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Methodological and Ideological Options

Model of the social–ecological system depends on model of the mind: Contrasting information-processing and embodied views of cognition

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ABSTRACT

Two core concerns of ecological economists have for decades been to consider the economy as embedded in broader social–ecological systems (SESs) and to include multiple perspectives in knowledge production. To address these concerns, I argue, ecological economists need to return to the ontological question of what constitutes the SES and the epistemological question of how to obtain knowledge about it. The article shows that autopoiesis complemented with the theory of embodied cognition addresses (1) the ontological challenge by articulating socio-cultural artifacts and ecological artifacts as a single entity, and (2) the epistemological challenge with universally shared schemas that describe goal-oriented activity. The power of autopoiesis is illustrated by outlining an embodied SES model of reindeer management as an alternative framing to the predominant information-processing SES model. An environmental policy measure that from the information-processing perspective looks like an adjustment of a control variable may from the embodied perspective disrupt an interconnected structure of social–ecological interaction. The article proposes a way to integrate the information-processing and embodied models. The results pose significant challenges for future research and policy efforts by ecological economists.

1. Introduction

The core concerns of the ecological economics community are remarkably persistent. According to Røpke (2005), the overarching concerns in ecological economics since the late 1980s have been to consider the economy as embedded in the life-support system of nature and in the broader social and cultural system; and to recognize that our poor understanding of human–environmental interactions calls for the inclusion of an extended array of actors and multiple perspectives in knowledge production. To address the first concern, the broad field of social–ecological systems (SESs) research has emerged (Anderies et al., 2004; Gunderson and Holling, 2002; Holling, 2001; Ostrom, 2007, 2009). In response to the second concern, the past few decades have been marked by an explosion of deliberative experiments and investigations in environmental governance (Levänen and Hukkinen, 2013). Yet tensions remain. To reverse the "technocratic elements of social–ecological management," participation needs to be "flexible…to allow for context-specific needs" and to develop "shared understandings of the system to be managed" (Stringer et al., 2006). Susan Owens reminds us of the difficult but central issue of discursive competence in the face of complex environmental choices: "The nurturing of civic virtues presents a major challenge at a time when so many people have become practiced as consumers but alienated as citizens; why should they cast off the former identity and assume the latter simply by virtue of coming into some deliberative forum…?" (Owens, 2000: 1146).

I will argue that the challenge of shared understanding stems from inadequate attention to the challenge of considering the economy as embedded in SESs; and that addressing these concerns requires revisiting the ontological and epistemological premises of ecological economics. To say that an extended array of actors and perspectives is needed to produce knowledge for environmental governance assumes coherence in how the SES is understood by the actors, both those who operate within the system and those who analyze it. Rather than taking seriously this assumption of deliberation, a good many ecological economists have based their efforts to integrate stakeholders in knowledge production on an in vitro model of social–ecological interactions — a model constructed by researchers and containing stakeholders as agents performing subroutines. The role of deliberation has been to provide data input and to fine-tune variables and their relationships in the analysts' models (Folke, 2006; Folke et al., 2005; Stringer et al., 2006; Tyler et al., 2007; Walker et al., 2002). This is not a promising starting point for deliberation, because it not only fails to address the problem of heterogeneous discursive competences identified by Owens (2000) — it rather assumes them. A well-intended effort to gain "iterative

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input" from the stakeholders "who know the system best" (Stringer et al., 2006) does not necessarily constitute a shared understanding, if such input must be expressed in concepts that are compatible with the analysts' model but incompatible with the stakeholders' understanding of the system.

When considering the embeddedness of human society and economy within the biosphere, it is important to distinguish between macro discussions, which typically use approaches such as social metabolism and various measures to operationalize scale (Fischer-Kowalski and Rotmans, 2009), and micro discussions, which refer to approaches such as governance of local SESs (Ostrom, 2007). This difference, although evident in past research on human–environmental interaction, should not distract us from the fundamental scale-free characteristic of contemporary conceptualizations of SESs. One of the unifying elements of otherwise diverse frameworks for analyzing SESs (Gunderson and Holling, 2002; Ostrom, 2007) is that they are holons, that is, frameworks that "can be presented at scales ranging from exceedingly fine-grained to extremely broad-grained" (Ostrom, 2005, p. 11). The scale-free aspect applies also to the embodied cognitive models described in detail later on (Clark, 2011; Hukkinen, 2012). Thus, while the empirical case with which I illustrate my point comes from a local SES of reindeer management, the core concerns of embeddedness and participation apply to all levels of analysis in ecological economics.

To address its intellectual concerns, the ecological economics community needs to return to the fundamental questions of what constitutes the SES (ontology) and how to obtain knowledge about it (epistemology). My objective is to diagnose critically the predominant heuristic of SESs that is based on the information-processing model of the mind, to develop an alternative SES heuristic that is based on embodied cognition and autopoiesis, and to integrate the two. I will first discuss SESs as autopoietic systems (Section 2). I then contrast the information-processing view of cognition with the embodied view, arguing that the latter view is compatible with the autopoietic systems notion (Section 3). This is followed by an illustration of the differences between the two views of cognition with an application to reindeer management (Section 4). I conclude by discussing the findings, proposing a way to integrate the two views (Section 5), and outlining implications for the future intellectual concerns of ecological economists (Section 6).

2. Social–Ecological Systems as Autopoietic Systems

The emergence of the concept of SESs reflects the perceived need among ecological economists to consider the economy as embedded in ecosystems and the broader social and cultural systems (Røpke, 2005). Yet the notion of embeddedness is ambiguous. Does it mean that the subsystem of economics is conceptually implanted as such within the broader social and ecological systems? Or does it mean that the result is a single system in which it is no longer possible to distinguish traces of the economy, ecosystems and society?

On the basis of a quick survey of the most quoted articles that Google Scholar yields by searching "social–ecological systems model," the first option has won. The influential SES model developed by Elinor Ostrom and co-workers is conceptualized in terms of four categories, two of which relate to the "social" (governance system and users) and two to the "ecological" (resource system and resource units) (Anderies et al., 2004; Ostrom, 2007, 2009). Similarly, the adaptive cycle model by Holling and co-workers is usually applied to primarily ecosystems or social systems (Gunderson and Holling, 2002; Holling, 2001). I recognize that in comparison with economic models in which the ecosystem is often either absent or unrelated to the economic system, these models are a remarkable improvement, particularly with their emphasis on intertwined coevolutionary feedbacks between ecosystems and socio-economic systems (Berkes and Folke, 1998). However, the key issue here is what is perceived to be intertwined with what — a question noted for example by network analysts of SESs (Bodin and Prell, 2011). The categories and subcategories of variables that are intertwined in these models can easily be classified in a binary fashion as either "socio-economic" or "ecological".

It appears advisable from both scientific and policy perspectives to contemplate more integrative theoretical frameworks with which to conceptualize SESs. I will here consider the autopoietic systems approach developed by Maturana and Varela (1980), because it explicitly incorporates the cognitive dimension that, as will become clear shortly, is crucial for understanding human–environmental relations. The approach enables me to tackle the two key challenges of ecological economists. The ontological stance underlying autopoietic systems recognizes no division between the social and the ecological, and the epistemological stance facilitates the exploration of shared mental models of human–environmental interaction among practitioners and analysts.

Maturana and Varela equate autopoietic systems with living systems that require energy from the outside. They use the metaphor of a machine to characterize autopoietic systems:

> An autopoietic machine is a machine organized (defined as a unity) as a network of processes of production (transformation and destruction) of components that produces the components which: (i) through their interactions and transformations continuously regenerate and realize the network of processes (relations) that produced them; and (ii) constitute it (the machine) as a concrete unity in the space in which they (the components) exist by specifying the topological domain of its realization as such a network.
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> [Maturana and Varela, 1980: 78–79]

When this conception of a system is applied to a SES, the social and the ecological cease to exist as separate subsystems. Instead, the SES is a network of relational processes that produce components which (i) continuously regenerate the network and (ii) constitute the SES in a particular domain. The critical difference with classical epistemology is that the components of the social–ecological system being observed are also constitutive elements of the cognitive act of observation. Maturana and Varela's epistemological point about observing an autopoietic system is helpful:

> Since it is a defining feature of an autopoietic system that it should define its own boundaries, a proper recognition of an autopoietic system as a unity requires that the observer performs an operation of distinction that defines the limits of the system in the same domain in which it specifies them through its autopoiesis. If this is not the case he does not observe the autopoietic system as a unity, even though he may conceive it.
>
> [Maturana and Varela, 1980: 109]

Thus, observation of a SES requires that the distinction of system limits takes place in the domain of the components of the system. This statement has profound cognitive implications. The cognitive operation that performs the distinguishing of a SES as a system needs itself to be in the domain of that system. This is qualitatively different from the prescription found in existing SES models, which states that the "knowledge of SES/mental models" of resource users (Ostrom, 2007: 15183 Table 1) or "issues deemed important to the stakeholders" (Walker et al., 2002: 8) must be incorporated as a variable of the SES model. These approaches involve a translation of stakeholder knowledge into the language of a SES model composed of interrelated variables. What the autopoietic notion of observation requires instead is that the way in which the analysts and the stakeholders understand the SES—the domain of observation—is the same, with no translations or conversions of knowledge in between; and that that domain is the domain of the SES.

To articulate an understanding of a SES that does not require two subsystems, the social and the ecological, and that does not get lost in