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PS-I: A User-Friendly Agent-Based Modeling Platform for Testing Theories of Political Identity and Political Stability

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Abstract

PS-I (Political Science-Identity) is an agent-based computer simulation platform originally developed to operationalize, refine, and test competing versions of constructivist identity theory. Based on an earlier prototype, the ABIR (Agent-Based Identity Repertoire) model, agents with repertoires of identities (or other potentialities) interact in localities of specifiable size and are influenced as well by cross-landscape values attached to particular identities. These values change over time, thereby simulating conditions in which individuals may express latent identities, or learn to use new identities, because of local pressures toward conformity and/or overall shifts in the relative attractiveness of presenting oneself as attached to one identity or another. Large batches of controlled virtual histories are used for comparative and statistical analysis. PS-I has been designed with two imperatives in mind: ease of deployment by users who know nothing of computer programming; and systematic correspondence between the algorithms for agent behavior and corroborated theoretical positions in political science and psychology. The non-technical user - the user with no programming skills - can use PS-I, to build and execute sophisticated models of substantial academic and policy interest. PS-I thus differs very significantly from existing platforms complexions and governance patterns are now under development. The substantive problems of interest that triggered the development of ABIR and PS-I related to the crisis facing social scientists using constructivist theories of identity to understand patterns of mobilization, attachment, and conflict based on cultural, ethnic, religious, or other traits. Although constructivist theory has been very successful in demonstrating the ineffectiveness of older 'primordial' or 'essentialist'notions of political identity, and in showing that identities are, within limits, fluid, tradeable, manipulable, and multiple, scholars employing these theories have been much less successful in studying the conditions under which and the limits within which collective identities can be stabilized, destabilized, created, or destroyed. The paper illustrates use of PS-I to study the dynamics of identity politics in a 'typical' authoritarian Muslim Middle Eastern country subjected to globalizing pressures, religious mobilization, and conflict in culturally divided societies.

Keywords:
Constructivist Identity Theory; Political Identity; Simulation Platform

Introduction

1.1

Over the last four years we have developed a "user-friendly" computational modeling platform known as PS-I (standing, originally, for "Political Science-Identity'). Our work in this area originated in the desire to investigate theories of institutionalization, including theories of the construction and deconstruction of hegemonic structures of power, beliefs, and identities (Verdery 1991; Lustick 1993; Laitin 1986; Calhoun 1995; Aronoff 1998; Brubaker 1996; Eley & Suny 1996). Using the tenets of constructivist identity theory as a guide, algorithms for the ABIR (Agent-Based Identity Repertoire) model were written that enabled simulation of large numbers of histories of virtual polities. By arranging the settings and initial conditions in theoretically interesting and empirically familiar ways, we aimed to explore the implications of the basic intuitions of that (widely shared) theoretical position and build upon it. Successes in these efforts have led to an expansion in the range of theoretical and empirical problems to which we have applied, and wish to apply, the models we can now produce with our increasingly versatile tool-kit (PS-I).

1.2

Computer programming skills are not needed by researchers using this platform to produce models of use to them. Nor are programming skills necessary to operate the models produced from this platform, adjust experimentally important aspects of landscapes, compose scripts for running large batches of model runs, or extract the data produced by these runs. Indeed a fundamental purpose of PS-I is to make available to political scientists and other social scientists (with no programming skills and no previous background in formal modeling) readily accessible agent-based modeling tools for exploiting islands of good theory to address and productively analyze political phenomena.

1.3

We see our work as an effort to harness computer simulation technologies to help put the increasingly good data available to researchers to better and more theoretically controlled use. We also aim to help redress the general imbalance in political science between top-down and bottom-up approaches. Our method is to use limited but well-corroborated middle range theories, based on solid empirical and historical foundations, to design agents and their environments. In this regard, constructivist identity theory - prominent in the disciplines of anthropology, sociology, and political science - has been of particular importance. The mechanisms implicitly or explicitly identified in these overalapping bodies of theory guided the production of the algorithms determining the behavior of agents at the micro level. We have understood this body of theory as pertaining to mechanisms productive of fundamentally evolutionary patterns out of adaptive responses to their environments by large numbers of (mostly) locally interacting agents. (Nagel 1994; Chafetz 1999; Byman 2000; Laitin 1988; Cederman 1997) We have drawn as well from evolution and evolutionary psychology (Boyd & Richerson 1985; Dawkins 1989; Dennett 1995; Barkow, Cosmides, & Tooby 1992; Campbell 1975), models of bureaucracy and bounded rationality (Simon 1997; Thompson 1967), theories of conflict regulation and management in divided societies (McGarry & O'Leary 1993.; O'Leary, Lustick, & Callaghy 2001; Hannum 1990; Montville 1987; Danspeckgruber 1997; Safran & Maiz 2000), and a variety of theories in social psychology (Abrams & Hogg 1990; Kowert ????; Bourhis, Turner, & Gagnon 1997; Brewer & Brown 1998).

1.4

Relying on now widely available computing capacity (Full utilization of our platform requires cpu speed of over 300 MHz and a Windows or Linux operating environment.) the models thereby constructed are utilized - via repeated simulation runs--to conduct extensive and highly disciplined thought experiments on what the world would be like if slightly alternative versions of these theories were true and on the robustness of observed patterns to perturbations, variable initial conditions, or changes in key assumptions. These findings can then be used in conjunction with real world data (in part by arranging the virtual templates to correspond in theoretically crucial ways to empirical cases of interest). Analysis of the distributions of histories thereby produced help us to extend and refine existing empirical claims, suggest sufficient conditions for the occurrence of phenomena which may be attributed to much larger numbers of variables than are necessary, identify and parse interaction effects and key non-linear relationships, create new avenues for empirical research and data gathering, and make substantiated forecasts about the implications of particular kinds of developments on the distribution of probable/possible outcomes.

Background and Significance

2.1

Both the natural and social worlds are complex - filled with high levels of interaction, multi-body problems, non-linearities, multiple equilibriums, positive feedback loops, path dependence, chaos, self-organizing processes, etc. As Murray Gell-Mann is famously said to have said: "Imagine physics if particles could think." Indeed it is generally agreed that the social world must be considered more complex than the natural world. Standard models in the social sciences, especially political science, are based on linear algebra, equilibrium assumptions, and/or translations of aggregated values for interacting variables into system end-states. These "top-down" approaches, modeling macro and micro effects from macro variables, often obscure or ignore the interactive complexities of the social world, including partially localized interaction patterns, because they are not tractable for linear modeling (Johnson 1998; Johnson 1999).

2.2

Bottom-up modeling, made possible by computer technology and advances in complexity and evolutionary theory, begins with large numbers of relatively simple components linked by well-documented or clearly plausible mechanisms of interaction. Computer simulation then endows the model with dynamism that can reveal the role of various complexity related effects in producing patterns, behaviors, and higher order mechanisms as emergent processes of vast numbers of partially constrained interactions (Hughes 1999). Top-down simulations of political or social domains assume the laws governing key macro-relationships are known, and ask what would happen if specific policy changes were implemented or specific events occurred (Holland 1998). In contrast, computational modeling (encompassing various types of agent-based models, including cellular automata) assumes that simple behaviors of the interacting units at the micro level are known and asks what patterns, distributions of outcomes, and law-like regularities on the macro level are more likely to emerge given variable circumstances, initial conditions, policy changes, or variation in those assumptions (Page 1999).

Closing the Gap between Computer Capacity and Modeling Techniques

2.3

Computing power as measured by micro-processing speed and availability to researchers has been accelerating at an astounding rate over the last two decades. However, exploitation of these stunning advances has proceeded at a much slower pace, leaving the gap between what we have the raw power to do, and what we know about how to use that power, expanding very rapidly. This expanding gap represents enormous missed opportunities and justifies special attention to the development of new ways to utilize computing power and new domains for its application (Panel on Modeling and Simulation of the Committee on Technology for Future Naval Forces 1997; Axtell 2000; Axelrod 1997; Benoit 2001; Epstein 1999).

2.4

Nowhere is this expanding gap between the potential of the hardware and its realization more apparent, than in efforts to apply insights from complexity science for explaining and predicting outcomes in the socio-political sphere. Work done under the general rubric of "complexity," or the study of complex adaptive systems, has proceeded most impressively at the abstract level--contributing substantially toward our understanding of emergence, chaos effects, fractal patterns, auto-catalytic systems, evolutionary speed, catastrophic change, local maxima, cascades of change, basins of attraction, and other related phenomena. However, the intellectual and scientific sources of this work, as reflected for example in the research programs associated with the Santa Fe Institute, lie mainly in applied math and physics, biology, computer science, neural networks, ecology, meteorology, and engineering. Impressive practical applications in these and related fields are easily cited (Hunt 2001; Perelson & Wiegel 1999; Zebulum, Pacheco, & Vellasco 1998; Ecological Society of America 1999; Gross & Louis 1997; Reynolds, Craig; Levitan 1997).

2.5

The same cannot be said for the social and political domains. Although some complexity theorists have argued for the applicability of their work to these fields, most attempts have not moved beyond exhortation, speculation, and metaphor (Casti 2000; Waldrop 1992). The slow pace of intellectual and scientific "technology transfer" can in part be traced to the two-culture problem. Natural scientists who may believe in a scientific method that knows no disciplinary borders nonetheless lack the sophisticated understanding of social and political issues necessary to demonstrate that their hunches about the applicability of complexity models to these domains can bear fruit. Meanwhile, social scientists most in touch with the special difficulties of analyzing culturally saturated social and political situations, are also resistant to hard science techniques. They often associate modeling of any kind with number-crunching searches for high regression coefficients or with rational choice and game theoretic work they see as divorced not only from real cases or data, but from assumptions that bear significant resemblance to the way it is believed human beings and groups actually behave. Indeed, increasing numbers of scholars, finding the models offered by their colleagues incapable of capturing the complexity of the effects they observe in the field, have moved away from positive social science - toward post-modernism, area studies immersion, or intricate interdisciplinary/thematic formulae.

2.6

But this anti-scientific trend is partly a reflection, not of the impossibility of effectively using formal and/or rigorous methods of analysis, but of the general failure of linear modeling and standard statistical techniques to keep pace with the level of nuance and complexity readily apparent in social and political domains. The problem is not that political scientists and others have been uninterested in rigorous approaches to the complexity of their domains. In fields such as political science and economics, researchers have been drawn to invest heavily in large scale data aggregation projects, injecting an important element of discipline into the enormously complex task of using history and comparative statics to infer useful knowledge from available data (Sambanis 2000; Minorities at Risk Project; International Social Survey Programme; World Values Survey; Eurobarometer homepage; Collier & Hoeffler 2000). With respect to ethnopolitical conflict, for example, real progress is being made in the collection, revision, and dissemination of standardized data organized in analytically useful categories. However, the artifactuality of much of the data manufactured for these studies (based on whatever indicators or surrogates for variables are most generally and most readily countable) and the outmoded theoretical underpinnings of the "primordialist" theory of political identity implicit in most of this work (coding people as having a singular, permanent "identity") have made it difficult to use patterns discerned in aggregate data for prediction or understanding of policy-relevant issues (Laitin and Posner 2001; Laboratory in Comparative Ethnic Processes).

2.7

A recent analysis demonstrates how striking was the failure in this regard of the high-profile "State Failure Task Force (King & Zeng 2001; Minorities at Risk Project). King and Zeng contend that if the most commonly used methods for statistical error correction were applied to its analysis, the Task Force "would correctly classify 0 percent of failures accurately." On the other hand, "predicting that states will never fail would have accurately predicted 98.3 percent of all state-years." Although they credit the Task Force as having produced the best data base of its kind, King and Zeng trace its poor explanatory/predictive performance to the impossibility of approaching data filled with interaction effects and associated non-linearities with no more systematic theoretical guidance than a wide-open search for correlations. The results have been impressive in terms of the methodological refinement, but not in relation to any attempt to make reasonably useful predictions about basic political questions of crucial theoretical and policy importance.

2.8

Meanwhile, hundreds of other scholars and thousands of graduate students in political science and economics, eschewing such data base driven studies of empirical patterns, are occupied with the tasks of elaborating and solving increasingly complicated linear equations. Such equations identify equilibria under various conditions of a priori preferences and amounts of uncertainty between very small numbers of fully rational actors. However, the equations can only be written for circumstances so simple (with extremely small numbers of interacting agents), so clearly circumscribed, and so static, as to sharply limit their usefulness for expanding empirical knowledge, generating fresh intuitions, or making policy relevant probabilistic predictions. Indeed, although this and related questions are hotly debated, the world as both social scientists and policy makers find it is inhabited by multiple equilibria, potent non-linearities, and individually adaptive and macro-evolutionary processes, all of which contradict the expectations of most strategic/rational choice models (Green & Shapiro 1996; Critical Review 1995; Brown, Cote, Lynn-Jones, & Miller 2000).

ABIR and PS-I: What Makes Our Platform and Research Program Distinctive?

ABIR and the PS-I Platform

3.1

In 1998 Lustick and Vladimir Dergachev began collaborating to produce the ABIR (Agent-Based Identity Repertoire) model, and then (over a period of two years) the first, beta releases of PS-I - the platform from which many different kinds of models, including different versions of ABIR, can be produced. From the outset, executable program files, for both ABIR and PS-I, have been made available on the web for free download. In addition, complete documentation for ABIR and partial documentation for PS-I, along with the source code for PS-I have been and are freely available to the programming community at the ABIR and SourceForge websites. For sample screen shots see here.

3.2

The non-technical user - the user with no programming skills - can use ABIR, and now PS-I, to build and execute sophisticated models of substantial academic and policy interest. PS-I thus differs very significantly from existing platforms. Toolkits such as Starlogo and AgentSheets are user friendly, but can only be used to produce a limited number of pre-cooked, 'toy' models and are unlikely to be of actual use to social science researchers focused on theoretically or empirically meaningful problems. SWARM, RePast, and ASCAPE, which in principle could be used to produce models of real experimental interest to social scientists, require users to be proficient in either C languages or Java (Dugdale n.d.; Tesfatsion 2001). Moreover, for ABIR at least, full documentation, written for non-programmers with no background in computational modeling, is readily available and may be downloaded here.[1]

3.3

Users can access the power of PS-I in two ways: through graphical interfaces specialized for particular families of models, or through the powerful scripting language provided. To use the scripting language to run batches of runs with particular models and record desired in Excel files one need only be able to supply simple expressions. With the graphical interfaces, users can produce models and observe and record data in particular runs simply by understanding the meanings of different parameter settings and typing desired values in dialogue boxes.

Applications of ABIR and PS-I

3.4

An important substantive objective of our work has been to help rescue a promising line of theoretical development - constructivist identity theory - from what has appeared to many to be an analytic dead end. Before providing a summary report of the work done with ABIR and PS-I that lays the ground for the present proposal, it is necessary to provide the particular theoretical context for the contribution we aim to make in this and related areas.

3.5

It is increasingly apparent how many of the dangerous conflicts around the world are defined in terms of some variant of "identity politics." Few imagine that economics, security, literacy levels, demography, and other factors are not contributing elements in these conflicts, but more than ever, serious efforts to understand the dynamics of collective identity formation and change are needed - not only to anticipate and prevent ethnopolitical conflict, but also to find institutional techniques for managing potentially conflictual relationships in different contexts. "Constructivism" is a label for a general approach to these problems emphasizing the processes which (contingently) produce and reproduce collective identities and propensities of individuals to identify with particular collectivities. In political science, sociology, anthropology, psychology, and international relations, numerous variants of constructivism (including "instrumentalism" and "circumstantialism") arose to counter older models of identity as "primordial" or "essential" characteristics of individuals or groups (Verdery 1991; Lustick 1993; Laitin 1986; Calhoun 1995; Aronoff 1998; Brubaker 1996; Eley & Suny 1996; Nagel 1994; Chafetz 1999; Byman 2000; Laitin 1988). Few serious social scientists now embrace primordialism in its starkest form - the notion that the true political or social nature of a group or an individual was somehow permanently stamped upon that entity and that, eventually, it will either express its "authentic" self or disappear. Nonetheless, this approach is still favored by journalists and many policy-makers (Kaplan 1993; Van Evera 2001).

3.6

However, virtually all social scientists and scholars of identity formation and change adopt constructivist positions of one sort or another. From this general standpoint, individuals and groups maintain not one identity, but repertoires or portfolios of possible identities - ways of presenting themselves to the world that evoked by, and are more credible or useful under some circumstances than others. Thus identities are seen as multiple, fluid, and influenced by surrounding incentive structures, pressures of local conformity, broader cultural changes, and the manipulative techniques of cultural or political entrepreneurs. Indeed it is widely agreed that it is the translation of observable heterogeneity among individuals into collective perceptions, goals, and behavior that requires explanation, that identities are malleable, tradable, and deployable, that groups and individuals have repertoires of identities that are activated differentially in response to changing incentive structures, and that some actors can have disproportionate influence on patterns in the activation or consolidation of particular identities at the group level (Lustick 2001).

3.7

But with few exceptions, the large literatures that apply constructivist principles have done so with a fairly limited set of objectives in mind. To an unsatisfying extent, scholars working on problems of individual and collective identity direct their work toward demonstrating that the assumptions of the constructivist program, or paradigm, hold, and that primordialist or essentialist expectations and assumptions are wrong, usually laughably wrong. This ritualized beating of dead horses can be explained in part by lack of theoretical imagination, but also in part because of the difficulties of gathering data suitable for the categories constructivist theory suggests as crucial. Either way the result has been an insufficient commitment to, and a disappointing record of, posing and answering more empirically and theoretically interesting questions - questions that primordialists could not ask (Chandra 2001).

3.8

Primordialism, for all its faults, had the virtue that once people were sorted into the proper "zoological" groups, with their essential characteristics divined, confident predictions could be made about the preferences, perceptions, and behavior of their members without actually examining or observing them. Constructivists, on the other hand, must 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 and changeable institutional circumstances. The data gathering problems created by the theory are compounded when the researcher's interests are directed toward exotic, logistically inconvenient, or even dangerous field sites.

3.9

As work done by many intrepid and theoretically sophisticated field researchers shows, it is possible to gather and analyze historical and contemporary data relevant to constructivist images of how people trade, instrumentalize, or contextualize their politically relevant identities. 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 (Lustick 1993; Laitin 1986). But such enterprises are enormously labor intensive and are difficult to distill or harness for policy-making purposes across a wide range of cases. Our commitment was to develop an agent-based modeling platform to accelerate the progress that could be made in understanding various aspects of identity politics and in generating new hypotheses susceptible to real world tests.

3.10

Over the last three years development and rapid expansion has been achieved in the power and flexibility, first of ABIR and more recently of PS-I, and in the sophistication of our techniques for gathering, organizing, and analyzing data from simulated histories. This progress has been achieved in close association with a stream of substantive projects focused on identity politics issues and related theoretical and empirical concerns. The first published work to appear from this project argued for the natural applicability of agent-based modeling approaches to the study of identity politics and explained the operation of the ABIR model in terms of algorithms distilled from constructivist identity theory.[2] Experimental results reported in that paper included analysis of Herfindahl Index scores depicting the "market share" of different identities at the endpoints of simulated histories. Results pointed strongly toward a curvilinear relationship between the size of prevailing identity repertoires at the disposal of individuals and the extent to which politicization of identity would concentrate within a relatively small number of identities attracting a large proportion of adherents - with highest Herfindahl Indexes present when the size of identity repertoires were neither very large nor very small. Another important finding was that very small reductions in the prevalence of a small number of socially available identities - i.e. conditions under which some identities were present in fewer of the repertoires of individuals than most other identities - produced a sharp increase in the extent of identity concentration (steep rises in the Herfindahl Index) within the range of identity repertoires of medium size. This research is responsive to questions that are implicit in constructivist identity theory (e.g., If identities exist within repertoires, what difference does it make how big the repertoires are?), but have virtually never been addressed, or even posed (Lustick 2000).

3.11

Work done with ABIR by Lustick and Miodownik drew on theories of opinion leadership and "deliberative democracy," using ABIR to study repertoires of arguments understood by citizens of a democracy rather than identities held by them (Lustick & Miodownik 2000). We reported evidence from our simulations that maintaining stable and pluralist democratic polities, especially when those societies are exposed to volatile external pressures (such as may be associated with globalization), is not automatic, can be achieved by moderate levels of education among the citizenry, but is especially sensitive to the effect of 5-10% of the population "attentive" to news and publicly articulated arguments and relatively more persuasive than the average citizen. Of particular note was the finding that such opinion leaders do double duty - when the problem facing the polity is atomization and an absence of social capital, opinion leaders increase "agreement clustering" (the formation of communities based on adherence to particularly salient arguments). However, when levels of disagreement in a polity are so low that stagnation sets in, opinion leaders help energize debate and make it more likely the polity will respond positively to new opportunities. They also serve, along with increased levels of education, to preserve healthy levels of diversity in polities otherwise pressured by turbulent environments into domination by one or two schools of thought. In combination with our work on political learning, we understand this result to support the idea that significant amounts of diversity that may reduce a polity's satisfaction level at any one point in time, nonetheless preserve its capacity to respond adaptively to radically different challenges that may be posed in the future.

3.12

ABIR and other PS-I produced models have also been used for more theoretical types of work. Research conducted in the spring and summer of 2000, by Lustick, Miodownik, and Philbrick, used ABIR to identify thresholds of identity institutionalization (Cederman 2001; Lustick, Miodownik, & Philbrick 2000). The specific focus of our was on conditions under which particular identities can take on a dominant or even hegemonic aspect - a position so entrenched that despite radical changes in circumstances and payoffs associated with activation on that identity, it remains dominant across the polity. Particular attention was devoted to the identification and result of thresholds of institutionalization as mechanisms for the translation of micro patterns of local adaptation among individuals into macro effects at the level of the collective. Strong evidence was found for the emergence of identity institutionalization, for the existence of a "crystallization" threshold, for the effectiveness of divide and rule strategies for the maintenance of an identity as dominant, for the efficacy of a network of organic intellectuals, and for hegemonic levels of institutionalization. Thresholds leading to hegemony were not observed. A substantially revised paper is forthcoming, featuring intensive treatment of a subset of the studies described in the 2000 APSA paper (Lustick, Miodownik, & Philbrick 2000; Lustick & Miodownik 2002).

3.13

A study by Eidelson and Lustick of parametric (system wide forces) vs. spatially-focused (forces crossing specific borders at specific places) explored the likelihood of cultural transformations in the face of different scales of immigration and the likely strength, under these conditions, of reactive nationalist/anti-foreigner movements in European countries (Eidelson & Lustick 2002). In a related study, van der Veen and Lustick constructed a model of a Europe-type polity divided into four national states and featuring characteristic mixtures of identities, including a broadly latent, but only marginally active "European" identity (Van der Veen, Maurits, & Lustick 2001). Preliminary results with this model highlight the effect of gradually increasing porosity of borders between these states, while simultaneously highlighting the path dependence and contingency associated with the emergence of a European identity across the European Union member states.

3.14

Another key focus of our work has been on vastly expanding the range of variables able to be manipulated by the end user within the PS-I framework. Based on our study of literatures on globalization, secessionism, self-determination, and ethnic conflict, we are identifying propositions that reflect a scholarly consensus about the causes of secessionism and its abatement or containment. We then use our templates for running simulations on these topics, expecting to produce patterns and distributions of outcomes conforming to these propositions. If we are successful, we will use similar simulation techniques to evaluate the persuasiveness of contending positions on such key questions as whether or not regional or ethnic autonomy increases or decreases secessionist pressures. Of specific importance here are new capabilities we are beginning to deploy that allow us to study the emergence of boundaries around regions featuring secessionist movements within states under differently posed political, cultural, economic, and international conditions.

3.15

We are currently working to hone our operationalizations of key variables. Secessionism, for example, is modeled by the transformation of active agents into "border" agents that can comprise a boundary within the landscape separating a homogeneous region from the central state while having its own emergent impact on the overall trajectory of the polity. The algorithm for the production of border agents requires favorable circumstances (an overall pattern of clustering that is not atomized); activation on an identity whose activated agents comprise at least 10% of the landscape but which is not the dominant (plurality) identity; and no greater representation of the dominant identity in the repertoires of agents activated on the "secessionist" identity than 20%.[3] Measurement of a virtual polity, or a region within the polity, for the amount of "anger" or "conflict" present at any time step is accomplished by counting the number of agents, at any particular time step, activated on an identity with a relatively low bias assigned to it, but whose repertoires contain at least one identity with a relatively high bias. The effects of catastrophic terrorism are explored by imposing a traumatic effect on a minority of agents such that they do not update their activations without a significantly greater amount of scanning and calculation of their environments (an increase in the Moore neighborhood of these agents from "1" to "2"). We then measure the difference this makes to the "performance" of the polity, measured by summing, at any time step, or over all time steps, the products of the number of agents activated on each identity and the bias assigned to it.

3.16

The notion of the "performance" of a landscape was used by Lustick, van der Veen, and Miowdonik to investigate the ability of populations to adapt and learn in an unpredictable environment. Most analysts model learning in groups (social or political learning) either through enhancements in the memory of group members or through changes in the connections among group members. We showed that certain forms of learning also result from changes in the knowledge repertoires of agents endowed with no memory. Not surprisingly, populations with larger knowledge repertoires were able to adapt to different situations better, noticing early opportunities for improvement and transforming themselves accordingly. This preliminary work suggests, however, a trade-off between the micro-level sophistication that encourages quick adaptation to new signals and the macro-level diversity that preserves elements of the population prepared to exploit developments by activating recently disfavored approaches. Comparable effects were noted with the introduction of elites capable of greater sensitivity to signals of change and greater influence over their neighbors (Lustick, Miodownik, & van der Veen 2001; Van der Veen, Maurits, Lustick, & Miodownik 2001). With the enhanced version of PS-I now available we can to control our experiments more carefully, with particular attention to variation in the predictability of the environments about which our populations are challenged to learn.

3.17

To illustrate the kind of work being done with the PS-I platform I here report some of the findings of work with a virtual Middle Eastern country called "Mepolity" (MEP). It was designed as model of a composite Middle Eastern Muslim country by combining propositions distilled from constructivist identity theory and expert knowledge of prevailing patterns of attachments, solidarities, and loyalties in the contemporary Middle East, reflecting especially characteristics of political life in Egypt, Iraq, Tunisia, Syria, and Jordan.

The Composition of Middle East Polity

3.18

As a model of a typical Middle Eastern country, MEP is not an attempt to capture the full economic, infra-structural, geographic, psychological, historical, sociological, cultural, and political complexity of any country or group of countries. Just as stripped down models of airplanes (models that themselves cannot fly) are used in wind tunnels to test the effects of changes in wing design, so can we learn about certain aspects of Middle East political life and its relationship to globalization by constructing a simplified model concentrating almost entirely on identity politics and processes of change in loyalties and solidarities exhibited by its inhabitants. With this caveat in mind, along with the associated principle that such an abstracted model cannot be used to make "point predictions" for any particular Middle Eastern country, we can proceed to explore the distinctive patterns of behavior that emerge from systematic investigation of this dimension of life and consider their implications in combination with other sources of intelligence and insight.

3.19

Middle East Polity is presented as a squarish but irregularly shaped array of agents representing, according to the choice of the analyst, households, people, clans, firms, organizations, villages, neighborhoods, or any other community small enough so that no one individual "agent" has anything more than a very marginal and indirect effect on the entire array. The polity is comprised of approximately 2260 such agents surrounded by a perforated boundary that exposes agents along the edge of the polity to direct contact with many agents operating within the regional and global environment adjacent to the polity. The environment is presented as comprised of approximately 7760 agents, in a torus (borderless) array. The activated and unactivated identities of the agents in MEP's environment are established in patterns that reflect the dominance of European and globalizing American market-oriented orientations in the international arena. But the environment also features specifically Middle Eastern characteristics.

3.20

The polity begins each history with exactly the same array of agents. Adjustments in this array, combined with the manipulation of the intensity of globalizing pressures, provide a wide range of opportunities for experiments to distinguish likely "futures" from highly unlikely futures and to investigate the first, second, and third order results of small changes that could be associated with US policy, internal developments, or regional and global processes.[4] Figure 1 is a screenshot of one version of the basic Middle East Polity landscape at time step 5 (t=5).[5] It shows the entire MEP itself, and parts of the outside environment bordering it.[6]

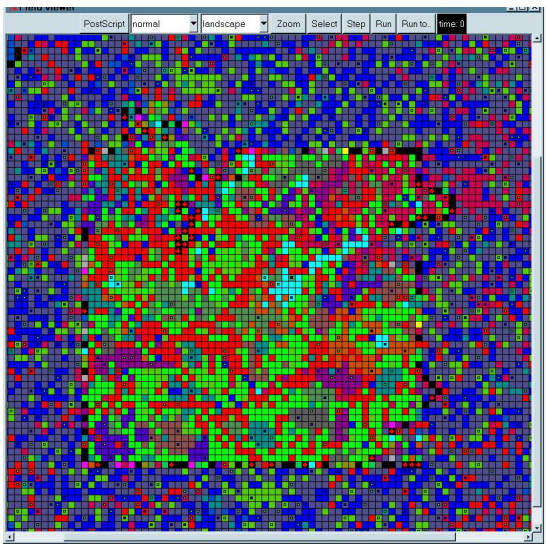

Figure 1.

3.21

The border of the polity is demarcated by an irregularly broken series of black (border) squares. In the northwest corner, along the upper portion of the eastern border and in the southeastern corner there are significant bends and turns in the boundary. Even where a territorial border, in the form of a barrier of black squares, is missing we notice the presence of an "identitarian" border - a sharp discontinuity between agents activated on identities prominent in MEP (greens, reds, oranges, brown, purple, etc.) and the dominant identities of the regional and global environment represented by two shades of blue. Maintenance of a polity's boundary with the outside world is not only due to

physically and legally enforced barriers to transactions from the outside but also to the pattern of distribution of cultural attributes, or identities, which lead influences from "outside" to be treated as unfamiliar and foreign. The identitarian boundary we see here arises as a result of the fact that most inhabitants of the polity itself have repertoires comprised of local and distinctive identities while the bluish identities which dominate the international arena are associated with the United States, with Europe, and with secular liberal democracy. Although these identities are present inside the polity, their relative foreignness makes it much less likely that inhabitants of the polity residing along its frontier will respond to contact with the outside world by activating their identities in accordance with those outside influences.

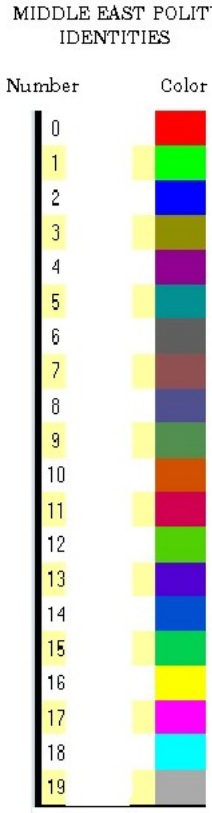

Figure 2.

3.22

Agents displaying reddish-orange color, corresponding to identity "0" in Figure 2 are activated on a secular autocratic identity expressing loyalty to the regime. Notice the predominance of reddish-orange in the northwestern quadrant of the polity depicted in Figure 1. This is the area where the capital city is located. The next most prominent activated identity is the shade of green labeled identity "1" in Figure 2, representing traditional, patriarchal Islam. This identity is widely diffused but is particularly prominent in the "rural" south and southwest. Most of the other colors, such as violet, with clusters in southwest, the northeast, and the southwest, and khaki, with clusters in the north and south, are ethnic identities. The red identity (corresponding to identity 11 in Figure 2), most prominent in the northeast, appears as a Kurdish-like group, with heavy concentration in a remote area of the country and close ties across an irregular relatively porous border with a diaspora of agents activated on that identity or harboring that identity in their repertoires. Other identities appearing inside MEP include purple (13), with small clusters in the southwest and southeast. This ethnic/tribal identity has special links with the regime, many of whose top leaders are affiliated with it, via the presence of this identity in their repertoires. Turquoise (5) is a Pan-Arab identity. Although present in the repertoires of large numbers of agents within the polity, and in outside environment of MEP, by t=5 the number of agents in MEP activated on that identity is almost always less than 17% of the number activated on the regime. The activated levels at t=5 of other MEP identities out of favor with the regime are even lower. These identities represent various ethnic solidarities and fundamentalist (15) and modernizing (12) variants of Islam. This latter identity is marked by the shade of green (12) represented by the cluster of agents just outside the southern border of MEP and just above its northwestern corner. Note that activated fundamentalist identities are hardly present inside the polity at the activated level at all, while modernized Islamic identity has a presence inside the polity that is small, but concentrated near the capital city (in line with the idea that its adherents are mainly urban based intellectuals).

3.23

The symbols appearing in some squares of MEP register some of the differences among groups of agents. A small square in the center of an agent means it is an entrepreneur. Accordingly, it operates with an influence level of 2 and a larger than average repertoire of 9 different identities. A small black triangle in the upper left hand corner of an agent means it is an innovator. Innovators have the large repertoires of entrepreneurs and the same propensity to respond sensitively and quickly to changing incentives by activating on other available identities. But innovators have an influence level of 1 rather than 2. A diamond means the agent is a "fanatic" - whatever identity is activated will always be activated, no matter what the identity weight calculations in that agent's neighborhood may be. A diamond with a small square inside the diamond indicates an inactive agent - an agent whose identity can change, and is determined by normal processes, but whose activated identity does not influence other agents in the neighborhood.

3.24

Agents in MEP also vary in ways that are not immediately visible.[7] While most have repertoires of six identities some have as few as 2. In addition to the size of an agent's repertoire, its composition is crucial to its "actual" identity. Agents activated at t=0 or t=5 on the same identity may be more or less similar to one another based on how many of the other identities in their repertoires are the same, i.e. "overlap." Thus MEP was designed with the complexion of the repertoires of the agents in mind and not simply the activated identity of each agent. A guide to the most salient identities in MEP is presented in Figure 3, labeled "Guide to Salient Identities." Across the top of this chart are listed the identities worthy of specific note along with their numerical labels and corresponding colors. Each column then contains a list of numbers indicating how prominent the identity is at both the activated level, and in the repertoires of agents (subscribed identities), both inside the borders of the polity and outside it. Thus we see, for example, that USA Globalizing identity (8) is extremely prominent in the external environment, both at the activated and subscription level, hardly present among activated identities inside the polity (at t=5 or even t=0), and only moderately present within the repertoires (subscribed identities) of agents within the borders of MEP. The sixth through tenth rows of data provide a quick sense of the substantive character of these identities since they report how much diversity there is in the repertoires of agents possessing different identities and, for each identity, which other identities are most and least likely to be present in the repertoires of the set of agents with that particular identity in their repertoires.[8]

			0	1	2	5	8	9	11	12	13	
			Secular	Trad.	Secular	Pan-Arab	globalizing	wataniyeh	Ethnic	moderniz	ethnic	(fu
			Autocratic	Islam	Dem.		USA		Kurd. Type	Islam	rgm related	Isla
			(Regime)		(Eur)	Turquoise	lavender/		diaspora		deep	
			Red/orange	light green	blue		dark blue	dark green	red	green	blue/purple	gre
1. Activated inside Polity t=0			563	563	54	167	7	110	123	141	93	
2. Activated inside Polity t=5			800	543	27	35	8	82	122	93	82	
3. Subscribed inside Polity t=0			928	1015	899	1022	477	998	431	537	736	
4. Activated outside Polity t=0			386	16	1749	312	3310	4	677	757	10	
5. Subscribed outside Polity t=0			1328	710	6445	3938	5537	803	1169	6237	914	
6. Average Rep size of initially actvated in polity			4.8	4.0	6.2	5.4	7.5	5.5	6.3	7.0	6.3	
7. Most in reprt of initially actvated agnt (inside)			13,5	15,9	8,12	2,9	NA	5,15	2,15	15,5	2,0	NA
8. Least in reprt of initially actvated agnt (inside)			1,15	2,13	0,13,1	13,1	NA	0,13	4,8	0,1	8,12	NA
9. Most in reprt of initially actvated agnt (outside)			13,5	NA	8,12	2,9	2,12	15,13	2,15	15,5	NA	NA
10. Least in reprt of initially actvated agnt (outside)			15,9	NA	15,11,9	13,8	15,1	15,8	13,8	1,0	NA	NA

Figure 3. Guide to Salient Identities

Notes on Abbreviations: reprt = repertoire Agnt = agent Rep = repertoire Trad = traditional Rgm = Regime NA = Not enough in category to warrant the measurement

3.25

Of special importance is the influence level of individual agents. As noted above, an agent with a higher influence level counts for more in the calculation of its identity weight and the identity weight of each of its neighbors in every time step. In Figure 4 a white and black checked pattern is used to indicate all activated on the secular autocratic regime identity (0) and having an influence level of greater than 1. The pattern produced by these highlighted agents reflects the regime's authority structure - its network of "bureaucrats." Bureaucrats are relatively influential agents. Lower echelon bureaucrats have an influence level, or identity weight, of 2, with relatively small identity repertoires - sometimes including only two identities. The relative "narrowness" of a bureaucratic repertoire indicates and creates a propensity for any one bureaucrat to stick closely to the regime or to whatever identity has captured the local bureaucratic apparatus. Upper level bureaucrats have an identity weight of 3 or 4.[9] Activated on the same identity and in proximity to one another, bureaucrats reinforce one another's activation on the regime identity and multiply the likelihood that agents in their neighborhoods, and bordering neighborhoods, will move toward that identity or maintain its activation even when biases or outside influences turn against it. These networks of influential agents act as "enforcers" of the regime's preferences and as an organized expression of its institutional capacity. The ratio of state officials and security personnel to ordinary citizens in MEP (about 5%) corresponds roughly to the ratio of domestic security personnel and civil servants to the adult population in Middle Eastern Arab states. The spatial arrangement of the bureaucracy in MEP features small numbers of higher echelon leaders (with influence levels of 3,4, or 6) in the national capital (a radiating web of checked squares in the northwest) and in "provincial capitals" (smaller webs of checked squares in the center, south, and east). These regional concentrations of regime authority are joined by looser strings of bureaucrats whose overall effect is to produce, usually, an area of dependable support for the regime identity anchored in the northwest, with extensions to the southwest and to the east northeast.

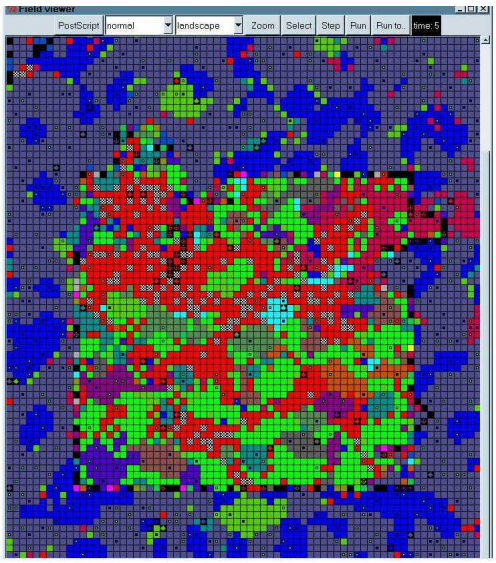

Figure 4.

3.26

Figure 5 shows MEP located within the larger globalizing/Middle Eastern landscape. Although other identities are present in the repertoires of agents comprising this unbounded space, by t=5 the overwhelming majority of them are usually (as in this case) activated on either European-style secular democracy (the dark blue labeled 2 in Figure 2) or USA/Globalizing identity (the pale shade of blue labeled as 8 in Figure 2).[10]

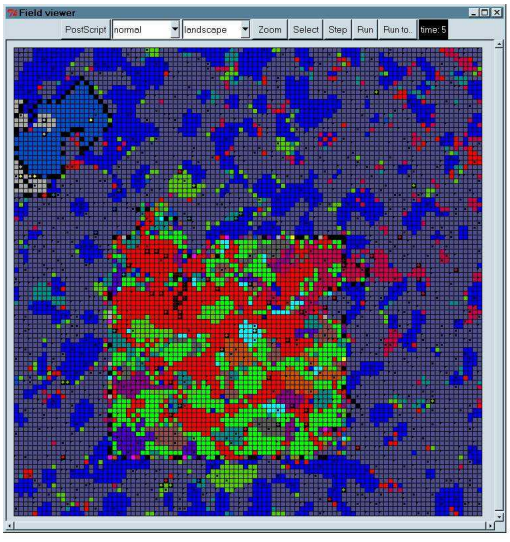

Figure 5.

Middle East Polity Histories Produced under "Standard" Conditions

3.27

ABIR and MEP can help social scientists come to grips with the problem of using historical knowledge when counterfactuals might well have been equally likely. The key is to consider how the distribution of histories produced from the same MEP starting point are affected by small changes in noteworthy variables. First dependent measures are established - those aspects of MEP histories to be observed and explained. One element of interest, both to scholars and to policy-makers with regard to the contemporary Middle East, is the robustness of current political arrangements. How likely, under differing conditions, is it that the identity group or groups affiliated with and represented by the regime are to remain as dominant over the next few decades as they are now.

> **A note on questions of time**: To relate findings from these experiments to the real world it is necessary to make some sort of judgment regarding the time frame involved. How long should one time step be imagined to be in the life of Middle East polity and of the agents within it? To what periods of real time should we imagine t=1000 or t=2000 correspond? There is no easy or firm answer to these questions, but some reasonable estimates can be made. One way to do so is to monitor the extremes of rapid change within the landscape and then match the number of time steps required for those changes to the number of months or years very unusually rapid change occurs in the real Middle East. Such estimates can be corroborated by considering how often people and groups usually adjust their identity commitments and then comparing that observation to the probabilities present in the landscape under standard or stable volatitlity settings. Using these techniques, a preliminary judgment can be made that 1000 time steps of MEP is equivalent to somewhere in the neighborhood of fifteen years; with every time step therefore estimated to represent approximately five and a half days.

3.28

We can measure the political success of identities in MEP in two ways:

Prevalence:
If MEP with all variables except the randomized bias changes are held constant across one hundred runs of the simulation, what is the average percent of agents in MEP observed as activated on specific identities of interest. This is conveniently observed by collecting this data at specific times for each run, for example t=1000 and t=2000, and then averaging those two values to produce one data point for each identity of interest for each run (history/future) of MEP.

Dominance:
A complementary measure is of the number of times, out of 100 runs, that particular identities of interest are activated by a plurality of agents inside the polity. This also can be observed by observing values for individual identity activation at t=1000 t=2000 and then averaging those two values.

3.29

By examining the distribution of outcomes in terms of these measures of MEP behavior we can gain a quick sense of what futures (or histories) for Middle East Polity (and by implication for a typical Middle Eastern authoritarian state) should be thought of, under standard or relatively stable conditions,[11] as probable (typical), what futures should be thought of as improbable (unusual), and what futures should be thought of as virtually impossible. In Figure 6 data is reported which show how each identity fared in a set of 100 histories (or futures).[12] We can see that on average the secular autocratic, regime-affiliated identity was activated by many more agents in these histories than any other identity. Although its average of approximately 1000 activated agents is less than the 1300 that would constitute a majority of the polity, its prevalence is more than twice that of its nearest rival - traditional/patriarchal Islam. None of the other identities do very well, though none are eliminated. Significantly, those that have some prominence - secular democratic, Pan-Arab, and Kurdish-type ethnic are each identities with strong or at least significant presence outside the borders of the polity.

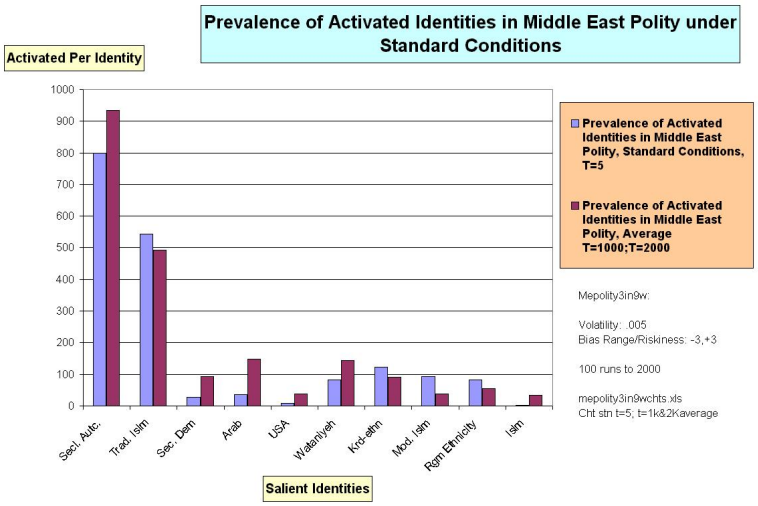

Figure 6.

3.30

These same histories can be considered in terms of how often each identity achieved "dominance" (a plurality of activated agents) within the polity. Figure 7 reports the data in this way. Not surprisingly the regime secular autocratic identity, which begins with a slight plurality, usually maintains that plurality - registering as dominant in 67% of the polity's futures. But we see that despite the fact that the regime identity outperforms traditional Islam in terms of its average prevalence (Figure 6), traditional Islam does emerge as activated by a plurality of agents in 26% of MEP futures. This does not mean that 26% of the time traditional Islam actually displaces the secular regime from its power position, since in many of these futures the regime identity remains in control of the bureaucracy, the capital city area, and one or two provincial capitals. It does mean that the regime is commonly faced with legitimacy challenges to its continuation and with the problem of using its political resources to repress or otherwise contain or neutralize that challenge.

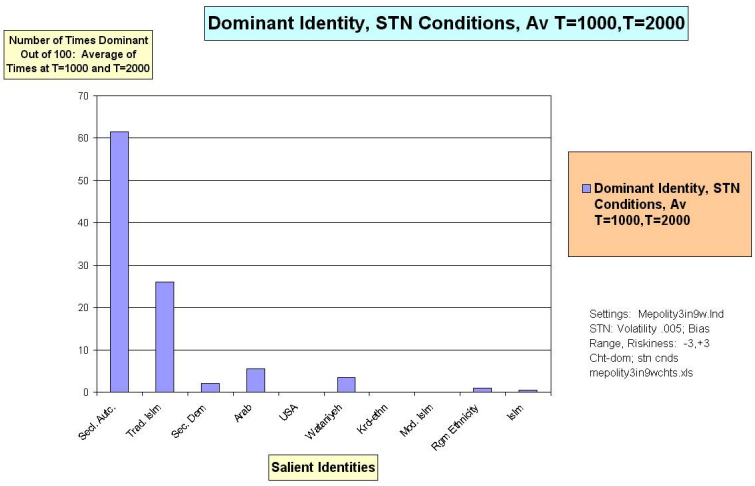

Figure 7.

3.31

Before examining data from a several different experimental manipulations of MEP, it is worth considering the predicament of the historian gathering information about the single one of these histories that, in his universe, had actually occurred. Typically, that scholar would consider his challenge as finding enough documentary and other artifacts, and interpreting them responsibly enough, so as to produce a rendition or narrative of that history that bore significant resemblance to what indeed had occurred - in terms of sequence and threads of causal relationships. But from the perspective I am advocating, and which is illustrated by just this one simple experiment of one hundred simulation runs, a prior question - independent of the versimilitude of the historian's narrative rendition of historical truth - is whether the one particular history he has (indirect) access to is a history representative of what the actual laws of this social universe would produce, given the streams of accidents that can push history into different paths, or whether it was a history that happened to occupy one of the tails of the distribution of probable histories. If the former, the historian can at least hope that generalizations from what he has observed may reach beyond the particularities of his "case." If the latter, then efforts to generalize from the case are not only futile, but downright misleading. The problem is not only that the historian has no method for determining where in the distribution his history is located. More worrisome is that because, by definition, evidence from counterfactual histories is unavailable, this entire problem is invisible. The fact that evidence does not present itself to challenge conclusions drawn from the evidence that is available traps the historian in the difficult predicament of knowing that accidents can massively determine outcomes while needing to learn something besides that from the study of history.

The Effect of Globalization Pressures: Volatility and Riskiness

3.32

I turn now to a discussion of findings using MEP to highlight strategies for coping with this predicament made available to historically minded social scientists by new techniques of computer simulation. Among the most interesting findings from experiments with MEP pertain to volatility. It is plausible to imagine that authoritarian regimes exposed to a more rapidly changing world might find themselves considerably *less* likely to survive or enhance their margin of political superiority. However, MEP experiments strongly suggest that increasing the volatility of change in the world within which the polity is located, i.e. increasing the pace of change in bias values (without changing riskiness, meaning the amount of fluctuation possible when change does occur), significantly *increases* the prevalence of the secular autocratic identity over time as well as the rate at which it sustains its plurality. Some of the data supporting this finding is displayed in Figures 8 and 9. These Figures show that both in terms of identity prevalence and dominance that increasing bias volatility from .005 to .009 yields *increases* in the success of the secular autocratic identity, decreases in the success of its main challenger - traditional Islam, and increases in most other salient rivals. Although large amounts of variance prevented many of the trends suggested by the charts from attaining statistical significance, statistical significance levels for this relationship were observed in several different ways, in particular with respect to prevalence scores. For example, when data from both of two separate conditions (differing distributions of ethnic and non-ethnic "national" identities) were pooled it was found that at t=2000 increased volatility increased the secular autocratic regime ID prevalence and decreased the traditional Islam ID ($p < .05$ [2-tailed]).

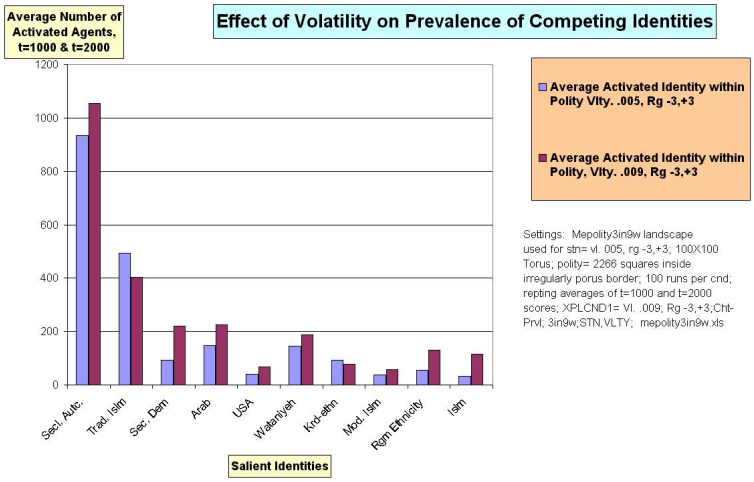

Figure 8.

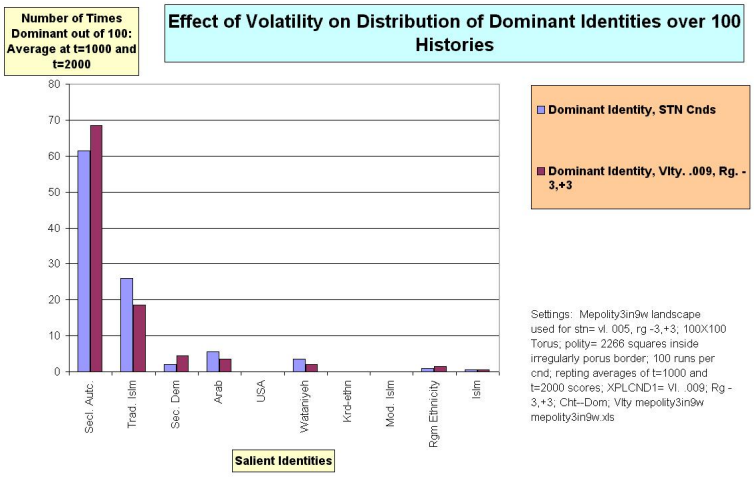

Figure 9.

3.33

However, although increasing the pace of change may assist the regime identity in sustaining its dominance - changing the amount of risk emanating from the global environment (by increasing the range of fluctuation of bias values) had the opposite effect. It hurt the regime identity's prospects and significantly boosted the performance of rival identities. Figure 10 compares the prevalence of competing identities under different conditions of riskiness, while maintaining the relatively stable setting for volatility of .005. Thus the blue columns indicate the prevalence of different identities averaged over 100 histories with the standard bias range setting of -3,+3 (the same values as are displayed in Figure 8) the yellow columns indicate the result of a *smaller* range setting (-2,+3), and the red columns indicate the result of a *larger* range setting (-4,+3). We can observe a quite regular pattern. Lower riskiness settings help the regime identity and its main rival, traditional Islam, while higher riskiness settings hurt the prospects of those identities. The damaging effect of highly risky environments on prospects for the regime identity is especially dramatic with respect to its ability to maintain a plurality. We can see from Figure 11 that when volatility is at standard levels, but the bias range setting is elevated, that prospects for the regime identity to maintain plurality drops well below 50%. On the other hand, the less parochial identities (secular democratic, USA/globalizing, and Pan-Arab)--identities drawing much of their strength from the global or Middle Eastern regional environment - benefit from a more dynamic pattern of change - both in terms of prevalence and plurality/dominance.[13]

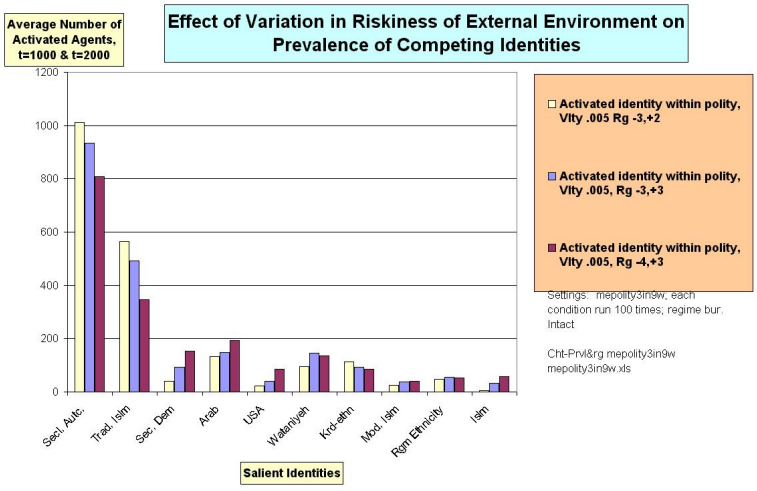

Figure 10.

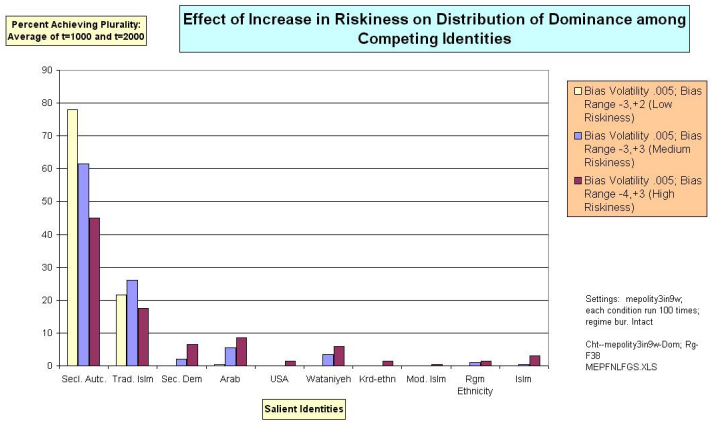

Figure 11.

3.34

When volatility is increased along with risk to produce a "turbulent" environment the regime identity still does worse than it does when risk levels are moderate, but better than when risk levels are high and volatility levels are relatively stable. Turbulent settings, however, significantly reduce prospects for traditional Islam while boosting the prevalence and dominance scores of secular democracy. These outcomes are consistent with the pattern we have seen of volatility's effects.

3.35

What can account for these interlocking patterns? It appears that the regime identity greatly benefits from the bureaucracy that serves as a skeletal and enforcing framework for its regions of strength. Volatile conditions bespeak a rapidly changing external environment where new ideas, economic relationships, and greater interdependence prevail. On a psychological level, these circumstances may drive citizens to seek shelter from the storm of rapid and confusing change, encouraging them to exhibit loyalty to secular autocratic regimes whose central authority structures are intact. On the political level, it would be more likely in such a world that nascent movements and groups, lacking the institutional structures to survive misjudgments and unfortunate conjunctures, would disappear at a more rapid rate than larger, more established identity groups. Thus, although the pace of change under globalization in such a case would be rapid and citizens would become increasingly aware of political and economic alternatives, the regime and the leading groups it represents can actually increase their expectation of continued dominance in the society.

3.36

According to this logic the negative effect of volatility on the traditional Islamic identity may be due to the fact that its source of strength is the large number of agents within the polity activated on this identity or having it in their repertoire. But domestically it lacks an apparatus of protection and externally it lacks an important presence in the international or regional environment. Under these conditions it tends to lose in competition for the loyalties of those agents forced by volatile conditions to abandon their activation on various smaller ethnic or religious identities. It loses to the bureaucratically strengthened regime identity and to identities with resources outside MEP (such as Pan-Arab and secular democratic), more likely to penetrate into the polity because of globalizing pressures. It also loses activated adherents to the *wataniyeh* identity (a national, supra-ethnic, territorially based attachment) which holds an attraction (is contained in the repertoire of) thirty-eight percent of the agents originally activated on traditional Islam. Finally, agents activated originally on traditional Islam have a narrower repertoire of identities than others. It change per se acts as a "modernizing" force then, in a volatile environment, entailing more changes of activation and more substitution of new identities for identities already present in repertoires, then over a given period of time the traditional Islamic identity will more often seem alien and even unavailable to its previous adherents than will be the case for identities present in larger repertoires.

3.37

However, if the pace of change per se is not the most salient aspect of pressures emanating from external sources, but rather an increasing riskiness or range of fluctuation in the forces affecting the polity, this has different implications. When globalization spawns significantly negative conditions for states in the Middle East - such as the imposition of punitive economic sanctions, a major drop in oil prices, or the loss of regular and long term delivery of very large levels of aid - regimes face risks from the interaction of factors that individually would not be worrisome. But when trends are negative for the regime affliated identity and when competing identities enjoy very favorable outlooks, some elements within the bureaucratic apparatus will respond to those opportunities by abandoning the autocratic regime. In such periods of relative regime weakness, religious and ethnic identities resurface in the public sphere and are able to gain strength from external ties to members of their diaspora communities. Indeed, these are also conditions under which we would expect greater penetration of identities not as well represented inside the polity, but carried forward from outside by waves of supportive developments in the regional and global environment. We would further expect that the external identities most likely to succeed in gaining significant footholds inside MEP would be those who are at least present in the repertoires of a critical mass of MEP inhabitants. And we would expect that the overall probability of the leading identity group losing its predominance in MEP would be highest when a weakened bureaucracy is confronted with a turbulent external environment.

The Effect of Weakening Bureaucratic Control

3.38

The plausibility of this "story," told by ABIR's simulations about the real world, can be tested by examining the effects of reductions in the efficacy of the regime bureaucracy. If the inferences drawn above are correct, then the relationships between volatility, range, and the performance of competing identities should change in response to a bureaucracy less able to act as the "whalebone" in the regime's corset of political and cultural control. Reductions in bureaucratic efficacy - whether due to political strains within the regime, subversion, or a reduction in side-payments made to bureaucrats by the regime to maintain their loyalty - were operationalized by changing the influence level of a subset of regime bureaucrats. Lower echelon bureaucrats affected by this intervention had their influence level of 2 reduced to 1. Upper echelon bureaucrats - those located in strategic nodes of the bureaucratic network and having higher influence levels--had their influence level reduced by 1: from 3 to 2, or from 4 to 3.

3.39

If we compare Figure 12 to Figure 13 we can see that as long as the environment is relatively stable (Figure 12) the regime identity's prospects for maintaining its plurality are not negatively affected by a mild reduction in bureaucratic efficacy. We see, in fact, that the percentage of histories featuring a regime identity plurality actually increased somewhat in association with the mild reduction in lower echelon bureaucratic efficacy. This percentage fell only moderately as a result of a mild reduction in the upper echelon (keeping the lower echelon intact). Under stable conditions, the rate of regime domination fell significantly only in association with a more considerable reduction in bureaucratic efficacy (at the lower echelon).[14] However, under volatile conditions (Figure 13) the percentage of regime identity pluralities dropped, both in response to mild reductions in either lower or upper echelon and to a significant reduction in lower echelon bureaucratic efficacy. This does corroborate the reasoning and interpretation offered above regarding the "shelter from the storm" effect of the regime's apparatus of power under volatile (but not risky) conditions.

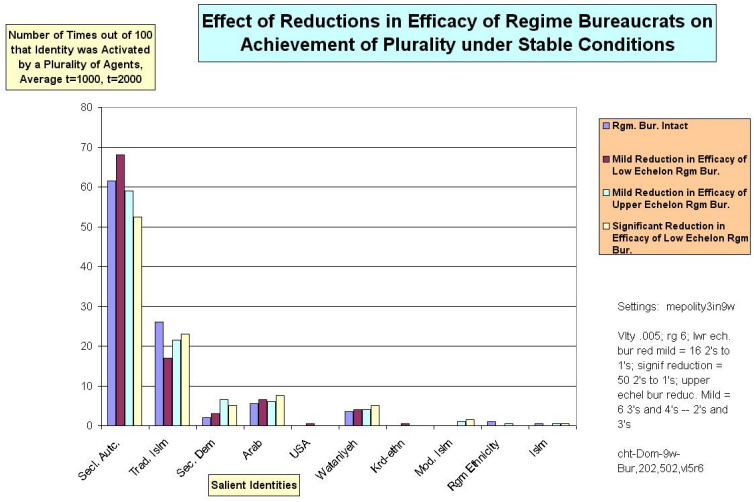

Figure 12.

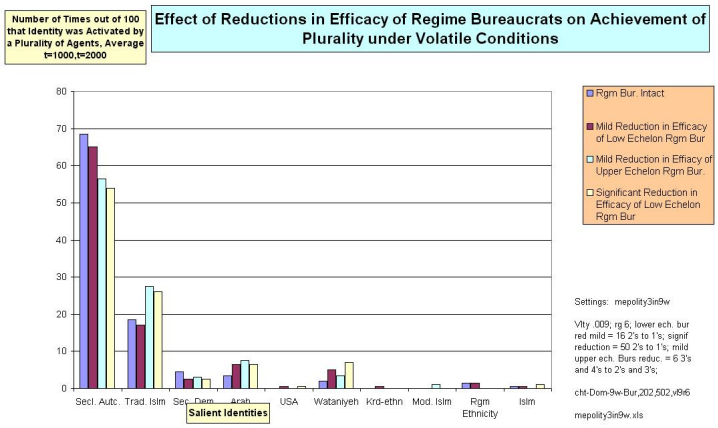

Figure 13.

3.40

Further corroboration is available from the data in these figures. By comparing the height of traditional Islam's columns in each figure, we see that weakening the regime bureaucracy does *not* help traditional Islam improve its attainment of plurality support under stable conditions, but *does* increase the percentage of traditional Islam dominance when conditions are volatile. As a general matter it is also worth noting how relatively potent is the effect on regime identity performance (and on the performance of its main challenger) of even a mild reduction in the efficacy of the upper echelon bureaucracy compared to either a mild or a much more significant reduction in lower echelon bureaucratic efficacy.

3.41

Another technique for analyzing and displaying the data is to focus, not on averages, but on the pattern of performance of specific identities over the entire collection of 100 experimental histories (or "futures"). The curves in Figure 14 depict all 100 prevalence scores of the regime and secular democratic identities under specified conditions. These scores have been ordered from smallest to largest. We can see that for the secular democratic identity (turquoise and yellow curves) whether the lower echelon bureaucracy has been significantly weakened or not matters little in those histories in (about 50% of the total) in which that identity failed to penetrate at all into MEP. In that range the turquoise and yellow curves lie virtually on top of one another. We can also see at the other extreme, in the handful of cases in which this identity was activated by more than 1000 agents (average t=1000, t=2000), that a significant weakening of the regime bureaucracy also did not matter. But in the range where the outcome of the struggle by secular democrats for a significant place in the political life of MEP was clearly in doubt (between the 75th and 95th percentiles of secular democratic prevalence scores), a gap does open up between the yellow and turquoise lines, i.e. between performance of the secular democratic identity when the regime bureaucracy was intact (yellow) and when it had been significantly weakened (turquoise). Because a less dramatic, but still noticeable reciprocal pattern appears between the blue and red lines (tracing regime identity performance) we can see that the distance between the red and turquoise curves in the crucial 75th to 95th percentile range is substantially less than the distance between the blue and yellow curves. This is strong corroboration for the interpretation offered above - that when confronting volatile globalizing pressures leading identity groups depend more on the repressive effects of their bureaucratic apparatus to fend off challenges from identities (such as secular democracy) whose source of strength lies outside the polity.

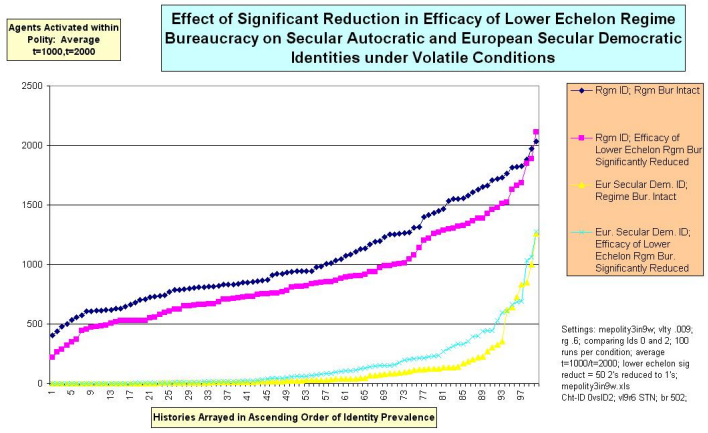

Figure 14.

3.42

Finally, using the same data presentation technique, we may consider the effect of attempts to use covert or overt means to establish pro-USA loyalties among selected portions of the MEP population. Such attempts were operationalized in MEP by adding identity (8) - USA, globalizing - to the repertoire of each agent activated on two different ethnic identities with concentrations of activated agents near the north-northeast frontier and the west southwest frontier: identities (4) and (6). This small intervention, by itself, had little effect on average outcomes.[15] And yet evidence that this type of educational, cultural, or political intervention at the repertoire level can play a significant role is reflected in the data displayed in Figure 15. The blue line in this chart shows the prevalence scores for the USA/globalizing identity over all 100 histories, from smallest to largest, under "normal" MEP conditions. The red line shows how the distribution of this identity's prevalence score changes when the identity (8) is inserted into the repertoires of that small minority of agents activated at t=0 on ethnic identity (4) or (6). We see that for the majority of histories, when the "accidents" of circumstances favorable or unfavorable to this and competing identities produced no real hope for USA/globalizing identity to establish a presence inside MEP, it made absolutely no difference whether the repertoires of two ethnic groups included or did not include this identity. However, under what must have been at least somewhat favorable circumstances (i.e. relatively favorable biases despite the presence of an intact regime bureaucracy and moderate volatility and riskiness levels) - between percentiles 62% and 90%--that a gap began to open between the prevalence of identity (8) within MEP with or without this infusion of USA/globalizing identity. And in the ten percent of histories in which the stream of biases must have been quite favorable for (8) and unfavorable for its rivals-above the 90th percentile - we see how very large a difference the adjusted repertoires produced. Only in this range of favorable biases, but also only when this identity had been added to the repertoires of the two target ethnic groups, do we see a very large difference and also the appearance, of prevalence scores representing activation of substantial portions of MEP on the USA/globalizing identity.

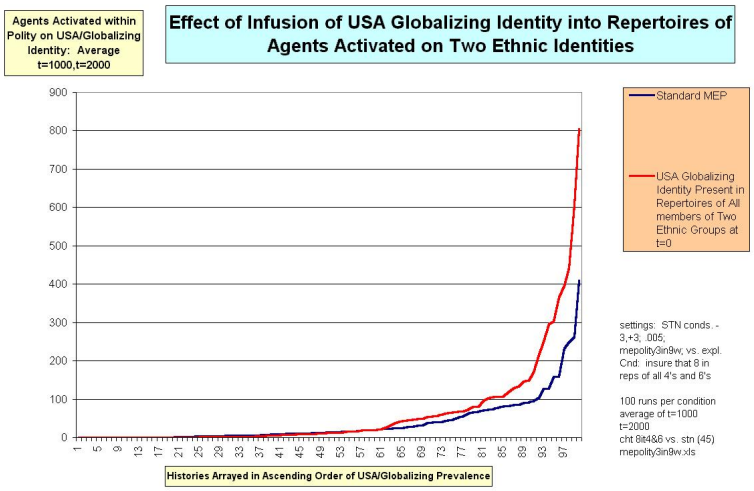

Figure 15.

Conclusion

4.1

Work with Middle East Polity, in combination with the now greatly expanded flexibility of PS-I for expressing cultural and political nuances and various kinds of theoretical principles, strongly suggest that it will be possible to create useful models of specific polities. The challenges of such work are enormous. Once the analyst begins to think in terms of modeling a specific country, much more data is available which could be considered relevant to constructing an accurate representation. At the same time, using as much data as is available can easily lead the researcher toward operationalizations entailing assumptions about micro-mechanisms and/or macro-causal or predisposing conditions that go beyond what well-corroborated middle-range theories can be used to justify.

4.2

Although it may not be possible to resist the impulse and attraction to "experiment" with "real" countries or situations, it would almost certainly be irresponsible not to encourage a primary commitment to the use of agent-based modeling tools such as PS-I for the production of virtual laboratories to frame, test, and refine the claims of abstract theory - claims operationalized and explored in virtual environments intended to evoke kinds of problems or kinds of structures, rather than very particular problems or particular political arenas. We are hopeful and excited at the prospect that scholars who may have heard of agent-based modeling, but who have been deterred from exploring its usefulness because of the programming demands of previously available platforms, will find in PS-I a congenial environment for exploring how this experimental method can contribute to their own research programs and to the more general challenge of advancing knowledge in the social sciences.

Appendix

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

1.1

To appreciate how simple and automatic 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 (shaded yellow) 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 of its sides and four at each of its corners.

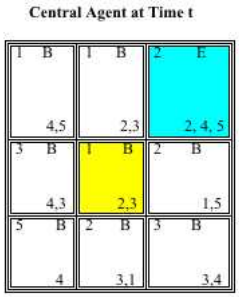

Figure 1

1.2

The digit in the upper left hand corner indicates which of the total of available identities (1,2,3,4,5) each of these agents is activated on at time t. The digits in the lower right hand corner indicate which identities are not activated by the particular agent, but yet are present in that agent's repertoire. Thus Central agent is activated on identity 1, and has identities 2 and 3 in its repertoire. The agent "east" of Central is activated on 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 "northeastern"neighbor (shaded blue) is an entrepreneur (E) whose repertoire is larger (four identities rather than three).

1.3

The grid labeled "Bias Values" indicates, for this particular time step, time t, how generally attractive or unattractive it is to be activated on 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

Figure 2

1.4

Entrepreneurs are more "persuasive" or "influential" than basic agents. Their influence level is 2, rather than 1. 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 activated on 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 Activated on Each Identity	0	1	0	0	0
Identity Weight per Identity in Central's Neighborhood	1	5	3	0	0

Figure ?

1.5

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 activated on 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.

1.6

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

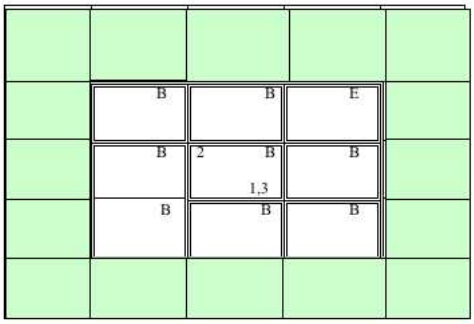

Figure 4

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Notes

[1] Similar documentation for PS-I is under preparation but will not be available until 2003.

[2] See the Appendix for a step-by-step illustration of how constructivist identity theory is operationalized for an exemplar agent through two time steps.

[3] That is, if all other conditions are met, an agent is eligible for transforming into a border agent if and only if no more than 20% of the agents activated on its activated identity have the dominant identity in their repertoire of identities.

[4] Each run of the simulation can be seen as a "future" by looking forward from the point of view of the polity at time zero (t=0) or as a history by looking backward from the point of view of any time step after t=0.

[5] In the experiments reported here with MEP, biases assigned to identities all start out at 0. Although it depends on chance and the volatility setting in use for any particular run, few if any biases change from 0 within the first five time steps. But adjustments of agents to one another locally take place even in the absence of any external signals about the advantages or disadvantages of activating on different identities. These adjustments are very similar in every run of the template and most of them have occurred by t=5. So a snapshot of MEP at t=5 is actually a more accurate representation of its effective starting point than a snapshot at t=0.

[6] The screenshot appears somewhat different from previous screenshots, and displays much more information about the landscape, because a customized version of PS-I, rather than the ABIR program itself, was used to prepare it. As noted above, PS-I is a tool-kit or platform for the production of an unlimited number of variants of the original ABIR model. PS-I 3.0 in its advanced but still "pre-release" form is available for downloading at http://ps-i.sourceforge.net/. Concerning ABIR and PS-I see http://www.psych.upenn.edu/sacsec/abir/.

[7] Moving the cursor over any particular agent in an ABIR landscape reveals the identities in its repertoire and its influence level, along with, of course, its activated identity.

[8] NA means that the number was too small to make the measurement meaningful. For details on how constructivist principles were used to guide production of a landscape in which identities would emerge as relational properties of interactions among agents, rather than as hard-coded "primordial" traits, see http://www.duke.edu/web/licep/4/lustick/pp. 4-7.

[9] There is one "leader" (occupying the square at coordinates 34,56) with an identity weight of 6.

[10] The small shape bordered with black squares in the upper left hand corner of the landscape is a primitive rendition of Israel. The bright shade of blue (14) represents a Jewish/Israeli identity. The gray (19) represents a Palestinian identity, concentrated in the occupied territories and a part of Israel itself. This portion of the landscape has little if any discernible effect on MEP but its presence acts as one indicator of bizarre behavior in the model suggestive of something being seriously awry (e.g. takeover of MEP by the Israeli Jewish identity; or takeover of Israel by a patriarchal Islamic identity).

[11] Because MEP is larger and contains many more different identities (20) than landscapes used in other experiments the standard or stable settings for range fluctuations is wider: -3,+3.

[12] Data described by this and other Figures in this paper are available in Excel format from the author atilustick@sas.upenn.edu. The "salient" identities are the identities that together comprise an overwhelming majority of all activated identities in the landscape though they are only a subset of the twenty activatable identities present in MEP and its environment.

[13] Statistical significance tests were done separately on the data at t=1000 and t=2000, but, for technical reasons, not on the averages between them-the data displayed in the Figures. Most of these relationships regarding the impact of riskiness on prevalence and dominance were significant at both t=1000 and t=2000 at the .01 or .05 level (2-tailed).

[14] The effect of a proportionately larger reduction of upper regime bureaucratic efficacy was not tested, though the expectation must be of an even greater reduction in the rate of regime dominance.

[15] Absent the addition of USA/globalizing identity to the repertoires of agents activated on the two target ethnic groups, that identity achieved a plurality not once out of 100 histories (t=2000, standard conditions). In the presence of this intervention, a USA/globalizing plurality was achieved once, but only once, out of 100 histories.

References

ABRAMS, Dominic and Michael A. Hogg. 1990. (eds.), *Social Identity Theory: Constructive and Critical Advances*. New York: Springer-Verlag.

ARONOFF, Myron J. 1998. "The Politics of Collective Identity." *Reviews in Anthropology*, Vol. 27, no. 1: 71-85.

AXELROD, Robert. 1997. *The Complexity of Cooperation: Agent-Based Models of Competition and Collaboration*. Princeton: Princeton University Press.

AXTELL, R. L. 2000. "Why Agents? On the Varied Motivations for Agent Computing in the Social Sciences." In Macal, BENOIT, Kenneth. 2001. "Simulation Methodologies for Political Scientists," *The Political Methodologist*, Vol. 10, no. 1: 12-16.

BARKOW,J., L. Cosmides, and J. Tooby. 1992. (eds.), *The Adapted Mind: Evolutionary Psychology and the Generation of Culture.* New York: Oxford University Press.

BOURHIS,Richard Y., John C. Turner, and André Gagnon. 1997. "Interdependence, Social Identity and Discrimination." In Russell Spears, Penelope F. Oakes, Naomi Ellemers, and S. Alexander Haslam (eds.), *The Social Psychology of Stereotyping and Group Life*. Oxford: Blackwell Publishers: 273-95.

BOYD, Robert and Peter J. Richerson. 1985. *Culture and the Evolutionary Process.* Chicago: University of Chicago Press.

BREWER, Marilynn B. and Rupert J. Brown. 1998. "Intergroup Relations." In Daniel T. Gilbert, Susan T. Fiske, and Gardner Lindzey (eds.), *The Handbook of Social Psychology,* Vol. II. Boston: McGraw-Hill: 554-93.

BROWN,Michael, Owen Cote, Jr., Sean Lynn-Jones, and Steven Miller (eds). 2000. *Rational Choice and Security Studies: Stephen Walt and His Critics*. Cambridge, Mass.: MIT Press.

BRUBAKER, Rogers. 1996. *Nationalism Reframed: Nationhood and the National Question in the New Europe*. Cambridge: Cambridge University Press.

BYMAN, Daniel. 2000. "Forever Enemies? The Manipulation of Ethnic Identities to End Ethnic Wars," *Security Studies,* Vol. 9, no. 3: 149-190.

CALHOUN, Craig. 1995. *Critical Social Theory: Culture, History and the Challenge of Difference.* Oxford and Cambridge, MA: Basil Blackwell.

CAMPBELL, Donald T. 1975. "On the Conflicts Between Biological and Social Evolution and Between Psychology and Moral Tradition." *American Psychologist*. December:1103-23.

CASTI, John. 2000. "Would-Be Business Worlds." *Complexity*. Vol. 6, no. 2: 13-15.

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

CEDERMAN, Lars-Erik. 2001. "Agent-Based Modeling in Political Science," *The Political Methodologist*, Vol. 10, no. 1: 16-22.

CHANDRA, Kanchan. 2001. "Introduction: Constructivist Findings and Their Non-Incorporation," *APSA-CP: Newsletter of the Organized Section in Comparative Politics of the American Political Science Association*. Vol.12, no. 1: 7-11.

COLLIER, Paul, and Anke Hoeffler. 2000. *Greed and Grievance in Civil War*. Washington, D.C.: World Bank.

CRITICAL REVIEW. 1995. Special Issue on Rational Choice Theory, Vol. 9, no. 1-2.

DANSPECKGRUBER, Wolfgang. 1997. (ed.), *Self-Determination and Self-Administration*. London: Lynne Rienner Publishers, 1997.

DAWKINS, Richard. 1989. *The Selfish Gene.* Oxford: Oxford University Press.

DENNETT, Daniel C. 1995. *Darwin's Dangerous Idea.* New York: Simon and Schuster.

DUGDALE, Julie. N.d. "An Evaluation of Seven Software Simulation Tools for Use in the Social Sciences."http://www.irit.fr/COSI/training/evaluationoftools/Evaluation-Of-Siumulation-Tools.htm.

ECOLOGICAL Society of America. 1999. "Computational Ecology," *NewSourceNEWS*, 65.

EIDELSON, Roy J. and Ian S. Lustick. Forthcoming 2002. "National Identity Repertoires, Territory, and Globalization." In Mabel Berezin and Martin Schain (eds), *Remapping Europe: Territory and Politics*. Baltimore: Johns Hopkins Press.

ELEY, Geoff and Ronald Grigor Suny. 1996. "Introduction: From the Moment of Social History to the Work of Cultural Representation," in Eley, Geoff and Ronald Grigor Suny (eds.), *Becoming National: A Reader*. New York: Oxford University Press: 3-37.

EPSTEIN, Joshua M. 1999. "Agent-Based Computational Models and Generative Social Science," *Complexity*, Vol. 4, no. 5: 41-60

CHAFETZ, Glenn, Michael Spirtas, Benjamin Frankel. 1999. "Introduction: Tracing the Influence of Identity on Foreign Policy." In Glenn Chafetz, Michael Spirtas, Benjamin Frankel (eds.),*The Origins of National Interests*. London: Frank Cass: vii-xxii.

GREEN, Donald P. and Ian Shapiro. 1996. *Pathologies of Rational Choice Theory: Critique of Applications in Political Science*. New Haven: Yale University Press.

GROSS J., Louis J. 1997. *Parallel Processing for Individual-Based Ecological Models.* http://ecology.tiem.utk.edu/~gross/nsfreport.797.txt

HANNUM, Hurst. 1990. *Autonomy, Sovereignty, and Self-Determination: The Accommodation of Conflicting Rights*. Philadelphia: University of Pennsylvania Press.

HOLLAND, John H. 1998. *Emergence: From Chaos to Order*. Reading, MA: Helix Books.

HUGHES, Barry B. 1999. *International Futures: Choices in the Face of Uncertainty*. Boulder: Westview Press.

HUNT, Allen G. 2001. "El-Nino: Dynamics, Its Role in Climate Change, and Its Effects on Climate Variability: The Limits of Predictability," *Complexity,* Vol. 6, no. 2: 16-32.

JOHNSON, Paul E. 1998. "Rational Actors Versus Adaptive Agents: Social Science Implications." Paper presented at the annual meeting of the American Political Science Association, Boston.

JOHNSON, Paul E. 1999. "Simulation Modeling in Political Science," *American Behavioral Scientist*, Vol. 24, no. 10: 1509-30.

KAPLAN, Robert D. 1993. *Balkan Ghosts: A Journey Through History*. New York: St. Martin's Press.

KING, Gary, and Lanche Zeng. 2001. "Improving Forecasts of State Failure." *World Politics*, Vol. 53, no. 4: 623-58.

KOWERT, Paul A. 1999. "National Identity: Inside and Out," in Glenn Chafetz, Michael Spirtas, Benjamin Frankel, eds, *The Origins of National Interests*. London: Frank Cass. 1-34.

LAITIN, David D. 1986. *Hegemony and Culture.* Chicago: University of Chicago Press.

LAITIN, David D. 1988. *Identities in Formation*. Ithaca: Cornell University.

LAITIN, David, and Daniel Posner. 2001. "The Implications of Constructivism for Constructing Ethnic Fractionalization Indices." *APSA-CP: Newsletter of the Organized Section in Comparative Politics of the American Political Science Association.* Vol.12, no. 1: 13-17.

LEVITAN, Bennett. 1997. "Models and Search Strategies for Applied Molecular Evolution." In M.R. Pavia, W.H. Moos, A.D. Ellington, and B.K.Kay (eds.), *Annual Reports in Combinatorial Chemistry and Molecular Diversity*. Netherlands: ESCOM Publishers.

LUSTICK, Ian S. 1993. *Unsettled States, Disputed Lands: Britain and Ireland, France and Algeria, Israel, and the West Bank/Gaza*. Ithaca: Cornell University Press.

LUSTICK, Ian S. 2000. "Globalization and the Resurgence of Identity Politics." Paper presented to LiCEP workshop, Duke University, April 22. http://www.duke.edu/web/licep/1/lustick/Lustickmemo.doc.

LUSTICK, Ian S. 2001. "Agent_based Modeling and Constructivist Identity Theory," *APSA-CP: Newsletter of the Organized Section in Comparative Politics of the American Political Science Association.* Vol.12, no. 1: 22-25.

LUSTICK, Ian S. and Dan Miodownik. 2000. "Deliberative Democracy and Public Discourse: The Agent-Based Argument Repertoire Model," *Complexity*. Vol. 5, no. 4: 13-30.

LUSTICK, Ian S. and Dan Miodownik. Forthcoming, 2002. ""The Institutionalization of Identity: Micro Adaptation, Macro Effects, and Collective Consequences." *Studies in Comparative International Development*.

LUSTICK, Ian S., Dan Miodownik, and Stacey Philbrick. 2000. "The Institutionalization of Identity." Paper presented to LiCEP workshop, University of Pennsylvania, October. http://www.duke.edu/web/licep/2/lustick/lustick.

LUSTICK, Ian, Dan Miodownik, and A. Maurits van der Veen. 2001. "Studying Performance and Learning with ABIR: A Research Note," In David Sallach and Thomas Wolsko (eds) *Proceedings of the Workshop on Simulation of Social Agents: Architectures and Institutions, October 6-7, 2000.* Argonne, IL: Argonne National Laboratory.

MCGARRY, John and Brendan O'Leary (eds.), 1993. *The Politics of Ethnic Conflict Regulation*. London: Routledge.

MONTVILLE, Joseph. 1987. *Conflict and Peacemaking in Multiethnic Societies*. Lexington, MA: Lexington Books.

NAGEL, Joane. 1994. "Constructing Ethnicity: Creating and Recreating Ethnic Identity and Culture." *Social Problems*, Vol. 41, no. 1: 152-176.

O'LEARY,Brendan, Ian S. Lustick, and Thomas Callaghy, eds. *Right-sizing the State: The Politics of Moving Borders*. Oxford: Oxford University Press, 2001.

PAGE, Scott. 1999. "Computational Models from A to Z," *Complexity*, Vol. 5, no. 1: 35-41.

PANEL on Modeling and Simulation of the Committee on Technology for Future Naval Forces, Naval Studies Board, National Research Council. George F. Carrier (Chair). 1997. *Technology for the United States Navy and Marine Corps, 2000-2035*, Vol. 9. Washington, D.C.: National Academy Press.

PERELSON, Alan S. and Frederik W. Wiegel, 1999. "Some Design Principles for Immune System Recognition," *Complexity,* Vol. 4, no. 5: 29-37.

SAFRAN, William and Ramon Maiz. 2000. (eds.), *Identity and Territorial Autonomy in Plural Societies*. London: Frank Cass.

SAMBANIS, Nicholas. 2000. "Partition as a Solution to Ethnic War: An Empirical Critique of the Theoretical Literature," *World Politics*. V. 52, no. 4: 437-83. Data available at: http://www.worldbank.org/research/conflict/papers/partition.htm.

SIMON, Herbert A. 1997. *Administrative Behavior.* New York: The Free Press, Fourth Edition.

TESFATSION, Leigh. 2001. "Software for Agent-Based Computational Economics (ACE) and Complex Adaptive Systems." http://www.econ.iastate.edu/tesfatsi/acecode.htm

THOMPSON, James. D. 1967. *Organizations in Action*. New York: McGraw-Hill.

VAN DER VEEN, A. Maurits, and Ian S. Lustick. 2001. "The Emergence of a European Identity: An Agent-Based Modeling Approach." Paper presented at the conference on Ideas, Discourse and European Integration at the European Union Center, Harvard University, May.

VAN DER VEEN, A. Maurits, Ian S. Lustick, and Dan Miodownik. 2001. "Studying Performance and Learning with ABIR: The Effects of Knowledge, Mobilizing Agents, and Predictability," *Social Science Computer Review*. Vol. 19, No. 3: 263-280.

Van Evera, Stephen. 2001. "Primordialism Lives!" *APSA-CP: Newsletter of the Organized Section in Comparative Politics of the American Political Science Association*. Vol.12, no. 1: 20-22.

VERDERY, Katherine. 1991. *National Ideology Under Socialism Identity and Cultural Politics in Ceausescu's Romania*. Berkeley: University of California Press.

WALDROP, M. Mitchell. 1992. *Complexity: The Emerging Science at the Edge of Order and Chaos*. New York: Touchstone.

ZEBULUM, R., Pacheco, M.A., Vellasco, M. (1998) "Comparison of different evolutionary methodologies applied to electronic filter design." In *Proceedings of the IEEE International Conference on Evolutionary Computation (ICEC98)*, Anchorage, Alaska: 434-439.

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