Behavior*. Princeton: Princeton University Press.