"An Agent-Based Model of the Exchange Theory of Interest Groups"

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Abstract

This paper presents some preliminary results of a project designed to develop an individual-level, system-wide theory of interest group politics that extends Salisbury's exchange theory. The model is a combination of formal theory and computer simulation. The simulation is designed with the Swarm tookit which is made available by the Santa Fe Institute. The model describes a process in which recruiters take issue positions and contact citizens to ask them to join. It investigates the implications of adding "incomplete information and rational ignorance" into the exchange theory.

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This paper describes a modeling effort that uses the Swarm simulation toolkit to build a model of the development of an interest group system. The aim is to develop a system-wide, individual level theory that helps us to understand why some interest organizations grow and some shrink, as well why some interests more well represented in politics than others.

The substantive motivation for the project lies in the exchange theory of interest group politics (Salisbury, 1969). Membership in an organized interest group results from the interaction of an interest organizer and prospective citizens. There are many such organizations, however, each of which contacts many citizens. This project, which is by no means complete, describes individual citizens as passive, "rationally ignorant" actors, who may join organizations if they are contacted and offered a policy package of which they approve. Interest organizations, which are represented by recruiters, make choices about what policy packages to offer and which citizens to contact. The recruiters described here do not interact with each other directly, but they do have indirect contact in the sense that they may be competing to capture the loyalty of the same citizens. Rather than focusing on the interaction of just one organization and its members, the long range goal is to understand the patterns of development in a diverse political community in which there are many kinds of interest organizations.

The Swarm simulation toolkit is designed for the modeling of "complex adaptive systems," models with large numbers of simultaneously interacting agents. The WWW site for the Swarm project is http://www.santafe.edu /projects/swarm. Swarm provides a programming framework that uses the Objective-C language. Swarm is under the GNU Public License, which means that it is "open source" software (sometimes referred to as "free software" in the sense that anyone who purchases a product designed with software under the GPL has a right to receive the source code for the project and also has the right to redistribute that source code. Like most computer programming enterprises under the GPL, Swarm is an evolving set of code that benefits from the contributions of support by educational institutions (such as the Santa Fe Institute) and volunteers who submit code. Another paper presented at the APSA 1998 meeting (Johnson, 1998) describes the Swarm toolkit in greater depth. The simulations reported here were done with Swarm 1.3, which was made available August 26, 1998.

This paper describes a work in progress. Many issues remain that need to be incorporated into the computer model, and many details that are included in the code already need to be investigated in greater depth. The plan is to first discuss the theoretical questions that motivate the study, second to describe the computer model, and third to present some findings and raise some new problems for research.

The Exchange Theory and Complex Systems

The logic of collective action (Olson, 1965) and the exchange theory of interest groups (Salisbury, 1969) provide the backdrop for the current investigation. Interest group organizers--called entrepreneurs or recruiters--face the job of contacting citizens and persuading them to join. The theory holds that organizations offer selective incentives--either tangible "material" benefits or intangible "expressive" benefits--that entice people to join. While many studies have emphasized the fact that expressive benefits are the driving factor in many interest organizations, there is only scant formal theory that helps us to understand that process.

The exchange theory has fueled a number of productive investigations of the activities of individual interest organizations. However, the exchange theory is, in its current state of development, not able to lead to understanding of system-wide political phenomena. This point, made powerfully in recent research by Gray and Lowrey (1996a), presents us with a major challenge. If the exchange theory makes meaningful statements only about the micro-level details of the interaction of one organizer and some citizens, where are we supposed to turn for broadly-applicable theories of representation and political change?

Gray and Lowery have been the leading proponents in political science of a sociological approach to organizations based on population ecology. Their approach emphasizes the resources available to groups, which are thought as species that seek to ''consume' members from the general public and compete for policy influence (1996a; 1996b; Lowery and Gray, 1993). ''Perhaps the central proposition of population ecology is that environments determine equilibria in terms of both absolute and relative numbers of individuals and species.' (Gray and Lowery, 1996a, p. 52). Following the language of ecology, groups are assumed to be in equilibrium, occupying separated niches. ''A population ecology orientation leads us to assume that interest organization density is set at an equilibrium level, albeit varying over time, by the environment.' (Gray and Lowery, 1996a, p. 64).

The sociological adaptation of the ecological notions has some shortcomings. Most importantly, it does not have any individual-level underpinnings. My personal opinion is that any aggregate level theory that lacks a coherent explanation in terms of individual behavior is unsatisfactory. This shortcoming of the aggregate level analysis has been recognized in ecology, where more recent emphasis has been placed on understanding individual behavior/adaptation (Judson, 1992. DeAngelis and Gross, 1992; Ives, 1995; Kauffman, 1993; Schmitz and Booth, nd; Forrest and Jones, 1995; Jones, Hraber, and Forrest, 1996). Many scholars agree on the desirability of building a bottom-up model because it better represents the intuition that biological selection and evolution happen at the individual level.

As an alternative to the sociological adaptation of the ecological metaphor, I choose instead to follow the lead of recent studies that have searched for individual level foundations from which to build system-wide models. The method of analysis is sometimes called "agent-based modeling" (Axelrod, 1997) or "complex adaptive systems" theory (CAS, as in Waldrop, 1992; Holland, 1998). A complex adaptive system describes a large number of individuals whose behavior is responsive to their environment and each other. Since the individuals are typically thought of as entities with limited amounts of information or for whom calculation is costly, his approach is naturally well suited to political models of interaction under conditions of limited information (see Epstein and Axtell, 1996) .

The system-wide implications of an agent-based model are sometimes called "emergent properties." An emergent property is an attribute of the aggregate model that is not obviously a result of the intentioned behavior of the individual agents. Examples of emergent properties, for example, are V-shaped duck formations, the regulation of temperature in a beehive by the movement of the bees, or equilibrium in an exchange economy. In the last example, each individual seeks only personal satisfaction, but under certain conditions the mutual interaction may (by an invisible hand) lead to an equilibrium that balances supply and demand.

In the interest group context, what are the system-wide properties that we seek to understand? First and foremost, we want to understand the process through which the political viewpoints held by the citizens in a society are 'mobilized' into interest organizations. The aggregate phenomenon of representation, a situation in which there are interest organizations to express certain points of view and their membership levels (somehow) mirror the citizen-base, is an emergent property of a political system. This is worth understanding because the issue priorities and decisions made in the government (legislative, executive, or judicial branches) are affected by the activities of organized interests (or the failure of some interests to organize).

The model presented here investigates the implications of an exchange theory with rational ignorance and incomplete information. Citizens are not well informed about the kinds of organizations that exist. This results from their existence in a state of "rational ignorance". Citizens may join organizations if they are personally contacted, but otherwise they do not. Before a citizen will join an organization, of course, there must be not only contact, but also an attractive offer, something for which the citizen is willing to exchange money and time. The problem of incomplete information is most important when we consider interest group recruiters (not citizens or prospective members). The recruiters have an idea that some small number of people would join if asked, but they do not know which ones would join. This incompleteness of information forces them to pay the high costs of contacting a lot of people who will not join in order to find the ones who will.

While it is quite easy to model the exchange of material selective incentives, it is more difficult to model the exchange of expressive benefits. As Salisbury proposed it , the exchange theory specifies the idea that citizens may receive emotional satisfaction from feeling that they have contributed to a cause with which they agree. However, a number of details are missing if we are to formalize this theory. It is necessary to craft a more precise model to describe the way interest group recruiters devise the "policy packages" that they offer to citizens, as well as a formalized model of the way in which citizens compare the many packages they might receive and decide whether to join any of the organizations. The model described here extends another project (Johnson, 1996) by incorporating a multidimensional space as well as a multiplicity of recruiters.

Specifying the Model

The computer code is written to allow as much generality as possible. Where possible, design choices are made to allow the model to be scalable and investigated under a number of conditions. There are many details to be specified in the design of a computer model. The multiplicity of options makes this modeling approach powerful and yet, in some cases, difficult to manage and interpret.

There are three parts to the design of the model. First, there is code for individual agents. Second, there is code that creates a swarm of these agents and orchestrates their interaction. In the Swarm parlance, that is called a "ModelSwarm." Third, there is an interface object that manages the simulation and allows the user to monitor and interact with it. This is called the "ObserverSwarm." These names are not required components of the simulation, but their usage makes it easier for Swarm programmers to discuss design questions among themselves.

The model has two kinds of agents, citizens and recruiters. Begin with the model of citizens. Each citizen has an ideal point $x_i^* \in R^m$ and a utility function $U_i(x)$ which indicates the desirability of all policy offerings. The computer code is designed so that N can be adjusted to equal any positive integer. For purposes of creating graphs, of course, it is most feasible to set N=1 or N=2.

The utility function used is the familiar Weighted Euclidean Distance model (Davis and Hinich, 1966; Davis, Hinich, and Ordeshook, 1970). Given a matrix of weights A_i, which indicates the importance of each issue and its interaction with other issues, this is written as

$$U_i(x) = -(x - x_i^*)A_i(x - x_i^*)$$

The matrix of weights can be adjusted to represent differences in tastes and emphasis among voters. If the matrix A_i is the identity matrix, (a matrix in which all coefficients are zero except the main diagonal, and those coefficients--a_{i11},a_{i22},a_{i33}, through a_{imm}--equal 1), then the voter's utility for a proposal depends solely on its distance from the ideal. For a more concrete example of a two dimensional model, where a policy offering consists of a pair, (x_1,x_2). The coefficients a_{i11}, a_{i12}, a_{i22}, are chosen, and then the utility of a policy is given by its "Weighted Euclidean Distance"

$$U_i(x) = -a_{i11}(x_1 - x_{i1}^*)^2 - a_{i22}(x_2 - x_{i2}^*)^2 - 2a_{i12}(x_1 - x_{i1}^*)(x_2 - x_{i2}^*)$$

As described in the introduction of this paper, the citizen is thought of as a passive entity, one that may join an organization if contacted. The additional structure inside an object of type citizen is used to determine the nature of the individual's response. Basically, the citizen will collect a list of all invitations received, and then evaluate them. A citizen's budget will restrict the number of invitations that can be accepted. Among the offers that are "tolerable" in their policy offering, the most attractive may be selected. There is another complicating factor, however, which is that citizens may decide to free-ride and make not contribution.

Consider first the idea that the recruiter tries to get citizens to join the organization. The critical aspect of this effort is the ability to contact individuals and make them offers. Suppose that a recruiter contacts a citizen and conveys the message that the organization is offering policy $p \in R^m$. A number of factors affect the citizen's response. First, the organization's policy offering has to be "close enough" to the individual's ideal before the citizen will even give the invitation serious consideration. Suppose each individual has a tolerance level, T_i, which indicates "how close" an organization's proposal must be to the citizen's ideal if that citizen is to join up. The tolerance level is the maximum amount of policy discord that a person can tolerate. A necessary condition for joining an organization is that $U_i(p) > T_i$. T_i can be thought of as an "exit level" of utility that a person can obtain by joining no organizations.

Not everyone who agrees with a cause will join, however. There are two reasons. Some individuals may not have resources to contribute, and some who do may choose to free-ride on the group's activities. Not everyone who agrees with a cause will feel the "warm glow" (Andreoni, 1988) from contributing, in other words. A citizen who joined an organization in the last time period may grow bored and resign, even though the organization's offerings are just as appealing. These factors are taken into account by adding three parameters for each citizen. First, there is a budget variable, b_i, which equals the number of organizations that a citizen can afford to join. Second, there is a "free-rider coefficient." This is a number FR_i in [0,1] which determines the probability that the citizen will choose to not join an organization that is otherwise acceptable. Third, there is a "loyalty coefficient" L_i in [0,1]. The loyalty coefficient gives the probability that a citizen will renew membership in an organization.

In this model, the citizen collects a list of all invitations received during a time period (in the code, this is the "invitationsList"). That list combines requests for membership renewal in organizations to which the citizen currently belongs as well as requests to create new memberships in various organizations. At the end of a time period, the citizen is told to process the invitations and the following algorithm is conducted. Invitations from organizations whose policy offers are tolerable are added to a list of tolerable invitations and the other organizations are deleted from the list of invitations and those organizations are sent rejection or resignation notices. Given a budget, b_i, the citizen sorts through the remaining offers to find the b_i most attractive organizations. This is implemented by repeatedly finding the most attractive invitation in the list, removing it and adding it to a list of worthy organizations (called the "bestList" in the code). That processing is repeated until the budget is exhausted. All remaining invitations on the "invitations list" are either sent a message that the individual will resign from that organization or refuses to join, as is appropriate.

The list of worthy organizations is then processed from best to worst. This is where the free-rider and loyalty coefficients take effect. If the citizen is not currently a member, and if a draw from a uniform distribution on [0,1] is greater than FR_i, then the citizen sends a message to the organization that it will join (and the recruiter adds that citizen to its list of members). Otherwise, a rejection message is sent. If the citizen is currently a member and if the loyalty coefficient L_i is greater than a draw from a uniform distribution on [0,1], the citizen will renew membership when asked to do so. Otherwise the citizen will send a resignation message.

The model for the organizational recruiter has two substantively important sets of routines. (The rest of the code is bookkeeping.) One set of routines governs the contacting of citizens and the other governs the adjustment of the organization's policy position. As the model is designed so far, the contact behavior is simple: the recruiter can contact all citizens or a randomly selected list of all citizens. The ability to make an offer to all citizens is better suited to describe electoral competition than interest group recruitment, but this possibility is used as a baseline to measure the effects of the recruiter's lack of information about which citizens will join.

The working premise is that an organization begins with some supply of resources, possibly obtained from a foundation (Walker 1983) or other sources. That initial supply of resources allows the organization to contact a fixed number of people for a fixed number of time periods. In the examples discussed here, each recruiter is given the resources to contact 10,000 citizens during its first four time periods. After the initial periods are finished, then an organization's recruitment level depends on its membership level. Presumably, existing members pay dues and provide resources with which additional members are contacted. The number of citizens who are selected to be contacted in this second stage can be adjusted in the model, but for the first runs, the number sampled is set equal to eight times the current number of members. This is an arbitrary setting based on empirical information about the volume of interest group recruiting and it certainly deserves to be "endogenized" as a variable that the recruiter can adjust.

One of the features that differentiates an interest organization’s on-going recruitment activities from a political campaign is that the interest organization is able to keep a list of existing members and contact them to renew their membership. The existing members have a much higher probability of renewing than does a randomly drawn citizen of joining. As such, the existing members are something of a "security blanket" for a recruiter. The models described here all suppose that the recruiter always contacts existing members in addition to contacting new prospects. This feature of automatically contacting existing members can be adjusted to explore its implications.

How does this model of contacting match up with "the real world?" In reality, interest organizations cannot contact all citizens, or even a comprehensive random sample. Instead, they are forced either to throw recruitment messages at broad audiences through the mass media or they use direct mail advertising to contact subsets of citizens found through mailing list brokers or by sharing lists with other organizations. The model as now designed does not incorporate those details, it only allows random samples, but the code is designed for the next logical step, to allow recruiters to exchange membership lists and draw samples from those lists.

The second important component in the model of the recruiter is the ability to create a policy offer that is made to the citizens. The recruiters are created with random starting points. After that, there are three possibilities for adjustment. First, a recruiter’s position may be "stuck" at the starting point. This exemplifies an organizational recruiter who begins with a proposition and is stubborn about it. Second, a recruiter’s proposal to new members may adjust to suit the interests of existing members. This is called the "median model" because the organization’s policy proposal is assumed to equal the multidimensional median of member ideal points. This is a surrogate for politics inside the organization.

The third model of position taking by the recruiter is also the most complicated. Suppose that the recruiter adjusts the proposal in an effort to increase the number of members in the organization. The recruiter always compares the total number of members after offering some package p against the number obtained with the previous package, q. If the policy package p causes membership to increase, then it will become the new baseline against which new proposals are considered.

The model discussed here describes an organizational recruiter who makes incremental adjustments when making offers to the citizens. Proposals are thought of as results of steps in directions in the policy space. The initial position and the distance and direction of movement in the first proposal are determined according to some random distribution. If a step results in an improvement in membership levels, then the recruiter’s next proposal continues in exactly that direction. The trigonometry is generalizable to N dimensions, but consider this two-dimensional example. If $q=(q_1+q_2)$ is the current position, and a move of distance d is considered in the direction Θ then the resulting proposal, $p=(p_1,p_2)$ is

$$p_1 = q_1 + d * \cos(\Theta)$$
$$p_2 = q_2 + d * \sin(\Theta)$$

The distance of the proposed changed, is chosen at random from a Uniform Distribution on [0,max]. The longest possible step, max, can be specified at run-time by the user.

If a proposal results in a net reduction in the organization's membership level, then the recruiter considers variations in the direction of movement away from the policy q. The working hypothesis is that a new proposal ought most likely proceed in the same direction as previous change. At any given stage, the direction of the next proposed change is found by taking the current direction, Θ, and adding a displacement, Δ. To capture this logic, the displacement Δ is drawn from a truncated Normal Distribution with a mean of 0. The distribution of Δ puts more weight on 0 than any other value. The direction Θ is measured in radians, so a change of -1 means a complete reversal in direction. If the agenda setter is intended to move only in a "forward" direction, the value of Δ can be restricted to fall between (-.5,+.5). This is done by truncating a Normal distribution at (-2,2) and then rescaling so it fits into the (-.5,.+5) range. If the proposal is allowed to completely reverse itself, then Δ would be restricted to fall between (-1,+1).

The individual level objects described thus far are created by and interact according to the instructions of higher-level objects, the ModelSwarm and the ObserverSwarm. A number of parameters are set in the ModelSwarm that can be investigated. For example, the Swarm toolkit includes many random number generation objects and statistical distributions. In the models described here, the ideal points have been assigned randomly (and independently) according to a Multivariate Normal Distribution with a mean of 50, a standard deviaition of 20, and covariance set equal to zero. I have only considered "circular preferences," ones for which the weight matrix A_i is the identity matrix. For the most part, the exit level utility values, T_i, have been kept fixed at a common value for all citizens. The free rider and loyalty coefficients can be set at run-time. Most work done so far has set FR=0 and L=1, so that the random fluctuations in membership due to those factors are kept to a minimum. Future investigation will of course explore many possibilities. Along the lines of KMP, one wonders what happens if the people with extreme attitudes on one dimension are also the people who place very little weight on the other issues.

There are number of other simulation modeling decisions must be made to rough out the basic structure of the model. For example, should the population of citizens be elaborated to include the birth, aging, and death of citizens? While it would be relatively easy to introduce turnover, the current strategy is to keep the list of citizens fixed or order to focus on other variables of interest.

By far the most ticklish questions concern the assumptions about the creation and destruction of interest group recruiter objects in the model. When should a recruiter die? How often should they be inserted into the model?

The rest of the coding exercise is focused on making the simulation generate meaningful diagnostic information and graphs. Recent changes in the Swarm toolkit make somewhat nicer looking "ZoomRaster" graphs (2 dimensional grids upon which one can plot the positions of the citizens and the interest group recruiters) and the EZGraphs that depict time-series data have been enhanced.

Exploring the Implications of the Model

In its current state of development, the model allows some insights but mostly it leads to more questions.

What is the effect of limited information? If an interest group recruiter could communicate directly with each and every citizen, we expect membership to be higher than if only a subset could be contacted. The interesting questions concern the effect of this "slippage" from potential membership to actual membership on the representative nature of the interest group system. There are also interesting effects is seen, however, when the coefficients the govern free riding and loyalty are varied.

Begin with a set of five interest group recruiters whose positions are permanently fixed. The population size is set at 100,000 (for no particular reason except time constraints. These simulations typically take a long time!). Each recruiter is allowed to contact 10,000 people chosen at random in each of the first four time periods, and then the number each recruiter may contact is equal to eight times its number of members. These models can be run with the free rider coefficient set to 0 and the loyalty coefficient is set to 1, so there is no unpredictable behavior. For each organization, a "potential membership" level is calculated by asking each citizen if that organization's policy offering is tolerable. In essence, potential membership is the highest possible membership an organization can expect to achieve if its position if fixed and if it competes with no other organizations for members.

Figure 1 presents a screenshot of a simulation in which there are five recruiters, whose policy positions are chosen at random from the same Normal Distribution from which citizens are drawn. In the bottom left one can see the parameter settings that governed the creation of the model. Some of these parameters--the ones that govern changes of position by the recruiter--are irrelevant in this case since the recruiter's policy offering is fixed. As indicated by the other coefficients, the citizens in this model are never free riders (FR_i=0) and furthermore they are highly loyal (L_i=1). In this setting, the key question is "how long does it take for the random sampling process take to find each and every citizen." Once they are recruited, citizens stay until they receive a better policy offer from another organization, so a membership base naturally accrues. The top part of the figure shows the membership rates of the organizational recruiters and the bottom left shows a grid that describes the positions of the citizens (dark dots) and the policy offers made by the interest organizers (M0,M1,M2,M3,M4).

Since each recruiter's policy offer is a fixed quantity, the interesting aspect of this graph is that the membership of all organizations gradually grows to its potential. The model allows each organization to contact 10,000 members in the first four periods, and this somewhat obscures the advantage held by organizations with a large potential membership. Organizations that have more members can make more contacts, so they grow more quickly and mobilize a higher fraction of their potential membership at any given time.

Figure 2 shows what happens when the possibilities of free-riding and disloyalty are introduced. In this model, the free-rider coefficient is chosen from a Uniform Distribution

[0,0.5]. This coefficient is put into the agent at the time of creation and remains fixed throughout its lifetime. The free-rider coefficient, FR_i, is the probability that the individual will refuse to join even though the organization's offering is tolerable. The loyalty coefficient is also set at creation time. It is chosen from a Uniform Distribution [0.6,0.9]. L_i is the probability that the individual citizen will renew an organizational membership if the organization is in the individual's list of worthwhile alternatives. In other words, $(1-L_i)$ is the probability that an individual will resign from an organization even if its policy offering is still acceptable.

The advantage of being a recruiter with a higher potential membership is the main point illustrated in Figure 2. When citizens are fickle, membership levels are lower. But there is a vital threshold effect illustrated here. Organizations with potential membership of 3180 or less see their membership level collapse. Recruiters 2 and 4, in fact, drop below 10 members and the simulation removes them from the program at that time. Recruiter 0 seems to be headed in that direction. In contrast, organizations with higher potential membership levels survive and develop relatively stable membership levels. The advantage of having a large potential membership is clearly seen in the differences between Recruiters 1 and 3. Recruiter 3's potential membership level, 4601, is slightly more than 10 percent higher than that of recruiter 1, which is 4179. The membership level of recruiter 3's organization averages approximately 910 in the last ten time periods shown, while that of recruiter 1 is about 570. In other words, a ten percent increase in membership potential converts itself into a 59 percent increase in membership.

Of course, a number of factors could alter this outcome. For example, the industrious recruiter 1 might increase the volume of recruitment activity. I am studying at this moment a way to allow the recruiters to adjust their recruitment activity to counteract these problems. Still, I think the major point here is important. Assumptions at the individual level about the distribution of tastes and at the organizational level about recruiting have important implications for the overall makeup we expect to develop in interest group politics.

What is the effect of crowding in the previous story?

One attractive feature of the simulation toolkit is that the seed value for random numbers can be set in the code so that the exact same random number stream can be investigated under different institutional conditions. The luck of the draw in Figures 1 and 2 gave us recruiters whose positions are relatively evenly spaced. Each citizen is willing to tolerate a group's policy proposal if it is within 10 units of its ideal, a fact which means that if organizations are relatively far apart in the space, they don't compete for members. (We might as well make five one-group models, a critic might observe.)

At run-time, the number of recruiters can be changed, and/or the simulation code can be written so that organizations are created and removed from the simulation. To illustrate the effect of crowding, Figure 3 shows what happens if there are 35 new recruiters are added to the 5 from the previous example. There is no free-riding or disloyalty, as the parameter settings indicate. The budget of each citizen is still set equal to 1, so citizens are forced to make a choice when they receive several attractive offers.

The differences between Figure 3 and Figures 1 and 2 are stark. Simply put, the possibility that organizations are forced to compete for their membership base with similar organizations breaks the simple relationship that previously existed between potential membership and observed membership levels. A scatterplot showing the relationship between "potential membership" and actual membership after 50 periods is presented in Figure 4. The relationship is certainly not tight enough to support a theoretical statement that the membership in organized interests is proportional to the interest and support in their positions held by the general public.

One of the most pressing task is to build a more complete model of the logic that governs the creation and death of organizations. In this model, no organizations are born after time period 0 and they die only when their membership drops below 10. Under those conditions, it does not appear that groups inhabit isolated niches in the policy space. If there were some entity that could stop organizations from taking issue stances that are close to each other, then this crowding effect would be ameliorated and the relationship between potential membership and observed membership would reappear. The problem, however, as evidenced Figure 3, is that several organizations can indeed exist in very close proximity. In the end, they compete for members, and until some of the recruiters decide they will close-up shop, there's no reason to expect this will change. The models discussed in the next section--quite by accident--shed some light on this problem.

What if policy offerings can be changed?

The models described so far put organizations at fixed positions. In reality, an interest organization's policy stances can change. I've developed two models of policy change, the "median model" of democratically governed groups and the "trajectory model" of the membership-maximizing recruiter.

If there is only a single recruiter, either type of recruiter position-taking usually leads the position into the center of the policy spectrum. A large number of replications (not done yet) will be needed to quantity the chances that an organization that follows the median voter will move its policy to an outer extreme. (As indicated in Johnson, 1996, it is possible for this to happen if the random draw of initial members has a median that is further away from the center than the mean of ideal points. Given that the distribution of citizen ideal points is Normal, this is unlikely). All of the examples I have seen thus far are similar to the displays in Figure 5 (for the median model) and Figure 6 (for the trajectory model). The policy position of the organization is labeled "M0" in the median model and "T0" in the trajectory model. The organization's position starts at the extreme right in this example. In the Proposal Display (bottom left panel of each figure), the history of the policy positions that the organization takes is shown. In a corporatist society, where all citizens are allowed to join only one organization, we should expect that organization's policy to be in the center of the preference distribution (as Olson (1982) expected).

The interaction of several organizations produces much more complicated patterns, however. Consider Figure 7, which shows what happens when five "median model" organizations exist. As the trajectories in the "proposal display" indicate, the organizational positions are drawn toward the center, as their positions do not converge around the multidimensional median, but hover near it. This arrangement produces a relatively even spacing that might account for the observation that organizations inhabit "niches" in the policy space.

If the number of organizations is significantly increased, some very interesting and complex dynamics begin to appear. In Figure 8, there are 40 organizations that adjust their membership according to the median model. These organizations confront free-riderism and their members are not perfectly loyal. And, vitally, the organizations have no way to communicate with all citizens simultaneously. Instead, they draw samples of 10,000 in each of the first four periods, and then they are only allowed to contact existing members and draw samples from the citizen list (sample size is eight times current membership level). This code is written so any organization with less than 10 members is removed from the simulation.

In Figure 8, there are 10 organizations remaining after 200 time periods. The positions of organizations 7 and 0 are virtually "on top" of each other, but the even spacing about the center of the policy space is unmistakable.

The high rate of organizational extinction in Figure 8 is a source for concern. Why are organizations that have the ability to adjust their policies to suit their membership base more likely to die out? To see they are indeed more likely to die out, consider Figure 9. In Figure 9, a model in which recruiter positions are fixed and organizations compete for members is presented. This figure is simply a re-run of Figure 3, except this one includes free-riding and disloyalty. The simulation in Figure 9 is identical in every respect then, with Figure 8, except that in Figure 9 organizational positions are fixed. In Figure 9, 28 of 40 organizations survive for 200 periods, about three times as many as the median model.

Why did so many organizations die when they were given the autonomy to govern themselves and adjust their positions? When subjected to free-riding and disloyalty of the same magnitude, organizations that are fixed in highly unpopular positions can go out of business, but marginally placed organizations are more likely to survive. The explanation has two parts. First, the process of "competitive exclusion" can be slow and unpredictable. Second, organizations in a close vicinity tend to be drawn together by the similarity of the tastes of their members.

Because organizations are contacting samples from the list of citizens, there is no logical reason why two organizations with highly similar policy stances cannot exist at the same time. Many citizens join the "wrong organization," in the sense that they are invited to join by a recruiter and they don't know that there are other organizations that they would in fact prefer. Because those people join, they participate and draw the organization in the direction of the other organizations that they "should have joined" at the start. They would switch to the other organization if they are contacted by it, but until they are, they stay and try to make the organization they joined look like the organization they should have joined. As two organizations are drawn together by the similarity of their members, a kind of "tipping effect" occurs and one organization ends up dominating the other because it is able to contact more prospective members. Hence, organizations grow initially because they are in a popular part of the policy space, and later they are wiped out when neighbors with bigger membership bases (and the ability to contact more citizens!) develop. Notice organizations 2 or 12 in Figure 8.

In Figure 8, it is not apparent (because the graphics are not excellent!) that the policy position of organization 7 is almost exactly on top of the position organization 0 at time 200. This is an example of two organizations that share a similar policy position and, at time 200, they seem to happily coexist. It doesn't stay that way for long. In Figure 10, a snapshot of the model at time 300 is shown and organization 0 is in the process of killing off organization 7. As an organization loses members, the number of prospects that it can contact is reduced, and (barring a lucky draw from the random number generator!) its membership spirals downward. Keep in mind, the budget of each citizen is restricted to equal 1, so this finding has to be qualified.

To illustrate the fact that the limited information in the model is a vital part of the explanation for the extinction of so many organizations, another set of calculations was done in which each organization can contact each citizen during each period. In addition to making the simulation taking much longer, the results bear out the hypothesis. In Figure 11, a model with 40 organizations that are median driven is presented. Each organization's position is broadcasted to all citizens in each time period. None of the organizations go out of business. Their policy offerings shift a bit, but they do not exhibit the same evenly-spaced pattern as was seen in Figure 8.

It appears that the method in which organizations adjust their policy offerings may also play a major role in our understanding of their development. If organizational policy offerings are adjusted by a recruiter in a search to increase membership, as described above, the dynamics in the system are quite different. Figure 12 shows what happens in a system with 40 of these recruiters. Two major contrasts appear. First, compared to the median model, more organizations survive through 200 periods (24 compared against 10). Second, the policy positions of the organizations are not arranged in an even symmetrical pattern about the center. Rather, there are organizations with very similar positions.

The conjecture that the interest group universe is populated with interest organizations that occupy niches which separate them from each other can be supported under a limited set of conditions. It appears that conjectures about the representativeness of the political universe will depend on individual-level assumptions made about recruiters and citizens.

Work that Remains

The findings here are presented as a snapshot of the development of this research project. I've made quite a bit of progress in the Swarm tookit and Objective-C coding. The model as currently designed gives promise that some important findings may await.

The models investigated here illustrate the importance of the problem faced by interest group leaders. Organizations must search for members in a sea of citizens, and in the process of searching, they can never be quite sure what they will find. Organizations that are fixed at positions on the extreme of the policy spectrum find fewer members, and must recruit at a higher volume than organizations at positions closer to the center. When organizational positions can adjust, there are complex patterns of interaction that occur among the competing organizations.

When organizations are governed by their median member, their positions tend to drift into the center of the policy spectrum and many organizations are put out of business because they are unable to contact prospects at a sufficiently high rate. The long run for such an environment seems to hold best possibility for an outcome consistent with the idea of niches in the political space that separate organizations. On the other hand, if organizations are created at random and fixed in place, or if their organizers can search in the space to increase their membership base, then the outcomes are more complicated. More organizations survive under those conditions and the positions they adopt do not seem to follow any pleasant spacing pattern.

At the current time, there are four major priorities in this research project. First, once they are isolated, interesting results need to be subjected to a high number of repetitions in order to ascertain their generality. I believe it is true that organizations governed by their median are more likely to die off over time than other organizations, for example, but more than a few simulation runs will be required to be convincing. Repeating an experiment is one of the things that is not so easy with the Swarm toolkit and some additional effort is required in coding.

Second, it is important to understand the implications of political interaction in a policy space of extremely high dimensionality. Suppose there are 100 dimensions to public policy. The model as currently written can easily handle such a conjecture. However, there is one problem. Each organization has to take a position on each of the issues, and each citizen has to have an opinion about each issue. It is possible to put a weight of 0 on an issue to represent the possibility that it is ignored. However, it is not so easy to specify the model in which recruiters are allowed to ignore some issues. It is not clear how to model a citizen's membership decision when an issue is ignored by an organization.

Third, additional care needs to be put into incorporating the possibility that organizations are added as time goes by. The code as currently constructed easily accommodates such birth events, thanks to the object-oriented nature of Swarm and the liberal usage of linked-lists. I have in fact run simulations in which organizations are added at random according to a schedule. I'm looking for a more persuasive design than simply adding organizations every 10th time period or so.

Fourth, the budget that controls the ability of citizens to join organizations has to be investigated. If the budget is 2 or 3, a person need not choose between organizations, and perhaps the selective pressure of competitive position taking will be weakened. The code is currently designed to investigate this problem. I'm interested to find out if increasing the budget of citizens with certain kinds of policy preferences will cause a significant change in the positions offered by (and membership patterns in) organized interests.

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