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Bibliographical reference

Dedeurwaerdere, T. 2017. From ecological psychology to four varieties of post-positivism in transdisciplinary science. *Environment Systems and Decisions*. Published on line on 2 November 2017.
T. Environ Syst Decis (2017). <https://doi.org/10.1007/s10669-017-9663-4>

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From ecological psychology to four varieties of post-positivism in transdisciplinary science

Comment on “Contributions to Brunswik’s Theory of Probabilistic functionalism”

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The paper on the “Contributions to Brunswik’s Theory of Probabilistic functionalism” reconstructs the foundational principles of an ecological approach to perception and social judgement as elaborated by Egon Brunswik. The argument convincingly shows the usefulness of these foundational principles for taking the agenda of transdisciplinary sustainability research forwards. Two main aspects from Brunswik’s research are shown to be especially relevant for contemporary research. First, Brunswik’s model allows building an approach of human–environment interactions, where the environment is an uncertain one, providing only unequivocal and ambiguous cues, however lawful the environment may be in terms of physical principles. Second, the model proposes a mechanism of adaptation to a probabilistic world, as organisms learn to employ probabilistic means to achieve goals. As the author explains, “probabilistic means” can be understood in a more general sense as the recourse to evolutionary useful heuristics (*proximal* cues) about the human and natural environment.

This position is highly critical of the positivistic approach of perception/social judgement (designated here as the positivistic correlational approach). The latter models perception/judgement as a univocal correlation between percept/

judgement and sensory/informational inputs, through measuring marginal variations amongst a set of independent variables that correspond to perceptual inputs and outputs. Brunswik’s ecological theory of perception therefore provides the building blocks of an alternative position that is highly relevant for analysing open-ended and complex dynamics in coupled human–environmental systems.

In this comment, we aim to further elaborate the consequences of such a criticism of the positivistic picture of a univocal lawful relation to the world. Therefore, we will focus on one of the key contributions of the paper, which is to show how the ecological psychology perspective can be compatible with scientific theory building and the building of reliable judgments about the world. In the same time, this comment aims to show that a more fine-grained typology can be build amongst the various possible “post-positivist” perspectives in transdisciplinary research, in a way that further builds upon the proposed principles elaborated by the author relying on Brunswik’s work.

1 Towards a dynamic interaction model between human and environmental systems

The paper on “Contributions to Brunswik’s Theory of Probabilistic functionalism” shows that a theory of decision making and perception should consider not only the modelling of the perceiving/judging organism (or a group of organisms in the case of group decision making), but also develop a modelling of the uncertain and unequivocal environmental inputs to these organisms. Indeed, the organism does not directly process a kind of “representation” of environmental features, but processes a set of contextual cues that have different degrees and levels of ecological adequacy. Depending on the probabilistic degree of adequacy and a set of “use weights” given by the organism to these cues,

This Perspectives paper is a comment on Scholz’s “Managing complexity: from visual perception to sustainable transitions—contributions of Brunswik’s Theory of Probabilistic Functionalism”, Environ Syst Decis. <https://doi.org/10.1007/s10669-017-9655-4>.

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the organism constructs a reliable and useful percept/social judgment. This model is metaphorically designated as the “LENS” model of perception.

Two important features of contemporary transdisciplinary research can be directly related to this probabilistic theory of reliable judgement under uncertainty. The first is the importance of formative learning and the second the co-evolution of the actors’ strategies and the institutional environment. We briefly elaborate on these two features, before highlighting in the next paragraph how these features can be used in the building of a more fine-grained typology of post-positivist approaches in the line of the probabilistic functionalism of Brunswik.

A first feature that goes beyond the positivistic correlational model of reliable social judgement in transdisciplinary science is the importance of formative learning processes. Formative learning in transdisciplinary partnerships results from co-construction process of research questions between scientists and societal actors and from the iterative assessment and adjustment of the research (Popa et al. 2015). In a similar way as in the case of Brunswik’s model, *the uncertainties of the actors over their own collective preferences and the absence of clear positioning over their multiple interests are not discarded* by transdisciplinary research, but constitute precisely the starting point of the knowledge co-construction (which corresponds to the building of a reliable judgement in Brunswik’s model). This position contrasts both with the mainstream economic approaches based on aggregation of choices under given collective preferences and the rational choice theories in political science that envision political bargaining where interests are also considered as a given. In the context of transdisciplinary partnership research, spaces of uncertainty over preferences and hybrid interest group belongings of actors are not reduced to “approximately given preferences/interests”. In contrast, the recognition of the uncertain and evolving nature precisely opens up the possibility of formative learning processes by each of the actors. Such learning processes open up new social possibilities for compromise and collective decision making, beyond the given status quo, inter alia, by recognizing the differences amongst the actors in a socially inclusive manner. Illustrative examples of such transformative and formative processes have been extensively discussed in the literature, such as formative participatory scenario analysis (Scholz and Tietje 2002; Brand et al. 2013; Njoroge et al. 2015) and community involvement in environmental justice research (Corburn 2005).

The second feature that goes beyond the positivistic correlational model of reliable social judgement is related to the transformation of the institutional environment. One example (amongst others) of transdisciplinary research that integrates this institutional dimension is the model of niche–regime interaction developed in the so-called transition theory (Geels 2011). The niche–regime model explicitly addresses the institutional dynamics by focusing on pilot

initiatives that explore radical innovations, which are designated as innovation “niches”. Within these niches, the research partners select the so-called change agents, which have shown leadership in promoting radical transformative initiatives (Rotmans 2012). Change agents often have first-hand knowledge of the institutional constraints, and such knowledge provides “*ecological adequate*” cues about transformation possibilities. With these change agents, a forward-looking research process is set up, based on a stepwise process of creative visioning on actionable territorial transition pathways. This method has proven successful in generating socially legitimate and scientifically credible solutions for change (Loorbach and Shiroyama 2016).

The focus on the “ecologically adequate” knowledge in transition theory, however, might lead to disregard the formative learning process. Indeed, the overly strong focus on institutional diagnostics by the change agents might undermine the role of collaborative framing of research and the role of formative learning processes in opening up new perspectives for explanatory and predictive understanding. That is, by focusing on the institutional transformation dimension, the interaction of the research process with the learning on the background beliefs and collective preferences might be neglected. In some situations, such as situations of well-established beliefs and low social controversy, this does not jeopardize the collaborative research process. However, in many situations of social transformation, beliefs and collective preferences are still in a process of transformation and subject to intense debate, and support from methodologies such as formative scenario analysis might be required to broadening the possibilities for social compromise and common planning beyond a given lock-in. Seen the crucial role of these formative learning processes, we will deepen in the next section the analysis of their contribution to the building of reliable judgments/planning accompanying sustainability transitions.

2 The LENS model applied to critical and interpretative approaches to transdisciplinary research

Although many methodological review papers have assessed the working of transdisciplinary partnerships, few scholars have analysed the nature and the governance of the formative learning processes in transdisciplinary research. To contribute to the building of a more fine-grained approach to the post-positivistic stance developed in the ecological psychology approach, this section will use a typology of formative processes adapted from the contemporary epistemology of participatory research (Willis and Jost 2007).

Usually, scholars distinguish between three major approaches to participatory research in a post-positivistic perspective. A first approach is the mainstream

post-positivist approach to participation, following the foundational work of Kurt Lewin (Greenwood and Levin 2006). In action research, researchers give up some control in order to do research in the natural environment and test specific hypotheses through real-world interventions in which practitioners directly participate. According to this approach, practitioners have scientifically relevant knowledge about implementation and unique know-how that is crucial in conducting the social experiments. Nevertheless, in many situations of action/intervention research, scientists still play the central role, as they have the methodological tools to integrate the various knowledge sources into a reliable understanding of reality.

The two other approaches considered in the literature, the interpretative and critical approaches, go one step further in the integration of uncertainty and non-univocal relationship towards the human and natural environment. The emphasis in interpretative research is on deepening contextual understanding through considering as many alternative perspectives that are considered valid from certain viewpoints and in certain situations. Indeed, the interpretative approach considers that both scientific and practitioners knowledge is incomplete, but also that both scientific and practitioners knowledge is based on background representations and values that have to be equally considered.

Critical theory, although recognizing the importance of interpretation and context, starts from a situation where the actors do not share a common will for entering into truly collaborative learning processes. Therefore, critical theory approaches to formative learning focus more specifically on a subset of interpretative perspectives, which can contribute to free actors from domination by certain interests. Its main emphasis is on responding to inequalities in society, by making oppression based on gender, race, nationality, ethnicity, sexual orientation, social class or work obvious and helping such oppressed groups to free themselves.

The relative success of the post-positivist, interpretivist and critical approaches to formative learning, however, also encounter important limits. Indeed, the interpretative approach, by reflecting on the many contextual understandings, produces a kind of “mirror” image of the existing practice related meanings, albeit in a pro-active engagement with the pluralism of contextual meanings (Walzer 1987). However, to support transition processes with a high degree of scientific uncertainty on likely evolutions of the system and feasible implementation pathways, more open-ended “forward-looking” processes are required where multiple and inconsistent values and interpretations can nevertheless coexist.

In such a situation of heightened uncertainty, a more knowledge-intensive and selective knowledge gathering process will be required, which is guided by scientifically reliable and socially robust knowledge of already available

social possibilities for transformations. This fourth approach is based on a forward-looking reflective equilibrium between transdisciplinary theorizing and meanings related to new social possibilities. In particular, formative learning in open-ended process in this fourth approach focuses on the co-construction of new meanings that are a result of the collaborative research itself and that are oriented towards future social possibilities of societal transformation. Through this focus, this approach *integrates both the probabilistic aspects of the LENS model of Brunswik, but also considers that new cues on human and social environment are constructed as a result of the research process itself* (cf. summary of the features in the last column of Table 1, and correspondence table with TPF principles in Table 2).

3 The triple “input processes” to dynamic ecological adequacy

The research on formative theory building and institutional framing shows the importance of integrating the dynamic aspect ecological adequacy into the design of transdisciplinary partnership research. This broad approach of reliable knowledge is also in line with the synthetic overview of the various “input dimensions” of transdisciplinary research processes in the foundational work on transdisciplinary by Ronald Scholz. In particular, in his book on “*Environmental Literacy in Science and Society*”, Scholz shows how transdisciplinary partnership research processes result from the dynamic combination of inputs from three different processes: the research processes, deliberation processes in public discourses and the decision processes by legitimized decision makers (Scholz 2011, p. 375). Depending on the kind of partnership, these legitimized decision makers can be politicians, members of public administrations or directors of organizations. The dynamics of the interaction between these three processes show the evolving nature of the “reliable judgement” built throughout the formative learning process.

The combination of the three input process, however, also shows the many pitfalls that need to be overcome in the construction of transdisciplinary research partnerships. For instance, as analysed by Scholz, even though inputs from legitimized decision makers is important in the framing of the institutional constraints, it is important that the research process itself remains entirely autonomous and guided by the methods and independence of scientific research. Peter Haas provides an interesting analysis of this tension in his work on the International Panel on Climate Research. Indeed, the Panel, although working within a mandate of the United Nations General Assembly, remains autonomous in its scientific work with the view to maintain scientific credibility (Haas 2004). Another major tension is the possible

Table 1 Typology of formative preference processes

	Theories of science–societal actors partnership research	Formative preference processes	Some key operations mobilized in the LENS model (Brunswick)
Post-positivist approach	Action Research (Lewin 1945) Randomized control testing (Duflo and Banerjee 2011)	Result from the contextual interpretation by practitioners of a given intervention based on a specified theory to be tested	No probabilistic processes by the scientists, contextual/experiential fine-tuning of an intervention model Works with the set of existing cues from the human and social environment
Interpretative approach with backward-looking reflective equilibrium between theory and practice	Organizational learning (Argyris and Schon 1974) Institutional diagnostics (Ostrom 2007)	Result from the broadening of the set of legitimate and valid contextual understandings that are present in a problem situation	Probabilistic judgmental process of both scientists and practitioners Works with the set of existing cues from the human and social environment
Interpretative approach with forward-looking/constructivist reflective equilibrium between theory and practice	Formative scenario analysis (Scholz 2011)	Co-constructed by scientists and practitioners when exploring the desirability and applicability of new social possibilities in a problem situation	Probabilistic judgmental process of both scientists and practitioners Produces new cues on possible human and social environment, as a result of the research process itself These are produced in relation to the entire set of features of the human and social environment
Critical theory approach	Street Science (Corburn 2005) Environmental Justice (Laws D: in Innes and Booher 2003, pp. 33–59)	Co-constructed by scientists and practitioners when addressing situations of social oppression and marginalization of social groups and ideas	Probabilistic judgmental process of both scientists and practitioners Produces new cues on possible human and social environment, as a result of the research process itself These are produced in relation to the “black spots” within current perspective taking on the human and social environment

Table 2 Correspondence table between the principles of TPF for visual perception/planning of sustainable transitioning and the typology of transdisciplinary research

	P1 Functionalism	P2 Dualist human– environment system	P3 Probabilistic information acquisition and process- ing	P4 Vicarious mediation	P5 Repre- sentative design	P6 Evolutionary stabilization	P7 Interlinkage of percep- tors
Post-positivist transdis- ciplinary partnership research	+++	+++				+++	
Interpretative approach (backward-looking equilibrium)	+++	+++	+++			+++	+++
Interpretative approach (forward-looking equi- librium)	+++	+++	+++	+++		+++	+++
Critical theory approach	+++	+++	+++		+++	+++	+++

+++ indicates that the principle is salient

manipulation of the process by societal stakeholders. This danger is discussed by Scholz in the case of the so-called shallow action research, which includes for instance consultancy research to corporate elites.

The building of a reliable judgement in situations of uncertainty through the various processes of formative learning highlighted in Table 1 is therefore possible, but also depends on some important social psychological conditions of cooperation. In general, to overcome the highlighted pitfalls, scholars highlight the importance of working within a specific protective space for conducting the transdisciplinary research. As stated by Scholz, transdisciplinary research emerges when a member from the science community and a legitimized decision maker or a member of the public notice that relevant phenomena can be better understood if knowledge from practice and from science is integrated (Scholz 2011, p. 375). In such situation, these actors might “leave” their usual action space for certain specified moments in time to collaborate, whenever relevant and according to agreed upon methodological steps, in the various phases of the knowledge co-construction process. In this process, they jointly agree on the topics of research, adjust their preferences and beliefs in an iterative way and work jointly on the societal translation and interpretation of the research findings (Lang et al. 2012; Scholz 2011, p. 376).

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