THE STRUCTURE AND DYNAMICS OF MOVEMENT PARTICIPATION*

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We develop a dynamic network model of collective action that explains how collective action can arise in the absence of selective incentives or disincentives from the voluntary action of rational actors in large groups. We show that the search for balance in social interaction among interdependent actors can yield a cascade of activism and result in a successful social movement. The characteristics of actors critical for movement success are identified. We also explore the structural conditions underlying a successful cascade of activism and thus identify the social dynamics of and the structural conditions for collective action in human society.

We develop and test a dynamic model that accounts for voluntary collective action across a range of contexts. These diverse contexts enable us to identify the social dynamics of and the structural conditions for collective action in human society. Our model yields results that sharply challenge arguments that rational actors will not contribute to the provision of a collective good, preferring instead to free-ride on the efforts of others. By extension, our results challenge Olson's (1965) argument that collective goods are produced only as a by-product of actors' pursuits of other goods, notably selective incentives or disincentives.

Our results fit empirical observations of social movements: Specifically, even when their own contributions do not appear to count, when costs appear to exceed benefits, when risks come to outweigh rewards, and when success cannot be realized unless many people pool their resources and act in concert, rational individuals will participate in social movements that provide collective goods. They do so without constraint and without concern for the selective incentives or disincentives that may accrue to them by virtue of their participation. We show how and when such actions yield movement success.

PREVIOUS MODELS

Because empirical observations of voluntary participation in collective actions defy Olson's prediction, other scholars have proposed alternatives to Olson's general model. These alternatives focus on the interdependence of individual actors. Noting that Olson's predictions assume that actors behave as if they were social isolates, others argue that models that recognize interdependence among individuals may resolve Olson's collective action problem (Granovetter 1978; Fireman and Gamson 1979; Coleman 1990).

Despite consensus on the importance of interdependent actors in explaining voluntarism in collective action, none of the models proposed to date provides a meaningful theoretical alternative to Olson's argument. In addition to the assumption that rationality is central to individual action, a meaningful alternative must satisfy the following conditions:

(1) Actions must be seen as purposefully oriented toward the achievement of a

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collective good—the collective good should not be a byproduct of other actions.

(2) There must be a large-group solution to the problem—models must apply to situations "in which no single individual's contribution makes a perceptible difference to the group as a whole" (Olson 1965:44).

(3) Models must offer practical solutions that do not rely on implausible assumptions about human behavior, social structure, or socioeconomic conditions.

In many models (Granovetter 1978; Oliver, Marwell, and Teixeira 1985; Marwell, Oliver, and Prahl 1988; Oliver and Marwell 1988; Macy 1990, 1991a), individuals are seen as interdependent in that they "take account of how much others have already contributed in making their own decisions about contributing to a collective action" (Oliver et al. 1985:504). By this definition, one actor's contribution or commitment to contribute tends to make others' subsequent contributions increasingly effective, thus triggering others' participation. Here the presence of a critical mass willing to shoulder a large portion—and sometimes most—of the total cost when no one else is willing or ready to join is necessary for successful collective action (hence, critical mass theory).

Although critical mass theory (Oliver et al. 1985; Marwell et al. 1988; Oliver and Marwell 1988) meets the first condition, showing "that the primary motive for collective action is the shared interest in the public good that is the explicit objective of the group" (Macy 1991a:730), it falls short of a large-group solution and relies on implausible socioeconomic assumptions. First, a collective good cannot be said to be jointly (aside from nominally) produced if only a few actors (i.e., a critical mass) shoulder most of the total cost while others contribute almost nothing. As resources become more heterogeneously distributed—a favorable condition for collective action according to Oliver and Marwell—fewer actors end up shouldering large proportions of the cost. Consequently, the "exploitation of the great by the small" becomes a central theme of critical mass theory—where those with great resources are exploited by those with few resources (a phenomenon unique to small groups). Collective goods are produced by a process that is only nominally collective.

Second, critical mass theory lacks practicality because it relies too heavily on an extremely unequal distribution of resources. Among members of the same beneficiary group (e.g., workers in labor movements, Blacks in the civil rights movement, indigenous peoples in independence movements), economic resources tend to be distributed homogeneously rather than heterogeneously. Noneconomic resources like time, which tend to be critical in collective action, are impossible for a few persons to monopolize. Movements emerge in contexts that are not characterized by extreme heterogeneity, and models of collective action need to account for this empirical reality.

Other models define interdependence differently. For Heckathorn (1992, 1993) and Gould (1993), individuals are interdependent in so far as they can limit others' choices through interpersonal influence. In this family of models, one actor's decision to participate (Gould 1993) or to exert influence (Heckathorn 1993) delimits the opportunity for others to defect, constraining them to join in the collective action regardless of their preferences. In these models, the key to successful collective action is whether "the regulatory interests that mandate cooperation overcome inclinations that encourage defection" (Heckathorn 1993:331).

The major problem with these models is that they are grounded on actions that are not purposefully oriented toward the achievement of a collective good—actors decide to contribute to a collective good, not out of their interests in the good, but out of their concern about possible social ostracism that might stem from defection. Interest in a collective good becomes irrelevant to the majority of a population,[1] particularly those who are forced to participate, making the production of a collective good "a byproduct of the pursuit of an altogether different (and private) object" (Macy 1991a:730). Equally problematic, the interpersonal influence pro-

[1] This trend is most clearly evidenced by Gould (1993), who dropped the "interest" variable from his model.

cess underlying these models rests on the premise of the sanctioning role of norms. Sanctioning norms are simply a type of selective incentive or disincentive (Opp 1986). Norm-based explanations of collective action, including these interpersonal influence models, are a subtle reformulation of Olson's selective incentive model. They share the basic conviction that collective action cannot arise out of voluntarism alone.

Given the limitations of prior interdependence-based models, Olson (1993) was perhaps not exaggerating to argue—almost three decades after publishing his *The Logic of Collective Action* (1965)—that "the great preponderance of this literature agrees that . . . very large groups are not able to achieve collective goals through voluntary collective action" (p. 568). We agree that interdependence is fundamental; we build on earlier contributions to produce a general model of collective action that meets the three conditions identified above, thus providing a meaningful alternative to Olson's (1965) argument and enabling us to identify the structural conditions that facilitate or block successful social movement activity. We show that large groups can achieve collective goods through voluntary action in the absence of incentives or disincentives.

HISTORICICIZING INTERESTS: A DYNAMIC NETWORK MODEL OF COLLECTIVE ACTION

The failure of prior rational-choice models stems from their implicit assumption that interests are fixed and that perceptions change. Thus, in critical mass theory, an ego's encounter with others facilitates only the exchange of information. In previous interpersonal-influence models, human interaction shapes actors' perceptions of opportunities for defection. In neither model, however, are actors or their interests shaped by their interactions with others.[2] Rather, interests are externally given and unchanging once given. This assumption of fixed interests misses the central dynamics of collective action—the "consciousness-raising," "micromobilizing," or consensus-mobilizing efforts of movement activists who strive to transform the value systems of bystanders and their own colleagues (McAdam 1982, 1986; Klandermans 1984; Snow, Rochford, Worden, and Benford 1986). As a consequence, other rational-choice solutions to Olson's problem cannot help but depict collective action as "elitist" (critical mass models), "opportunistic" or "involuntary" (influence models), or simply "cold-minded business" (selective incentive models).

Moving beyond this static image of social movement dynamics, we relax the assumption of fixed interests to capture collective action in its historical context. We view *human interaction* as the furnace of collective action in which ordinary men and women become activists. In our model, interactions shape interests. Interests are sensitive, not insensitive, to history. The difficulty lies in identifying an independent foundation for fluid interests from within rational choice. We argue that identity provides this foundation, and consequently our model allows both interests and perceptions to be sculpted by prior action sequences. Thus, our model responds to Tilly's (1978) call for explanations for "how a contender's collective action at one point in time changes the conditions which are relevant to the next round of action" (p. 229).

Shaping interests is a delicate process, and we show that the social structure of collective action is fundamental to this process. Only a limited number of social structures can sustain a dynamic process that yields new or increased interests. The central feature of these structures is that they enable the coupling of interest and identity. Yet process is much more fragile than is structure. The key element is that actors recognize action dynamics when they occur: They must see iterations as iterations, for it is only through action dynamics that actors will, in real life and in our model, come to see themselves as activists.

[2] A notable exception is Macy's (1990, 1991a) learning model, which requires a consistent reinforcement schedule. However, such a schedule is difficult to establish without a control system, and "in the absence of a consistent reinforcement schedule, people will not behave in a predictable fashion" (Hechter 1987:65). Perhaps more problematic, actors in Macy's model reflexively react to the persistence of social "bads." This assumes that the intersubjective process of meaning construction is unproblematic, an assumption that seems rather implausible.

Yet what seems unproblematic in modeling—an iteration—is absolutely fundamental to collective life.

Our model is based on two obvious sociological propositions: (1) Actors are interdependent, and (2) activism is enhanced through increasing embeddedness in an activist network. The micro-dynamics of collective action captured by these two propositions are realized in a tangible context in which some actors are more influential than others and in an action sequence in which past, even failed, action begets new conditions for future action.

Actors Are Interdependent

First, we assume that *actors tend to base their decisions about participation upon others' decisions* (Granovetter 1978; Oliver et al. 1985; Marwell et al. 1988; Oliver and Marwell 1988). It follows that one's participation tends to encourage others' participation by making collective action more likely to succeed. Therefore one's defection tends to discourage others' participation by making collective action less likely to succeed.

In real life, this interdependent decision-making process is conditioned by access to information as well as by access to power and other factors. Our model incorporates these conditions. Because information on others' decisions, interests, and resources are not always accurate or readily available (Macy 1990, 1991a), we recognize that social networks structure the availability of accurate information on others' commitments. In our model, individuals have accurate information only on actors to whom they are directly tied. Thus, the assumption of forward-looking behavior of rational actors that Macy (1990, 1991a) criticized as too stringent becomes practical, although looking forward is bounded by an actor's own network.

We also model the effect of power or social leverage. Actors, while subject to others' influence, also try to gauge their own ability to shape others' decisions. Hence, ego's potential effect on alter's decisions has implications for ego's own decision-making. The extent to which ego's contribution could induce alters to contribute to the provision of a collective good is essentially a function of ego's social leverage over alters. This forward-looking behavior is likewise bounded by ego's network.

Oliver et al. (1985) argue that ordered decision-making (from the most to the least interested in an accelerative production function) is a necessary condition for an interdependent decision-making process to yield successful collective action. But real contexts are never so neat. The bounded nature of forward-looking behavior makes perfect orderliness implausible in real life. Yet the possibility of forward-looking behavior, however bounded, makes perfect randomness unlikely as well. We assume that actors who are more interested tend to initiate collective action before less interested actors do, but that they need not do so.

As with the interpersonal-influence models, we also view actors as interdependent in that *actors try to influence their neighbors* (Gould 1993; Heckathorn 1993). We believe that interpersonal influence is one of the two processes underlying the dynamics of collective action. In Gould's and Heckathorn's models, interpersonal influence is invoked to "regulate" other's inclinations to pursue their individual rationality or to "coerce" contributions out of reluctant or resistant bystanders. Consequently, actors confront restricted opportunities for defection, ultimately losing the freedom to pursue their own agenda.

In contrast, we assume that actors seek balance in their social relations and thus exercise interpersonal influence in order to induce homophily *with regard to the pursuit of a collective good* (Lazarsfeld and Merton 1954; Kandel 1978). Interactions between activists and bystanders and among like-minded activists open up precious opportunities for what Snow et al. (1986) call "frame alignment," a process through which people's attitudes, values, and behaviors become increasingly similar to those of other actors to whom they are tied.

An interpersonal influence process based on homophily carries implications for the model. First, influence operates independently of one's cooperation status so that it is no longer selective. Second, influence neither rewards nor punishes and thus does not involve selective incentives or disincentives. Finally, the direct outcome of influence is not that alter matches ego's level of cooperation, but rather that their attitudes and values

become more similar. Hence, influence centers on each actor's *level of interest* in the provision of a collective good, not the decision to contribute. In our model, whether to contribute is ultimately an actor's free and rational choice. In this context, the decision to participate is consistently voluntary and purposive with regard to the collective good.

Asymmetries in interests across tied actors provide a basis for interpersonal influence. Thus, if actor A has higher interest than actor B, actor A exercises upward influence on actor B (upward because A's influence enhances B's interest). At the same time, actor B is exercising downward influence on actor A (downward because B's influence decreases A's interest). Outcomes of the influence process are conditioned by the actors' relative power in the network.

We assume that actors are consistent and that they exercise influence as constrained by their prior participation in the following ways:

(1) Actor A's nonparticipation deprives A of moral justification for exerting upward influence on actor B (Gould 1993), even if A has higher interest than B.

(2) Actor A, who chooses to participate, will not exert downward influence that may frustrate actor B's participation, even if A's interest is lower than B's.

This consistency rule, superimposed on the rule of asymmetries in interest, establishes conditions for influence, as summarized in Table 1. Influence is bidirectional, but not all interactions involve efforts to influence others. Nonparticipants are not necessarily hostile to the efforts of others, and in fact they may be thrilled that their neighbors are trying to provide them with a collective good. Thus, they have no incentive to proactively dissuade participants from contributing their resources to a movement. They are also indifferent to the behavior of other nonparticipants. *Only the presence of upward influence triggers downward influence.* Nonparticipants only exercise downward influence reactively, when they are exposed to the upward influence of their neighbors.

The dynamics of collective action are shaped in large measure by the fact that participants need to reach out to others to increase their numbers. By doing so, participants risk exposure to downward influence. Accordingly, any movement expands at some risk, for contact with nonparticipants exposes participants to potential downward influence. This process is similar to that underlying the cascade model developed by Boorman and Levitt (1980), in which the heterodox (social animals) are at risk to orthodoxy by virtue of their contacts with the orthodox (asocial animals). This model was generalized for ideational contexts by Bearman and Podolny (1987).

Table 1. Effect of Participation and Assymetries of Interest on Interpersonal Influence

Actor A	A's Interest Greater Than B's	A's Interest Less Than B's
Participates	Upward influence	No influence
Defects	No influence	Downward influence

Embeddedness Enhances Activism

Because participation in a movement yields cognitive shifts that ex post account for participation, individuals often discover that they are movement activists after extensive involvement in activist networks. Increased embeddedness in activist networks yields a context for the deep ideational changes that are usually thought to yield participation in a movement (McAdam 1982, 1986; Bearman 1993). It follows that an identity as an activist and interest in a movement are produced within networks of interacting activists, and that contact with like-minded activists is the principal mechanism by which commitment is enhanced. Accordingly, the model developed here assumes that once individuals participate in collective action, their interests are plastic. If they have contacts with other participants, individuals who join a movement can experience a dynamic increase in their level of interest. In this model, influence operates on interests subsequent to individual decisions about participation and creates a context in which densely knit groups of interacting participants fuel continued participation across the many opportunities (seen as iterations) that confront them.

Influences Are Uneven

Influence presumes contact. Networks structure contact by determining the range of one's influence over others, by delimiting the degree or extent of influence that one can exert, and by determining the cost of influence. Range refers to the number of persons ego can reach. The more actors ego is tied to, the more widely ego's influence may extend. The extent to which ego exercises influence over an alter is a function of their relative power in the network (Freeman 1977, 1979; Bonacich 1987; Gould 1993). Here, we expand beyond dyadic power to consider how an individual's structural position shapes the outcomes of the influence process. Thus, ego's leverage over alters is conditioned by the alters' positions and the extent to which they are subject to countervailing influences. It follows that the cost of influence is a function of power relations in the network.

There are several ways to conceptualize power in social networks. We focus on centrality, and use Bonacich's (1987) measure of centrality that explicitly defines ego's power as conditioned by the power of the alters to whom ego is tied. This measure captures the power of actors in terms of their control over the flow of information in an interpersonal communication network.

Collective Action Occurs in the Context of Social Structure

Actions cannot be decoupled from their social settings; they are deeply rooted in social structures that can facilitate or block fresh action including collective action. Actions cannot be meaningfully modeled in the absence of images of social structure. Hence, any explanation of voluntary collective action must identify the social structural bases for collective action. We define social structures on the basis of how personal traits are distributed across populations and how actors are connected with each other.

First, following network-based approaches to social structure (White, Boorman, and Breiger 1976), we define social structure as a network of interpersonal ties. We pay particular attention to the enabling or disabling role of the network density.

Second, we also define social structures in terms of "the joint distribution [of a population among positions in a multidimensional space] whose main parameters are univariate variations and multivariate covariations" (Blau and Schwartz 1984:10). The multidimensional space of our dynamic social network model is described by three parameters: interests, resources, and power/centrality. Actors have certain levels of interest in a collective good and have discretionary resources that could be consumed toward the provision of the collective good; actors also occupy a position in a network of interpersonal relations.

What is often called group heterogeneity captures the unidimensional variations of these three parameters. We model interests, resources, and power/centrality as distributed according to chi-square distributions with varying degrees of freedom. Varying the degrees of freedom (d.f.) enables us to vary the extent of heterogeneity. We test the effect of group heterogeneity when d.f. is set at 3, 7, and 20. Group heterogeneity is largest when d.f. equals 3 and smallest when d.f. equals 20. The average of the interests and resources variables is constrained to be 1. A social network of personal ties is generated by partitioning a 100-member population into five groups of equal size. Roughly 30 percent of all ties are sent across groups. Interpersonal ties within each group and across groups are distributed following a chi-square distribution with varying degrees of freedom (equal to 3, 7, and 20).

The multivariate covariations among these parameters (interests, resources, and power/centrality) have important implications for the model. Power, measured as centrality, is distinguished from other resources in that it enables the indirect production of a collective good through the interpersonal influence process, although power cannot be consumed as a direct input for the provision of a good. Hence, we test how collective action is shaped under "collective action regimes" defined in terms of the relationships between power/centrality and interest and between power/centrality and resources. *Regimes describe the social structure of the challenging group, not the structure in which the challenging group is embedded.* Table 2 identifies the four collective action regimes of interest.

Table 2. Definition of Four Collective Action Regimes

Correlation between Power/ Centrality and Resources	Correlation between Power/ Centrality and Interest	
	Positive	Negative
Positive	Privileged regimes	Impoverished regimes
Negative	Rebellious regimes	Estranged regimes

When central actors (those with social power) control resources and have a high interest in the provision of collective goods relative to peripheral actors in the challenging group, we find an elite or *privileged* regime. Consider the women's movement in the 1960s. Women who participated in the Commission on the Status of Women in 1961 and later founded the National Organization of Women were mainly professionals (Freeman 1975). Compared to the women occupying more traditional female roles, professional women stood to gain more from gender equality and thus had more interest in the movement. Professional women also had more economic and noneconomic resources at their disposal than did their traditional counterparts. Furthermore, their jobs as professionals allowed them to benefit from and manipulate far-reaching networks of interpersonal ties that their counterparts lacked. Here, interest, resources, and power/centrality are all positively correlated.

By contrast, an *impoverished* regime is one in which centrality and resources are positively correlated, yet those with the greatest centrality and the most resources have little interest in the provision of collective goods. Those who have a high interest in a collective good are pushed to the periphery and left without resources or social power. Organized insurgency is almost impossible in such a setting, for even if the heterodox actors on the periphery are mobilized into insurgency, their efforts are likely to be blocked by the orthodox elite whose interest in mobilization is low. In these settings, actors may resort to subtle forms of everyday resistance, what Scott (1985) has identified as weapons of the weak. Because these strategies are designed to be invisible, analysts and actors may not be aware of them. They may not be aware of, in our terminology, each iteration. The failure to recognize resistance further reduces the possibilities for successful collective action.

In the *estranged* regime, centrality is negatively associated with both interest and resources. Actors who are highly interested in the provision of a collective good have resources, but they are estranged from other members and thus lack social leverage over their neighbors. In the ordinary course of events, they can exercise very little influence. As with the impoverished regime, sustained movements are extremely unlikely. If a movement occurs, action is likely to be explosive. Motivated, resourceful actors without any social leverage are drawn to highly symbolic and violent protests as the most rational strategy for achieving influence.

In *rebellious* regimes, central (powerful) actors have a high interest in collective goods and few resources. They have little to lose. This is the ideal-typical case for revolution, but the rebellious regime also fits cases in which central actors in communication networks lead social movements (e.g., the civil rights movement).

THE FORMAL MODEL

Our model has three components: production functions and individual payoffs, decision-making algorithms, and an interpersonal influence process. The variables that enter into our formal model and the subsequent analyses are defined in Table 3.

Production Functions and Individual Payoffs

Following Macy (1990), the production function is modeled as a cumulative logistic function of the total contribution rate (π_t):

$$Y_t = \frac{1}{1+\exp(10[.5-\pi_t])}, \qquad (1)$$

where Y_t is the production level at the tth iteration (i.e., the probability of providing a public good or removing a public bad given π_t), and π_t is the ratio of total contributions to total resources. This cumulative logistic function accelerates in its early phase, but decelerates in its later phase so that it simultaneously deals with what Oliver et al.

Table 3. Definition of Variables Used in the Analysis

Variable	Definition
Interest	Level of interest in collective goods. Initially ranges between 0 and 5 with a mean of 1 and an upper limit of 100.
Resource	Discretionary and consumable resources (money, time, etc.) that actors contribute toward the production of collective goods. Ranges between 0 and 5 with a mean of 1.
Power/centrality	The capacity of an actor to exert influence over others. Measured following Bonacich (1987).
Rebellious regime (X_1)	Coded 1 if interests are positively correlated with power and resources are negatively correlated with power; 0 otherwise.
Impoverished regime (X_2)	Coded 1 if interests are negatively correlated with power and resources are positively correlated with power; 0 otherwise.
Estranged regime (X_3)	Coded 1 if interests and resources are negatively correlated with power; 0 otherwise.
Network density (X_4)	The extent to which actors are tied to each other. Ranges between 0 and 1.
High density (X_5)	Coded 1 if X_4 is greater than or equal to .50; 0 otherwise.
Power heterogeneity (X_6)	Inequality in the distribution of power/centrality across actors. Coded 1 if distributed across actors most homogeneously with d.f. = 20; coded 2 if distributed moderately heterogeneously with d.f. = 7; coded 3 if distributed most heterogeneously with d.f. = 3.
Interest heterogeneity (X_7)	Inequality in the distribution of interest across actors. Coded following X_6.
Resource heterogeneity (X_8)	Inequality in the distribution of resources across actors. Coded following X_6.

(1985) identify as the "start-up" problem *and* the problem of "suboptimality."

The share of collective goods going to ego i at the tth iteration, denoted B_{ti}, is a function of both the total amount of collective goods provided and i's level of interest:

$$B_{ti} = Y_t R_{total} I_{ti}. \tag{2}$$

The total volume of public goods provided is given by the production level Y_t multiplied by total resources (R_{total}). Its value to each individual is obtained by weighting it by the level of interest in collective goods (I_{ti}) that ego has.

Ego i's contribution at the tth iteration, denoted C_{ti}, is a function of ego i's own resources (R_i) and ego i's decision to participate (V_{ti}):

$$C_{ti} = R_i V_{ti}, \tag{3}$$

where $V_{ti} = 1$ if ego i decides to participate at the tth iteration; otherwise $V_{ti} = 0$.

Accordingly, ego i's net benefit, denoted S_{ti}, is ego i's share of a collective good, net of its cost:

$$S_{ti} = B_{ti} - C_{ti}. \tag{4}$$

Decision-Making Algorithms

Following the rational-choice model, actors are "individualistically rational" in that each actor weighs action strategies and chooses the strategy the actor expects to produce the greatest *personal* benefit. In this simulation, actors face two action strategies: participation or defection. Defection carries no cost and may lead to benefits derived from others' contributions. Others' contributions, which are considered at the moment of ego's decision, are the sum of the contributions made by ego's neighbors alone:

$$\pi_{ti(V_{ti}=0)} = \frac{1}{R_{total}} \sum_{j=1}^{n} R_j V_{tj} T_{ij}, \ (i \neq j), \tag{5}$$

where $T_{ij} = 1$ if i and j are directly tied; otherwise $T_{ij} = 0$.

Participation carries some cost, but it may also yield more benefits than defection. The benefit derives from contributions made by ego's neighbors before ego's own decision

(equation 5), from ego's own contribution, and from the contributions likely to be made by ego's neighbors after they are exposed to ego's influence. The last two benefits come only with ego's participation. Because each actor tries to influence others to whom he or she is tied (Oberschall 1973; McAdam 1986), each actor's decision to participate has subsequent implications for his or her neighbors whom he or she tries to influence. The level of contributions ego expects from his or her neighbors through the exercise of influence over them is a function of the neighbors' resources and ego's degree of influence. Considering that each actor not only has his or her own power but is surrounded by powerful neighbors, we measure the degree of influence (P_{ij}) ego i could exert over a neighbor j as the geometric mean of ego's power (P_i) relative to the neighbor's power (P_j) and to the power of the neighbors (P_k) of neighbor j:

$$P_{ij} = \sqrt{\frac{P_i}{P_i + P_j} \times \frac{P_i}{\sum_{k=1}^{n} P_k}}, \quad (i \neq j; i \neq k). \tag{6}$$

Hence, the total contribution level ego i expects upon participation is:

$$\pi_{ti(V_{ti}=1)} = \frac{1}{R_{total}} \left[\begin{array}{l} \pi_{ti(V_{ti}=0)} + R_i \\ + \sum_{j=1}^{n} P_{ij} R_j (1 - V_{tj}) T_{ij} \end{array} \right], \tag{7}$$

where the last term in square brackets refers to the indirect production component of the total contribution by ego i. The $1 - V_{tj}$ element ensures that none of ego i's neighbors are double-counted. The T_{ij} element (coded 1 if i and j are directly tied; 0 otherwise) ensures that this forward-looking behavior is limited within i's ego network. Ego i's expected net payoff upon defection, $E\{S_{ti(Vti=0)}\}$, and upon cooperation, $E\{S_{ti(Vti=1)}\}$, are obtained by substituting π_t with equation 5 and 7, respectively, for equations 1, 2, and 4.

Ego's final decision about whether to participate is a probabilistic function of ego's expected net payoff from contributing. Formally, the probability for ego to participate, $P\{V_{ti}=1\}$, is modeled as a cumulative logistic function of the expected marginal benefit (M_{ti}) of ego's participation:

$$P\{V_{ti} = 1\} = \frac{1}{1 + \exp(10[1 - M_{ti}])}, \tag{8}$$

where the expected marginal benefit (M_{ti}) is obtained by

$$M_{ti} = \frac{E\{S_{ti(V_{ti}=1)}\} - E\{S_{ti(V_{ti}=0)}\}}{R_i}, \tag{9}$$

where R_i stands for the cost of participation. Ego decides to participate when the probability of participation is greater than or equal to a random number; otherwise ego decides not to participate. Following Macy (1990, 1991a), decisions are probabilistic, not deterministic. Resources are assumed to be nondivisible (i.e., individuals contribute all or nothing of their discretionary resources).

The Process of Interpersonal Influence

The extent to which upward or downward influence by an actor changes others' levels of interest is a function of the degree of asymmetry in their interests and the degree of influence. Formally, increases in ego i's interest, $UP1\{I_{ti}\}$, due to upward influence by neighbors j is given by

$$UP1\{I_{ti}\} = \sum_{j=1}^{n} (I_{tj} - I_{ti}) P_{ji} V_{tj} (1 - V_{ti}) T_{ij}, \quad (i \neq j), \tag{10}$$

where I_{ti} or I_{tj} denotes ego i's or neighbor j's level of interest, P_{ji} denotes j's degree of influence over i, V_{ti} or V_{tj} denotes ego i's or neighbor j's action choice, and T_{ij} denotes whether ego i is tied to alter j ($T_{ij} = 1$ if i and j are directly tied; 0 otherwise). As Table 1 shows, upward influence operates only when i chooses to defect ($V_{ti} = 0$) and j chooses to participate ($V_{tj} = 1$) and I_j is greater than I_i. And, only those who are directly connected to ego i exert upward influence (i.e., when $T_{ij} = 1$). Similarly, the total decrease in ego i's interest, $DOWN\{I_{ti}\}$, resulting from the downward influence by neighbor j is given by:

$$DOWN\{I_{ti}\} = \sum_{j=1}^{n} (I_{tj} - I_{ti}) P_{ji} (1 - V_{tj}) V_{ti} T_{ij}, \quad (i \neq j). \tag{11}$$

This downward influence operates only when i chooses to participate ($V_{ti} = 1$), j chooses to defect ($V_{tj} = 0$), I_j is less than I_i, and i and j are directly connected ($T_{ij} = 1$). Note that the difference term involving I_{ti} and I_{tj} in equations 10 and 11 indicates that both i and j are moving toward the arithmetic mean point between them.

Finally, mutual reinforcement among activists is formally modeled as

$$UP2\{I_{ti}\} = \sum_{j=1}^{n}\left(\sqrt{I_{ij}^2 + I_{ti}^2} - I_{ti}\right)P_{ji}V_{tj}V_{ti}T_{ij}, \quad (i \neq j), \tag{12}$$

where $\sqrt{I_{ti}^2 + I_{tj}^2}$ is a geometric balance point toward which both i and j are moving. This reinforcement process operates when both i and j choose to participate ($V_{ti} = 1$ and $V_{tj} = 1$), independent of their relative levels of interest, and i and j are directly tied ($T_{ij} = 1$).

As noted, influence is costly. We make two assumptions for modeling the cost of influence. First, we assume that the average cost of influence is obtained by dividing the average resources available to an individual by the product of network density and the total population of the group. This ensures that the scope of interpersonal influence is not delimited by the total resources available to the group or by network density. Second, we assume that the cost of influence is sensitive to power relations. Hence, the cost to ego i to influence alter j is a function of alter j's centrality relative to ego i's centrality. In sum, the cost of influence, K_{ij}, that ego i is expected to pay to influence neighbor j is given by:

$$K_{ij} = \frac{1}{N(Density)}\left(\frac{P_j}{P_i}\right). \tag{13}$$

Cost accrues only to upward influence because downward influence is exercised reactively. Actors try to influence as many of their neighbors as possible. When an actor lacks sufficient resources to influence all of his or her neighbors, then that actor is assumed to be selective; that is, the actor chooses to invest his or her resources in those whose contributions could be biggest (cf. Marwell and Oliver 1993). Formally, ego i ranks neighbors in descending order by size of their *expected* contributions and invests his or her resources in his or her neighbors in that order until all of i's resources are consumed. Ego i obtains j's expected contribution by multiplying j's resources by his or her power relative to j's power. Our model does not distinguish between contributions and the cost of influence. For actors in this model, the price of influence is considered a component of one's contribution.

We present results from a computer simulation using the formal model described. The simulation starts with all actors preferring defection. Actors make sequential decisions on whether to participate in collective action. The sequence is determined by evenly mixing the rank of interests with a randomly generated rank. Each actor is allowed only one decision at each iteration. Interpersonal influence follows the decision-making period. Hence, the effect of influence is felt at each subsequent iteration, and no influence operates at the start. Interests, which are exposed to interpersonal influence, are allowed to change over iterations, and these changes create new conditions for the subsequent iteration. However, actors' resources and centrality remain constant over time.

Each simulation is composed of 200 iterations. Iterations represent collective action events—for example, a large-scale street demonstration, or alternatively what Scott (1985) calls "the weapons of the weak," such as footdragging or working-to-rule. Hence, many of the actors and even the target group may fail to notice that iterations are taking place. This is particularly true in the early phase of a movement. In fact, many iterations have probably taken place before people began to be aware of a meaningful collective action sequence.

CASCADE OF ACTIVISM: THE DYNAMICS OF PARTICIPATION

Figure 1a shows the course of contributions for the four collective action regimes. The key finding is that collective action fails in the impoverished and estranged regimes; successful collective action occurs only in the privileged and rebellious regimes. The successful movements tend to follow a similar pattern. At the early or "pioneer" stage of a movement, the first 105 iterations in the privileged regime and the first 80 iterations

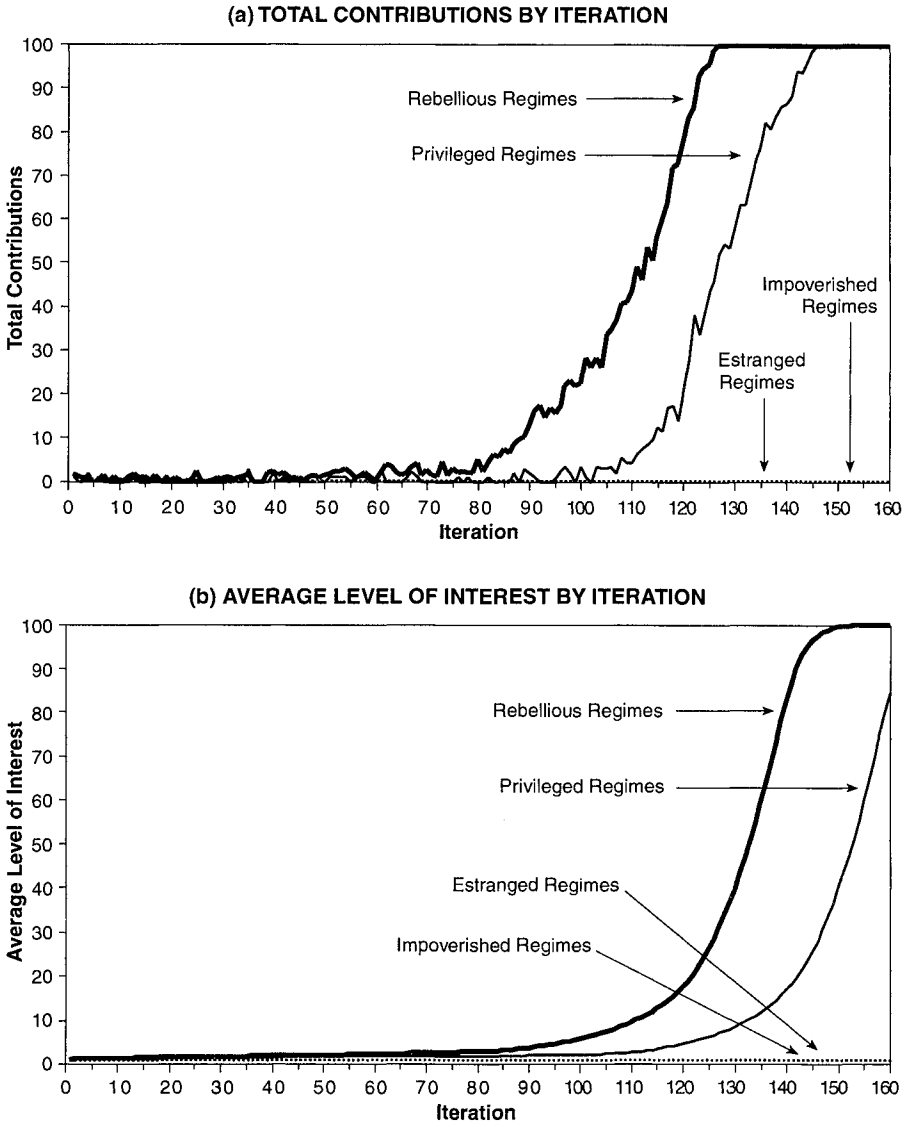

Figure 1. Total Contributions and Average Level of Interest, by Iteration: Four Collective Action Regimes

Note: For these simulations, network density = .1, power heterogentity = 3 d.f., interest heterogeneity = 3 d.f., and resource heterogeneity = 20 d.f. Total contributions are sum of contributions per iteration. Average level of interest is sum of interests across actors divided by 100 per iteration.

in the rebellious regime, a handful of actors initiate collective action, only to repeatedly fail. This pioneer period is followed by the "start-up" period—the 106th to 120th iteration in the privileged regime and the 81st to 95th iteration in the rebellious regime. The start-up period is characterized by a slight increase in the total volume of contributions that leads to an explosion of participation. Shortly thereafter, most of the population participate.[3]

What drives these patterns of participation? Figure 1b shows changes in the average level of interest for the four collective

[3] Others report similar sudden outbursts of participation (Boorman and Levitt 1980; Bearman and Podolny 1987; Glance and Huberman 1994).

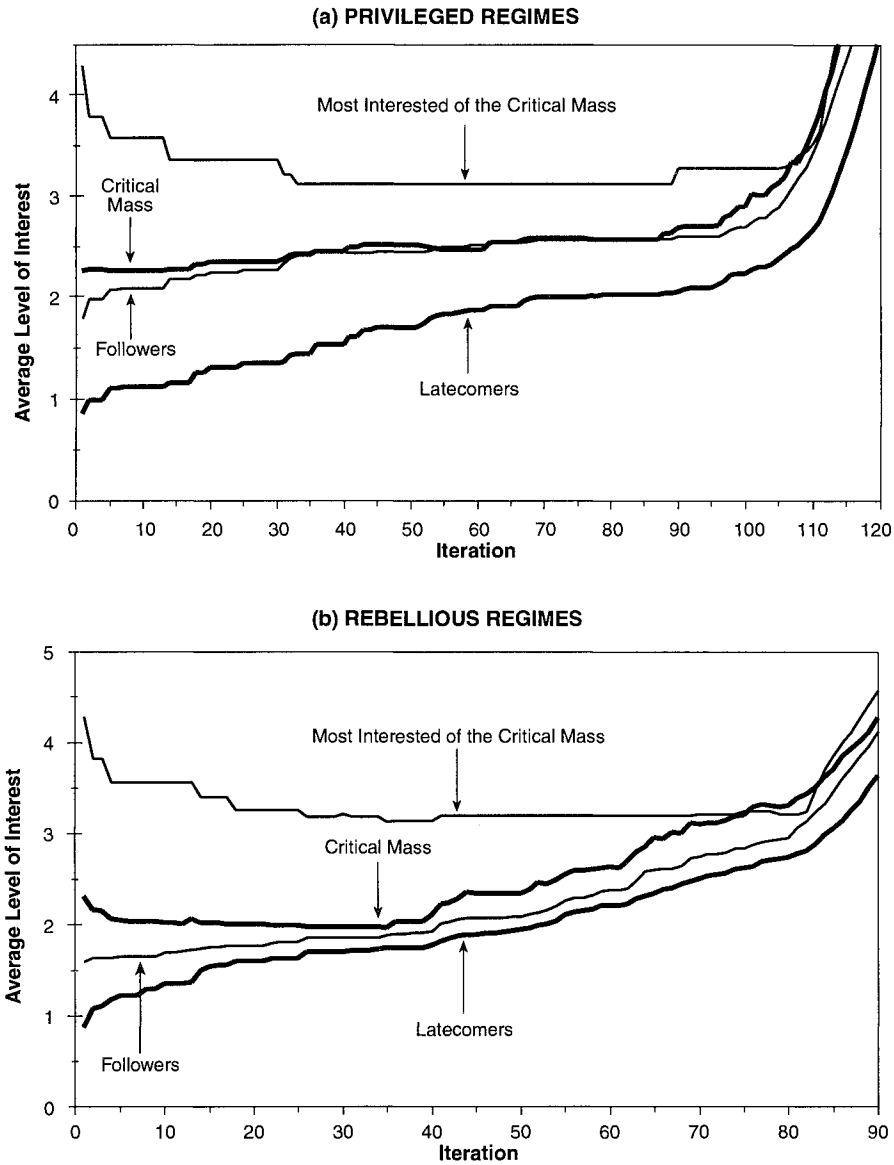

Figure 2. Average Level of Interest by Iteration for Three Groups: Privileged Regimes and Rebellious Regimes

action regimes. Fundamental is the sudden surge in the average level of interests that occurs only in the privileged regimes and the rebellious regimes.

Figures 2a and 2b show changes in the average level of interest over iterations for three groups of actors in the privileged and rebellious regimes: the "critical mass" (those few individuals who consistently participate during the pioneer period), the "followers" (those who join the movement during the start-up period), and "latecomers" (those who participate late in the game).

While in Figure 1a the total contributions fluctuate at low levels until around the 100th iteration in the privileged regime or the 80th iteration in the rebellious regime, Figures 2a and 2b reveal that two dynamic micro-level processes cause followers to become more radical and leaders to become more pragmatic. On the one hand, a few movement activists (the most interested of the critical

mass) consistently exercise upward influence on others. Exposed to the influence of these enthusiasts, actors in the "grassroots" slowly align with the committed activists and transform their ideological framework to correspond to that of the enthusiasts (Snow et al. 1986). This process is reflected in the slow but steady increase in the average level of interest among followers and latecomers in both regimes.

Simultaneously, some nonparticipants counter the upward influence of activists with their own downward influence. Consequently, the more contact activists have with defecting neighbors, the more pragmatic they become. This trend is shown by the decrease in the average level of interest among the most interested members of the critical mass in both regimes. In both the privileged regimes and rebellious regimes, the consciousness-raising activities of activists dominate the heartbreaking effects of defection, ultimately leading to a steady increase in the average level of interest. In the impoverished and estranged regimes, by contrast, the opposite occurs.

At a critical moment, the average level of interest increases sharply, occasioned by new members joining the pool of activists. The resulting expansion of the initially small group of activists greatly enhances the opportunities for interaction among activists, setting off a bandwagon effect of mutual reinforcement. Thus, despite numerous failed attempts at collective action, the activist view spreads across the population. This cascade of activism suggests a radicalization of consciousness, that in turn is reflected in increased contributions, thus making successful collective action possible.

This model of collective action shows that an event at one point in time, whether successful or not, can create new possibilities for subsequent collective action. Any attempted collective action provides fodder for the micro-dynamics through which apathetic bystanders, exposed to the consciousness-raising activities of enthusiasts, become increasingly sympathetic to movement goals and ultimately identify themselves with the movement. The development of a collective identity among segments of the potential constituency is an important legacy of past activism to be mobilized for future actions, a process observed in many social movements, such as the labor movement (Sewell 1980; Golden 1988), peasant uprisings (Shin 1994), and the women's movement (Mueller 1987; Taylor 1989).

Our dynamic network model also demonstrates the possibility of voluntary collective action without any "selective incentives." Neither economic incentives or disincentives were provided for either participants or nonparticipants, and actors were not forced to participate independent of their preferences: They participated voluntarily on the basis of rational calculation. Although they influenced each other, they exercised this influence not to "force" their neighbors to participate, but to reach balance. This process shows that collective action can occur from a voluntaristic basis; thus we reject Olson's conclusion that voluntary collective action is not possible in a large group.

THE CRITICAL MASS: AGENTS OF CHANGE

Oliver and Marwell (Oliver et al. 1985; Marwell et al. 1988; Oliver and Marwell 1988; Marwell and Oliver 1993) show that a small group can create the conditions for subsequent collective action. Our model supports this view, showing that during the "pioneer" period when success is unlikely, only a few persons consistently commit to the cause. They trigger a cascade of activism that paves the way for mass participation in subsequent iterations. Clearly, the critical mass is important for successful collective action; but who are they?

Oliver and Marwell argue that the critical mass is composed of persons interested enough to initiate action and resourceful enough for their contributions to make a difference in the probability of success. Resources are a crucial prerequisite for the critical mass, whose members are drawn disproportionately from the elite. This image of the critical mass is appropriate for explaining late phases of a social movement when it is largely institutionalized and depends on a sustained inflow of various resources. However, the image does not fit well with early phases of social movements, phases that are often characterized by "the excess of political energy among masses" (Piven and Clo-

Table 4. Differences between Means of Three Characteristics for Three Groups in a Social Movement: Privileged Regimes and Rebellious Regimes

Characteristic	Group		
	Critical Mass	Followers	Latecomers
Regimes Combined			
Power/centrality	1.70 (.14)	1.47 (.19)	.80 (.34)
Interest	2.28 (1.17)	1.88 (.75)	.83 (.65)
Resources	.86 (.36)	.88 (.33)	1.02 (.31)
Number of cases	9	20	171
Regimes Separated			
Resources in privileged regimes	1.14 (.14)	1.11 (.35)	.98 (.32)
Number of cases	5	9	86
Resources in rebellious regimes	.51 (.14)	.68 (.15)	1.06 (.29)
Number of cases	4	11	85

Notes: Numbers in parentheses are standard deviations. Differences between the means are determined by pairwise *t*-tests. Boxes and asterisks indicate significant differences.

$^{*}p < .05$ $^{**}p < .01$ (two-tailed tests)

ward 1979:*xxi*). Our results reveal that a critical mass is not necessarily drawn from the elite and its members are likely to participate well before institutionalization of the movement.

Table 4 compares the levels of interest, resources, and power/centrality for the critical mass, followers, and latecomers across privileged regimes and rebellious regimes. Note that across both regimes the critical mass tends to have more power and greater interest than do members of the other two groups, although the difference between the critical mass and followers is not statistically significant. With respect to resources, the comparison of means is misleading because the resources possessed by the critical mass are regime-specific: Members of the critical mass are likely to be rich in privileged regimes but poor in rebellious regimes. This suggests that resources are not crucial for the critical mass. What the critical mass shares across both regimes is commitment and a central position in the social network. The critical mass must be interested enough to initiate action even when others are not willing to join. Members also must have sufficient social leverage so that their actions induce others to join.

The fact that the critical mass can be poor, particularly in the rebellious regime, does not mean that its members contribute little and make others shoulder most of the costs. On the contrary, the critical mass makes important contributions in terms of both volume and timing. Table 5 compares the cumulative contributions made by the critical mass and the richest members of the beneficiary group during the pioneer and start-up periods when the probability of success is small and during the subsequent insurgent period until all members participate.

During the early periods in the privileged regime, the average contributions made by members of the critical mass far exceed those made by the richest actors. Later, when success is almost certain, the richest actors rush into the movement, contributing more than the critical mass. Yet even with these heavy contributions at the last minute, the critical mass's overall contribution remains

Table 5. Average Cumulative Contribution and Average Participation for the Critical Mass and the Richest Members: Privileged Regimes and Rebellious Regimes

Characteristic	Privileged Regimes		Rebellious Regimes	
	Critical Mass	Richest Members	Critical Mass	Richest Members
Average resources	1.14	1.75	.51	1.79
Average cumulative contribution	52.7	45.9	41.0	9.1
Pioneer and start-up periods	23.0	3.8	24.6	0.0
Insurgent period	29.7	42.1	16.4	9.1
Average participation	.32	.18	.65	.04
Pioneer and start-up periods	.17	.02	.54	.00
Insurgent period	1.00	.92	1.00	.48

greater than that of the richest members. In the rebellious regime, contributions made by members of the critical mass are far more conspicuous, despite the fact that the critical mass includes many of the poorest members of the population. The critical mass consistently contributes much more than the richest members whatever the chances of success. In this rebellious regime, the richest actors adopt an extremely opportunistic strategy – they join the movement only at the last minute. Although relatively poor, the critical mass makes large contributions over the long run. Olson (1965) and Oliver et al. (1985) suggest that the provision of collective goods (however suboptimal) results from the exploitation of the great by the small. If only it were true. Our findings suggest that the small generally contribute more than the great, and that in rebellious regimes, the small are often exploited by the great.

The direct contributions made by the critical mass are extremely important for movement success, in large part because their early contributions create a context for others to contribute. In contrast to predictions derived from critical mass theory, our model shows that the rich are both opportunistic and sterile: They contribute only when a lucrative return is guaranteed and their contributions beget no additional contributions. Considering the opportunism of the richest actors in our model, their contributions are the last thing one would want to rely on. The same pattern seems to hold in everyday life.

Neither interests, nor resources, nor power/centrality are sufficient to induce actors to assume the role of the critical mass. An analysis of the interpersonal ties among members of the critical mass and ties between members of the critical mass and their followers provides further insight into the character of the critical mass. Figure 3 portrays the social networks of members of the critical mass and their followers in privileged regimes and rebellious regimes.[4]

A central finding is that the critical mass forms a densely interlocking clique, while most followers are only marginally tied to this densely knit network of activists. Recall that followers do not differ from the critical mass with respect to interests or resources. Clearly, the critical mass is not composed of isolated individuals, but is recruited intact from a small densely interlocked segment of the population. In the critical mass, interest and identity go hand in hand.[5]

This densely interlocking social network of activists plays a special role in the devel-

[4] We report only geodesic ties that lead to members of the critical mass.

[5] The importance of the interlocking social network for the critical mass is further evidenced by the presence of a pseudo-critical mass, comprised of those with personal characteristics similar to those in the critical mass but who fail to play a leading role. A comparison of the social networks of the pseudo-critical mass and the critical mass reveals that members of the pseudo-critical mass are either excluded from or only marginally linked to the central activist core. Figure 3 shows that in addition to high centrality and a firm commitment to the cause, actors must also be deeply embedded in a densely interlocking network of activists to assume the role of the critical mass.

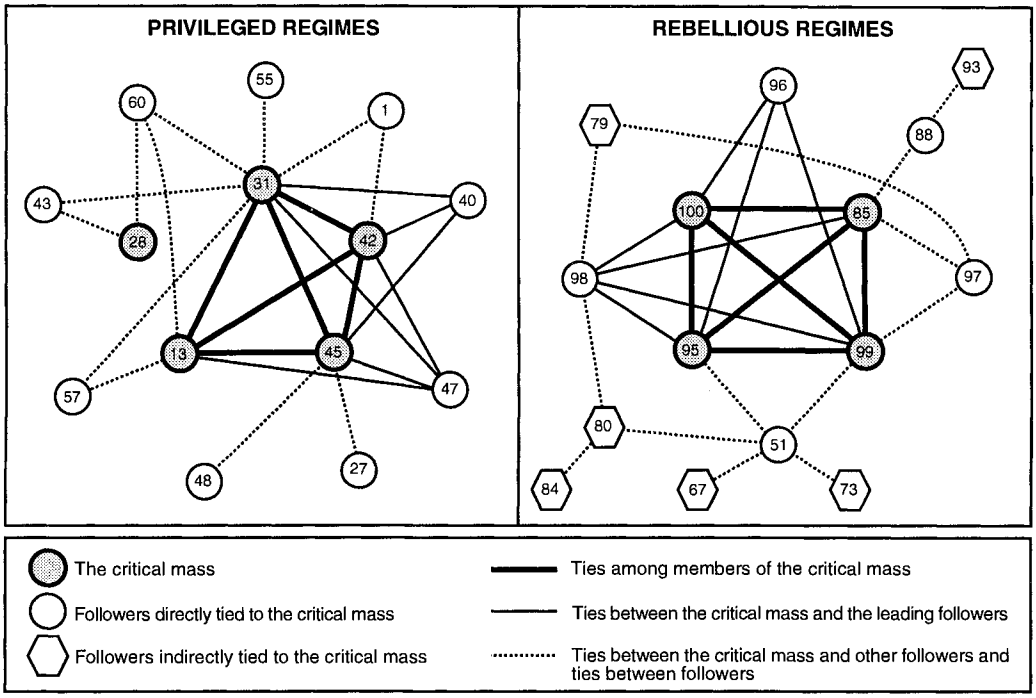

Figure 3. The Social Network of the Critical Mass and Their Followers

Note: Numbers refer to a ranking of each actor by resources.

opment of collective consciousness and the cascade of activism. Densely interlocked network ties insulate the critical mass from counter-pressures exerted by defecting neighbors throughout the long early stages of a social movement. Without the capacity for mutual encouragement, members of the critical mass risk apostasy in which leaders convert from activism to defection. As Axelrod (1984) argued,

> [T]he development [of cooperation] cannot take place if it is tried only by scattered individuals who have no chance to interact with each other. But cooperation can emerge from small clusters of discriminating individuals, as long as these individuals have even a small proportion of their interactions with each other. (P. 68)

Dense ties among members of the critical mass enhance commitment by making possible stable encounters with other activists. With expansion of the activist network through recruitment of followers, the critical mass becomes increasingly surrounded by like-minded activists. This process yields heightened interest in the collective good, and accounts for the sudden surge of interest among both members of the critical mass and their followers.[6]

These findings provide insight into the process of identity formation and its consequences. The development of collective identity and solidarity among activists does more than "provide the basis for actors to shape their expectations and calculate the costs and benefits of their action" (Melucci 1989:34). Identity and solidarity also help activists to preserve, and even further enhance, their initial commitment in the face of the cross-pressures exerted by defectors. Tight networks create an ideological envelope in which militancy is intensified and from which activism diffuses across the population. The diffusion of activism enables the subsequent expansion of identity, opening up new opportunities for further activism. *This symbiosis between identity and interest is the key to the success of any social movement.*

[6] Coleman (1990) identifies an apparently similar process. He argues that the enclosure of social networks can overcome free-rider activity through the creation of norms and sanctioning systems.

$$\begin{aligned}
\text{CAI} = \alpha_1 \quad & + \beta_1 X_4 + \beta_2 X_4{}^2(1-X_5) + \beta_3 X_6 + \beta_4 X_7 + \beta_5 X_8 + \beta_6 X_5 + \beta_7 X_5 X_4 \\
& + \beta_8 X_5 X_6 + \beta_9 X_5 X_7 + \beta_{10} X_5 X_8 + \\
\alpha_2 X_1 \quad & + \beta_{11} X_1 X_4 + \beta_{12} X_1 X_4{}^2(1-X_5) + \beta_{13} X_1 X_6 + \beta_{14} X_1 X_7 + \beta_{15} X_1 X_8 \\
& + \beta_{16} X_1 X_5 + \beta_{17} X_1 X_5 X_4 + \beta_{18} X_1 X_5 X_6 + \beta_{19} X_1 X_5 X_7 + \beta_{20} X_1 X_5 X_8 + \\
\alpha_3 X_2 \quad & + \beta_{21} X_2 X_4 + \beta_{22} X_2 X_4{}^2(1-X_5) + \beta_{23} X_2 X_6 + \beta_{24} X_2 X_7 + \beta_{25} X_2 X_8 \\
& + \beta_{26} X_2 X_5 + \beta_{27} X_2 X_5 X_4 + \beta_{28} X_2 X_5 X_6 + \beta_{29} X_2 X_5 X_7 + \beta_{30} X_2 X_5 X_8 + \\
\alpha_4 X_3 \quad & + \beta_{31} X_3 X_4 + \beta_{32} X_3 X_4{}^2(1-X_5) + \beta_{33} X_3 X_6 + \beta_{34} X_3 X_7 + \beta_{35} X_3 X_8 \\
& + \beta_{36} X_3 X_5 + \beta_{37} X_3 X_5 X_4 + \beta_{38} X_3 X_5 X_6 + \beta_{39} X_3 X_5 X_7 + \beta_{40} X_3 X_5 X_8. \qquad (14)
\end{aligned}$$

THE STRUCTURE OF PARTICIPATION

Collective Action Regimes and Collective Action

Collective action cannot succeed unless the upward influence of the critical mass dominates the downward influence of their defecting neighbors. What structures—defined in terms of collective action regimes, network density, and group heterogeneity—facilitate upward influence and block downward influence? To analyze the structural prerequisites for a cascade of activism, we ran 1,296 computer simulations across various structural conditions defined by the intersection of action regimes, network density, and the distributions of power/centrality, interest, and resources. The outcome of each simulation is summarized by a Collective Action Index (CAI). The index is the sum of total contributions made across 200 iterations of each simulation divided by 200 and ranges between 0 and 100. The higher the CAI, the more likely collective action is to succeed. The CAI is regressed on collective action regimes, network density, and group heterogeneities according to equation 14 (above). Table 6 reports OLS regression outcomes across all four action regimes and the average CAI scores for each regime.

We have already noted that collective action is most likely to succeed in the privileged regimes and the rebellious regimes and fail in the impoverished regimes and estranged regimes. Table 6 suggests that collective action *can* succeed even in impoverished regimes and estranged regimes under certain conditions, as the average CAI is 26.0 for privileged regimes, 56.4 for rebellious regimes, 11.0 for impoverished regimes, and 5.6 for estranged regimes. However, a careful look at Table 6 reveals that in the impoverished regimes and the estranged regimes, collective action succeeds only when network density is high (i.e., above .49). In fact, all coefficients are insignificant when network density is below .49. Because network density above .49 is unlikely in a large group, collective action will fail in impoverished regimes and estranged regimes.[7]

The characteristic that distinguishes the privileged regimes and rebellious regimes from the estranged regimes and impoverished regimes is whether those who occupy central positions in the social network have an interest in the provision of a collective good, thus initiating collective action. In the privileged regimes and the rebellious regimes, those most interested in the provision of a collective good are socially influential individuals; whereas in the impoverished regimes and the estranged regimes, influential individuals are either uninterested or actively hostile to the movement. For a social movement to be successful, some socially influential actors must be committed to the cause and must initiate action. A sudden surge of interest in a collective good is unlikely to occur among ordinary people when powerful actors oppose it. Note that in this context the initiatives of preexisting leaders in overcoming the efficacy problem by maximizing their social leverage over individual contributions turns out to be central to the success of collective action (Oberschall 1973).[8]

[7] There may be contexts in which a large group could experience the *sense* of heightened connections required to yield successful collective action, for example, the kinds of processes described by Anderson (1983) as *imagined* communities.

[8] Although Oberschall (1973) places more em-

Table 6. OLS Coefficients from the Regression of the Collective Action Index (CAI) on Selected Independent Variables: Four Collective Action Regimes

	Regimes							
	Privileged		Rebellious		Impoverished		Estranged	
Independent Variables	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Network Density ≤ .49								
Intercept	−30.28**	(4.79)	−70.63**	(4.79)	.01	(4.79)	−.16	(4.79)
Network density	24.14**	(28.56)	297.71**	(28.56)	−.31	(28.56)	−.84	(28.56)
(Network density)^2	140.55**	(67.05)	−248.26**	(67.05)	1.27	(67.05)	4.10	(67.05)
Power/centrality heterogeneity	7.44**	(1.21)	9.73**	(1.21)	−.01	(1.21)	.09	(1.21)
Interest heterogeneity	12.08**	(1.21)	19.28**	(1.21)	.01	(1.21)	−.09	(1.21)
Resource heterogeneity	−4.91**	(1.21)	2.86*	(1.21)	.00	(1.21)	.10	(1.21)
Average CAI	9.77		33.44		.02		.08	
Network Density > .49								
Intercept	−47.51**	(7.69)	63.32**	(7.69)	−91.20**	(7.69)	−57.44**	(7.69)
Network density	36.33**	(8.26)	19.23**	(8.26)	113.16**	(8.26)	71.08**	(8.26)
Power/centrality heterogeneity	9.93**	(1.79)	1.10	(1.79)	−8.59**	(1.79)	1.38	(1.79)
Interest heterogeneity	37.99**	(1.79)	4.69**	(1.79)	26.66**	(1.79)	3.42	(1.79)
Resource heterogeneity	−12.50**	(1.79)	−.16	(1.79)	1.29	(1.79)	5.81	(1.79)
Average CAI	48.69		88.50		26.48		13.37	
Average CAI for all densities	26.00		56.40		11.00		5.60	

Note: Numbers in parentheses are standard errors; $R^2 = .86$.

*$p < .05$ **$p < .01$ (two-tailed tests)

Table 6 also shows that collective action is far more robust and frequent in rebellious regimes (average CAI = 56.4) than in privileged regimes (average CAI = 26.0). This is a new finding. On one hand, our findings support Macy (1991a), who showed that collective action occurs even when interests and resources are negatively correlated. On the other hand, contrary to Macy's prediction that collective action is more frequent when interests and resources are positively correlated, we show that the likelihood of a successful collective action is far higher in rebellious regimes than in privileged regimes. The reason is counter-intuitive. In privileged regimes the potential critical mass is likely to be overloaded with resources. Thus, the negative coefficient for resource heterogeneity in the privileged regimes complements our earlier findings about the identity of the critical mass. Although resources are not crucial to the critical mass, an excess of resources makes participation too costly for one to take the initiative.

These findings modify claims advanced by Oliver and Marwell. Based on the notion that the critical mass comprises persons who are highly interested and resourceful, Marwell and Oliver (1993) argue:

> [A] positive correlation between interest and resources (or among other factors) is *always* beneficial for collective action. . . . By contrast, a negative correlation between interest and resources is *extremely* unfavorable for collective action. (P. 23; italics added)

phasis on "formal" leadership based on preexisting organizations, we highlight the role of "informal" leadership based on the networks of interpersonal ties. However, this subtle distinction becomes less important because formal organizations often provide "foci" around which individuals organize their social relations (Feld 1981).

Our model, however, shows that a positive correlation between interests and resources sometimes increases the chance of successful collective action (as is the case in privileged regimes), but just as often this positive correlation has a negative effect (as is the case in estranged regimes). Likewise, successful collective action occurs when interests and resources are negatively correlated, as is the case for the rebellious regime. What ultimately determines the success of collective action is the pattern of covariance between power/centrality and interests, not between resources and interests.

Network Density and Collective Action

Conventionally, dense social networks are believed to facilitate collective action (Oberschall 1973; Tilly 1978; Fireman and Gamson 1979). Social networks have been shown to be responsible for differential recruitment (Snow, Zurcher, and Ekland-Olson 1980), for participation in the Mississippi Freedom Summer project (McAdam 1986), and for participation in the Paris Commune of 1871 (Gould 1990). Despite these findings, most formal models of the effect of network density on collective action show mixed outcomes. For example, Marwell et al. (1988) and Marwell and Oliver (1993) find that increasing social network density extends the reach of an organizer, which in turn produces greater total contributions. Yet Macy (1991b) finds the opposite effect, showing that a dense network tends to inhibit collective action because it decreases one's ability to discriminate between defectors and cooperators. For Gould (1993), the effect of network density is more complex. In Gould's model, network density facilitates collective action when the least central actor initiates action. When the most central actor initiates action, however, network density evidences an inverted U-shaped relationship with action. Gould shows that above a low threshold (.1), network density is deleterious to collective action because heightened density strengthens the impact of cross-pressures from peripheral actors.

Against this background, we find that dense social networks always facilitate collective action. When network density is less than or equal to .49, the effect of network density shows a curvilinear pattern (U-shaped in the privileged regimes but inverted U-shaped in the rebellious regimes). However, this positive effect of network density levels off sharply as network density goes above .50, which is reflected by the much smaller but still positive coefficients in the privileged regimes and the rebellious regimes.[9] Increasing network density beyond an unlikely level makes collective action possible even in the impoverished regimes and the estranged regimes.

These findings reveal three patterns in the effect of network density. First, when network density is close to 0 (e.g., .01 or .05) and individuals are essentially social isolates, contributions result only from individual considerations and interpersonal influence does not operate. In the absence of social ties, collective action does not succeed (Kim 1995). On the other hand, when network density approaches saturation (i.e., density above .5), the "local" boundary of rationality becomes globalized and no transaction costs accrue to interpersonal interactions, including information exchange. In saturated social networks, contributions result from greatly enhanced "group efficacy," and successful collective action is the norm, not the exception. Both contexts constitute the two forms of *structureless* social networks, or what White et al. (1976) describe as the null structures.

The real world is structured, and therefore network densities usually range between these two extremes. Within a realistic range of network density (between .05 and .49), the effect of network density is *positive* and significant only in the privileged regimes and the rebellious regimes. The coefficients for network density are greatest in these two regimes, suggesting that increasing interpersonal interactions is the most decisive factor determining the success of collective action. The positive effect for network density is much larger in the rebellious regimes than it is in the privileged regimes. In rebellious regimes under which central actors have little

[9] The effect of network density here resembles Gould's (1993) when random actors initiate contributions. However, this does not mean that our finding supports Gould's. In our model, central actors initiate collective action. Gould argues that the effect of network density is negative when central actors take the initiative.

to lose, increasing network density becomes the single most important structural condition for successful collective action.

These findings support what we know should be true from empirical observation: Although bounded by types of collective action regimes, network density is positively associated with collective action. Network density enhances collective action because with increasing density, individuals are brought into communication with one another. Consequently they share information, develop more similar world views, and develop the relational bases for shared identity. As density increases, local worlds are elided, and individuals are freed from the cross-pressures characteristic of localist social structures.

Group Heterogeneity and Collective Action

There are two competing arguments regarding the effect of group heterogeneity on collective action. One argument finds that heterogeneity in interests and resources facilitates collective action by helping a critical mass form (Olson 1965; Hardin 1982; Oliver et al. 1985; Marwell et al. 1988; Oliver and Marwell 1988). Another argument maintains that under certain circumstances, group heterogeneity can impede collective action through subcleavage formation (Heckathorn 1992, 1993). We find a complex relationship between group heterogeneity and collective action, depending on the collective action regime and the degree of network density.

Table 6 shows how the effect of group heterogeneity depends on the four action regimes and network density. In the privileged regimes and the rebellious regimes, when network density remains within a plausible range (i.e., below .5), increasingly heterogeneous distributions of centrality and interests enhance the probability of successful collective action. On the other hand, resource heterogeneity has mixed effects on collective action because it plays a complex role in group formation, particularly in the formation of the critical mass. Members of the critical mass have high centrality and high interest in the provision of a collective good. The more heterogeneously distributed are power and interests in privileged regimes and rebellious regimes (in which power and interests are positively correlated), the more committed to the cause and influential the critical mass becomes. Consequently, the critical mass becomes motivated to initiate collective action, their social leverage is enhanced, and collective action is more likely to succeed. The apparently contradictory impact of resource heterogeneity—negative in privileged regimes and positive in rebellious regimes—points to our earlier conclusion that when the distribution of resources overloads the potential critical mass, collective action will fail. In privileged regimes, low resource heterogeneity ensures that the critical mass is not burdened by too many resources. In rebellious regimes in which resources are negatively correlated with centrality and interest, increasing resource heterogeneity tends to free the critical mass from the burden of possessing too many resources.[10]

In sum, group heterogeneity has no effect on the success of collective action when formation of a critical mass is structurally blocked, either because centrality and interests are negatively correlated (as in the impoverished regimes and the estranged regimes) or because of extremely low network density. Bounded by these conditions but within a plausible range of network density, the effect of group heterogeneity on collective action is largely determined by how it helps the critical mass form.

CONCLUSION

A large literature is devoted to solutions of the Olson problem: Under what conditions

[10] Increasing network density increases beyond .49 changes the effect of group heterogeneity across regimes. In privileged regimes, high network density adds to the positive effect of interest heterogeneity and the negative effect of resource heterogeneity, suggesting a symbiosis between identity and interest. In rebellious regimes, however, high network density greatly reduces the positive effects of power and interest heterogeneity. This suggests that an excess of group identity and solidarity makes personal attributes largely irrelevant. High network density in the other two regimes causes some of the group heterogeneity variables to be significant. However, these effects of group heterogeneity in a context of extremely high network density are substantively meaningless, because heterogeneity and density are orthogonal in tangible settings.

will rational actors, in the absence of incentives or disincentives, contribute to the provision of a collective good? Scholars have invariably assumed that interests are externally given and fixed. The assumption that interests are fixed has locked theorists into depicting participation in a movement as a byproduct of opportunism or, at best, "non-outcome-oriented" behavior (Elster 1989). Against this tradition, we assume that interest is a social and historical construct that can be directly incorporated into a dynamic model of collective action. Our model socializes and historicizes interests. Interests are seen to be shaped through a historical process of interpersonal influence, and the process of forming interests is seen to be a central element in determining the likelihood of successful collective action. Historicizing interests enables us to show that rational actors will, under specific structural conditions, voluntarily participate in social movements in the absence of selective incentives or disincentives. Specifically, we identify a cascade of activism as a foundation for voluntary collective action. This voluntaristic mechanism works only in privileged regimes and rebellious regimes in which central actors who are committed to the cause initiate action. In other regimes, such cascades of activism are unlikely to occur.

Our model provides new insights into the composition of the critical mass, the role of network density in shaping collective action, the historical problem of recognizing action sequences, and ultimately, the possibilities for successful collective action in highly repressive regimes.

Our model confirms the crucial role played by a small group of highly active individuals in making successful collective action possible. In all models, the critical mass is composed of persons who are most interested in collective action. In contrast to previous work, however, we show that the critical mass need not command a disproportionate share of a group's resources. Centrality—the capacity to exert leverage over others in the challenging group—is more important than resources. But centrality is only a necessary condition for the emergence of a critical mass. Fundamental is the organization of motivated actors into a densely linked activist core that is insulated from counter-pressures encouraging defection—what we identify as an ideological envelope. Our model predicts that the crucial actors during the early stages of a movement are distinguished from others by their positions in a network of tied actors, not by their resource base. The wealthy join movements opportunistically, long after the diffusion process that drives increased interest in a movement has occurred. Evidence from numerous case studies of social movements, such as Jenkins and Perrow's (1977) study of the United Farm Workers, suggests that this pattern is also likely to be observed empirically.

Our model also suggests that network density plays a crucial role in shaping movement outcomes, thus providing theoretical support for the large empirical literature that documents a positive relationship between interpersonal ties and activism. Despite this robust finding, little is known about how networks facilitate activism and what dimensions of networks are responsible for the success of a movement (Gould 1993; McAdam and Paulsen 1993). Reviewing the relevant literature, Friedman and McAdam (1992) note:

> [N]etwork theory fails to offer a plausible model of individual action and therefore a convincing mechanism by which interpersonal contacts and organizational memberships draw individuals into activism. (P. 160)

Beyond this, little is known about what kinds of network structures facilitate collective action. The dynamic social network model we develop provides potential solutions to these problems. Interpersonal ties are seen as the conduit not simply for information exchange or organization, but for interpersonal influence, which operates on interests as actors seek balance across their relations with others. Through networks constituted by ties of interpersonal influence, local activism and interest can be widely diffused, creating a cascade of activism. The search for balance creates an interlocking network of activists that provides an ideological envelope that enables the production and reproduction of activism in the core while protecting activists from cross-pressures.

Increasing network density fosters the emergence of critical mass insulated within an activist core. Yet the effect of increased

network density is sharply felt only in a few structural contexts—the privileged regimes and the rebellious regimes. Across other collective action regimes however, increasing network density within plausible ranges fails to yield an insulated, densely interlocked activist clique. While interpersonal ties are important, the structure of these ties and their distribution across interacting populations are fundamental.

When collective action fails, actors are structurally unable to recognize and act on action sequences. Action sequences need not be successful to engender increased interest in a movement. Successful collective action in the privileged regimes and the rebellious regimes can follow early failures or partial successes, which play a critical role in increasing the average level of interest across the population of a challenging group. The recognition of others' participation creates the conditions for influence, which may trigger a cascade of activism and spread an activist culture. In impoverished regimes or estranged regimes, collective action sequences are likely to be unrecognized. When challenges emerge in these regimes, analysts are certain to find, ex post, evidence of early and subtle forms of everyday resistance such as singing, foot-dragging, and working to rule, but the social structure necessary for *actors* to recognize and act on such resistance appears, ex ante, is largely absent. In impoverished regimes and estranged regimes, the problem of collective action lies in the process by which network ties, constructed on some basis other than resistance, emerge as salient relations through which political or ideational influence flows. There are models for such fundamental transformations of regimes in the historical record.

Most interesting are instances of successful collective actions in highly repressive regimes whose power rests largely on the deconstruction of civil society. Clearly, in such regimes (e.g., Eastern Europe) repression increases the costs of participation and lowers the probability of success. However, while authoritarian or totalitarian regimes deconstruct the formal secondary associations (the traditional bases for group mobilization on the basis of interest), interpersonal friendship and kinship networks remain largely intact. These small-scale friendship networks can provide the structural bases for resistance that is insulated within the matrix of everyday activities. Although individuals can falsify their preferences in public (Kuran 1995), the presence of loosely coupled opposition networks under the right circumstances fosters the emergence of widespread opposition precisely because their private nature insulates them from cross-pressure. Repression may slow down a cascade of activism by reducing organizational connectivity, but this can have the paradoxical effect of creating multiple sources of local opposition.

The sudden catenation of loosely coupled islands of opposition can quickly yield a revolutionary situation when actors recognize their actions and others' actions as challenging the existing regime. This appears to have occurred throughout Eastern Europe in 1989, a situation vividly documented for East Germany by Pfaff (1996). Here and elsewhere, the key to the success of a movement rests on a unique combination of social structural building blocks and the flow of interpersonal influence.

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