Interdependence, Uncertainty, and Incompleteness in Teams and Organizations

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INTRODUCTION

In our previous study, we put forth a working agent based model to solve social problems such as organizational decision-making. We presented a classical uncertainty model. For organizational tradeoffs, the uncertainty principle means that under interdependence, the probability of applying sufficient attention to a plan or to execute it shifts uncertainty in an opposing direction, and vice versa, *iff* the state of interdependence continues (Note: the symbol *iff* means "if and only if"). As time passed, we witness a new econophysics (e.g., McKelvey, Salmador, Morcillo, & Rodriguez-Anton, 2013) model of the interaction. Unlike the classical model proposed by Conant and Ashby (1970), econophysics indicates that adaptability formed by cooperation and knowledge is the key to team and organizational success. However, these aforementioned models are passive to interdependence. Scholars have proposed that social systems operate in states of interdependence (Smith & Tushman, 2005), but interdependence causes uncertainty (Lawless, 2013), but the mathematics becomes intractable (Jamshidi, 2009). Schweitzer, Fagiolo, Sornette, Vega-Redondo, Vespignani and White (2009) claim that the effort to mathematically model and control social interdependence has not been successful. We are developing a mathematical model of social uncertainty relations to replace traditional models of the interaction, as well as an update of our previous model.[1] With our mathematical model of interdependence, we propose that indirect control becomes possible.

BACKGROUND

We report on the development of a mathematical model of social uncertainty relations to replace traditional models of the interaction, as well as our earlier model. Our goal with this mathematics is to control hybrid teams, firms and systems (i.e., where a "hybrid" is an arbitrary combination of humans, robots and machines). But uncertainty is created by states of interdependence between social objects: at one extreme, interdependence reduces to independence between agents, producing rational but a-social effects; at the other extreme, interdependence de-individuates a group's members until individual identity dissolves into a group (e.g., strong cults, mobs, gangs, and well-run teams or firms). In earlier studies, we have reviewed the structure of teams; in this report, we focus on how interdependence impedes efforts at direct control by making meaning incomplete. We begin with bistability to simplify interdependence, and generalize to full interdependence.

MAIN FOCUS OF THE ARTICLE

Tradeoffs. The interdependent tradeoffs to control a system requires channels that enhance the ability of management to diminish the destructive interference from inside or outside of an organization. It means that tradeoffs form cross-sections that reflect defensive and offensive maneuvers to expand or limit the size of an organization. Tradeoffs mean that as perspectives shift, what is observed to change in an organization

also shifts (Weick & Quinn, 1999); that illusions are fundamental to organizational hierarchies (Pfeffer & Fong, 2005) by driving or dampening feedback oscillations (Lawless, Whitton, & Poppeliers, 2008); and that uncertainty tradeoffs explain why criteria for organizational performance has been intractable (Kohli & Hoadley, 2006).

We defined illusions as bistable, opposing interpretations of the same reality held in mind simultaneously. An example of bistability is easily apprehended by comparing a stable image with a bistable illusion (Figure. 1). On the left is an easily understood stable picture of the Department of Energy's (DOE) legacy waste management operations using cardboard boxes (i.e., prior to 1985, DOE used the cardboard box for most of its solid radioactive wastes, causing significant environmental problems; in Lawless et al., 2008). On the right is a bistable illusion of either an old woman looking downward and to the left, or of a young woman looking over her right shoulder. Cacioppo and colleagues (1996) established that two incommensurable images cannot be held in awareness simultaneously. Generalizing, the presence of two independent interpretations or concepts requires a focus on one that precludes a simultaneous focus on the other.

Interdependence: In our earlier paper, we defined social influence as a form of social entanglement, which means that entangled elements can be manipulated together (von Bayer, 2004). From social influence perspective, interdependence was defined as operating across neutral individuals as a superposition of waveforms composed of two or more simultaneous values that linearly combine under constructive interference such as rationalizing similar views into a single world view, or under destructive interference to disambiguate dissimilar views into the best concrete plan. Both interdependence and entanglement are fragile, do not always produce uniform effects, and experience rapid decay. With the uncertainty principle for organizational tradeoffs, we attributed the problem to the recondite nature of tradeoffs; the greater the clarity of an interdependent social situation (observation), the greater the uncertainty in the effects from social influence (action).

Field Model. Putting uncertainty aside until later, the effects of a community matrix *A* can be measured in the field. Assume that competition for resources occurs within and between groups; that, unlike the inability of individuals to multitask (Wickens, 1992), multitasking is the purpose of a group (Ambrose, 2001). The optimal group multitasks seamlessly,

Figure 1. Stable vs. bistable illusion

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