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Analysis

Varieties of experimentalism

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ABSTRACT

Across a range of disciplines and issues, experimentalism has emerged as a prominent approach for addressing environmental problems. Yet the meaning of "experiment" varies markedly across these domains. We survey the diversity of experimentation, identifying three distinct experimental logics—controlled, Darwinian, and generative. Building on Pragmatist philosophy, we argue that each of these logics has different strengths and weaknesses, but taken together they offer a valuable experimentalist approach to environmental problem-solving. However, from a transdisciplinary perspective, it is important to recognize the different values, purposes, and stances toward knowledge that they entail. Controlled experiments primarily aim to isolate causality, while Darwinian experimentation endeavors to enhance systemic innovation and generative experimentation seeks to generate new solution concepts. Appreciating these differences allows us to be more reflexive about an experimentalist agenda, illuminating the appropriate role of these logics and suggesting possibilities for fruitfully combining them. To advance this reflexive agenda, we also distinguish between epistemic and political learning and argue that experimental approaches to environmental problem-solving may benefit from being more sensitive to this distinction.

A quiet revolution is afoot in efforts to address environmental challenges and promote sustainability. Over the last decade or so, economists, policymakers and communities have expanded their use of experimentation to understand human behavior, evaluate policy, and solve environmental problems. This experimentation ranges from experiments designed to value environmental goods or understand common pool resources to climate change pilot projects and experiments in watershed governance. Some of these experiments take place in the laboratory; some in the field. Some are designed by ecological economists; others are developed by cities or regions to address local environmental challenges. Diversity characterizes this experimental revolution. It is inspired by the experimental movement in economics, by demands for evidence-based policy and by the need to find creative solutions to intractable environmental problems.

We observe six broad uses of experimentation in environmental problem-solving (not including the extensive use of experimentation in ecological and evolutionary science):

1) To adaptively manage ecosystems in the face of socio-ecological uncertainty and change (Lee, 1999; Walters and Holling, 1990);
2) To encourage socio-technical and design innovations that support transitions to sustainability (van den Bosch, 2010; Gross, 2010; Rotmans and Loorbach, 2008; Hoogma et al., 2002);
3) To conduct basic research on economic and environmental behavior and to value environmental goods (Noussair and van Soest, 2014; Osbaldiston and Schott, 2011; Hoyos, 2010; Gowdy, 2007; Gintis, 2000; Hanley et al., 1998);
4) To design and evaluate different institutional and governance arrangements for managing environmental resources (Rommel, 2014; Bulkeley and Castán Broto, 2013; Bos and Brown, 2012; Greenstone and Gayer, 2009; Ostrom, 2006);
5) To encourage social and political learning and to mobilize support for sustainability (Ceschin, 2014; Brown and Vergragt, 2008; Brown et al., 2003; Irvine and Kaplan, 2001) and
6) To harness learning processes as an institutional strategy for democratic governance (De Burca et al., 2014; Overdevest and Zeitlin, 2014; Overdevest et al., 2010).

This wide range of uses of experimentation suggests that it is an important strategy for environmental problem-solving. Yet even a quick scan of these literatures reveals that they do not necessarily mean the same thing when they use the term "experiment." Clearly, experiment and experimentation are protean concepts (Karvonen and van Heur, 2014). An interrogation of the different meanings of experiment can help to advance and delimit the potential of experimentalism as an overarching strategy.

For a number of disciplines, including economics and ecology, "experiment" typically means a randomized controlled trial. From this perspective, an experiment is a "trial" (an intervention) where conditions are controlled in order to isolate its effect. This meaning of experiment

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is drawn from the laboratory and is focused on deductive knowledge production. For other fields, such as planning and architecture, and for many practitioners and policymakers, the term "experiment" is more associated with innovation and design. From this perspective, an experiment is a novel attempt to solve a problem. These two conceptions are not necessarily antithetical—it is quite possible to use controlled experimentation to evaluate novel solutions. Yet the logics of control and solution generation are not necessarily convergent and may have different imperatives.

Why should ecological economics care about this broader range of meanings? Drawing on the problem-oriented philosophy of environmental pragmatism (Karkkainen, 2003; Norton, 2005; Overdevest et al., 2010) and a mission driven, transdisciplinary, and pluralist view of ecological economics (Norgaard, 1989, 2004; Funtowicz and Ravetz, 1994; Martinez-Alier et al., 1998; Max-Neef, 2005), we argue that ecological economics needs an array of experimental strategies to tackle environmental problems. Our position is inspired by the rising attention across a range of disciplines to the value of experimentation for addressing some of our most intractable environmental problems, such as climate change, sustainability, water governance, and energy transitions.[1]

While inspired by this agenda, our goal is to foster greater reflexivity about the varied conceptions of experiment that it entails (Popa et al., 2015). In the remainder of the text, we refer to "experimentalism" when speaking about experimentation as a distinctive strategy and to refer to Pragmatism's appreciation of the experimental method in general. "Experimentation" is used in more neutral terms to refer to experiments in their various forms.

To think of experimentalism as a generic *strategy* for environmental problem-solving requires attention to the values, purposes and knowledge criteria entailed by different conceptions of experimentation (Böschen, 2013). Such attention can foster awareness of the appropriate uses and limits of experimentation and help to identify where different conceptions of experimentation can be used together in a complementary or hybrid fashion to produce collective learning (Norgaard, 2004). And it can make it clearer where different values, purposes and attitudes toward knowledge are only weakly commensurable (Martinez-Alier et al., 1998) and where issues of scientific adequacy must be addressed in conjunction with value judgements (Farrell, 2011).

Building on the philosophy of Pragmatism, we distinguish three basic logics of experimentation: controlled, Darwinian and generative. We offer a comprehensive comparison of the three logics and conclude by outlining how the different types of experimentation can promote learning processes, both in an epistemic and political sense.

1. Pragmatism and Experimentalism

To think of experimentalism as a strategic approach to problem-solving, it is useful to situate it in a conceptual framework that views different experimental types as alternative or combinable tactics useful for different purposes. We find this conceptual framework in the philosophy of Pragmatism. A number of scholars have made the wider case for Pragmatism as a philosophical framework for adaptive, reflexive and problem-oriented environmental governance (Light and Katz, 1996; Karkkainen, 2003; Norton, 2005; Bromley, 2008; Overdevest et al., 2010; Popa et al., 2015). Our goal is not to reproduce their arguments, but rather to articulate the Pragmatist rationale for embracing multiple experimental logics for strategic problem-solving.

Experimentation is a central motif for Pragmatist philosophy, particularly in the work of Charles Peirce and John Dewey. Inspired by Darwinism, this motif represents Pragmatism's naturalism of logic and ethics and its belief, as Norton writes, that "[e]very belief must be tried, over and over, by the jury of experience" (2005, 79). Yet we find no unified conception of experimentation in Pragmatism. Peirce largely focused on experimentation as a scientific method, arguing that the experimental "method of science" allows and encourages the constant examination and revision of the status quo (Peirce, 1992, p. 109). One of the leading logicians of his time, Peirce was one of the early contributors to the development of the concept of randomization in experiments (Manzi, 2012).

Dewey sought to expand the scope of application of experimentation beyond the scientific domain. Recognizing that experimentation had led to a "gigantic forward movement in science," (Dewey, 1911, p. 554), Dewey hoped experimentalism could also become central to democracy and ethics. Building on Dewey's understanding of experimentalism, Donald Schön offered a useful and succinct definition of experiment: "In the most generic sense, to experiment is to act in order to see what action leads to. The most fundamental experimental question is, 'What if?'" (1983, 145).[2] The philosophical grounding for this experimentalism is a deep appreciation of uncertainty as an inescapable human condition (Bromley, 2008).

Experimentation is a key strategy for dealing constructively with uncertainty (Sanderson, 2009) and is closely linked to the Pragmatist emphasis on inquiry and creativity.[3] Peirce declared the simple adage "Do not block the way of inquiry" to be one of the key rules of philosophy (Peirce, 1998, p. 48). In complementing the two classical accounts of inference–induction and deduction–with his own mode of abduction, he tried to pin down this character of science as inquiry, i.e. as a creative and open-ended endeavor. Creativity, for Pragmatists, is not an endowment of a few geniuses but rather "an anthropological universal in human action" (Joas and Kilpinen, 2009, p. 323). In contrast with rational choice theory, Pragmatism views means and ends as interdependent and as shaped experimentally through action (Whitford, 2002; Bromley, 2008). Experimentalism is therefore a process of iterative adaption to new circumstances and experiences that entails a certain idea of progress and improvement but no teleological endpoint. This perspective leads to an appreciation for historicity and to a conception of growth as a continuous reconstruction of experience (Dewey, 1938; Koopman, 2010, 2011).

Peirce's concept of abduction is valuable for thinking about varieties of experimentation. Although the precise meaning of the term is still debated by Peirce scholars, it is broadly speaking a conjecture (hypothesis) generated from a body of incomplete knowledge. Unlike deduction, it is an "ampliative" inference that generates new ideas. It draws on experience and habit, but unlike induction it "pulls things together into some form of coherence that allows … further investigation" (Mullins, 2002, 199). Hintikka (1998) argues that Peirce's concept of abduction also reflected his strategic sense of how science accumulates knowledge over the long term. For Peirce, abduction economically generates hypotheses worthy of subsequent testing and evaluation (Kapitan, 1992; McKaughan, 2008). Adding abduction alongside deduction and induction, Peirce offers a wider lens for appreciating different types of experimentation.

A final Pragmatist point helps to draw together our strategic conception of experimentalism. Pragmatism understands meaning as indeterminate until "fixed" in relation to a particular situation or purpose. From this perspective, the type of experiment deployed depends on the particular purpose, which in turn often depends on what is problematic and on pre-analytic values and visions (Costanza, 2001). When

[1] See Irvine and Kaplan (2001); Rotmans and Loorbach (2008); Callon (2009); Bai et al. (2010); Berkhout et al. (2010); Evans (2011); Hoffman (2011); Farrelly and Brown (2011); Bos and Brown (2012); Bulkeley and Castán-Broto (2012); Castán Broto and Bulkeley (2013); McGuirk et al. (2015); and Nastar (2014), among others; for more cautionary views, see Jordan and Huitema (2014) and Van der Heijden (2014).

[2] For Dewey, an experiment "operates to change the customary state of things, and thereby to present challenges to thought, seeming discrepancies, unexpected phenomena, that require explanation" (Dewey, 1911, 554).

[3] Given the problematic connotation and history of social experimentation, ethical concerns must be taken very seriously. From a Pragmatist perspective, however, an experimentalist approach cannot be ruled to be ethical or unethical in general (Weber, 2011). Experiments, however, do raise important ethical issues, but these must be judged on a case-by-case basis (Greenberg and Shroder, 2004, 8; Krohn and Weyer, 1994; Doorn, 2015).