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Extended Abstract

Science, organization and sustainability: A multilevel approach

Nikhil Joshi, Ph.D[1],*

[1] Lifel.Org, 201-TV Industrial Estate, 248-A, S.K. Ahire Marg, Worli, Mumbai 400 030, India, http://www.Lifel.Org

E-Mail: nikhil.joshi@lifel.org

* Author to whom correspondence should be addressed; Tel.: +91-22-24912101; Fax: +91-22-4914152

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Introduction

Some of the most pressing ecological and social problems facing us today are known to arise through interactions between self-organizing processes across two or more different levels in organizational hierarchy. For instance, ecosystem degradation [1] that accompanies socioeconomic development is largely attributable to the interactions between self-organization processes in our socioeconomic organizations and those in underlying ecosystem organizations. Social organizations like families, and communities are known to decline in the course of national and global socioeconomic development at the next higher levels [2]. Similarly self-organizing processes in globalization are known to significantly influence socioeconomic and political developments within nation states [3,4]. A deeper understanding of such multilevel phenomena requires self-organization models that span multiple levels.

While it is clear that understanding and addressing such problems requires multilevel models in self-organization, much of our current scientific research is confined to single research domains. This raises a question - can we develop new research methods that can allow researchers working on single research domains to collectively explore and build models addressing multilevel problems? If this can be done, then it will enable a two-way exchange; where domain level researchers can look at multilevel problems, and new insights from multilevel research can in turn spur domain level research.

Cross-disciplinary research inherently poses many challenges. Researchers from different disciplines can have their own way of framing a research problem [5]. The dimensions of a problem, and the framing of the problem can also vary with changes in the context of the research. This poses a real

challenge in integrating research from multiple researchers into a coherent model that can address real life cross-disciplinary problems. Multilevel research in living systems is even more challenging, due to the added complexity of living systems and the multiplicity of coupled levels in such systems.

Methods

In this research, I have attempted to surmount some of these challenges by using an overarching multilevel hypothesis as high-level conceptual scaffolding that serves as a common conceptual frame to integrate research from across research disciplines. Common framing allows research from different disciplines and different levels to be aligned and integrated to build a multilevel model that can reveal new insights that are not observable at the level of any single research domain.

Results and Discussion

This research has produced two multilevel hypotheses [6] that present social self-organization as an extension of a much larger pattern in natural self-organization. They also point to the possibility that a high level organizational similarity could exist between three different networks that functionally modulate resource flows and enable adaption in groups or ecosystems of interacting species at different levels in hierarchy -the Mycorrhizal fungal networks in the soil that modulate resource flows and enable community effects between terrestrial autotrophic species [7–9] , the gut bacterial networks [10,11] that modulate speciation and resource flows in heterotrophic species in ecosystems and financial investment networks (investment markets) [12,13] that modulate resource flows in the socio-economic domain.

In this talk, I outline these developments. These ideas not only present new avenues in cross-disciplinary research, but also open up exciting new possibilities for aligning our socio-economic systems with underlying ecological systems. This research also illustrates how research insights from across multiple domains like linguistics, cognitive science, neural networks and machine learning, energetics, community learning and biology can be integrated to develop multilevel models that can help address some of the most pressing issues in social and ecological sustainability.

References and Notes

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