An Agent-Based Model of International Norm Diffusion

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Abstract

This paper introduces an agent-based model designed to simulate how norms become globally relevant. Building off of the theoretical foundations of policy diffusion research, this paper formalizes four diffusion mechanisms – coercion, competition, emulation, and learning – in order to explore their spatial and temporal dynamics. The model is anchored by three variables that capture fundamental aspects of international society: hierarchy, neighborhood, and identity. The four different diffusion mechanisms operate on these variables, creating distinct over-time trajectories. Three important dynamic patterns are compared across different model specifications: the shape of the adoption S-curve, the power distribution amongst adopters and non-adopters, and the degree of regional clustering.

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1 Introduction

At the end of the eighteenth century, several states passed legislation banning the trade of slaves, which had been an enormous part of the global economy over the preceding two centuries and has existed in various forms throughout human history. By the middle of the nineteenth century, the norm of freedom of the individual had replaced the norm of slavery in the international society of states. The United States had not only stopped participating in the slave trade, but fought a devastating civil war resulting in the end of slavery despite centuries of social development based around a slave system. In Russia, Tsar Alexander II successfully emancipated the serfs, reforming a system of ownership of humans into a system of free individuals, although still highly unequal. In the late nineteenth century, New Zealand became the first state to extend voting rights to women. By the middle of the twentieth century, women's suffrage had been adopted in a majority of the states in the international system. Newly independent states that formed in the wake of decolonization included women's suffrage without the national debates that had characterized the earlier adoptions. These two stories, amongst many others, suggest that changes in the social order within nations are not only temporally clustered, but are interdependent pieces of larger global processes.

Norm diffusion has long been recognized as an essential feature of the study of international relations. Norms are thought of as social forces which act on states' identities, and their diffusion is an outgrowth of states' interactions. Theories of norm diffusion explain how principled ideas gain power and change states' identities and behavior. An international norm begins with a principled idea shared by only a few individuals and organizations and ends as a globally institutionalized cultural trait with the power to shape the behavior of governments throughout the world. Norms spread through a population in a patterned way, called a "life cycle" which consists of three stages: emergence, acceptance, and internalization. In between the first and second stages, a burgeoning norm undergoes rapid growth in acceptance; a "norm cascade" (Finnemore & Sikkink 1998). Early adopters alter the context for the remaining potential adopters, creating feedback mechanisms which accelerate the rate of new adoptions. A principled idea becomes an international norm once it changes the way most actors in the system behave. Ideas often leave rules or institutions as observable symbols of their constitutive power, and there are behavioral markers in the historical record which reflect the process of norm diffusion. The dynamics of world cultural change create an empirical pattern which can be measured and modeled. The goal of this paper is to investigate the diffusion process by formalizing these constructivist assumptions and dynamics.

In order to better understand the diffusion process, I focus on four mechanisms which have been developed in the diffusion literature: *coercion*, *competition*, *emulation*, and *learning* (Franzese & Hays 2008, Dobbin, Simmons & Garrett 2007). *Coercion* refers to direct and indirect external forces which lead a state to adopt an innovation. Coercion can take the form of a powerful state advocating for reform, or it can manifest in the prevalence of a norm throughout the system, creating coercive social pressure to conform. *Competition* refers to policy adoption which is driven by the potential for and the limited supply of rewards, which are only available to adopters. *Emulation* occurs when states are uncertain about what they should do, so they mimic prestigious states regardless of the merits of the institution they adopt. Finally, *learning* occurs when states know they need a policy to deal with a particular problem, but are not sure about which policy would be best. By observing others, especially states that have successfully solved their policy problem, potential adopters choose the institution they believe is best suited to their needs. The differences in the logic of diffusion that these mechanisms represent will provide the theoretical leverage to understand why some states deeply internalize norms, while others only adopt them symbolically.

There are many examples of scholarly attention to the diffusion of norms and institutions in all sub-fields of IR. Earlier work looks at the spread of democratic governance (Kadera, Crescenzi & Shannon 2003, Mitchell 2002, O'Loughlin, Ward, Lofdahl, Cohen, Brown, Reilly, Gleditsch & Shin 1998) and economic policies (Elkins & Simmons 2004, Guzman 2006, Henisz, Zelner & Guilln 2005). In conflict and security studies, scholars have been interested in many norms, including the conduct of states in wartime (Katzenstein 1996), weapons bans such as the prohibition on the use of land-mines (Price 1998, Capie 2008), the spread of conventional weapons and nuclear non-proliferation and non-use (Price & Tannenwald 1996, Eyre & Suchman 1996). In the international organization sub-field, important examples include global policy convergence in environmental policies (Ward 2006, Tews, Busch & Jörgens 2003, Jänicke & Jacob 2004, Jänicke 2005) and legal norms such as the evolution of prohibition regimes (Nadelmann 1990) and the spread of legal systems and European courts (Alter 2014, Mitchell & Powell 2011).

Constructing a model of each of the four diffusion mechanisms – coercion, competition, emulation, and learning – requires attention to both individual motivation as well as systemic properties. An agent-based model (ABM) offers a powerful tool to explore the dynamics of norm diffusion. In this paper, I will: 1) define the structure of the model and translate the diffusion mechanisms into a system of agent and environment rules, 2) explore the emergent phenomenon of each diffusion mechanism as measured by the shape of the adoption S-curve, the power distribution amongst adopters and non-adopters, and the degree of regional clustering, and 3) discuss future simulations.

ABMs are a class of formal models generally represented and analyzed through computational simulation (Axelrod 1997, Cederman 2005, Epstein 2011, Gilbert & Troitzsch 2005). Epstein (2011, 7) explains the basic design logic: "Situate an initial population of autonomous heterogeneous agents in a relevant spatial environment; allow them to interact according to simple local rules, and thereby generate or 'grow' the macroscopic regularity from the bottom up." The system is written into an object-oriented computer program and observed as it evolves over simulated time. There are three main components defining the model: the agents, the environment, and the rules which link agents to each other and to their environment. Agents are "distinct parts of a program that are used to represent social actors...[and] to react to the computational environment in which they are located"(Gilbert 2007, 5). Agents have the ability to perceive, move, communicate with others, act, and remember. The environment is the "virtual world in which the agents act" (Gilbert 2007, 6). Most commonly, the environment is a lattice, a grid that can represent geographical or ideational space. It can also represent ties in a network structure as relational variables among the system of actors.

ABMs are now a well-established tool for researchers who wish to model social processes (Tesfatsion & Judd 2006). In international relations, ABMs have been used to study such topics as the evolution of cooperation (Axelrod 1986), the dissemination of culture (Axelrod 1997), the cause and evolution of insurgencies (Bennett 2008, Cioffi-Revilla & Rouleau 2010, Weidmann & Salehyan 2013), the size of wars (Cederman 2003), and the spread of zones of peace and democracy (Cederman & Gleditsch 2004). ABMs are valuable because they offer a strong correspondence between agents in their programmed environment and real-world actors such as individuals, states, and corporations in social environments such as society, the international system, and markets. The aspects of identity, external pressures, and inner reconfiguration in the norm diffusion process make agent-based models an excellent modeling choice.

2 Theory

In this section, I explain how important characteristics of the diffusion process can be represented with an ABM approach. I propose the following model to explain change in the international system. The model defines convergence of a ***R****eceiver* to ***S****ender* as a function of three variables, hierarchy, neighborhood, and identity. Agents interact in a series of dyadic exchanges such that system dynamics emerge from the dyads. All agents have the opportunity to interact with one another, but the likelihood of social influence between any two agents is given by a function of three dyadic variables. Without specifying a particular functional form, I can write this as the following:

$$C_{RS} = f(H, N, I)$$

where C_{RS} is the convergence of the ***R****eceiver* towards the ***S****ender*. H is the the difference in rank between **R** and **S**. N is the neibhorhood connection between **R** and **S**. I is the identity of the **R** and **S** which may be more or less congruent with the norm.

2.1 Definitions

I will begin by defining the key concepts. Each definition has two parts. First, I offer a general discussion of the meaning of these concepts in terms of their application to international relations. Second, I offer a definition that is specific to the ABM framework. The act of translating the verbal theoretical description to the formal model requires some abstraction. Despite being highly abstracted, each formal definition must be precise enough to be executed in a well-specified computer program. This feature of formal models allows others the ability to critique the assumptions in an open and specific manner.

2.1.1 Convergence

How should a state organize its bureaucracy? What type of judicial system should it establish? How should it set its tariffs? Such questions imply that states have autonomy to set their own policies and design their own institutions, and a naive observer may expect to see great variety in the design of states. Instead, there is a high degree of similarity amongst the institutions and policies of states in the international system. For various reasons, states often adopt policies or institutions that other states have already put into place. This is the concept of convergence. For example, Finnemore (1996, 38) identifies the diffusion of "formal state science policy bureaucracies" amongst members of UNESCO. Finnemore contrasts demand-side theories to supply-side theories and finds evidence supporting the idea that these science policy bureaucracies spread because states were learning from international organizations. Another prominent example is gender mainstreaming (True 2003, True & Mintrom 2001), the proliferation of women's policy bureaucracies throughout the globe.

Convergence is defined as a change in the form of one actor such that it becomes more like another actor. Formally, a ***Receiver*** state is said to converge toward a ***Sender*** state when an element i_R of its identity I_R changes to match the corresponding $i_S \in I_S$.

- $i_{St} = 1$
- $i_{Rt} = 0 \rightarrow i_{Rt+1} = 1$

2.1.2 Hierarchy

The first aspect of the international system that is represented in the model is hierarchy. Recent work on hierarchy (Lake 2009) are the latest manifestation of Thucydides' millenia-old adage about power, "the strong do what they can and the weak suffer what they must." The concept of hierarchy is built upon the concept of a systemic set of power relationships. To better clarify the relationship between hierachy and power, I first introduce the concept of dependence.

Dependency describes a relationship between two organisms in which one relies on the other for survival or sustenance. In general, relationships characterized by dependency tend towards convergence in form and behavior from the weaker toward the stronger. However, just because there is a difference in the strength of two actors, it does not mean that there is a corresponding level of dependency between the two. The international system is characterized by interdependencies. Deutsch (1968, 255) gives a concise definition of interdependence that clarifies the meaning of dependency:

> Two countries are interdependent if a change in country A, say a rise in the general price level, is followed by some predictable change in country B, such

> as perhaps also a rise in the level of prices there. If a change in country B has as big an effect in country A as the change in A had on B, then we may call their interdependence symmetrical.

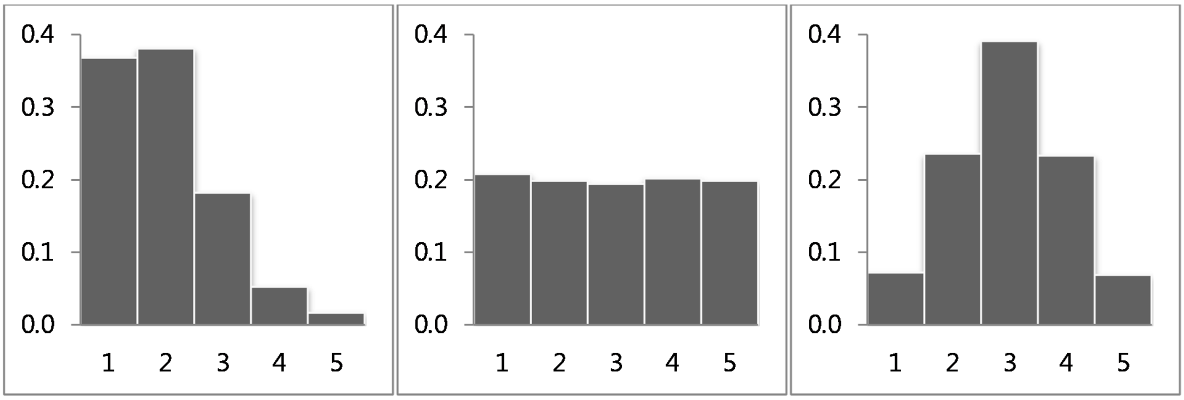
Thus, according to Deutsch's definition, dependency can be thought of as the inequality in interdependence between two interacting organisms. Dependency is fundamentally a relational concept. It is closely related to the concepts of power and hierarchy. Power is traditionally defined in political science as the ability of A to change the internal structure of B without altering its own structure. "Power in this narrow sense is conceived on the analogy of the hardness scale of minerals, of the scratching of glass by a diamond, or of the 'pecking order' in a chicken yard" (Deutsch 1966, 111).

There are two sources of power, hard (material) and soft (ideational). Material power is based on physical capabilities that can be mobilized towards the purpose of political influence. In international relations, this is generally conceived of as military capabilities. Ideational sources of power are the mechanisms of social influence that do not emerge solely from material inequality. However, in practice the two are linked closely because the militarily powerful are able to control sources of soft power. The concept of prestige captures the dual nature of power. Some actors are venerated and are socially influential due to the respect they have earned by virture of being leaders. However, leaders often rise to such prestigious positions because they control material resources. Therefore, social power is hard as well as soft.

While the two faces of power can be discussed separately, it is difficult to distinguish between them empirically. There is a strong tendency to favor material power which can be measured more systematically than ideational power which is difficult to measure. In the formal model, however, there is no need to worry about the complexity between physical and social foundations of power. Dependency is operationalized as the extent to which power/rank differences increase the likelihood of convergence.

If there is one interacting population, the members can be sorted into a hierarchy. Figure 1 shows the theoretic relative frequency of different ranks in the social system based on different distributions. For social rank, the first hypothetical distribution is based on the probability mass function of the Poisson distribution with λ set to 1. This hypothetical distribution of power is characterized by many more weak actors than strong. It indicates the high degree of inequality between the higher and lower ranks: a few very powerful states, a middling number of somewhat powerful states, and a large number of

Figure 1: Poisson, Uniform, and Normal Distributions Representing Hierarchical Rank



very weak states.

The Poisson distribution is a potentially good choice because it corresponds well to the empirical record. However, other choices are possible. A second assumption might be that there are an equal number of states represented at different levels of social rank or power which would be represented by the uniform distribution. Alternatively, there could be a large middle class with few very powerful and very weak states. The third column of Figure 1 shows a distribution of this type, a normal distribution which has been truncated and assigned five integer values using cutpoints. While some distributions are more realistic than others, it is possible to test whether the findings are robust to various assumptions of the underlying distribution of rank and power.

- $H_S > H_R \rightarrow$ "top-down"
- $|H_S - H_R| \leq 1 \rightarrow$ "bottom-up"

2.1.3 Neighborhood

Neighborhood can be understood in two ways, community and network. As "community," neighborhood refers to a world divided into subcategories of relevant regions. While relevant regions are defined in large part by geographic factors, they are smaller than continental regions (Nye 1968). Regions are often hard to define empirically. Huntington (1996) has argued for large cultural regions, but others have criticized his classification for being both too general (the inclusion of all majority-muslim countries into one category) and too specific (isolating Japan). Katzenstein (2005) emphasizes the social nature of regions, arguing that geography is arbitrarily defined. Regions can also be thought of as economic units that are more diffuse than states but more connected than the globe. The regional political economy approach operationalizes regions as geographically clustered preferential trade agreements (Mansfield & Milner 1999). Whether culture, geography, or economic factors are used to determine how a region is defined, there is one common thread to all uses of regions. States share more in common with other states within their own region than with states from other regions. Furthermore, the almost certainly interact more with states in their own region. Thus, regions define barriers to social influence.

Despite the existence of world society in which all parts of the globe are interconnected to some degree(Meyer, Boli, Thomas & Ramirez 1997), regionalism is a persistent feature of the international system (Mansfield & Milner 1999). Regionalism implies that the global community is constituted by relatively weak ties between regions. This is represented dyadically by regional communities where the ties are stronger between members of the same region than between members of different regions. However, within the regionalist approach it is still possible that some members of the global community are relevant to all others regardless of their region. Even in systems with globally relevant actors, most members are regional first. In the global perspective, regional ties are not necessarily weak, but they do not preclude strong global ties.

The relevant question is whether **R** and **S** are in the same region or not. This makes neighborhood a dichotomous indicator. However, neighborhood can be defined in a continuous way if it is conceived of as a network. This would lead to a question about the strength of the community ties between two states. The use of the network metaphor helps address the problem of using only physical geography (contiguity/distance) to establish arbitrary regions. Scholars of international organizations have argued that shared IO membership is a good way to think of global ties (Pevehouse 2005, Pevehouse & Russett 2006). Others have focused on the structure of alliance ties (Maoz, Terris, Kuperman & Talmud 2007, Maoz 2011). The present analysis dichotomizes neighborhood, but future extensions need not be limited by the current modeling restriction.

- $N_S = N_R \rightarrow 1$
- $N_S \neq N_R \rightarrow 0$

2.1.4 Identity

Identity is like genetic code (Florini 1996). It is the structure of an organism that, in addition to environment, conditions the behavior of that organism by determining underlying preferences. States are like organisms in that they have a set of domestic institutions and attributes. This structure consists of the formal rules that define the powers of government. While institutions are key, they alone do not constitute the identity. Identity is also attributed to culture, "facts on the ground," the resource endowments, and the population in terms of its size and organization. In other words, identity is everything that defines a state. Some configurations of identity will more readily lead to particular adaptations than others. That is, the way in which the ruling group is organized (1) and the characteristics of the population (5) are likely to alter the likelihood of adoption. For instance, some populations may have cultures that are consistent with international norms (Acharya 2004). Alternatively, some ways of organizing the government may alter the way that elites interact with their own populations and the international environment, making norm adoption more or less likely.

Identity is made up of two elements of the set of I, i and i^* (read i-star).[1] i^* represents internalization, the latent aspect of norm adherence. It is the largely unobserved aspect of norm. i represents the expression of the norm, and it is observed by the other actors in the system. For behavioral research purposes, we often assume that if we observe i then it must be true that i^* is also present. In other words, that $p(i^* = 1|i = 1) = 1$. Whereas we focus on behavior in the empirical social sciences for obvious reasons, many of our theories hypothesize unseen structures that are related to behavior but not necessarily in straightforward (linear) ways. Unfortunately for empirical scholars, it is not sufficient to observe a behavior and infer that it represents an internalized belief.

Table 1 is a cross-tab of the typology of agents. Rather than refer to these types using their formal descriptions, $(i = 1, i^* = 1); (i = 1, i^* = 0); (i = 0, i^* = 1); (i = 0, i^* = 0)$,

[1]The identity should be thought of as having many elements. For the model, we will focus on only two of these elements and pay close attention to how they are related. However, we can actually conceive of i and i^* as subsets of I. i^* is the set of elements necessary to internalize a norm. In other words, it is a multidimensional norm. Thus, while we are assuming only one dimensional norms, the model can extend to n-dimensional norms. However, I suspect that each increase in the number of dimensions will geometrically increase the level of complexity.

Table 1: Definition of Identity

Expression	Internalization: $i^* = 1$	Internalization: $i^* = 0$
$i = 1$	True Believers	Poseurs
$i = 0$	Uninitiated	Nonbelievers

I introduce four names that capture the basic aspects of each agent-type, true believers, poseurs, uninitiated, and non-believers. **True Believers**, **(TB)** are norm internalizers and norm expressers. The term has both positive and negative connotations. Hoffer (1951) uses the term to refer to individuals in social movements who are radicalized and believe deeply in the movement ideologies. He uses the case of Nazi Germany, and points to the danger that true believers can have in shaping society. On the other hand, just as the mass movements that led to totalitarianism had true believers, all social movements must have them. Whether or not a norm is normatively good is not at issue, rather it is the structure of the identity of the true believer that we are concerned with. **Poseurs**, **(P)** are not norm internalizers, but they do express the norm. For whatever reason, they believe it is better to demonstrate to the world that they follow a norm. This type of actor is common to ethnographers who study counterculture (Fox 1987), but the prevalence of poseurs extends into all social systems. The existence of this type of actor is especially problematic for empirical studies because poseurs behave just like true believers. **The Uninitiated**, **(U)** are norm internalizers but not norm expressers. They have not yet begun expressing the norm. This could be due to the fact that they haven't been exposed to the norm or exposure was from the wrong type of actor. If they adopt a norm they become true believers. **Non-Believers**, **(NB)** have neither the internalization nor the expression of the norm. Like true believers, they are in a stable state. i and i^* are in congruence. However, non-believers may still adopt i. If so, they become poseurs.

Recall that I am modelling the convergence of R to S along the expression dimension, i. This means that the model is set up to study the following two cases, when the uninitiated become true believers and when non-believers become poseurs.

- $U \rightarrow TB$
- $NB \rightarrow P$

While these cases are interesting, there are many other processes that could be imagined in this framework. How do poseurs become true believers $P \rightarrow TB$? How do non-believers become true believers and vice versa? Assume that the likelihood of simultaneously changing internal and external norm adherence is low compared to experiencing the change in a sequence. Then, there are two pathways between these two types. Does the path taken matter, $NB \rightarrow P \rightarrow TB$ vs $NB \rightarrow U \rightarrow TB$? What about backsliding? Do TBs ever 'lose their norm' and revert to being the uninitiated, $U \leftarrow TB$? What conditions would lead a poseur to quit with the facade and become a non-believer again, $NB \leftarrow P$? These are questions that will be explored in future iterations of the model.

3 Models

Figure 2 provides a visual representation of the model set-up. The lattice is the spatial environment of the agents, and in this case it is made up of 10 rows and 10 columns. An agent exists at each cell, and its shape and color identify its type as discussed in **??**. The two sliders to the left of the lattice indicate that approximately 80% of agents would begin the simulation with the internal norm, $i^* = 1$. Of the population of agents with $i^* = 1$, 10% start with the external norm, $i = 1$. Each agent has a rank within the global hierarchy (1, 2, 3, 4, 5). The histogram to the left of the lattice shows the distribution of power. In this case, hierarchy is drawn from the poisson distribution. The lattice is divided into two equal parts which are indicated by the two shades of green.

In each round, one agent $\boldsymbol{R}$ is selected at random to be the potential ***R****eceiver*. Then, one other agent $\boldsymbol{S}$ is selected as the ***S****ender*. $\boldsymbol{R}$ is the agent who will potentially change, and $\boldsymbol{S}$ is the agent whose attribute will potentially be transmitted to $\boldsymbol{R}$. For each tick, the two randomly chosen agents R and S are activated, and H, N, and I are observed. Once a dyad ($\boldsymbol{RS}$) has been selected, it will potentially converge along a particular feature i^* given by the function specified in terms of $f(H, N, I)$.

Consider Figure 3. The red cell indicates that this agent has been selected as **R** and the agent on the blue cell is **S**. Both **R** and **S** are of rank 1, so the difference in hierarchy $H_S - H_R = 0$. They are not in the same region, so they score zero for neighbors. **R** is a nonbeleiver (i = 0, i* = 0) while **S** is an uninitiated (i = 1, i* = 0). In this case, due to an as yet undefined rule, **R** does not converge to **S**.

Comparing Figure 3 to Figure 4 offers an example of convergence. Figure 3 takes place one time period in the future. Two new agents are selected, as indicated by the red and blue cells. As we can see, **R** has changed from an uninitiated to a true believer due to

Figure 2: Initialization

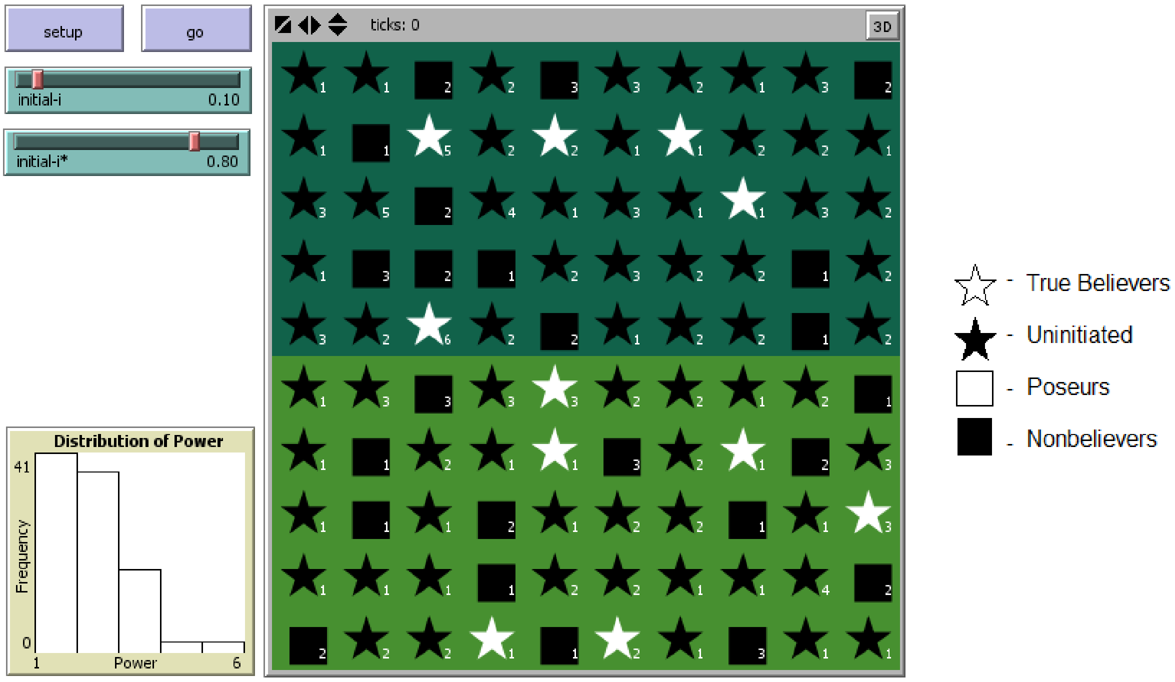


Figure 3: Non-convergence

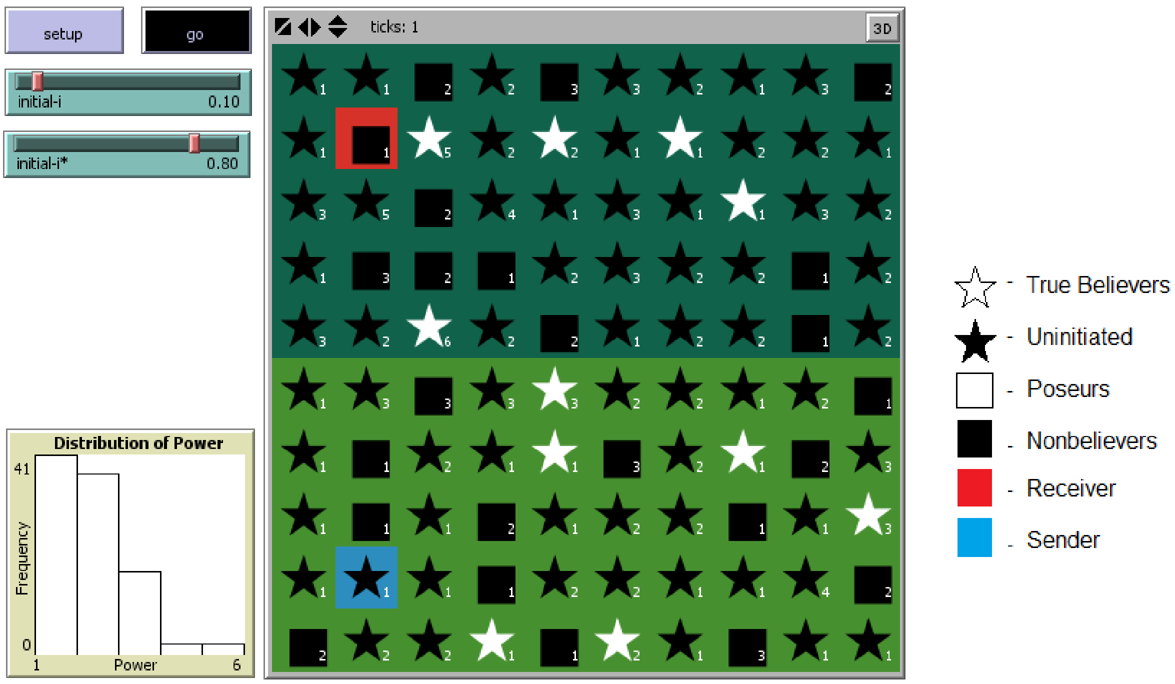
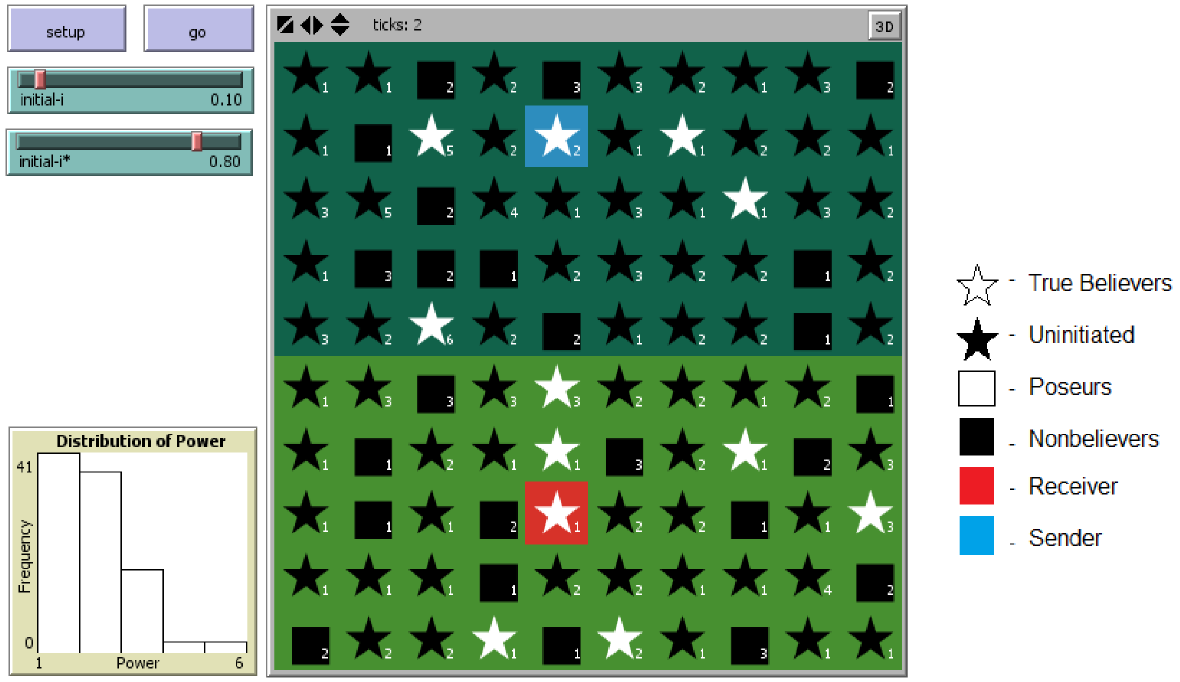


Figure 4: Convergence



its contact with **S**. In this case, the agents were from differing neighborhoods indicating that social influence was not hindered by the difference. **R** is of rank 1 and **S** is of rank 1, so the difference in hierarchy $H_S - H_R = 1$. This indicates that social influence came from above (but not from the top).

The ways of defining the function which maps *Hierarchy*, *Neighborhood*, and *Identity* onto Convergence are limitless, so I draw on the diffusion literature to help guide the specification process. I focus on four diffusion mechanisms to specify the functional form of f(.): coercion, competition, emulation and learning (Franzese & Hays 2008, Dobbin, Simmons & Garrett 2007, Elkins & Simmons 2005). Each diffusion mechanism produces distinct patterns. I present ideal types of each of these mechanisms in isolation by specifying an agent based system.

Table 2 summarizes the different rules used for each mechanism.

3.1 Coercion

Reading from left to right on the first row of Table 2, I define coercion as a top-down, global mechanism in which the sender must be a true believer while the receiver can be

Table 2: Formal Definitions of Diffusion Mechanisms

	Hierarchy	Neighborhood	Identity	
	$H_S - H_R > 0$	$N_S = N_R$?	$i_S^* = 1$?	$i_R^* = 1$?
Coercion	X		X	
Competition		X		X
Emulation	X	X		
Learning				X

an uninitiated or a non-believer.

Coercion refers to the involuntary changes undergone in a unit due to external pressure. For instance, one common form of direct systemic coercion is the conditionality requirements that the IMF sets in order to provide aid and loans (Dobbin, Simmons & Garrett 2007). In general, the coercion mechanism describes "a world in which a few powerful players exercise disproportionate influence over others – through carrots and sticks, using go-it-alone power, by serving as focal points, or through hegemonic ideas" (Dobbin, Simmons & Garrett 2007, 462). The direct effect of coercion is best understood through an example of power inequality in a dyadic relationship. If the more powerful state desires a particular change in the less powerful state, it can use a variety of direct means, from bribing to propaganda to the use of force, to accomplish its goal of affecting change in its subordinate. There is also an indirect power relationship which is defined as the level of dependence characterizing the relationship between the two states. The mechanism is still coercive, but it does not require a policy or even the interests or attention of the more powerful state.

3.2 Competition

Reading from left to right on the second row of Table 2, I define competition as a bottom-up, local mechanism in which the receiver must be an uninitiated while the sender can be a true believer or a poseur.

Actors often have to invest in reforms before they are eligible for external support. In the case of competition, states may be competing over a material reward that is only available to a certain class of states. If there is a limited supply of that good, then there are incentives to compete against the other actors who also desire that support. The key distinction between competition and coercion is the difference between rivalrous and non-rivalrous goods. In the case of coercion, there is an unlimited supply of the benefit such that the adoption of one actor reduces the utility in adopting for others. In competition, however, the ability of one actor to attract and capture a good limits the amount of goods available to other actors. Economic policies such as corporate tax rates designed to capture foreign direct investment creates a race-to-the-bottom effect. Actors converge on the policy or institution resulting in the lowest cost to potential investors; that is, the best possible situation for the investor and worst for the group of reformers (Drezner 2001). Alternatively, states may be competing over social status. The desire of leaders to boast their state's achievements should not be discounted as a motivation. Topping the list of a development indicator, especially the level of women's representation, is of potentially great value to the leaders of some states. Regardless of the motivation, the key to the competition mechanism is that there is a limited amount of benefits available to potential adopters (outside of the costs/benefits of the institution itself).

States are more likely to compete with others of the same rank. If the adoption of some trait leads to a competitive edge amongst ones' peers, actors will be pressured to adopt. Competition piques when actors are of a similar rank because it is easier to surpass those close to you than those far ahead. This logic is the same regardless of whether the competition is over social status or an economic good. This means that the likelihood of convergence increases as the difference in rank of $\boldsymbol{S}$ to $\boldsymbol{R}$ decreases. For the same reason that competition occurs amongst actors of a similar rank, competition is more likely amongst members of the same neighborhood. Although teams compete against each other, most of the social interaction occurs within teams. Thus, when rank is concerned, the competition within the team for status is greater than any individual rivalry amongst players of opposing teams. The probability of interaction is higher if $\boldsymbol{S}$ and $\boldsymbol{R}$ are from the same region.

3.3 Emulation

Reading from left to right on the third row of Table 2, I define emulation as a top-down, local mechanism in which the sender can be a true believer or a poseur and the receiver can be an uninitiated or a non-believer.

In competition, states are motivated by rivalries with states of a similar status. In emulation, lower status states look to global and regional leaders as models. Especially in cases of high uncertainty, actors may look to their esteemed peers in order to gain information about what they should do and how they should do it. DiMaggio and Powell note that mimetic isomorphism is a common response to situations "when goals are ambiguous, or when the environment creates symbolic uncertainty, organizations may model themselves on other organizations" (DiMaggio & Powell 1983, 151). In other words, states may not even be aware that they have a policy problem before they are adopting policies designed to solve it. The international system defines both the problem and the solution before a given society is even aware that it has a problem. In general states value prestige, but they also seek to maximize similarity such that there are regional as well as global leaders. In this way, state identities are strongly conditioned by fads that originate with the innovator class.

3.4 Learning

Reading from left to right on the last row of Table 2, I define learning as a bottom-up, global mechanism in which the sender can be a true believer or a poseur while the receiver must be an uninitiated.

Learning occurs when a state sees the benefits that come from adopting some policy by observing and communicating with others. The first thing to note about social learning is that individuals are lazy; the availability of information is a key to how states learn. Actors will either find it too difficult or too costly to create a list of all possible policy alternatives. Instead, they will be drawn towards models which are available to them whether because nearby actors have a particular policy or institution, or because an actor is familiar with a particular policy. "One clear expectation is that experiences of those governments with which one communicates and interacts will be most available ... However, it is also likely that the policy of prominent nations will be highly available, and consequently, policy makers will tend to weight those cases disproportionately" (Elkins & Simmons 2005, 44). The availability mechanism highlights the fact that information is transmitted through channels of communication. One way to gain information about a reform is to select the policy that has been demonstrated to most efficiently accomplish the desired policy goals. Oftentimes, this will be weighted most heavily those actors who are similar in terms of the global hierarchy.

4 Computational Investigation

To summarize the discussion above, the model has the following parts:

1. Each agent is distributed onto a lattice with a fixed position. There is one and only one agent on each cell.

2. The lattice is divided into n neighborhooods.

3. The internal norm i^* is distributed in the population with some probability π_{i^*}.

4. Of those with the internal norm i^*, some proportion of those states begin with the external norm i.

5. Each agent has a social rank from 1 (lowest) to 5 (highest) which is distributed in one of three ways:

   (a) Uniform [1,5]

   (b) Normal (2.5,1)

   (c) Poisson (1)

4.1 Emergence

Figures 5, 6, and 7 show the average outcome over 10 runs for each of the diffusion mechanisms as well as the minimum and maximum runs. The three figures show quantities of interest over time: relative power of adopters to non-adopters, regional differences in adoption, and the shape of the adoption S-curve. While most of these results are not especially surprising given the assumptions of the model, they offer a good starting point to discuss the general patterns associated with the mechanisms. The parameters used for each of these simulations are:

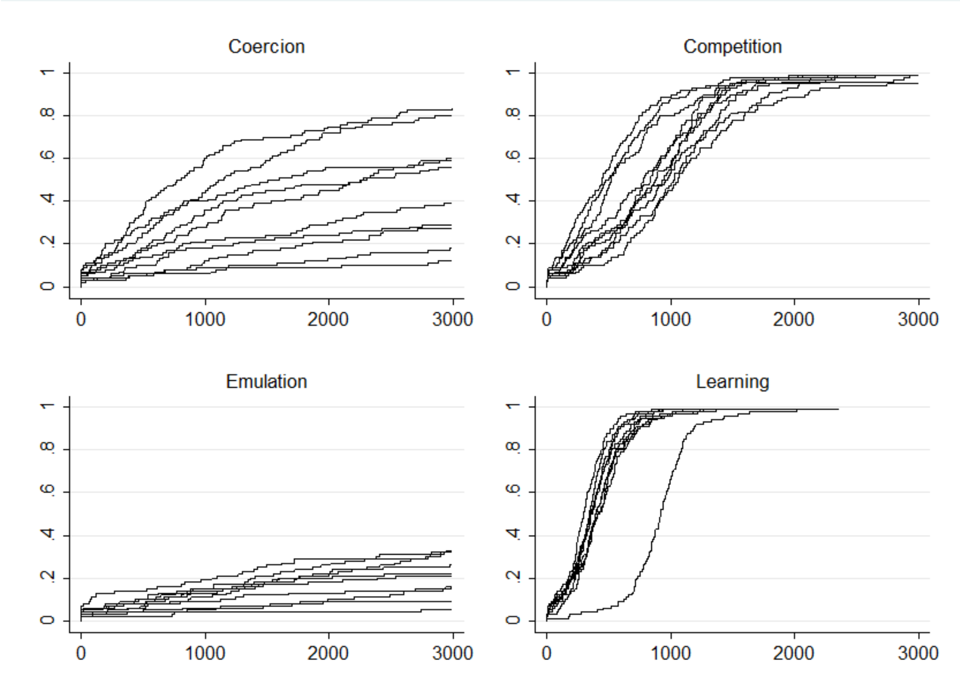
1. The proportion of states with i^* at setup, $\pi_{i^*} = 1.00$

2. The proportion of states with i at setup, $\pi_{i^*} = 0.05$

3. $n = 2$ regions

4. An unequal social hierarchy distribution, Poisson ($\lambda = 1$)

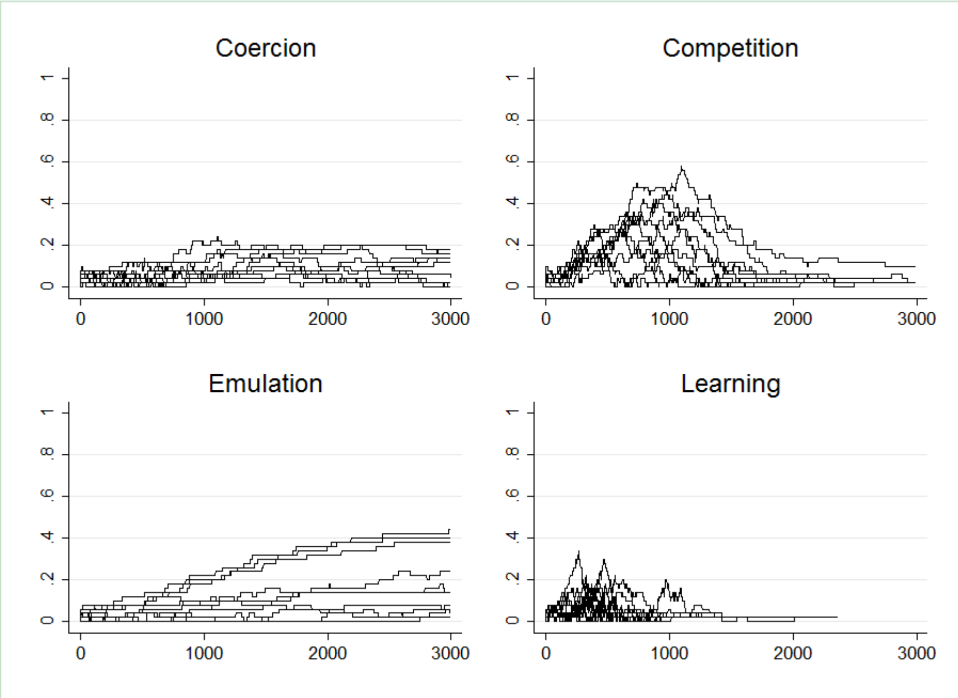
Figure 5: Adoption S-Curves, Proportion i = 1



4.1.1 Speed and completeness of adoption cycle

Figure 5 shows the S-curves of the different mechanisms. While it is premature to make general claims about the behavior of the different mechanisms, these initial trials are telling. The learning mechanism is by far the fastest, while emulation is the slowest. Furthermore, although it is not necessarily obvious based on the truncated time frame, neither coercion or emulation tend to produce systems that end with full adoption while competition and learning do result in complete population adoption. It is theoretically possible for coercion and emulation to result in full adoption, but this is rare because it would require the initial population of norm adherents to include the most powerful states. In the empirical world, this special case may actually be a common way for norms to spread. However, in the parameter space, these cases are infrequent. Thus, the model has identified an interesting implication, we may only observe norms that originate amongst the most powerful states because other potential norms originating from below never spread widely.

Figure 6: Regional Differences in Proportion i = 1



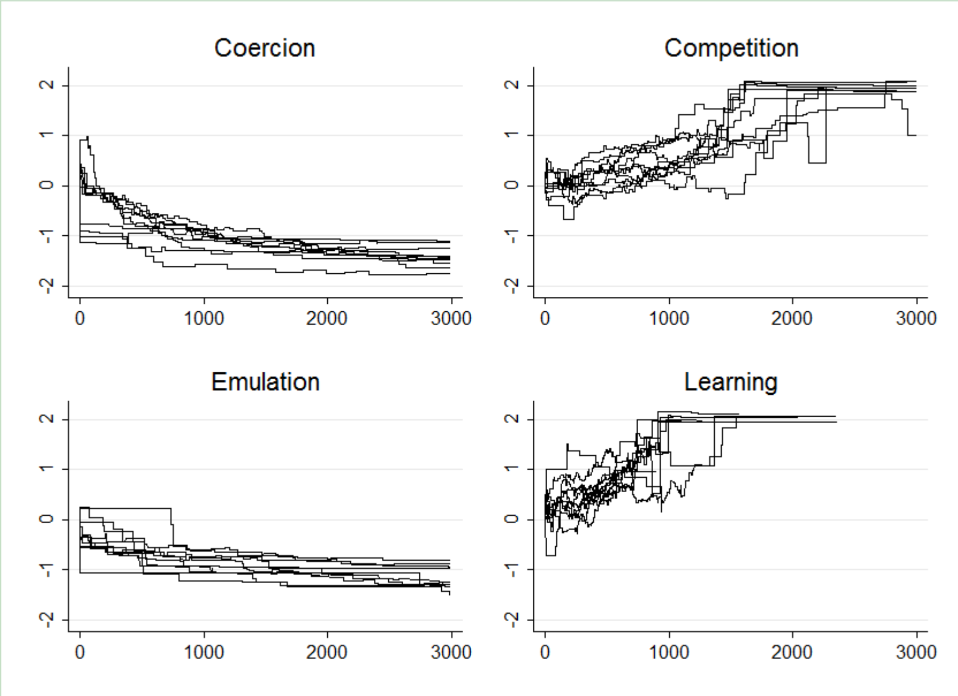
4.1.2 Regional Prevalence

Figure 6 shows how differences in regional adoption patterns emerged over the course of the simulations for the different mechanisms. The plots show the 10-run behavior of the absolute value of the difference between regional prevalence. Unsurprisingly, competition and emulation demonstrate regional dynamics while coercion and learning do not. However, the pattern of regional adoption was not predicted beforehand. In competition, one region will "take off" ahead of the other due to chance conditions. Over time, the lagging region closes the gap. In emulation, the regional difference is slow to emerge, but it continues to grow. This means that emulation can produce lasting regional differences. Such lasting changes may be an analogue to speciation in the biological sciences in which different species emerge from the division of an original species. Because of the barrier between the two regions, the social dynamics of the system encourage differences between regions to emerge and be solidified.

4.1.3 Relative Power

Figure 7 shows the average power of the population of adopters divided by the average power of non-adopters. This measure is intended to capture the strength of the commu-

Figure 7: Difference in Average Power between Adopters and Nonadopters



nity of norm adherents. It is conceptually similar to the measure of the strength of the democratic community (Kadera, Crescenzi & Shannon 2003). However, operationally, it has a key difference because power in their model sums to one in each year whereas rank does not in my model. In emulation and coercion, the average power of the adopters is less than the average power of non-adopters. For both mechanisms, this difference grows over time so that by the end of the simulation, the powerful states are much less likely to have the norm than the weak states. The somewhat surprising finding is that the average strength of the community of adopters increases relative to non-adopters in the case of competition and learning. This implies that, despite the fact that learning and competition are limited to states of a similar status ± 1, it is not only possible for an innovation to diffuse from below. It is actually the case that relatively powerful states are adopting more quickly than weak states.

4.2 Typical Runs

The final set of figures gives a sense of how the model performs. The four examples show a typical run for each mechanism. The same initial parameters that generated the 10-run trial were used. Learning exhibits a classical diffusion S-curve. There are some regional differences, but they are small. On average, regional differences wash out, and the typical run displays this behavior. The average power of the norm adherents compared to the average power of the non-adopters is close to equal for most of the simulation. However, as the S-curve approaches its second inflection point, the average power of the adherents grows relative to the non-adherents. This implies that the non-adopters are relatively weak compared to the adopters.

The typical case for competition also produces a classic S-curve, but it takes longer to complete the diffusion cycle than the learning mechanism. Initially, the two regions have similar numbers of adherents. Not long into the cycle, regional differences begin to emerge. There is no reason why one region will be quicker than the other, but they are likely to have different adoption patterns. The regional difference continues to grow and peaks about half way through the diffusion cycle. It then declines as the lagging region finishes its cycle. The relative power of norm adherents compared to non-adherents remains relatively equal throughout the simulation until the end. Like learning, the average power of adherents compared to the average power of non-adherents increases as the diffusion cycle matures.

In a typical run for coercion, the S-curve is much flatter than either learning or competition which means the process of diffusion occurs more slowly. It also does not generally reach full adoption in the population. There are no strong regional dynamics, although chance can lead some regions to appear to have faster cycles than others. Because coercion is a top-down mechanism, it is not surprising that the average power of adherents decreases relative to the average power of non-adherents as the simulation goes on. This means that at the end of the simulation, it is the strong states that are the remaining non-adopters while the weak states have all adopted.

Finally, for emulation, the S-curve is the flattest among all the diffusion mechanisms. A typical run of emulation does not lead to full adoption within the population. While initial differences between regions are small, these differences grow over time and can become quite large by the end of a simulation. Like coercion, the average power of adopters decreases relative to the average power of non-adopters over the course of the diffusion cycle. This means that the powerful states are holdouts. In terms of regional dynamics, some regions may gain close to full adoption while other regions have a very low level of norm prevalence.

Figure 8: Coercion typical run

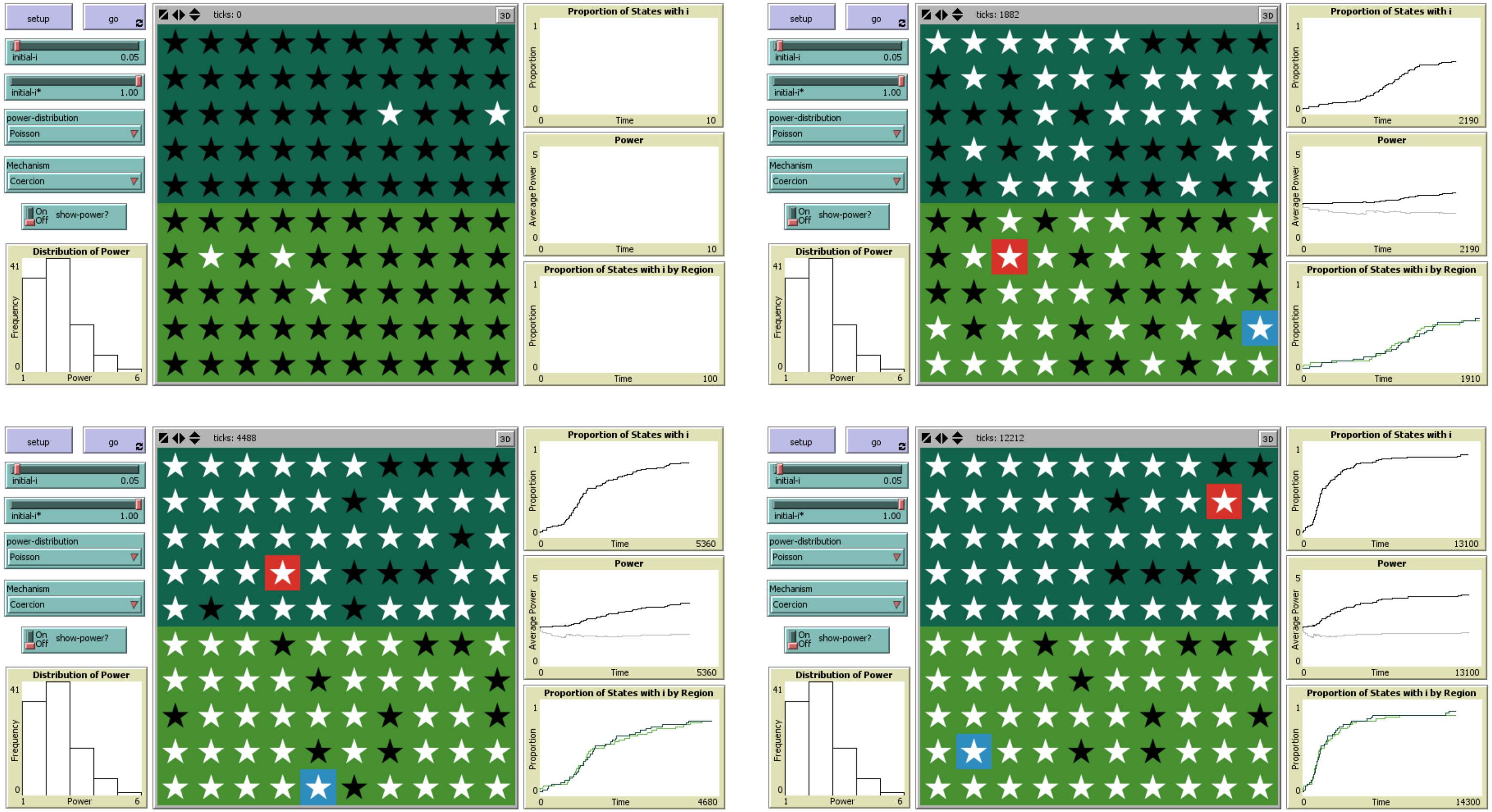


Figure 9: Competition typical run

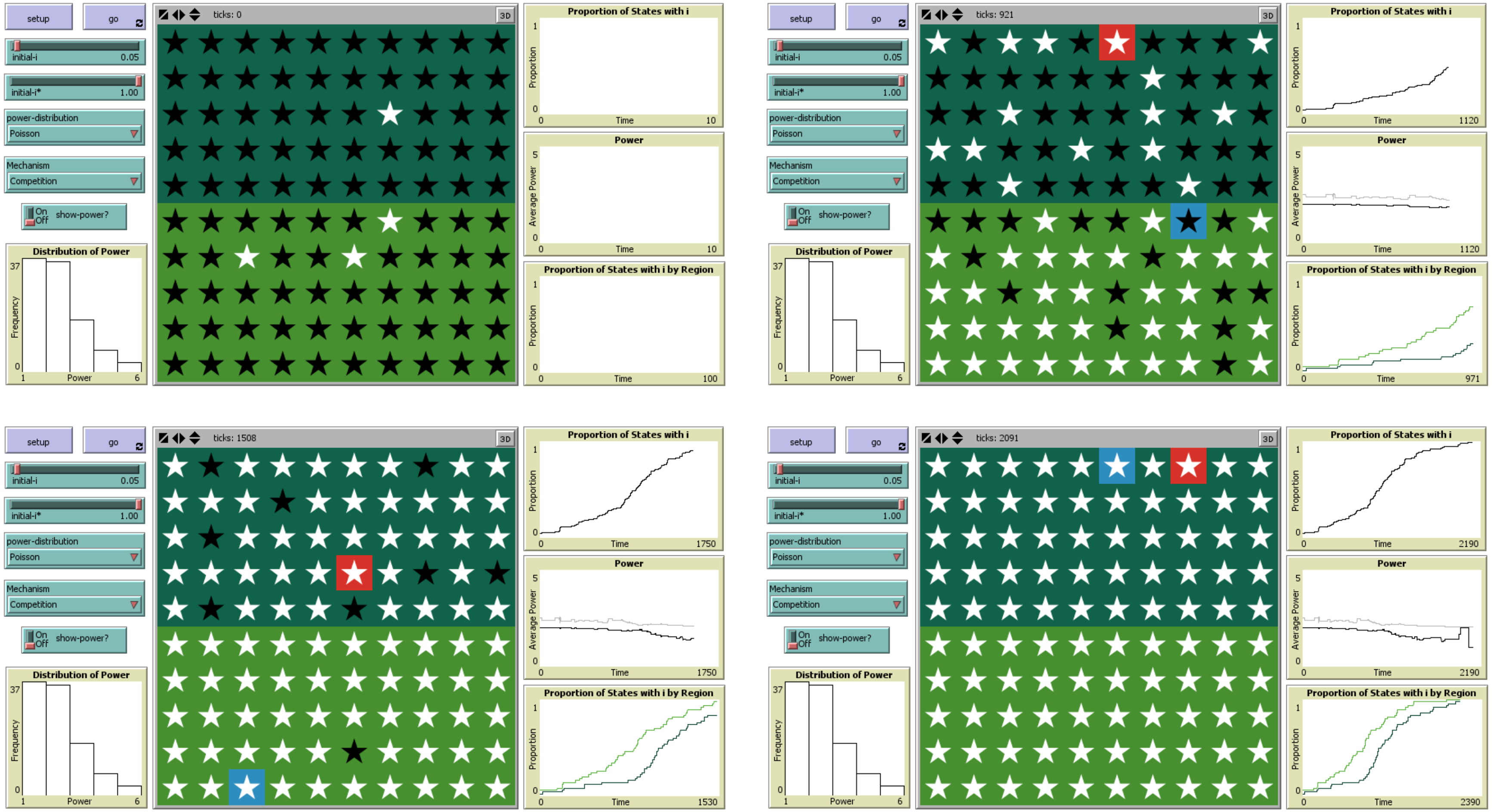


Figure 10: Emulation typical run

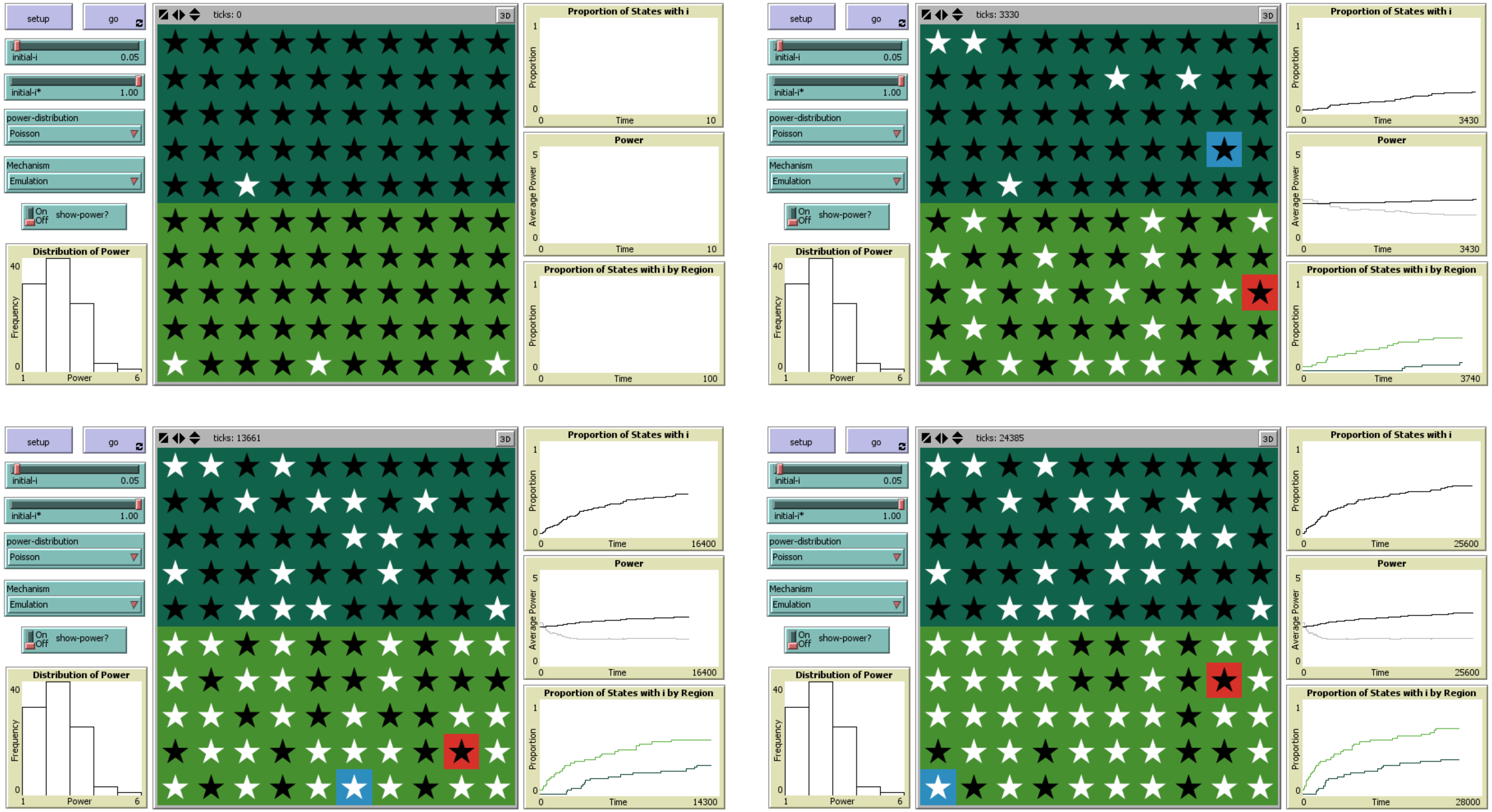
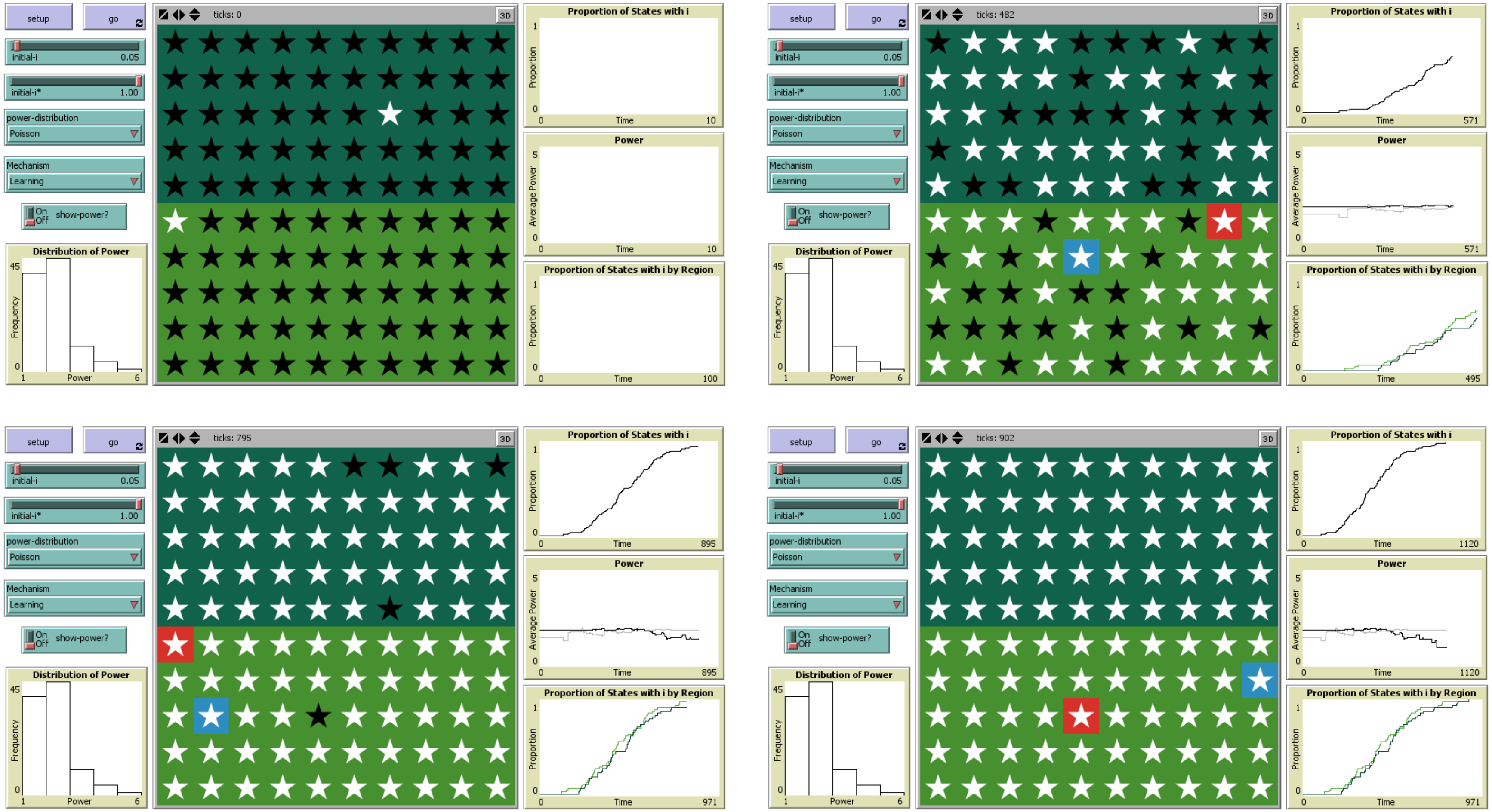


Figure 11: Learning typical run



5 Conclusion

5.1 Contribution

This model contributes to the understanding of norm diffusion in several ways. First, it provides a formal account of the norm life cycle that is consistent with large body of constructivist research. Finnemore & Sikkink (1998) posited several specific claims about the norm life cycle which I reproduce in the formal model using limited assumptions. For instance, they argue that the dominant mechanisms of norm diffusion differ based on what part of the life cycle a norm is in. My model demonstrates that if we observe a fully accepted norm, coercion and emulation are unlikely to have been dominant in the earliest stages of the life cycle. The agent-based model provides a way to distinguish between cases of norm diffusion that are empirically very similar. If we suspect that the likelihood of norm internalization varies accross diffusion mechanisms, we can make predictions about which norms will be powerful and which are weak.

Second, the formalization of the norm life-cycle theory also helps advance the empirical literature. In general, scholars of norms have been more focused on theory generating than theory testing due to the difficulty of observing states recreate their identities in the global social milieu. Yet, it is possible to observe the power of ideas given a specific focus and using formal logic to capture latent and unobservable processes. For sound methodological reasons, much empirical constructivist research relies on small-n comparative case studies. However, there is also room for large-n analyses in the study of norms. By formalizing the norm life-cycle, I am able to investigate aspects of norm diffusion that have previously been overlooked by qualitative scholars and ignored by quantitative scholars. The model suggests that differences in the spatial and temporal pattern of norm diffusion between the various mechanisms will be an important piece to the empirical puzzle.

Finally, this model helps clarify the long-standing agent-structure debate in the field of IR. Rather than argue which is ontologically prior, I adopt an approach in which both agents and the structure are simultaneously constituted. On the one hand, the structure of the system appears to be created by the interactions of the agents. However, those interactions are not dependent solely on the attributes of the agents; the structure is fundamentally distinct. On the other hand, despite the strong environmental impact on agent behavior, agents are distinct units that are driven from within as much as they are responsive to their environment. Thus, as many constructivists have argued, agents and structures are mutually constituted and cannot be analyzed independently of their environment just as a system cannot be understood without reference to the individuals comprising it. While many have come to this conclusion theoretically, many fewer have been able to specify empirical or formal models that take the agent-structure problem seriously. Using agent-based modelling to represent this important feature of the international system is an important theoretical contribution.

The analysis presented in this paper represents a first step in understanding the norm life cycle. So far, it has shown that a small number of relatively noncontentious assumptions are sufficient to reproduce important arguments from the extant literature. Through further investigations, previously unknown relationships and deductions may emerge from the model. By answering the questions posed in the previous section, the agent-based model presented in this paper will potentially provide numerous insights on the norm life cycle and policy diffusion literatures.

5.2 Future Simulations

Because models are created with respect to a particular empirical phenomenon, it is unsurprising that the present model is able to accurately describe the norm diffusion process. However, there are an infinite number of models which could be constructed to fit the empirical record. Thus, for a model to be useful, it is necessary but not sufficient that it predict the phenomenon it was designed to explain. Once the model is created, we can discover what other implications can be derived from it rather than simply observing whether or not a model fits particular data. One advantage of simulation is its ability to explore a wide parameter space (de Marchi 2005). With the small set of variables included in this model, it is already a large task to explore the different combinations of parameters without complicating the model further. Nonetheless, the model as constructed is easily amenable to including more detail. Future simulations may include more assumptions, but the current parameters are sufficient to ask and answer a wide range of questions relating to norm diffusion. For instance, the following questions will guide the next iteration of model exploration.

What about those special cases in which powerful states start with a norm? In other words, how do initial conditions matter? Under some conditions, it really matters which states are amongst the first to have the norm. Furthermore, There may be a threshold effect of initial relative power. In some mechanisms, a norm may never fully spread to the population if the initial value of relative power of norm adherents to the population is too low. In the learning and competition mechanisms, it is possible for a norm to spread under almost any set of initial conditions. For emulation and coercion, a higher level of initial relative power may be necessary to lead to full adoption. To test this, I can calculate number of runs where each mechanism can "escape" a low condition of initial relative power. For coercion and emulation, many norms never get off the ground because they are initially distributed to weak states who are unable to spread the norm vertically. This may lead to interesting patterns concerning regional outcomes. It can potentially provide answers to questions about what the initial power and regional distribution of norm entrepreneurs must be in order to spark a cascade.

A second question which will be explored further is how does the initial distribution of power change the diffusion patterns of the different mechanisms? The Poisson, uniform, and normal distributions are much different assumptions about the structure of the global hierarchy. A more equal international society may produce different outcomes. Paradoxically, one early result is that emulation and coercion are more likely to reach full adoption in a more equal society (represented by the uniform distribution) than an unequal society (the Poisson distribution). I also suspect that the important regional differences in the emulation mechanism will diminish as equality increases while no change in regional dynamics will occur in the other mechanisms.

A third important question not explored in this paper that can be answered by the model is how does the number of neighborhoods change the outcomes? More neighborhoods implies fewer agents per neighborhood. This will likely impact the speed at which competition and emulation occur. Further, it may decrease further the completeness of the diffusion process for the emulation mechanism.

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