

The Institutionalization of Identity: Micro Adaptation, Macro Effects, and Collective Consequences*

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Constructivist approaches to the emergence and stability of collective identities are now widely accepted. But few of the assumptions of constructivist theory regarding repertoires of identities and their mutability in response to changing circumstances have been examined or even articulated. The article shows how different conditions of a fluid and changing environment affect the stabilization or institutionalization of an identity as dominant within a polity. We used the Agent-Based Identity-Repertoire (ABIR) model as a simulation tool and confined our attention to relatively simple identity situations. Strong evidence was found for the emergence of identity institutionalization, the existence of a “crystallization” threshold, the effectiveness of divide-and-rule strategies for the maintenance of an identity as dominant, the efficacy of a network of organic intellectuals, and hegemonic levels of institutionalization. Thresholds leading to hegemony were not observed. Preliminary results from experiments examining more complex identity situations have been corroborative.

Identity Institutionalization and the Conventional Wisdom of Constructivism

One blessing of a research program is the instruction it gives us about the questions we should not ask. In the study of political identity the constructivist research program has liberated scholars operating within its heuristic boundaries from having to consider or refute “primordialist” or “essentialist” positions. This is a major accomplishment of constructivism, writ large to include approaches or “schools” often described with terms such as “instrumentalism,”

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“circumstantialism,” “perennialism,” or “strategic manipulation.” All these are simply variations on fundamental constructivist assumptions. Each tends to emphasize a different aspect of constructivism or a slightly different assessment of the relative importance of such crucial corollaries of constructivist theory as identity multiplicity, fluidity, incentive responsiveness, strategic manipulability, or entrepreneurial efficacy.

A fundamental axiom of constructivism is that identities—the stable syndromes of associations, feelings, and beliefs we refer to when we use that term—are constituted by larger processes. The fundamental insight is that the social world is not given to us as pre-organized in some immutable fashion, but that the categories of action and interpretation that help us produce and reproduce a familiar world are themselves constructed out of processes in which we participate, but which we may or may not understand. Our own participation in these processes may be based on, or best interpreted according to, models of instrumentally rational calculations, simple algorithmic reactions, reflexive or “instinctual” behaviors, externally coerced or induced choices, etc. Although these activities affect who we are by affecting the circumstances we encounter, there is no escaping the extent to which the structure of possibilities and influences surrounding our behavior produces, constructs, or indeed “constitutes,” our identities.

In other words, it is widely agreed that

- political and politicizable identities are not stamped “primordially” on groups or individuals within groups;
- translation of observable homogeneity among individuals into collective perceptions, goals, and behavior requires explanation;
- identities are malleable, tradable, and deployable;
- groups and individuals have repertoires of identities that are activated differentially in response to changing incentive structures;
- some actors can have disproportionate influence on patterns in the activation or consolidation of particular identities at the group level.

The challenge now facing those working within this paradigm, and interested in identity politics and conflict, is to operationalize the categories of constructivism so that progressive problem shifts can move attention beyond the hard core of constructivist assumptions toward the testing of interesting, knowledge-producing propositions (Chandra 2001).¹

Substantively this means, especially, using constructivist approaches to explain the stability that exists in the operation of collective identities despite the fluidity and malleability of the entities and processes from which they emerge. For against the grain of expectations associated with constructivism, many scholars of ethnic, religious, national, and other collective identities, have raised the question of how some of these identities can be so regular, long-lasting, reliable, and sustained if the world is as complex, the external constitutive forces as powerful, and identities as fluid as constructivist theory would lead us to believe.

Perhaps the most influential approach to the stability of certain collective identities has been to identify nationalism, or political identities like national-

ism, with the imperatives of industrial civilization (Gellner 1983). Others search for clues in evolutionary psychology, analyzing how ethnic or national solidarities may function as equivalents to selected behaviors in the ancestral environment (Johnson 1997; Gil-White 2001). Others have argued more simply that ethnicity and nationalism are best understood as constructed extensions of kinship associations or territorialist identifications, but constructions whose tenacity is based on real propensities of human beings to be more powerfully motivated by such tropes than by others (Connor 1994; Smith 1986). Some go so far as to revive a fuzzy version of primordialism which is claimed to exist even if the essentialist metaphysics of the old school are abandoned (Byman 2000; Van Evera 2001). Some political scientists treat conflicting ethnic groups as unitary rational actors with unchangeable preferences—preexisting entities caught in security dilemmas or unable to solve the kind of coordination problems it is imagined that decisionally monolithic actors can encounter in their relationships with one another in the midst of uncertainty (Posen 1993; Lake and Rothchild 1998; Fearon 1998; Legro 1993). We are thinking also of those advocates of constitutional or electoral schemes who presume identity categories will not arise, change, or be reinforced in response to changes in those schemes (Rabushka and Shepsle 1972). Most of these scholars, however, in each of these subcategories, usually accept the principle that over long periods of time, all categories and dispositions are contingent on processes of social construction.

One reason, perhaps, for the continuing attractiveness of primordialist-type approaches, despite the weakness of their theoretical foundations, is the methodological problems they help researchers avoid. Primordialism has the virtue that once people are sorted into the proper “zoological” groups, with their essential characteristics divined, confident predictions can be made about the preferences, perceptions, and behavior of their members without actually examining or observing them. Constructivists, concerned with the emergence and disappearance of what Ron Suny has called “provisional stabilizations,”² cannot rely on a quasi-zoological chart, or a “periodic table” of human identities to establish a stable framework for studying interactions among distinct and ontologically primitive groups (Eley and Suny 1996). On the other hand, constructivism does not require the world to be imagined as a “bloomin’ buzzin’ confusion” of constantly shifting shapes and meanings. Within the time frames that matter to us and with regard to our own consciousness of our social world, processes of institutionalization can produce collective identities that take on the aspect of immutability, of naturalness commonly associated with hegemonic beliefs. These “noble lies,” as Plato called them in *The Republic*, these lodestars of our lives, can function as if they are permanent, mainly because their permanence is an unexamined, indeed an unposed, question. But to study such processes as they relate to the formation and reformation, the institutionalization and de-institutionalization, of collective political identities requires researchers to somehow probe the multiplicity of identities available to individuals, the range of “identity projects” available within a population or across overlapping or intermingled populations, and the relationship of those identities and projects to changeable sets of preferences, institutional circumstances,

and presumptions of immutability. The data-gathering problems created by such demanding questions are compounded when the researcher's interests are directed toward exotic, logistically inconvenient, or even dangerous field sites.

As work done by intrepid and theoretically sophisticated field researchers shows, it is possible to gather and analyze data relevant to constructivist images of how people trade, instrumentalize, or contextualize their politically relevant identities (Laitin 1986, 1998; Slymovics 1998; Verdery 1991; Schatz 2000). It is even possible to discover or arrange natural experiments to use available data to explore the plausibility of certain basic expectations of the overall constructivist posture. Although the overwhelming majority of this research has been focused on simply illustrating or demonstrating the constructed/constituted nature of political or cultural identity, the ambitions of constructivists are far greater. They include explaining patterns in the emergence and transformation of different collective identities within the same population, the conditions under which formerly distinct populations can combine under the umbrella of a new identity, and the circumstances and behavior patterns that lead to "self-determination" challenges from newly distinguished groups.

Indeed there are a host of fascinating and important questions that constructivist identity theory implies, but which have not as yet yielded to effective empirical exploration. For example:

- If we understand that identities are multiple, how multiple are they, and what difference does it make if groups vary on this dimension?
- If we understand that identities are responsive to incentives, how responsive are they, and what difference does it make if incentives fluctuate rapidly or slowly, or within a narrow or wide range?
- If we understand that identities can be institutionalized, how does that occur and under what conditions of incentive fluctuation, repertoire size, and leadership can institutionalized identities be stripped of that status?
- If we understand that political organization can produce or consolidate identities, how much organization does it take to stabilize or protect a dominant identity, and under what conditions of repertoire size, environmental turbulence, polity size, etc.?
- If we understand that entrepreneurs of culture or identity can conjure new imagined communities, how different are they from non-entrepreneurial identity-deployers, how many of them are necessary, and how many make a significant contribution to the behavior of the group as a whole?

Our strategy for addressing such questions, and for sharpening the expectations of constructivist theory so as to enable and encourage real world empirical research, is to use the power of computer simulation and agent-based modeling to produce thousands of virtual histories of polities arranged as simply as possible to incorporate the formalized tenets of constructivist theory. By adjusting parameter settings and then producing large numbers of simulation runs, or virtual histories, we can then explore the relative robustness of various factors claimed to be important by constructivist scholars in the institutionalization and de-institutionalization of collective identity.

Institutionalization is here measured by the proportion of a population expressing a particular identity. Marginal increases in the prevalence of an iden-

tivity in a population can lead the group across two thresholds—one of “crystallization” and one of “hegemony.” Each threshold represents a sharp increase in the resistance of a dominant identity group to losing its dominant status. When an identity group passes the first threshold, it is prevalent enough to shape competitive processes in its favor. In this sense it can be thought of as a “regime” threshold. If the identity group passes the second, hegemonic, threshold, so we hypothesize, its status as the dominant group is protected not only by its simple ascendance and by the systematic effects that ascendance have on its ability to defeat rivals, but also on the likelihood that serious challenges to its position will even arise.

After briefly explaining our Agent-Based Identity-Repertoire model as a virtual operationalization of constructivist theory, we will report the results of our use of this tool to address a subset of these questions. The questions posed and answered in this article pertain to the consolidation of collective identities as dominant, the role of threshold effects in the production of different levels of institutionalization, and the circumstances and patterns under which institutionalized identities can be destabilized.

Agent-Based Modeling as a Technique for Studying Collective Identity

The virtual worlds we create with the Agent-Based Identity-Repertoire (ABIR) model are inhabited by agents operating according to simple algorithms—recipes for responding to their world that are not only consistent with the cognitive limitations we know are true of human beings, but which reflect the key propositions of constructivist theory, as adumbrated earlier. These agents interact with one another locally, monitoring the identities that their neighbors are displaying. The agents are also aware of the general attractiveness or unattractiveness of displaying any particular identity at any particular time, regardless of the identities displayed (activated) in their neighborhood. This information changes randomly, but at a rate and within an interval that can be manipulated for experimental purposes. As a “structural” feature of the world inhabited by the agents, these general signals (known as “biases” attached to particular identities at particular times) are available to all agents. Knowledge of these generally available signals is combined with each agent’s local knowledge to determine whether it will maintain the display of its currently activated identity, or change that displayed identity to one that is more popular locally and/or more attractive generally. In these artificial worlds, then, no aspect of collective organization or collective identity is present other than that which arises out of the complex processes emerging from repeated inter-agent interactions over time.

In agent-based (or computational) modeling terms, these worlds are known as landscapes—two-dimensional spaces inhabited by an array of square-shaped agents. Each square-shaped agent interacts in each time period with agents in its “Moore neighborhood” (made up of the eight agents positioned along its sides and touching its corners). As shown in Figure 1, a “screenshot” of the model in operation, each agent appears as a “gray” or “black” agent. A number is assigned to each color (see Figure 2). The color each agent displays at any

“time step” is its currently “activated” identity. At the beginning of a “run” (which will be a “history” of the polity) the landscape can be “reseeded,” randomizing both the distribution of activated identities and that of subscribed identities. Thus each agent is endowed, as each individual is in constructivist models, with a “repertoire” of identities. This follows from the principle contained in virtually every variant of constructivist identity theory—that individual identities are better conceived of as repertoires of selves that may be presented to the world, or that may emerge as “presentations of self” under conditions that trigger or “activate” them.

For example, a man in the Balkans with a collection of five politically relevant “selves” or identities might display himself to those around him as Bosniac, Muslim, Yugoslavian, Croat-speaker, or citizen of Sarajevo. Which identity he “activates” and when would depend on a number of factors emphasized by constructivist theorists and by social psychologists whose fundamental conceptions largely correspond to the assumptions of constructivist theory (Abrams and Hogg 1990; Hogg and McGarty 1990; Shin, Freda, and Yi 1999). These factors include:

- how people around him are displaying themselves;
- how generally rewarding he believes it to be, at a particular time, to activate one identity or another;
- how fluidly he responds to marginal changes in incentives attached to competing identities;
- how turbulently the relative attractiveness of different identities change;
- how many identities are spread across the population whose activation patterns affect activated identities in his neighborhood.

If we leave open as an empirical question the issue of how large we should imagine the “time steps” as being (hours, days, months, years), we can suggest that at one time step this individual might advance his Yugoslavian identity, while subsequently he could present a Muslim identity or a Bosniac identity to those around him. These changes in the individual’s activated identity would be prompted by (non-local) shifts in the political climate and by (local) shifts in the identities activated by the specific individuals with whom he has regular contact. Shifts in the political climate that could change the value of being “Bosniac” versus “Yugoslav” could include the eruption of ethnic cleansing campaigns in other parts of the Balkans, declarations of diplomatic recognition or support of various factions and states by different great powers, outcomes of significant battles, etc. (In the model such non-local influences are operationalized by the changing “biases” assigned to individual identities and accessible, via the mass media, to all agents.) Locally, depending on patterns of identity activation, such changes at the general level might or might not result in changes in activation patterns among the individuals with whom he has contact. If the individual’s neighbors activate alternative identities, the complexion of the neighborhood could change, thereby changing the weight of pressures on him to activate the identities newly adopted or forsaken by his neighbors, and benefiting now from a higher or lower general bias. Under extreme circumstances, such as might attend flight to Italy, this individual might

even absorb a new identity into his repertoire, say “European,” cast out an old one (“Yugoslavian”), and then even activate the newly acquired European identity.

Constructivist theory asserts or implies that all of these micro adjustments occur, cumulatively producing patterns we then notice at the macro level as collective identity changes. What ABIR does is implement these general rules in a systematic way. In each time-step, each agent does a simple survey of activated identities in its neighborhood, combining that information with the negative, positive, or neutral biases associated with those identities at that time and with an awareness of the identities in its own repertoire. Each agent then “decides” to maintain its currently activated identity, activate an alternative from its repertoire instead, or even replace one identity in its repertoire with another very popular and attractive identity.³ Each agent thus acts independently, but within specific circumstances shaped by complex webs of reciprocal interdependence among agents and the changing structure of exogenously produced biases. By running the simulation with identical parameter settings many times, and then varying those settings in strategic ways, regularities in the distributions of collective outcomes (attributes of the landscape as a whole) can be examined and used to test increasingly refined hypotheses implicit in constructivist theory. Valuable opportunities are thereby created for studying directly how outcomes at the macro level are linked to variation in different factors seen to be operating at the micro level.⁴

The identities in each agent’s repertoire, including its activated identity, comprise a subset of the total number of identities present in the repertoires of all agents in the landscape. These identities, and even identities available in the political space but not initially present in a particular agent’s repertoire, can be activated by that agent or brought into its repertoire and then activated. The simple algorithms which determine how and when an identity is included or extruded from an agent’s repertoire, or activated by an agent, were designed to correspond as closely as possible to the assumptions of constructivist theory.

In previous work we reported the results of experiments that corroborated and elaborated some of the basic propositions of constructivist theory.⁵ In that work we focused particularly on the implications of changing repertoire size as a determinant of overall patterns of collective identity formation. Here we are interested in basic processes of institutionalization as they would arise in a world ordered by constructivist principles. Can identities that are fluid, malleable, and changeable at the micro/individual level give rise to the kinds of patterns we commonly observe—of stability at the collective level, accompanied by the possibility of sudden transformations? We are interested, in other words, in the way patterns produced by micro-level behavior emerge as mechanisms shaping outcomes at the macro level (Holland 1998).

Experimental Objectives and Hypotheses

A key feature of any institutionalization process is the appearance of discontinuities in the relationship between aggregated pressures for change and the results of those pressures. Our virtual experiments seek to determine

if such discontinuities (the “stickiness” often imputed to institutions) arise as the effect of distinctive thresholds being passed. In other words we have sought to observe “threshold effects” arising at the macro level in histories of interactions among large numbers of agents when the algorithms governing individual agent behavior at the micro level make no provision for such macro effects. We then examine patterns of variation in large numbers of histories run from the same or comparable initial conditions in order to answer questions about institutionalization and de-institutionalization of collective identities.

According to the theory of political institutionalization offered by Lustick, continuous processes of stabilization and destabilization of norms, beliefs, or identities feature two kinds of discontinuities marked by two different kinds of thresholds (Lustick 1993; O’Leary et al. 2001).⁶ Normally, efforts to deepen institutionalization of a norm, belief, or identity are rewarded more or less smoothly with increments of stabilization. As more people embrace the norm, adopt the belief, or come to view the identity as “theirs,” the norm, belief, or identity is more deeply and reliably embedded within the community as a whole. The two kinds of discontinuities interrupting this process are understood as thresholds, dividing it into three parts, or stages. Movement from one stage to another entails a shift in the order of magnitude in the scale of political conflict that would surround efforts to reduce the institutionalization of a collective norm, belief, or identity.

The metaphor of threshold is key. It is a kind of gear with a ratcheting effect. Deepening or broadening the institutionalization of a belief means moving in the direction encouraged by the teeth of the gear. Two thresholds are imagined. One corresponds to the integration of the idea within the legal order of the community (the regime threshold). The second corresponds to the effective transformation of the idea (belief, norm, identity, etc.) into the common sense, or naturalized culture of the community (the hegemonic threshold). As each of these thresholds is approached and passed, a discontinuous “jump” is observed, marking a sharply disproportionate increase in the effects of incremental increases in attachments to the idea on the level of its institutionalization (as measured by the likelihood that the idea will achieve dominance or remain dominant in the community). De-institutionalization of a belief entails moving backward, in the direction opposite to that of the teeth of the gears. Therefore crossing of the “regime” and/or “hegemonic” thresholds in the reverse direction is modeled to require more effort and to be associated with greater risk of severe dislocation than movement toward institutionalization. The idea is that reversing an institutionalization process is possible, but if that process has crossed either or both threshold(s), that is, if the gears have ratcheted into place, then moving “backward” can be expected to entail considerable and even violent disruptions in political life.

One objective was to explore the emergence of hegemonic identities—identities whose survival as dominant is so secure that their replacement is virtually impossible under stable conditions and rare even under conditions of environmental turbulence or stress. We wanted to investigate the process of institutionalization whereby marginal or linear increases in the prevalence of an identity in a polity, or landscape, would produce substantial or even non-

linear increases in the subsequent presence of that identity and/or its likelihood to achieve or retain its dominance (plurality) against other identities.

We label the identity activated by a plurality of agents in a population as the “dominant identity” (DI). As the number of agents adopting the DI as their activated identity increases, the proportion of the population expressing the DI increases along with its resistance to losing its status as dominant. We hypothesized that at a particular triggering level of prevalence in the population the DI’s resistance to losing its dominance would sharply rise—reflecting a threshold of institutionalization. In line with Lustick’s two-threshold theory of institutionalization, we undertook our experiments with the expectation of finding two points of discontinuity—a crystallization or “regime” threshold and a “hegemonic” threshold. We expected that challenges to and replacement of dominant identities would be normal and frequent under conditions of stress prior to passage of the first threshold, much less likely between the first and second thresholds, and extremely rare beyond the second threshold.

The experiments we designed with regard to the conditions of de-institutionalization were inspired by three variables Lustick identified to help explain the institutionalization or de-institutionalization of a hegemonic identity—the presence or absence of:

- Gross discrepancies between the claims of an identity project and the realities of the world in which it operates;
- Alternative interpretations of reality, or alternative projects with at least an abstract appeal to inhabitants of the political space;
- Political entrepreneurs—risk-taking, imaginative leaders inclined to exploit opportunities for large gains in the face of small odds.

In the experiments we report here we used simple landscapes in which each agent had two available identities in its repertoire out of a total of four different identities present in the repertoires of agents in the landscape.⁷ That is, if identities 0, 1, 2, and 3 are present in the landscape, each agent has within its own repertoire two and only two of these—0 and 1; 0 and 2; 0 and 3; 1 and 2; etc. Of the two identities in an individual agent’s repertoire one is activated, while the other is not. In some of these experiments we also designed the landscapes so that histories would begin with all agents in the landscape activating one of only two of the available identities. To evaluate the implications of “divide-and-rule” opportunities for sustaining different levels of dominance we produced histories with three subordinate identities confronting one dominant identity. Although we did not employ entrepreneur agents in these simplified environments, we did introduce the leadership variable by testing one of Gramsci’s hypotheses about the role of “organic intellectuals.” Would a network of particularly persuasive agents make a strong contribution to an identity group’s ability to achieve and sustain hegemonic levels of dominance?

By examining the role of leadership in an agent-based model, we can more easily appreciate the practical political importance of the presence of institutionalization thresholds. For example, leaders of identity-based political groups, who could acquire knowledge about where their group’s present level of collective strength was located in relation to a crystallization threshold, could use

that knowledge in their mobilization efforts. Assuming resources applied to efforts to attract new recruits or to mobilize followers are scarce, then such leaders would significantly benefit by escalating their efforts in zones immediately adjacent to either side of the threshold (to achieve high marginal returns on resources expended or avoid drastic losses from marginal lapses of effort) while de-escalating their efforts in zones further from the threshold.

For all the experiments we used the same operational definitions and measures:

- An identity is institutionalized insofar as the level of its presence in the complexion of the polity (landscape) endures despite sustained exposure to negative incentives for its expression;
- An identity has passed a threshold of institutionalization if a nonlinear shift occurs;⁸
- An identity is hegemonically institutionalized if its preeminence in the complexion of the polity endures in at least 90 percent of its histories.⁹

The Experiments

As noted, the landscapes used to run our initial experiments featured only two visible (activated) identities—a dominant identity (gray) and a subordinate identity (black)—although two other identities were available as the unactivated identity in each agent’s repertoire. The landscapes were inhabited by 2,400 agents. The dimensions were 50 by 50, but the row of 50 agents along the top and the row of 50 agents along the bottom of the square were established as “immutable and inactive” boundaries. We produced the landscapes under two types of conditions: stable and turbulent.

Conditions of turbulence featured increased volatility in the pace at which biases were reassigned to identities and wider ranges in the biases available for reassignment. By “volatility” we are referring to the aspect of environmental change that pertains to how often changes occur in the relative attractiveness of one identity over another. By “range” we refer to the potential size of the changes, however often they occur. Thus, if the incentives and disincentives attached to the particular identities in an agent’s repertoire remain relatively stable over time, that environment could be described as having low volatility. But if those incentives and disincentives could change greatly, then that environment could be described as being “risky,” as featuring the potential for wide swings in the incentives and disincentives attached to particular identities. We consider environments in which volatility is high and bias range is wide, or risky, as “turbulent.” For example, the environment for Eastern Europeans in the 1970s and early 1980s was relatively stable with respect to the attractiveness of individual “activation” of particular identities within their repertoires. In the late 1980s and early 1990s, following the rather sudden collapse of the Soviet bloc, the rate of change in the relative attractiveness of available identities increased greatly (higher volatility), as did the range of variation describing the attractiveness of these identities (greater range, or riskiness). In recent years, on the other hand, the incentive structure for identity activation seems to be more stable. This set of transformations with respect to

collective identities in Eastern Europe over the period of the last twenty years would thus be modeled as an initial set of relatively stable and low settings for bias volatility and range, followed by a period in which settings for volatility and range increased, followed again by a period in which those settings fell toward, but perhaps not all the way down to, their original levels.

A crucial element in the simulation involved modeling the level of dominance of an identity in a polity as the proportion of the landscape activating the identity in question. Then, by varying the initial proportion of the landscape activating the “superordinate” or “dominant identity,” we could study the effect of different initial levels of dominance on the extent of subsequent institutionalization. While expecting, of course, that increased initial dominance would lead to increases in subsequent levels of identity institutionalization, we hypothesized that the rate of change in the degree of increase would not rise in linear fashion. In other words, if we could identify a non-linear increase in the expected prevalence or the expected rate of domination of an identity in response to an incremental increase at some particular point of initial institutionalization of that dominant identity, we would thereby observe an institutionalization threshold—a large increase in the “returns to size” (the contributions toward sustaining dominance associated with increments in the initial amount of dominance) enjoyed by that identity project.

This hypothesis flows directly from the conclusions of Lustick’s 1993 study, which treated state boundaries as problematically institutionalized beliefs and traced staggered and non-linear patterns of change in the level of institutionalization of state boundaries over long periods of time. Our hunch is that the stable sets of expectations that comprise collective identities should behave similarly and that, if modeled precisely, the assumptions of constructivist identity theory would produce similar patterns. In regard to the Lustick model of institutionalization, we hypothesized that there would be two “non-linearities” or thresholds (a crystallization or regime threshold and a hegemony threshold) in the returns to size that could be expected by increasing the initial prevalence of the dominant identity.

Our overall objective was to see if our hypotheses with respect to increasing returns to size, thresholds of institutionalization, and resistance to the replacement of the initially dominant (most prevalent) identity by a formerly subordinate identity, would be corroborated in both stable and turbulent environments.¹⁰ In our first set of experiments we seeded 11 landscapes at time zero ($t = 0$), with increasing percentages of agents activating the “dominant” (gray) identity. The first landscape was seeded with exactly 1200 (50% of the total population) dominant agents and 1200 (50%) subordinate (“gray”) agents. The next was seeded with 1224 (51%) gray, 1176 (49%) black, and so forth, until the last was seeded with 1440 (60%) gray, 960 (40%) black. We then ran each of the landscapes 20 times, allowing each to evolve during 500 generations ($t = 500$). Thus, we generated and recorded the outcomes of 220 landscapes. Figure 1 presents a typical screenshot (at $t = 500$) of a landscape used in the experiment.¹¹

The results of this experiment are represented in Figure 2. To avoid clutter we report the data only as percentages. We observe a clear relationship be-

Figure 1

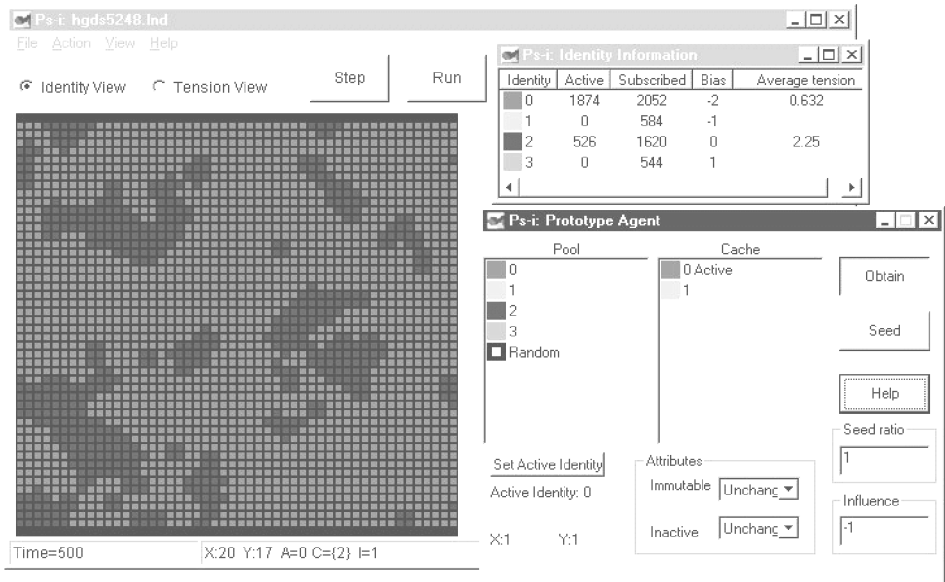
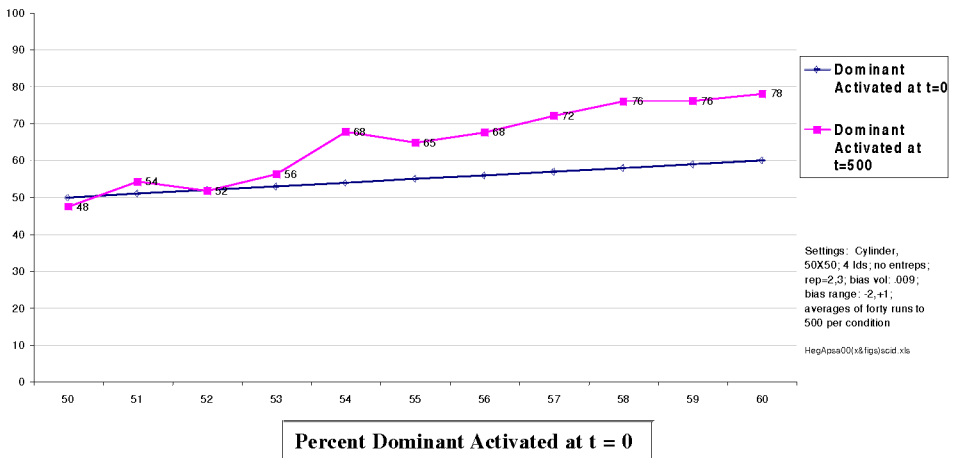


Figure 2
Effect of Initial Dominant/Subordinate Ratio at t = 0
Dominance at t = 500 under Stable Conditions



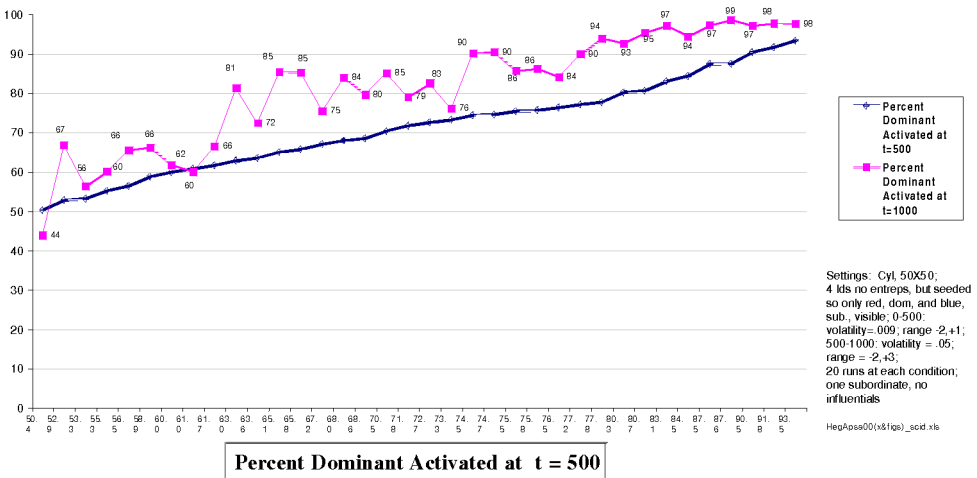
tween level of early dominance and level of growth. The points we use as a possible (crystallization) threshold are the landscapes in which 53 percent and 54 percent of agents are gray. Using the rules specified earlier, we can establish that these two points do bracket a threshold in the relationship between initial extent of dominance and subsequent extent of dominance under relatively stable conditions.¹²

However, is there a second threshold—a hegemonic threshold? Following passage through the crystallization threshold we see a slight drop and a leveling-off in average dominance. We then see two increases. However, neither of these increases produces a second threshold according to our rules.¹³ Moreover, none of our observations meet our criterion for hegemony by exceeding a level of domination of 90 percent. Thus, within this relatively small range of variation for initial dominance under stable initial conditions, we observed increasing returns to size after an initial threshold, but neither a second threshold nor the achievement of hegemonic levels of institutionalization.

Overall these results support our initial (and rather commonsensical) expectation that identities predominate in an environment to the extent that they are more present in it at the outset. However, they also suggest that even relatively small margins of initial advantage can translate dependably into sustained levels of predominance, that this transformation can occur suddenly, and that a higher order regularity (threshold effect) can be observed when multiple histories are collected.

In the second experiment, we wanted to test the robustness of our findings and extend our analysis by examining the effect of stressful conditions on the ability of the dominant identity (DI) to maintain its dominance and further institutionalize its presence within the agents' population. First of all, would the same pattern of a pronounced crystallization threshold appear? Would the threshold appear at the same point in the baseline level for DI? Additionally, under stressful conditions, and looking further along the continuum of initial conditions of dominance, would passage of the crystallization threshold be followed, eventually, by the appearance of hegemonic institutionalization?

Figure 3
Effect of Size of Dominance at t = 500 on Dominance at t = 1000
under Turbulent Conditions



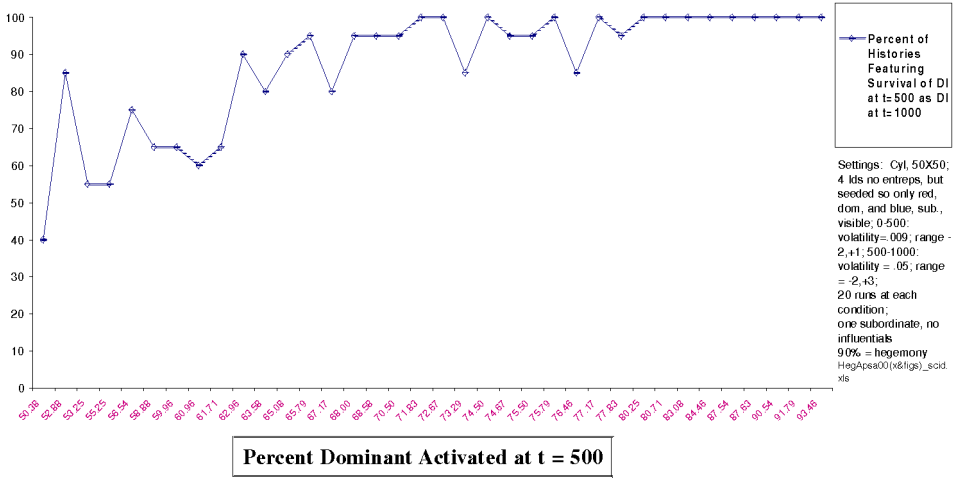
Thirty-seven landscapes at $t = 500$ were used as starting points for this experiment. The numbers of gray-activated agents in these “naturally grown” landscapes varied across the entire range of dominance at $t = 500$.¹⁴ 93.5 percent of the agents were gray in the landscape with the highest initial level of dominance; 50.4 percent were gray in the landscape with the lowest level of initial dominance. Each of these landscapes was then run 20 times, under turbulent conditions, for an additional 500 time-steps to $t = 1000$. This procedure generated a total of 740 histories. Data from these runs is displayed in Figure 3.

Under the relatively stable conditions prevailing for the histories displayed in Figure 2, the result was initial instability preceding a threshold increase between $DI = 53$ percent and $DI = 54$ percent. After this sharp increase, values of DI at $t = 500$ continued rising, but not very steeply, until a plateau of sorts was reached at the point where DI at $t = 0$ was activated by 58 percent of agents. In Figure 3, for histories run under turbulent conditions, we also observed a steep rise bracketed by lower and higher levels, but with a jaggedness (a variability) present in each of the lower and higher zones not found in Figure 2. But can we consider that the rise in Figure 3, as steep as it may appear, contains a threshold of institutionalization? Applying our operational definition we can indeed identify a threshold as located between the ninth and twelfth values for DI at $t = 500$: representing DI control over between 62 percent and 65 percent of the landscape at $t = 500$.¹⁵

Overall it would appear that stressful or turbulent conditions can produce favorable opportunities for the subordinate identity, but that the returns to size may not be reliably enjoyed by the dominant identity until it establishes a substantially larger margin of superiority. Thus the jaggedness of the results are associated with higher levels of turbulence that open more opportunities for identities, whether dominant or subordinate initially, to achieve lopsided victories. Specifically, the steep rise in the payoff of initial dominance under conditions of stress occurred only after the dominant identity controlled 62 percent of the landscape and reached a plateau once it was activated across 75 percent of agents. In the earlier experiment, under stable conditions, we saw that the threshold appeared at levels of initial dominance of 53 percent of the population and reached a plateau once it was activated across 60 percent of agents.¹⁶ Thus, while an institutionalization threshold appears under both conditions, our experiments suggest that turbulence can delay its appearance and delay the point at which one can expect the reliable reproduction of dominance as well. Further evidence for this interpretation is drawn from the fact that the average standard deviation for histories run under turbulent conditions is 72 percent larger than that for histories run under stable conditions.

Using the data displayed in Figure 4 we can study institutionalization effects in a different way—not by measuring prevalence scores but by noting how often the initially dominant identity was dominant at the end of the history. Figure 4 displays the results of the same experiment described in Figure 3, but showing how often the initially dominant identity was still dominant at the end of the history. We see that a crystallization threshold of institutionalization is observed, and that it appears at approximately the same location as when the dependent measure is average extent of dominance rather than reli-

Figure 4
Percent of Histories in which Dominant Identity at t = 500
Remained as Dominant at t = 1000



ability of achieving dominance. The threshold zone is bracketed between the ninth and tenth observations (generated from positions of initial dominance of 62 percent and 64 percent).¹⁷ Measured in this way, we see that a hegemonic level of institutionalization was reached immediately after the crystallization threshold, though not reliably reproduced until the point corresponding to an initially dominant percentage of 77 percent. Additionally, we see that as in Figures 2 and 3, a gradually achieved plateau of reliably produced high levels of dominance is observed in Figure 4. However, this plateau, measured in terms of rate of dominance, is at a higher level of institutionalization and does not appear until the initial level of dominance reaches 77 percent. At this point the level of end-point institutionalization observed is hegemonic.

In general, then, the experiments corroborate expectations of increasing returns to size, a crystallization threshold of institutionalization, and hegemonic levels of institutionalization. In the experiments reported so far we found thresholds present in both stressed and non-stressed histories when the effect of size was measured by the average size of the DI at t = 1000. The threshold appeared when the level of domination of the gray identity rose from 62 percent to 65 percent of the population in stressed histories and from 53 percent to 54 percent in non-stressed. It also was observed when the institutionalization was measured by the likelihood of remaining DI at t = 1000. However, although hegemonic levels of institutionalization were reached in all cases, we did not find evidence of *thresholds* leading to hegemonic levels of institutionalization.

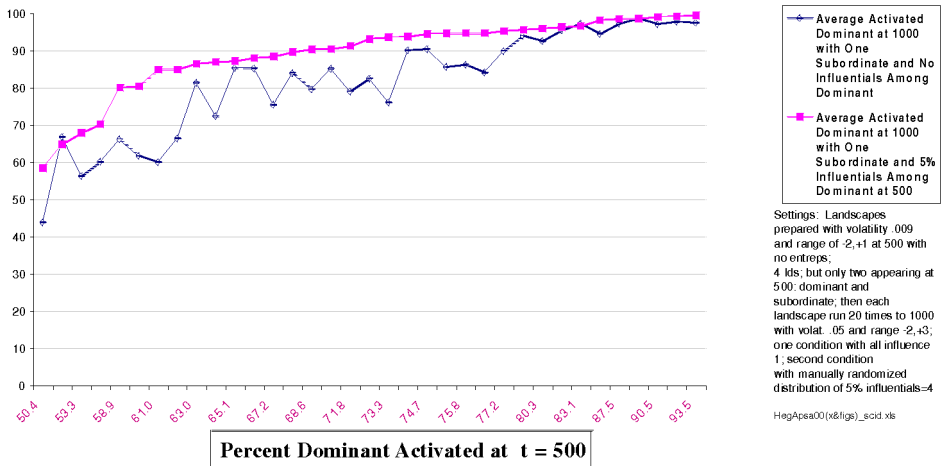
Next, we began to explore one aspect of the third variable identified by Lustick in his 1993 theory of hegemonic institutionalization and de-institutionalization—leadership. To this end we examined the effect of dedicated operatives—articulate individuals strongly imbued with particular political

values and trained in the arts of persuasion and organization. Antonio Gramsci called them “organic intellectuals,” the political equivalent of foremen on the factory floor. In the promotion, consolidation, and defense of a hegemonic project organic intellectuals serve, according to Gramsci, as the “whalebone in the corset” (Gramsci 1983: 340). We operationalized this notion by transforming, in each landscape, a randomly selected group of agents activating the dominant identity. Each of these agents was endowed with powers of persuasion or role-modeling such that their influence on agents in their Moore neighborhood was counted as “4” rather than “1” in the calculation of identity weights. We hypothesized that adding networks of markedly influential agents to dominant identities would increase the stability of their dominance and relocate thresholds to lower levels of dominant identity presence in the landscape.

In our first experiment regarding the effect of “influentials,” we maintained the turbulent environmental settings and began with the same 37 landscapes employed in the experiments reported in Figures 3 and 4. However, we changed the identity weight (influence) of five percent of the dominant (gray) agents at $t = 500$. Thus, in each of these landscapes five percent of the agents activating the dominant identity at $t = 500$ were transformed into “influentials” by randomly substituting agents registering an influence level of “4” for existing dominant agents with the standard influence level of “1.” Again, each influential agent (IA) present in the Moore neighborhood of any other agent would be included in the identity weight calculation of that agent as having a value of “4” rather than “1.” Although it strongly resists doing so, an IA *can* change identities and if it does it will subsequently wield its disproportionate weight on behalf of its newly activated identity.

Figure 5 displays the results of running each of these 37 landscapes, with five percent of dominant agents operating as influentials, 20 times from their

Figure 5
Effect of Initial Size of Dominant and Presence of Influentials on Margin of Dominance at 1000 under Turbulent Conditions



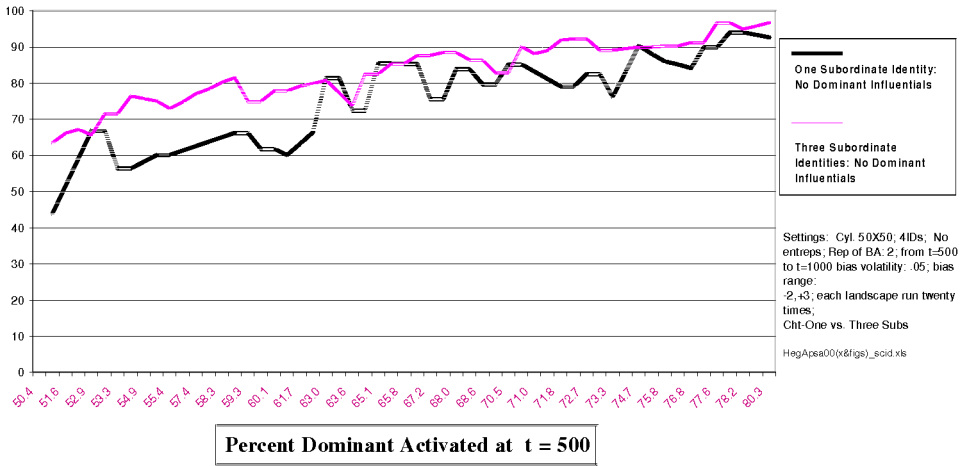
starting points at $t = 500$ to $t = 1000$ and compares the results of these histories to data displayed in Figure 3—data gathered by running the same landscapes, but *without* the dominant influentials present at $t = 500$.

Overall it appears that the presence of influentials helped the dominant identity respond earlier to turbulent environments and the challenge of one subordinate identity by achieving reliably high levels of dominance. In the curve describing histories of landscapes containing dominant influentials, the steep rise in the payoff of initial dominance to the size of DI at $t = 1000$ occurred prior to, and begins at a higher level than, the curve describing histories of landscapes absent the dominant influentials. Although this rise is not steep enough to quite qualify as a threshold, the two curves are similar in that steep and early increases in the robustness of this relationship were followed eventually by stable and hegemonic levels of institutionalization. But these high levels of institutionalized dominance occurred earlier, more reliably, and more stably when dominant identity groups were welded together by networks of influential agents than when those agents were absent. For example, without influentials present, DI control of 59 percent of the population at $t = 500$ yielded an average of 66 percent at $t = 1000$. With influentials present, DI control of the same proportion of agents at $t = 500$ yielded an average of 80 percent activating the initially dominant identity at $t = 1000$. Without dominant influentials present at $t = 500$, hegemonic levels of institutionalization at $t = 1000$ were achieved and maintained when 77 percent of the landscape's population was activating DI at $t = 500$. With dominant identity influentials present, hegemonic levels of institutionalization at $t = 1000$ were achieved and maintained when only 68 percent of the landscape's population was activating DI at $t = 500$. Moreover, this hegemonic level of institutionalization was achieved without the severe instability that preceded achievement of hegemony in histories of landscapes that did not include five percent dominant influentials.

We interpret these findings as evidence of the critical importance of Gramscian "organic intellectuals" to the protection of hegemonic projects and their eventual institutionalization. A question that then poses itself is whether the same contribution these influentials make to the construction and defense of a hegemonic project could be made if the dominant identity faced not one challenging subordinate identity, but three. Would the principle of "divide and rule" operate to enhance the hegemonizing effect of a network of dominant influentials? Alternatively, would the presence of different potential threats to the position of the dominant identity decrease the amount of success enjoyed by the dominant identity or increase the likelihood that one of these challenges would be successful?

To answer these questions we compared the effect of introducing three subordinate identities against one dominant identity, to the effect of introducing dominant influentials in landscapes where their activated identity faces only one subordinate challenger. Using a variety of randomly seeded landscapes at $t = 0$ we produced a large number of landscapes (at $t = 500$) with one dominant identity and three alternatives. We selected 43 of these landscapes such that the dominant identity was activated at regularly increasing intervals. The lowest level of initial DI prevalence in these landscapes was 42 percent, rising to

Figure 6
Effect of One vs. Three Subordinate Identities on Institutionalization of Dominant Identity



80 percent. To control for relative sizes of subordinate identities, none of the 43 landscapes employed featured an alternative (subordinate) identity that was more than twice the number activating the smallest alternative identity.¹⁸ We then ran each of these 43 landscapes, featuring four contending identities, 20 times to t = 1000 at stressful settings.

In Figure 6 we compare moving averages for DI's at t = 1000 when the dominant identity confronts one subordinate alternative (black line) vs. when it confronts three (gray line). We note that when confronted with one subordinate identity the DI begins to achieve very high levels of dominance at t = 1000 once it controls about 65 percent of the landscape at t = 500. It first reaches hegemonic status after controlling 75 percent of the landscape at t = 500. It is able to reliably produce hegemonic status after controlling 77 percent of the landscape at t = 500.

By contrast, when confronted by three separate alternative identities instead of a united opposition, the dominant identity achieves higher levels of institutionalization from comparable positions at t = 500. Thus the DI confronting three alternatives first achieves very high levels of dominance at t = 1000 once it controls at least 58 percent of the landscape at t = 500, and it first reaches and reliably produces hegemonic status after controlling 71 percent of the landscape at t = 500.

Particularly striking is that even with a bare majority of agents at t = 500 the dominant identity experiences a significant average increase in its presence when its opposition is divided into three groups. When DI at t = 500 is just over half the landscape, it enjoys an average level of institutionalization at t = 1000 of 63 percent of the population when facing three contenders, compared to an actual loss of its dominant status when facing only one—an average of 1054 agents, or 44 percent of the landscape, for the DI at t = 1000.

Figure 7
Effect of Number of Subordinate Identities and Presence of 5 percent Dominant Influentials on Dominance Institutionalization

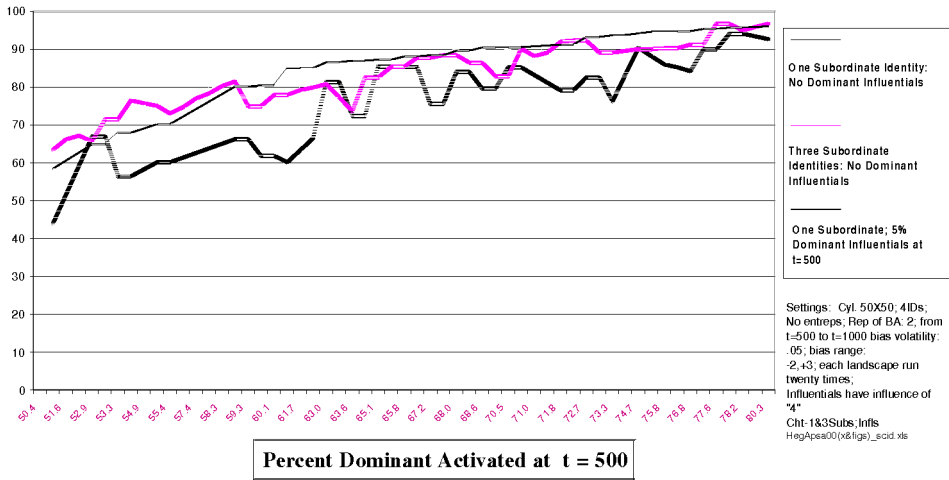


Figure 7 combines data from the display in Figure 6 with data from the display in Figure 5 to permit comparison of the effects on patterns of institutionalization of two separate conditions—conditions we may expect would enhance institutionalization prospects for initially dominant identities:

- the presence of five percent dominant influentials;
- the division of opposition into three alternatives.

The data in Figure 7 indicate that over most of the range of values for DI at $t = 500$, DI's possessing a network of 5 percent influential agents (thin black line) came to control larger proportions of their landscapes at $t = 1000$ when facing a single challenger than did DI's that lacked the network of influential agents but confronted a divided opposition (gray line). In absolute terms, however, this difference was relatively small compared to the advantages which either one of these conditions conferred when compared to DI institutionalization patterns in the absence of either one (black line). We also observe that both a divided opposition and organic intellectuals (i.e., influentials) achieve much greater rates of reliability in the reproduction and institutionalization of dominance than when neither of these conditions is present. Thus each of these conditions decreased the variability of outcomes. In the five percent dominant influential condition with one subordinate, the standard deviation of outcomes was 21 percent smaller than in the absence of dominant influentials. When the DI enjoyed a divided opposition but lacked dominant influentials, the standard deviation of outcomes was 35 percent smaller than when the DI faced a single, united opposition. Finally we note that DI's enjoying either a divided opposition or a network of organic intellectuals need not wait until a threshold is

crossed for their institutionalization levels to rise, as is the case for DI's lacking these conditions. It may be hypothesized, however, that institutionalization thresholds exist, but at levels of initial DI institutionalization below the lowest observations in these experiments.

Overall what we learned from our experiments was that in a relatively simple landscape, or polity, populated by agents with two alternative identities drawn from an array of four possible identities:

- Dominant identities do enjoy increasing returns to size, indicating an institutionalization effect;
- With the opposition to dominance concentrated in one, two, or three alternatives the institutionalization effect is expressed both in terms of absolute growth of the dominant identity and in rates of survival as dominant;
- A crystallization or regime institutionalization threshold can be observed even in the absence of stressful conditions, and with low levels of initial advantage, and is regularly observed under varying conditions;
- Hegemonic levels of institutionalization can be regularly observed, varying as to the point of their onset with the presence of hypothesized variables, though the hypothesized "second threshold" leading to hegemony was not observed;
- A network of influential agents can contribute strongly to the reliability of attainment of hegemonic levels of institutionalization;
- Under conditions of environmental turbulence, increasing the number of alternative identities confronting a dominant identity helps the dominant identity protect and expand its dominance.

Conclusion

The institutionalization of norms, values, and identities, whether hegemonic or not, shapes the terrain of all political struggles. The presence of non-linear transformations in processes of institutionalization or de-institutionalization makes some of those struggles considerably more consequential than others. It should be clear here that we are not advancing agent-based modeling as a technique for addressing the psychological aspects of institutionalization and hegemonic construction. We are, however, suggesting that the shadows of such processes can be systematically examined at the collective level. Here we have tried to develop and apply new agent-based modeling techniques for doing so. The virtual worlds we have designed help us explore the plausibility of theories concerning the translation of individual experiences of consciousness into distinctive patterns of stabilization and change at the macro level.

The strongest overall result of the experiments was that institutional effects can be observed. In the polities we explored, an early margin of dominance endowed leading identities with a disproportionate likelihood of subsequently increasing their presence in the polity or maintaining their dominance. In this simple but fundamentally important sense we were able to demonstrate systematic micro-macro linkages. Patterns at the micro level, of agents individually adapting to local conditions, produced systematic effects at the macro level (specific dominance patterns in multiple histories across the polity as a whole). We were also able to show that these micro patterns often translated into macro

effects via threshold mechanisms—dramatic increases in the likelihood of cascades toward dominance by the leading identity that helped leading identities institutionalize their dominance. Having traversed these thresholds, dominant identities were shown to have enjoyed a much greater probability of resisting efforts by rival identities to reduce their control of political space or replace them as dominant identities.

But while we found crystallization thresholds, and hegemonic institutionalization, we did not find second (hegemonic) thresholds. What we found instead was that following steep increases in institutionalization effects, further increases in the rate of returns to size tended to be gradual. Still it bears emphasis that we did observe zones of hegemonic domination (the emergence of extremely high levels of institutionalization)—zones within which dominant identities survived as dominant with a 90 percent certainty or ended their histories by controlling, on average, 90 percent of the political space.

While we did not conduct strictly controlled tests of hypotheses relating all three of Lustick's variables (gross discrepancies, alternative interpretations, and entrepreneurial leadership) to patterns of appearance and disappearance of hegemony, we did demonstrate the operationalizability of important dimensions of each one in an agent-based modeling environment and their relevance to patterns of institutionalization. As noted, "gross discrepancies" (operationalized by periods of high bias volatility and range that exposed all identities, including dominant identities, to relatively extreme negative biases) were shown to increase the vulnerability of dominant, though not hegemonic, identity projects as well as increase opportunities for non-dominant projects ("alternative interpretations") to replace dominant projects. Lastly we found striking support for the Gramscian hypothesis that networks of "organic intellectuals," akin to foremen on the shop floor or Jesuits in the Catholic Church, could make a very significant contribution to the institutionalization and maintenance of domination. In our work this domination is exercised by identities that otherwise would not have the substantive basis to survive assaults by rivals or the vicissitudes of a turbulent world.

At this stage of our work the development and refinement of definitions, operationalizations, manipulations, and experimental techniques are as important, if not more important, than the findings themselves. We were satisfied with our operationalization of turbulence via adjustment in the volatility and range of bias variation, but we need to do more work to know the conditions under which particular settings of these parameters should be considered "high," "low," etc. We believe the operationalization of "threshold" which we employed, while complex, was effective in helping us distinguish significant discontinuities from less dramatic shifts. On the other hand we are aware that work in other fields in which strict operational definitions of discontinuous effects have been necessary, could help us streamline our approach and make our coding rules for the identification of thresholds less arbitrary.

In addition to these tasks, subsequent work on the problem of institutionalization, and on broader questions of modeling relationships between micro and macro aspects of any institutionalization or de-institutionalization process, will require tightly controlled, well-understood landscapes and manipu-

lations in which interaction effects among all three variables said to be important can be parsed. We suspect, based on work reported here and in Lustick, Miodownik and Philbrick (2000), that further investigations of the results of environmental turbulence will yield intriguing and somewhat ironic results. One such expectation is that although generalized instability may enhance the prospects for radical rearrangements of political attachment patterns, and while such rearrangements may be unlikely in the absence of such turbulence, already established political identities will be in a better position than any one challenger to emerge from a relatively turbulent period as dominant. We also look forward to exploring the specific effects on these processes of entrepreneurial leadership (using entrepreneur agents), of sizeable proportions of apathetic agents, and of variation in the overall size and shape of the political space which agents inhabit.

Notes

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1. For a convenient exposition of various positions on the deployment of constructivist theories for analyzing identity conflicts, see the symposium edited by Kanchan Chandra (2001).
 2. Suny used this phrase in a lecture at the Solomon Asch Center for Study of Ethnopolitical Conflict, University of Pennsylvania, June 1999.
 3. The inverted commas around “decides” signal that these agents are not actually making rational choices based on comprehensive and forward-looking assessments of probabilities, options, and preferences, nor on any memory of the result of actions taken in the past. Agents respond “adaptively” in a highly bounded, simple, and automatic way. The action of each agent at each time-step is, indeed, fully and exactly determined by the few signals it processes and the components of its identity repertoire at that time-step. A precise explanation of a “time-step in the life” of an agent operating according to ABIR algorithms is provided in Appendix 1. The algorithms themselves, which govern the behavior of agents and are used to operationalize constructivist theory for the ABIR experiments reported later, are included in Appendix 2.
 4. The executable program for ABIR, capable of replicating all the experiments reported here, is downloadable at <http://www.polisci.upenn.edu/abir>, along with a manual explaining its use.
 5. ABIR and ABIR-inspired approaches have also been used to investigate the conditions enhancing stability and diversity in deliberative democracies; the impact of globalization on identity conflict, immigration and national identity; processes of Europeanization; interactions between economic interests and identity norms; and learning as an emergent process. For links to these papers and publications, visit: <http://www.polisci.upenn.edu/abir>
 6. The application of the theory in these volumes is mainly to the institutionalization of changeable state boundaries, but the theory is presented as a general model of institutionalization, without regard to the content of the beliefs or norms involved.
 7. More complex landscapes, with larger repertoires of identities per agent, and present in substantial numbers within the array as whole, were also studied (Lustick, Miodownik and Philbrick 2000). The results corroborated those obtained in work with simpler settings. For reasons of space, only the results of the simpler experiments are reported here.

8. An important feature of agent-based modeling is that it forces operationalizations to be more precise than is the norm for discussions of transformations in collective identity or levels of institutionalization. We are willing to label a sharp change in the dependent variable as evidence of a threshold having been passed if and only if: (1) The ratio of change in size (amount of prevalence of a dominant identity—the independent variable) to change in the effect of size (resistance to losing its dominant status—the dependent variable) is greater than one to three; (2) This sharp change is rapid enough to occur within an interval representing no more than 10 percent of the range of variation in the size of the independent variable, while the change in the effect of size (the dependent variable) represents at least 30 percent of the difference between the minimum and maximum observations; (3) The average effect of size (the dependent variable) following the shift is larger than the average effect of size prior to the shift by a margin of at least 30 percent; (4) The average dominance displayed by the dominant identity before the shift does not exceed the lowest observation in the interval between the beginning of the non-linearity and its end (the threshold zone), while after the shift, the average dominance displayed by the dominant identity is higher than the highest observation in the threshold zone.
9. Our definition of institutionalization threshold implies that there is a maximum of three thresholds that could be observed in any institutionalization process. Since each threshold must represent a minimum of 30 percent of the variation in observations, 90 percent is a reasonable, if somewhat arbitrary, marker for hegemonic institutionalization.
10. A bias volatility setting indicates the probability that at any given time-step any particular identity will be eligible for a randomized change in the bias assigned to it. A setting of .009 indicates that this will occur nine out of 1,000 time-steps. The bias range setting, for example “-2,+1,” indicates the minimum and maximum values that can be assigned to an identity to reflect a generalized “advantage” or “disadvantage” for an agent activating that identity. Histories in a “stable environment” were produced by using a bias setting of .009 and bias range set on (-2,+1). To simulate more “turbulent environments” we changed the stress settings to a bias volatility of .05 and bias range of (-2,+3).
11. Color versions of this screenshot (dominant identity red, subordinate blue) and other figures can be found at http://www.polisci.upenn.edu/bir/_private/publications/SCID_Color_figures.doc
12. In keeping with the operational definition of threshold presented above, analysis of the data shows that the ratio of change in the size of the Dominant Identity (DI) at $t = 500$ to variation in the size of DI at $t = 0$ is more than 3:1 $\{[1626-1351]/1351 = 0.2; .2/[(1296-1272)/1272 = .02] = 10\}$. The amount of change in DI at $t = 0$ is equal to or less than 10 percent of the entire range of values observed for DI at $t = 0$ $(1296-1272 = 24; 0.1[1440-1200=240] = 24)$. Also, the amount of increase in identity institutionalization within the threshold zone $(1626-1351 = 275)$ is at least 30 percent of the total increase of identity institutionalization observed $(.3 \times 731 = 219)$. Finally, the average size of DI at $t = 500$ for histories produced from landscapes on the high side of the threshold zone (average of 1739 red agents) is higher than the highest observation in the zone (1626 red agents), while the average size of DI at $t = 500$ for histories produced from landscapes on the low side of the zone (average of 1228 red agents) does not exceed the lowest observation in the threshold zone (1351 red agents).
13. Although each of these increases along the X-axis (DI at 0) is 10 percent of the total range along that axis—thereby satisfying one requirement—neither increase—from 1624 red agents (56%) to 1729 red agents (57%)—(105 agents) nor from 1729 red agents (57%) to 1824 red agents (58%)—(95 agents) produced an increase of at least 219 agents that would have satisfied the expectation of a 30 percent increase on the Y-axis.
14. Thirty-seven landscapes were selected from the 220 landscapes generated in the previously described experiment. The 37 landscapes used included 36 produced by arranging all 220 landscapes in order of the size of DI at $t = 500$. We then chose every fifth landscape, supplemented by one landscape, with 1357 activated dominant, added in order to smooth out the curve of initial conditions.
15. We see that $\{[2049-1595]/1595 = .28; [1562-1481]/1481 = .05; .28/05 = 5.6\}$. Thus the ratio of change in the payoff to initial amount of dominance is greater than three to one. Again, the difference between the maximum and minimum observations for DI at $t = 500$ is $\{[2243-1209] = 1034\}$. Ten percent of this is 103, which exceeds the difference between the maxi-

imum and minimum observations within this interval $\{[1562-1481] = 81\}$. Furthermore, the amount of increase in identity institutionalization within the threshold zone is at least 30 percent of the total increase of identity institutionalization observed $\{[.3 \times 1289] = 387; [2049-1595] = 454; 454 > 387\}$. Additionally, the average of observations to the high side of the zone containing the threshold (2136 agents) exceeds the highest observation within it (2049 agents) and the average of observations to the low side of the zone (1442 agents) is less than the lowest observation within the zone (1481 agents). We did test for a threshold between the eighth and twelfth observations of DI at 500. At these points DI at $t = 500$ is 1463 (61% of the landscape) and 1511 (63% of the landscape); the values for the corresponding observations at $t = 1000$ are 1442 red agents (61%) and 1954 red agents (81%). Thus following our threshold rules we *cannot* characterize this increase as containing a threshold. The ratio of change in the size of DI at $t = 1000$ to variation in the size of DI at $t = 500$ is more than 3:1 $([1954-1442]/1442 = .36; .36/[(1511-1463)/1463 = .03; .36/.03 = 12]$. Moreover the amount of change at DI at $t = 500$ $(1511 - 1463 = 48)$ is less than 10 percent of the entire range of values observed for DI at $t = 500$ $(2243-1209 = 1034; .1 \times 1034 = 103)$. Also, the amount of increase in identity institutionalization within the threshold zone $(1954-1442 = 512)$ is at least 30 percent of the total increase of identity institutionalization observed $(.3 \times [2343-1054 = 1289] = 387)$. Furthermore, the average of observations to the high side of the zone containing the threshold exceeds the highest observation within it. *However*, the average of observations to the low side equals; but it does not exceed the minimum value within it (1442).

16. Comparing the data displayed in Figures 2 and 3 is a bit tricky. For one thing, the initial DI range of 1200 to 1440 red agents (50% to 60% of the population) represents sizes of the dominant identity at $t = 500$, not at $t = 0$. Moreover this range includes not all histories observed, but only the smallest 25 percent of beginning DI's registered along the X-axis.
17. Using the threshold calculation formulas we see that $(90\%-65\%)/65\% = 38$; and that $(1511-1481)/1481 = .02$. Thus the ratio of change in the size of DI at $t = 1000$ to variation in the size of DI at $t = 500$ is more than 3:1. Moreover the amount of change at DI at $t = 500$ $(1511-1481 = 30)$ is less than 10 percent of the entire range of values observed for DI at $t = 500$ $(2243-1209 = 1034; .1 \times 1034 = 103.4)$. Also, the amount of increase in identity institutionalization within the threshold zone $(90\%-65\% = 25\%)$ is at least 30 percent of the total increase of identity institutionalization observed $(.3 \times 60\% = 20\%)$. Finally, the average of observations to the high side of the zone exceeds the highest observation within it, while the average of observations to the low side is less than the lowest observation within it.
18. In contrast to the previous experiments, in which the smallest DI's considered at $t = 500$ included at least 50 percent of the population, in this experiment we also examined histories of landscapes featuring DI's which, at $t = 500$, were as small as 42 percent of the population. In light of the consistently high values achieved at $t = 1000$ by DI's at $t = 500$ below 2000, we put a ceiling on the upper range of our $t = 500$ landscapes.

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Appendix 1

Central Agent—A Time-Step in the Life of One ABIR Agent

To appreciate how simple and automatic these constructivist mechanisms are at the micro level and how rapidly they combine into the complex arrays we see as collective identity, consider the example of one agent (let us call it “central”) as it lives through one time-step. Each square in this nine square grid represents one agent. Central (light gray) and its neighbors, who are basic (B) agents, each have three identities drawn from a total pool of five. Central has eight neighbors—four along each side and four at each corner.

Central Agent at Time t

1 B 4,5	1 B 2,3	2 E 2, 4, 5
3 B 4,3	1 B 2,3	2 B 1,5
5 B 4	2 B 3,1	3 B 3,4

The digit in the upper left hand corner indicates which of the total of available identities (1, 2, 3, 4, 5) is activated by each agent at time t . The digits in the lower right hand corner indicate which identities are not activated by the particular agent, yet are present in that agent’s repertoire. Thus Central agent is activating identity 1, and has identities 2 and 3 in its repertoire. The agent “east” of Central is activating identity 2, and has identities 1 and 5 in its repertoire. The letter in the upper right hand corner of each square indicates whether the agent is a basic agent (B) or a cultural entrepreneur (E). Central’s “north-eastern” neighbor (dark gray) is an entrepreneur (E) whose repertoire is larger (four identities rather than three).

The grid labeled “Bias Values” indicates, for this particular time-step, time t , how generally attractive or unattractive it is to activate one identity or another. Note that this general level of attractiveness is an exogenously produced feature of the environment of all the agents. Bias values can be set to vary often or rarely (bias volatility), and within a narrow or wide range (bias range). Whatever the pattern and rhythm of change in biases assigned to different identities—fluctuation rates and limits determined by the user prior to the beginning of the computer run, each identity at each time-step does have a bias

associated with it. This table of bias values, then, shows what bias values are assigned to which identities at this particular time-step, time t .

Bias Values

Identity	Bias
1	-2
2	1
3	1
4	0
5	-1

Influentials are more “persuasive” or “influential” than basic agents. Influentials can be endowed with influence levels of any whole number greater than 1. Entrepreneurs are influentials with other particular attributes unimportant for this exercise. Their influence level is 2. This means that an entrepreneur is counted by its neighbors as contributing an extra unit of identity weight. So in this neighborhood, for example, Central agent counts three agents as activating identity 2. But one of these agents is an entrepreneur. That means one additional identity weight unit is added to Central agent’s assessment of the status of identity 2 in its neighborhood. Since the bias for identity 2 at this time-step is 1, an additional identity weight unit is added to Central agent’s assessment of the status of identity 2. Accordingly, the identity weight for identity 2 at this time-step, in Central Agent’s calculation, is 5. The table labeled “Identity Weights” shows these calculations for each of the identities present in Central agent’s neighborhood at time t .

Identity Weights

Identity	1	2	3	4	5
Number of Agents Activated per Identity	3	3	2	0	1
Bias Assigned In this Time-Step to each Identity	-2	1	1	0	-1
Number of Entrepreneur Agents Activating each Identity	0	1	0	0	0
Identity Weight per Identity in Central’s Neighborhood	1	5	3	0	0

In the Identity Weight Table we see that identity 1, Central agent’s activated identity at time t, has an identity weight of 1. This flows from the fact that although 3 agents (including Central agent) are activating identity 1, at this time period identity 1 was suffering from a -2 bias value. (In other words, it was not, in general, rewarding to be seen as a “1.”) On the other hand, identity 2 was activated by 2 basic agents and one entrepreneur agent in the neighborhood. That score of 4 (1 for each of two basic agents and 2 for the entrepreneur) combined with a bias value at time t of 1 to produce an identity weight of 5 for identity 2. We see that Central has identity 2 in its repertoire and, since identity 2’s weight is the identity with the largest identity weight in the neighborhood, and since it is at least 2 units more than the weight of Central agent’s currently activated identity—1, Central agent, at time T+1, activates on identity 2 with identity 1 relegated to the unactivated part of its repertoire. Note that Central agent activates for time T+1 on the basis of calculations of ID weight at time T.

The identity status of Central agent at t+1 is displayed in the grid labeled Central agent Neighborhood: T+1. Notice that the activated and unactivated identities in the other eight agents are not displayed. This is because each of them acts as a “central agent” in their own neighborhoods. What their identity complexion will be at t+1 would require knowing, therefore, the activated identities and agent characteristics (entrepreneur or basic agent) of the eight agents proximate to each of them. The shaded portion of the diagram shows the agents, in addition to those in Central’s neighborhood, whose identities would need to be known in order to determine how their identities might have changed from time t to time t+1.

Central Agent Neighborhood: T+1

	B	B	E	
	B	2 B 1,3	B	
	B	B	B	

Appendix 2

Micro Rules for Agents in ABIR

The Landscape:

A population of square shaped agents in a two-dimensional array comprises a landscape. The shape and size of the landscape is stipulatable.

The Environment:

The environment of the landscape has biases toward each identity present in the repertoires of agents in the population, that is, toward all subscribed identities. The set of bias values toward identity x , $B(x)$, is stipulatable. Bias values for each identity change randomly and at a rate determined by an environmental volatility setting.

Agents:

Many types of agents can inhabit the environment, including basic agents, influentials, and entrepreneurs. Influentials are basic agents whose contribution to the identity weight calculations on those in its neighborhood is greater than 1. Entrepreneurs are influentials with an identity weight of 2 who are also more sensitive to change in their environments. Each agent has a repertoire of C identities. The elements of C will be chosen from a series of D identities ($D \leq 20$) such that no two elements in C may be identical. The first element of repertoire C is deemed the activated identity. The activated identity is the way in which that particular agent presents itself to its neighbors. Each agent's elements in C other than the activated element are unknown to other agents.

During each turn, each agent interacts with its Moore neighborhood of agents.

All entrepreneurs act first and in parallel. All other agents, in each time step, then act in parallel. After entrepreneurs act, all basic agents act in parallel. Each basic agent A looks to his eight neighbors and goes through the following process.

Each agent looks to its Moore neighbors and goes through the following process. (For an extended example, see Appendix 1.)

1. Identity weights for all activated identities in the neighborhood, including the activated identity of agent A in the center of the neighborhood, are calculated. The identity weight (IW) contribution of any agent in a neighborhood is equal to its influence. The IW of an identity in a neighborhood is equal to the sum of the influences of agents (including the agent in the center) in that neighborhood activating that identity, plus that identity's environmental favorability bias.
2. If the identity weight of agent A 's activated identity is equal to or greater than the IW of any other activated identity in its neighborhood, then A 's activated identity remains unchanged, A 's repertoire C does not change, and the process ends.

3. If an identity, x , in C other than A 's activated identity, has an IW 2 or more points greater than that of A 's activated identity, then x becomes A 's activated identity. (Entrepreneurs are more sensitive than other agents, and activate an alternative identity in response to an IW for that identity that is only 1 point greater.) The formerly activated identity becomes a non-activated identity in C . If the IW's of more than one identity in the neighborhood and within C are 2 or more points greater than the IW of A 's activated identity, then the identity with the biggest IW becomes the activated identity for A . If these IW's two points bigger than the IW of A 's activated identity are equal, then one of these identities becomes A 's activated identity. Which one? Answer—the one with the largest subscription in the neighborhood, then in the population, and then the lowest digit between the two identity labels.
4. If an identity, x , not in agent A 's repertoire, is activated with an IW at least 5 points greater than A 's activated identity (3 points for entrepreneurs), then x is added to A 's repertoire and the identity in A 's repertoire with the lowest IW in the neighborhood is removed from the repertoire. If multiple identities are thereby candidates for removal, the removed identity is listed at the extreme right of the cache.
5. If an identity, x , not in A 's repertoire, is activated with an IW at least 7 points greater than A 's activated identity (6 points for entrepreneurs), then x becomes an activated identity of agent A , the formerly activated identity becomes a non-activated identity within A 's repertoire, and an identity in A 's repertoire is removed, using the same procedure as in step 4, above.

Initial Conditions:

Agents' initial repertoires are given with a uniform and random distribution. The percentage of entrepreneurs in the population is set at the beginning of each run.