Computational Models of Culture

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Axelrod (JCR, 1997)

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- Culture is defined as the set of individual attributes that are subject to social influence.
- Premise 1: people are more likely to interact with others who share many of their cultural attributes.
- Premise 2: interactions between two people tend to increase the number of attributes they share.

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- A list of features (e.g., 5).
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- Cultural Similarity: percentage of features that have the same trait.

Model Space

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- No movement.

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Interaction

- Each site can interact with its Von Neumann neighbors.
- Interaction is proportional to the cultural similarity two neighbors have.

TABLE 1

A Typical Initial Set of Cultures

74741	87254	82330	17993	22978	82762	87476	26757	99313	32009
01948	09234	67730	89130	34210	85403	69411	81677	06789	24042
49447	46012	42628	86636	27405	39747	97450	71833	07192	87426
22781	85541	51585	84468	18122	60094	71819	51912	32095	11318
09581	89800	72031	19856	08071	97744	42533	33723	24659	03847
56352	34490	48416	55455	88600	78295	69896	96775	86714	02932
46238	38032	34235	45602	39891	84866	38456	78008	27136	50153
88136	21593	77404	17043	39238	81454	29464	74576	41924	43987
35682	19232	80173	81447	22884	58260	53436	13623	05729	43378
57816	55285	66329	30462	36729	13341	43986	45578	64585	47330

NOTE: The underlined site and the site to its south share traits for two of the five cultural features, making a cultural similarity of 40%.

Model Dynamics

1. At random, pick a site to be active, and pick one of its neighbors.
2. These two sites interact with probability equal to their cultural similarity. An interaction consists of randomly selecting a feature on which the active site and its neighbor differ (if there is one) and changing the active site's trait on this feature to the neighbor's trait on this feature.

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- Note: Markov process with absorbing states. Number possible states in Table 1 is 10^{500} (more than number of atoms in universe).

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- Cultural region: contiguous sites with an identical culture.
- Stable regions: number of cultural regions in which each region has no similarity to any adjacent regions.

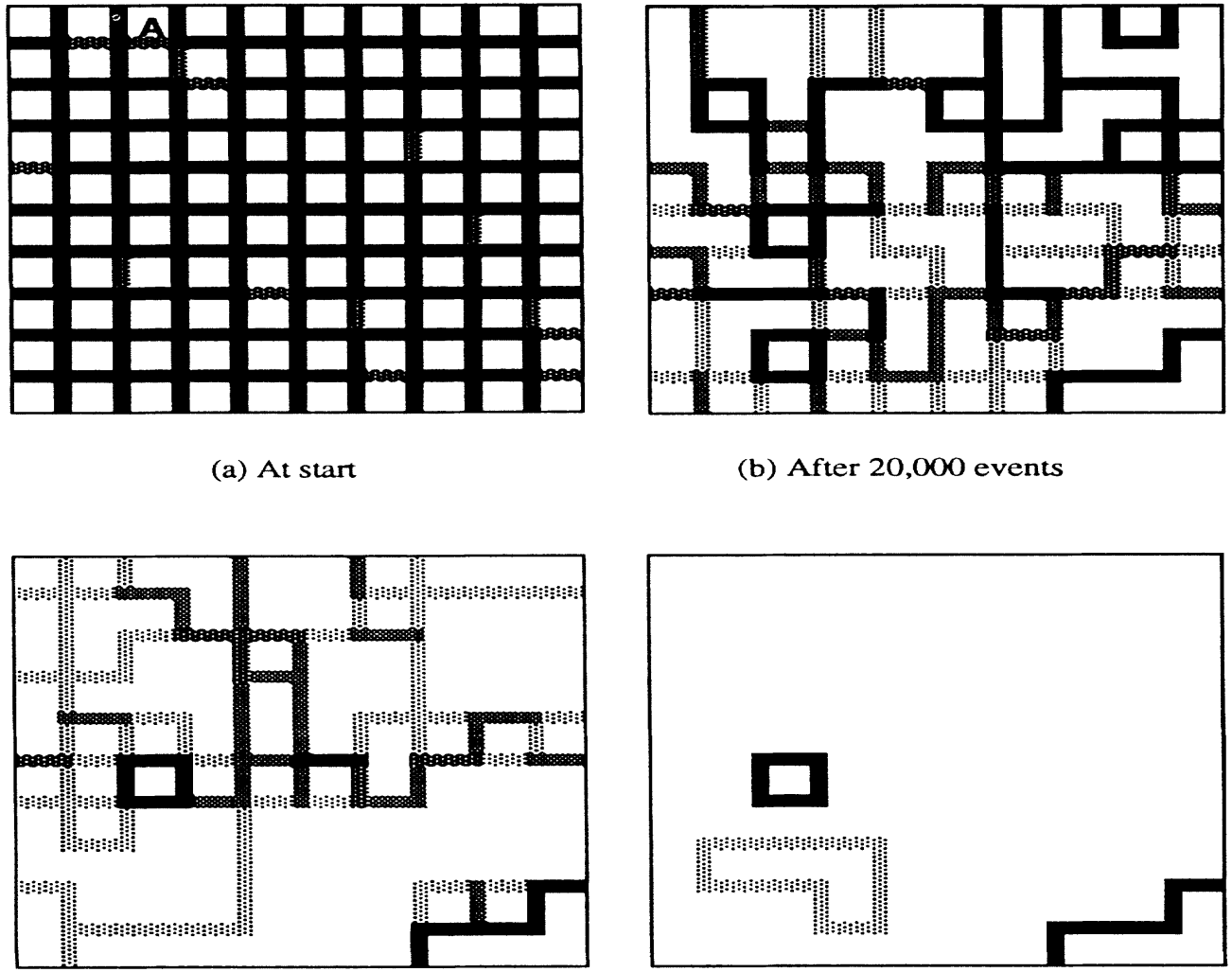

Figure 1: Map of Cultural Similarities

NOTE: Cultural similarity between adjacent sites is coded as black ≤ 20%, dark gray = 40%, gray = 60%, light gray = 80%, white = 100%. This run was conducted using five cultural features and 10 traits per feature, using the initial conditions shown in Table 1. Each interior site has four neighbors.

Results: Number of Stable Regions

- Number of features and number of traits per feature.

TABLE 2

Average Number of Stable Regions

Number of Cultural Features	*Traits per Feature*		
	5	*10*	*15*
5	1.0	3.2	20.0
10	1.0	1.0	1.4
15	1.0	1.0	1.2

NOTE: These runs were done with a territory of 10 × 10 sites, and each interior site had four neighbors. Each condition was run 10 times.

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- Why? More features makes it more likely traits will be shared and thus more likely states will interact and share another cultural trait.
- As the number of traits per feature increases, the likelihood of complete cultural convergence decreases.
- Why? Few features and many traits means that it is likely two neighbors will share no features and be unable to interact.

Results: Number of Stable Regions

- Range of interaction (4, 8, and 12 neighbors).

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- Range of interaction (4, 8, and 12 neighbors).
- Larger neighborhoods result in fewer stable regions.
- Cultural convergence is easier when the range of interaction is larger.

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- Another run: 5 features, 15 traits per feature, small neighborhood.

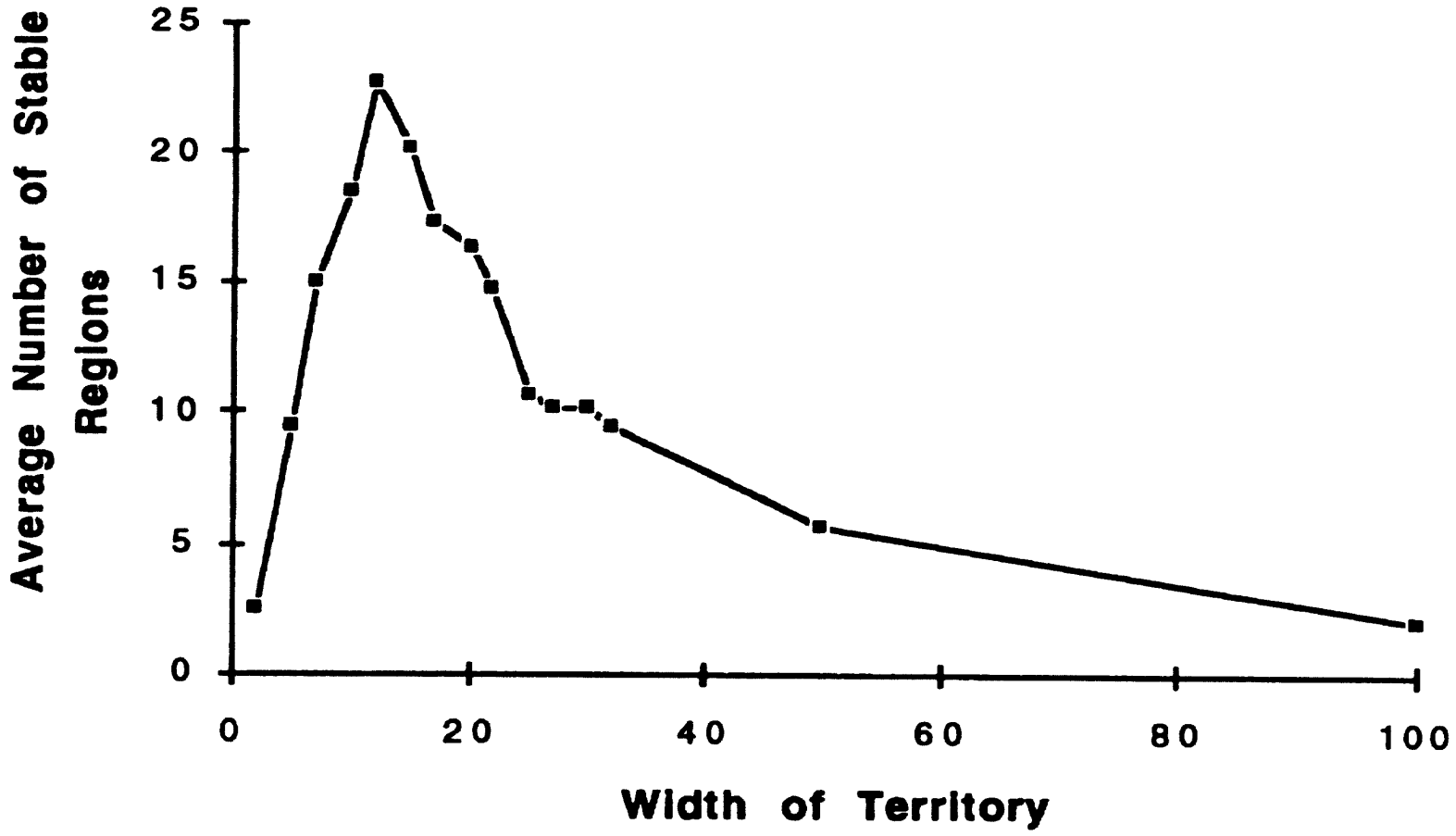

Figure 2: Average Number of Stable Regions

NOTE: The parameters for these runs are five cultural features, 15 traits per feature, and four neighbors for interior sites. Each territory size was replicated 40 times, except the territories with 50 × 50 sites and 100 × 100 sites territories, which were replicated 10 times.

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- Size of territory had no substantial effect on the number of cultural regions.
- Another run: 5 features, 15 traits per feature, small neighborhood.
- Both small and large territories have few stable regions, whereas moderate-size territories have the largest number of stable regions. Why? Need to examine cultural zones.

Results: Number of Stable Regions

- Cultural Zones: a set of contiguous sites, each of which has a neighbor with a compatible culture (at least one feature in common).

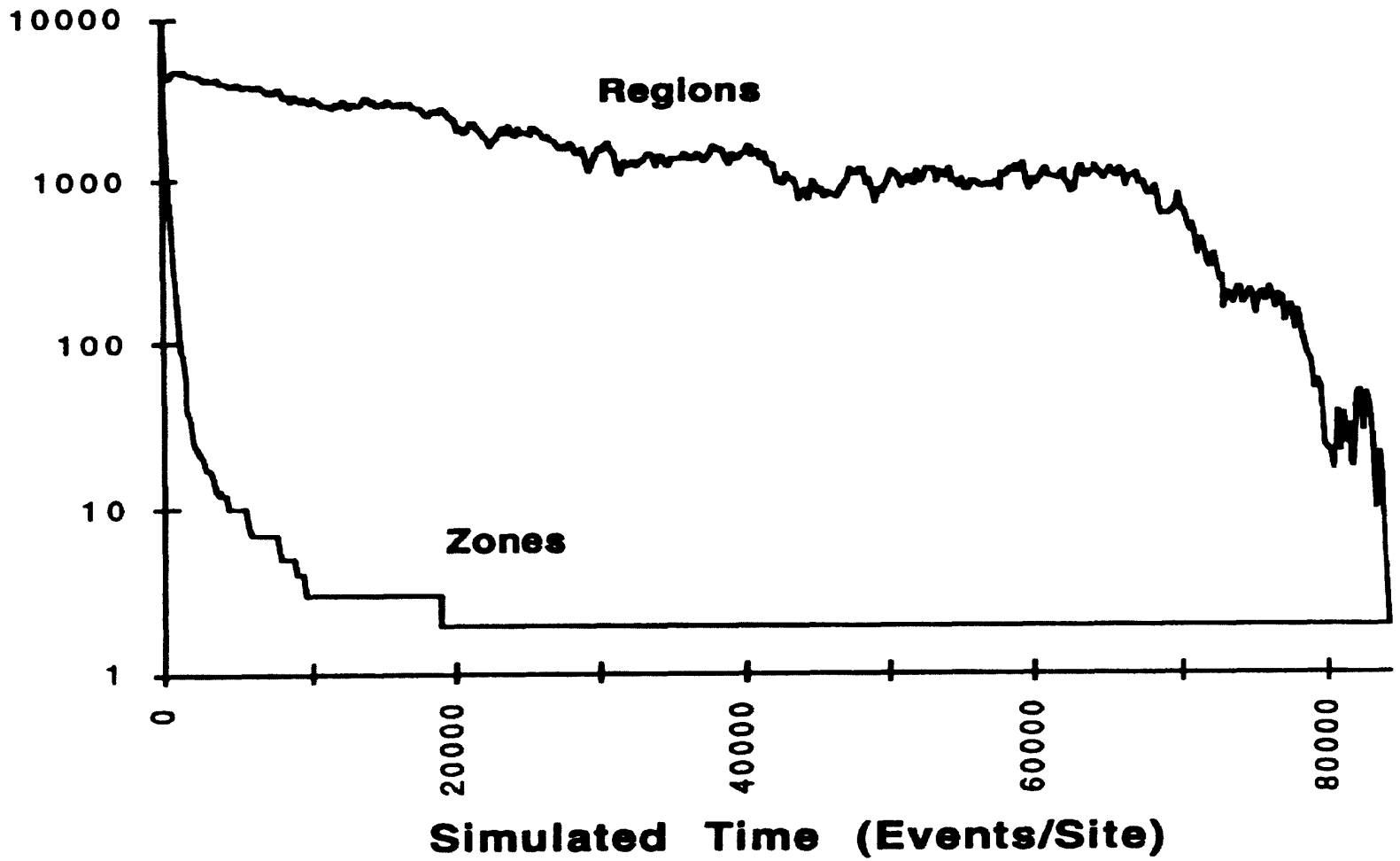

Figure 3: Number of Cultural Regions and Cultural Zones over Time in a Run with a Large Territory

NOTE: The territory is 100 × 100 sites. The other parameters are as in Figure 2. Note the logarithmic scale.

Results: Number of Stable Regions

- For most of the run many compatible cultures where trying to survive in 2 cultural zones, until a single culture prevailed.

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- 2) decreases with the range of interaction,
- 3) decreases with more cultural features, and
- 4) decreases with large territories.
- Even if there is no advantage to adopting a particular cultural practice, those in the majority may drive the minority out.

Take-Away Points

- Very general model, no specific empirical target.
- Simple rules.
- Use illustrative runs to highlight model features.