

Quantum theory to foster deep transformations toward strong Sustainability

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Abstract :

Transdisciplinarity is increasingly seen as a promising paradigm for strong sustainability. Following a common typology, two “Modes” of transdisciplinary can be distinguished: A theoretical “Mode 1”, largely inspired by quantum theory, and a practical “Mode 2” transdisciplinarity involving multi-stakeholders approaches. So far, Mode 1 and 2 have been developed independently. In this communication, I discuss the potential of using insights from quantum theory to foster deep transformations toward strong sustainability, by closing this gap between Mode 1 and 2. As a first example, I show how a generalization of the quantum complementarity principle to sustainability assessment can be used to better address two major issues (integration and implementation). Then, I explore how quantum insights suggest powerful sustainable pathways, by shedding light on subjectivity, the possibility of free-will and the “co-arising” of personal and systemic change. Finally, a general strategy is proposed, that combine robust quantum methodological insights with a careful exploration of ontological insights.

Keywords : Agroecology, Participatory, Complementarity principle, Subjectivity, Worldview

Introduction

Strong sustainability requires deep, large-scale and urgent transformations (Waddell et al., 2014). These transformations cannot be only technical, but they must also involve changes at the social/political level, as well as at the personal level (i.e. in the way individuals “see the world”, especially as regard their relationship to nature, Niles and Tachimoto, 2018). To foster these transformations, a promising trend is the development is transdisciplinary research, which consists in integrating non-academic sources in the production of knowledge (Scholz and Steiner, 2015). Two modes of transdisciplinarity research have been identified, on the basis of the work of Helga Nowotny, Peter Scott and Michael Gibbons, in the field of the sociology of science (Nowotny et al., 2013): “Mode 1” corresponds to a theoretical approach, motivated by the search of a unity of knowledge, with the general aim to understand of the world; By contrast, “Mode 2” corresponds to a practical approach, typically consisting in participatory problem-solving projects with stakeholders. To date, both Modes 1 and 2 have been developed almost independently (Scholz and Steiner, 2015). For transdisciplinarity to be really useful for sustainability transformations, some authors have highlighted to need to better link Mode 1 and Mode 2 Transdisciplinarity (Max-Neef, 2005). Otherwise, the risk is that “Mode 1” has no sufficiently rapid and tangible impacts in the real-world, and that “Mode 2” remains too superficial, given the tremendous sustainability challenges ahead.

In this paper, I explore the potential of quantum theory as a source of insight to foster deep transformations toward strong Sustainability, by closing the gap between Mode 1 and Mode 2 transdisciplinarity. Quantum theory is at core of the theoretical foundations of Mode 1

Transdisciplinarity, as developed by quantum physicist Basarab Nicolescu (2014). It is particularly important in two fundamental axioms of transdisciplinarity: “levels of reality” and the “principle of the included middle” (see Nicolescu, 2014). By contrast, at first sight, quantum theory seems at odds with the idea of involving non-academic practitioners in very practical problem-solving projects (Mode 2 Transdisciplinarity). Indeed, quantum concepts and language often sound esoteric and mathematically abstract. The science of quantum physics itself is typically performed in the research lab, in extremely constrained experimental conditions (to maintain “quantum coherence”), by particularly skilled and trained scientists. Yet, beyond this first idea, I argue that quantum theory could in fact be a powerful source of insights in participatory problem-solving projects with stakeholders. This position has been developed in detail in a recent paper, as well as a possible strategy combining two kinds of insights: methodological and ontological (Rigolot, 2019a). In the present communication, my aim is to show how his strategy can be applied to tackle strong sustainability issues, taking illustrations from some of my own studies in the field of livestock farming sustainability transformations (Rigolot, 2018; 2019a, 2019b).

Quantum theory and sustainability assessment

According to Alrøe and Noe (2016), although many approaches and tools have been developed in the last decades for sustainability assessment, two key issues remain: i) The integration problem (the fact that different tools produce different assessments); ii) The implementation problem (i.e. the barrier between sustainability assessment and transformation). As an innovative way to deal with these two issues, these authors propose a generalization of the complementarity principle from quantum theory to sustainability assessment (Alrøe and Noe, 2016). Taken in the radical sense of Niels Bohr, the complementary principle means that “*two observations of an object, such as the determination and momentum of an elementary particle, exclude each other in such a way that prevents getting the full picture of the object, so we are left with complementary phenomena that cannot be combined*”. From their long experience with assessments of food systems, Alrøe and Noe have identified two relevant forms of complementarity:

- The *observer stance complementarity* corresponds to the fundamental methodological form of complementarity, as defined by quantum mechanics: In short, “*the conditions for defining the observed system as it is (without interaction) precludes the conditions necessary for observing it (with interactions)*”. Elaborating on this, the authors distinguishes two modes of sciences: detached (“*describing the world as it is and producing general knowledge*”), and involved (“*focusing on enabling action and change in concrete context*”). These two modes of sciences correspond notably to two sustainability assessment tools (complex and expert-based versus simpler and participatory). Another form of observer stance complementarity lies in the assessment position, whether it is “from within” the system or “from without”.

- In *value complementarity*, “*the mutual exclusion of two observations of the same object stems from different values that determine what observations are relevant or desirable*”: The focus here is on the normative conditions of observation. Alrøe and Noe give three examples of value complementarity: *Naturalness* versus *Care* to value animal welfare, authentic versus rich nature to value nature quality, and three perspectives to value growth and sustainable development (*Growth without borders; Growth within limits; Growth and ecological injustice*) (Alrøe and Noe, 2016).

As further developed by Alroe and Noe (2016), the integration problem in sustainability assessment can be seen as a complementarity issue, in a deep sense. This approach is very helpful to understand that the integration problem cannot be overcome, for example by methods of indexation (i.e. by integrating different kinds of assessments, typically into a number). However, by acknowledging this complementarity issue, the integration problem can be better handled yet (if not overcome). To this aim, it is essential to distinguish complementarity from other forms of perspectival differences in participatory projects, such as dilemmas and incommensurability, as they cannot be dealt with the same methods. By definition, incommensurability implies that it is impossible to incorporate representations of the same object from one perspective into another (because of differences in the theoretical framework, concepts...). However, incommensurable observations may still “*be performed concurrently and supplement each other to give a fuller, if multifaceted, representation of the object*”, which is not the case for complementarity.

The complementarity principle also provides an explanation for the implementation problem, as assessment and transformation are based on two incompatible modes of science (*detached* and *involved* observer stance). Therefore, according to Alroe and Noe (2016), “*the implementation problem cannot be resolved by developing still more advanced and complex methods, if these approaches employ a detached observer stance that is directed by the norms of science*”. Building on this analysis, I have myself proposed another explanation of the implementation problem, based on a dynamic view of complementary issues and the concept of worldview (Rigolot, 2018). Worldview has been defined as “a structuring system of meaning, informing how humans interpret and co-create reality”. Many authors have argued that sustainability transformations require some shift in worldviews (Beddoe et al., 2009). In my analysis (Rigolot, 2018), I show that different ideal-typical worldviews identified in literature are associated with Alroe and Noe’s specific examples of complementarity. Considering sustainable transformations as shift in worldviews has important implications for the development of new strategies and the role of sustainability assessments. Particularly, criteria and methods used in current sustainability assessment are virtually meaningless for a same actor in a new transformed system, due to complementarity issues with emerging worldviews. In that case, trying to improve existing criteria is not necessarily a good approach for sustainability transformations, and value-based approaches that aim at communicating and mediating sustainability values should be more fruitful. However, such value-based approaches should be aimed not only at coordinated and cooperative actions, but perhaps more importantly at mutual transformations of stakeholders’ own perspectives (Rigolot, 2018).

Quantum theory and sustainability pathways

Fostering mutual transformations of stakeholders’ own perspectives might be more easily said than done. Again, quantum theory could be very useful in that perspective, to build sustainability pathways. As mentioned in the introduction, transformations cannot be only technical, but also require changes at the social/political level, as well as at the personal level. In other words, as framed by O’Brien and Sygna (2013), sustainability transformations require change in three “spheres” of transformations: 1) The *practical sphere*, representing behaviors and interventions; 2) The *political sphere*, representing “*systems and structures that shape change in the practical sphere*”; 3) The *personal sphere*, representing “*the subjective dimensions that influence behaviors and interventions, and how systems and structures are perceived and experienced*”. James and Brown (2019) have shown how this

“three spheres” framework can be used to frame organic conversions in agriculture as transformations, as they involve practical, political and personal changes. The temporal logic of these changes in the three spheres is essential in one want to foster sustainability transformations. Although James and Brown (2019) highlight “*the messy and non-linear nature of change*”, their analysis implicitly suggests some kind of temporal logic in organic transformations, which is in fact quite widespread in sustainability sciences communities (Rigolot, 2019b). Schematically, it seems that going through hard and painful times is a necessary and quite central part of the transformation process. Following this implicit temporal conceptualization, the political sphere especially plays a major role to enable changes in the other spheres, whereas it seems that transformations in the personal and practical spheres cannot be scaled-out to effect transformations in the political sphere (James and Brown 2019). Moreover, the farmer may appear a bit passive in the process, waiting that a “window of opportunity” enables him to “fortuitously escape” the constrains of his conventional system (James and Brown 2019).

However, some studies have shown that other temporal logic in the three spheres evolution are possible. Particularly, Coquil et al. (2017) show that new ideas and farmers’ epiphanies can play key initiating role in the transformational process, whereas these seem to happen only “in a second time” in James and Brown’s (2019) analysis. Particularly, these authors show that “farmers’ professional transitions were initiated by four factors (often in conjunction): (i) access to the unthinkable, (ii) practical difficulties, (iii) awareness of the gap between “doing” and “thinking” and (iv) external constraint”. Particularly, “access to the unthinkable refers to the subjectivity of discovery and to access to a new realm of possibilities through a discovery”. As I have developed in a response to James and Brown (2019) paper, insights provided by Coquil et al (2017) make a strong difference in the narratives that can be made around organic conversions, by shedding light on the personal sphere. In this conceptualization, the converting farmer appears rather as a curious and open individual, sometimes experiencing a remarkable subjective experience, with the possibility to become a “key individual” himself soon or later. As a consequence, contrary to James and Brown’s (2019), this analysis suggest that transformations in the personal sphere can in fact powerfully scale-out to effect transformations in the political sphere, through political agency in the broad sense (O’Brien, 2015).

Generally, these differences in temporal logics when framing organic conversions reveal some kind of “chicken and egg” problems, which are typically raised by sustainability transformations (Rigolot, 2019b): It seems that changes in the “personal sphere” require changes in the “political sphere” first, but changes in the “political sphere” cannot change without prior changes in the “personal sphere” too. This raises deep theoretical questions. Particularly, an emphasis on the personal sphere as in Coquil et al., (2017) suggests that individuals are able to deliberately engage in a transformational process, in spite of unfavorable constrains in the political and practical spheres. To address this theoretical question, insights from quantum theory are particularly helpful. Indeed, a quantum ontology recognizes and legitimates the fundamental importance of subjectivity. Particularly, the International Relations scholar Alexander Wendt (2015) has recently proposed an updated version of the “quantum consciousness hypothesis”, integrating the latest scientific breakthroughs in a rigorous manner, as reviewed by Rigolot and Orlando (2019). This “quantum consciousness hypothesis” could give a physical basis to explain consciousness, considered as “*collapse of a quantum wave function into a defined reality, resulting in the everyday world that we perceive and experience*” (O’Brien, 2016). Following this approach, individuals are seen as entangled

and “intra-acting”, rather than fully separable entities. Moreover, social structures are seen as both external and “*internal to human beings collectively*” (Wendt, 2015, p 208). In the case of organic conversions, the structures that are constraining transformations do not “come from nowhere”. Instead, they reflect a particular view of the world (in this case of that legitimates high-input agriculture, a prioritization of yields...), as well as power dynamics and interests (Rigolot, 2019b). This quantum approach gives a strong meaning to the co-arising of the personal and political spheres, which can emerge through the practical sphere of transformation. This is in sharp contrast with the mainstream paradigm largely based on the assumption of classical physics, “*where agents are discret individual or self-interested states that interact through local causation, with little or no role for subjectivity, consciousness, intentionality or free will*” (O’Brien, 2016). As a perspective, we plan to explore formally this quantum conceptualization with “quantum-like models”, as developed in the field of quantum cognition (Busemeyer and Bruza, 2012). In these models, farmers’ preferences are not seen as “well defined”, as in classical decision-making models, but rather in “superposition”. As part of our on-going participatory projects with stakeholders, we expect that these quantum formalisms will be useful for decision-makers in generating powerful alternative narratives and more relevant recommendations, compared to representations based on a classic model of human beings.

Conclusion

Despite its reputation of being abstract and laboratory-based, quantum theory has the potential to facilitate fruitful collaborations between science and practice on “equal footing” (Scholz and Steiner, 2015a), as part of Mode 2 transdisciplinarity projects. Quantum insights convey a radical meaning, which could enable larger and deeper collaborations with stakeholders, where fundamental theory and practice could be deeply interconnected. However, the use of quantum theory in applied projects raises important issues, with serious potential pitfalls. Because of the real dangers of careless interpretations, scientific communities are often suspicious toward quantum approaches. As proposed in Rigolot (2019a), a strategy is to consider the previous insights as methodological tools, in a first step (other worth-mentioning examples of stimulating quantum-inspired methodologies are Q methodology and agential realism, Rigolot, 2019a). In a second step, my opinion is that we should remain open to ontological insights, i.e. the occurrence of “real” quantum phenomenon impacting the macroscale, such as in the “quantum consciousness hypothesis”. This position is controversial, as these ontological claims are quite speculative. However, I believe ontological insights could be very powerful and necessary in that they convey a much-needed sense of wonder and humility. This is consistent with the claim of taking seriously different kind of knowledge and epistemologies (such as local and indigenous) in transdisciplinary research. In this way, rather than a new discipline or super-discipline, strong transdisciplinarity could mature as a “different manner of seeing the world”, based on a fundamentally new relationship between the Subject and the Object (Max-Neef, 2005). This emerging worldview could be an essential part of strong sustainability.

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