Chapter 2
Social Network Analysis and Bistability:
From Theory to a Computational Model of Control

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ABSTRACT

Traditional social science models, including those for social network analysis (SNA), have so far not succeeded in establishing a valid computational model of social science, especially autonomy. A wide-ranging call has been issued to develop a fundamental replacement for traditional science in order to be able to mathematically control organizations and systems composed of humans, machines, and robots that can work together effectively to solve problems that organizations and systems composed of humans now solve intuitively. We report our progress with the development of a fundamental control theory based on social network analysis.

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INTRODUCTION

General recognition exists that a new theory of social science is required for the mathematical control of organizations and systems. A special issue of *Science* in 2009 on social network analysis (SNA) called for a new theory of social science to be able to better utilize SNA models (e.g., Barabási, 2009). Schweitzer and his colleagues (2009) concluded that game theory was unsatisfactory, and the National Academy of Sciences (NRC, 2008; NRC, 2009) drew similar conclusions about data mining and SNA, respectively. To counter these weaknesses, we review our progress in developing a fundamental theory of social interdependence different from game theory.

Few mathematical models of social interdependence exist other than game theory. Yet the problems with game theory are legion (Lawless et al., 2010a). These issues mirror the past problems with using traditional social learning theory to craft a workable theory of social groups (Moreland, 1996).

BACKGROUND

Interdependence in organizational interactions mimics quantum bi-stability or multi-stability.

When attempting to get at the heart of the cultural keys to organizational success, such as defined by very fast revenue growth, or long term stability, we find that classical models used to extract data from the humans within the organization are unsatisfactory in capturing the true dynamics of the organization. We propose a model of interdependence analogous to the quantum model that more accurately portrays those dynamics.

Per physicist Feynman (1963), the double slit experiment was the key paradox in quantum mechanics. He often said that if you think you do understand it, you need to reconsider, because the results from quantum interactions are anti-intuitive (Gershenfeld, 2000).

In the double slit experiment performed with photons, it is common to demonstrate that light is in two states simultaneously: particles and waves. When light is in its wave form, it is subject to interference. Interference can be both constructive and destructive. In constructive interference, two waves of light reinforce each other. In destructive interference, the waves cancel each other out.

This same model can be applied to the interdependence in the social interaction in regards to agreement and disagreement. Humans think in classical images that correspond to what they believe is physical reality. The problem with quantum mechanics is that it can't be described in classical images (Bohr, 1955). We need to see beyond classical interpretations of the subject or event under discussion in order to elicit the interdependent nature of the interaction.

To model this, consider any bistable optical illusion: the drawing that can be interpreted as either two faces facing each other, or alternatively, a vase. The Necker Cube is another such illusion (see Figure 1; also, Figure 2 can be interpreted as either an old or young woman). These illusions represent two mutually exclusive interpretations of a single dataset. Both of these interpretations cannot be held in awareness simultaneously, and in fact, any attempt to see one image or the other automatically destabilizes the presence or certainty of the other (Lawless et al, 2010a).

When this concept is applied to social interaction, similar results are derived. For example, a Christian and a Muslim (agents) approaching a conversation about religion will find themselves at odds, even though the subject they are discussing, religion, is common. Should one agent in the conversation begin to convince the other that its religion is the right one, the classical image of religion held by the agent being convinced will begin to destabilize as uncertainty increases. On the other hand, should each agent hold firmly to its position, no agreement is ever reached, and we can say that the bistable illusion—that there