Title
Towards a Computational Science of Culture

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Towards A Computational Science of Culture

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Introduction

Cultures are dynamic realities. Human societies are continuously experiencing waves of fashions, fads, crazes, revivals, new religious movements, and political ideologies. Not all such trends are equally successful at transforming the beliefs and behavior of the members of a society. Understanding why some cultural ideas achieve a higher level of distribution in and acceptance by a population than other ideas is critically important for both commercial as well as scientific reasons. Unfortunately, the task of understanding and modeling the creation and spread of cultural ideas has traditionally been parceled out to multiple disciplines with little crosscutting fertilization and synthesis of ideas needed for cumulative development of knowledge. Psychologists study mental characteristics of individuals such as memory, adaptation and problem solving. Sociologists study the emergent collective behavior of social groups. Social network analysts study the geometry of the structure of various social groups. Until recently, these researchers have lacked a common language needed to productively communicate with one another. Computation is emerging as a common language allowing scientists studying seemingly different phenomenon to abstract out the dis-similarities to see the structure that is common to their problems.

Psychology was the first one to undergo the cognitive revolution. However, traditionally artificial intelligence and cognitive science have focused on individual cognition at the expense of sociocultural processes and their relationship to an agent's cognition. Some have even called for cognitive scientists to ignore social aspects of cognition (Fodor 1980), although, thankfully not all followed such advice (Bartlett 1932).

Traditionally sociologists were limited to verbal or static game-theoretic equilibrium models, forcing them to make unrealistic assumptions such as homogeneity among agents, and limiting their analysis to small populations consisting of a few agents. As economist Scott Moss recently lamented, "in more than half a century since the publication of von Neumann-Morgenstern (194x), no significant progress has been made in the development of models that capture the process of interaction among more than two or three agents" (Moss 1998). He goes on to claim that agent-based simulation is such a model. Agent-based social modeling uses the computer tools designed by the multiagent systems researchers to build a number of interacting software programs (called *agents*) that interact with each other using simple rules of interaction to study the emergent social characteristics of dynamic societies. The growing acceptance of agent-based social simulation has shown the promise of using computational processing tools to analyze various social phenomena such as culture. Recent attempts by researchers (such as Carely *et al.*) to combine agent-based modeling with advances in the field of social networks has yielded powerful dynamic models of social groups. However, most existing agent-based social simulation models assume rudimentary models of agent cognition and the resulting lessons have little relevance to the real world social phenomena of interest. For instance, most existing multiagent models of belief change (such as Bainbridge 1994; Doran 1998; and Epstein 2001) model belief as a bit whose value can change from 0 to 1 or vice versa. While such agent societies may suggest mechanism for the development of segregated neighborhoods, complex belief systems such as Tibetan Budhism or capitalism can never emerge out of societies of agents with such limited belief representation capabilities!

We believe that in order to make progress on understanding interaction between the micro and macro phenomenon and to relate the social and the cognitive processes a cognitively rich multiagent social simulation approach is needed. Such a synthesis offers us the hope of designing dynamic computer models of societies that can increase our understanding of a variety of aspects of individual and social behavior. We are currently designing models of a cognitively rich multiagent society to model belief changes in a population (Upal 2005). This involve (a) building cognitive models of an individual agent that can acquire and comprehend concepts embedded in dialogue, and (b) building a society of cognitively rich agents that can organize themselves in social network topologies such as small-world (Watts 1998) and scale-free networks (Barabasi 2003). The agents can then use these relationships to communicate their ideas with those they are related to. Keeping to the agent-based simulation maxim of, "keep it as simple as possible but not simpler" we will design progressively more complicated models understanding changes in social behavior as a consequence of each change. We believe that the development of such a model can lead to precisely predictive models that can be used by decision makers to understand consequences of their decisions and make better decisions.

References

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