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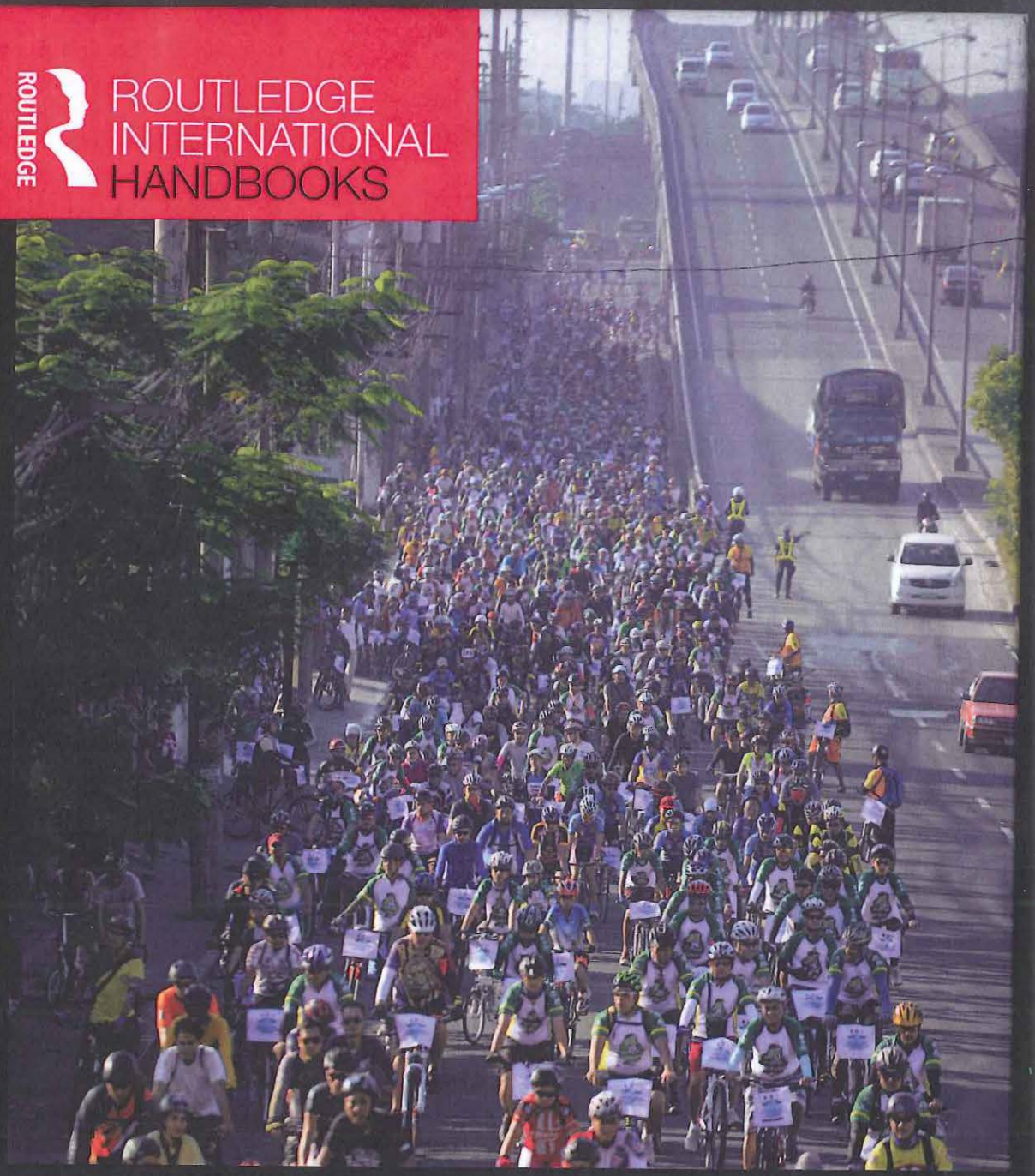

Routledge International Handbook of Social and Environmental Change

Edited by Stewart Lockie, David A. Sonnenfeld and Dana R. Fisher

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Social learning to cope with global environmental change and unsustainability[1]

J. David Tàbara

In the current context of global environmental change and increasing unsustainability, social learning can be understood as the cultural and structural processes through which human societies reframe their worldviews and establish new patterns of interaction with biophysical systems to better cope with the unintended, unwanted, cumulative and often unexpected collective consequences of social action. Social learning can be conceived both as the *process*, as well as the *outcome*, of institutional transformation and creation in response to human-induced environmental change. On the one hand, social learning occurs within a given *social-ecological system of reference*, which includes both the human and biophysical conditions in which learning takes place. On the other hand, learning materializes as a complex and combined result of various *dynamics and mechanisms* whereby new frames, capacities and goals reorient collective behaviours towards desired conditions. However, the final outcomes of social learning cannot be fully anticipated. Indeed, we cannot know what we will know and what eventually will result from our knowledge, mostly because this depends on the processes we will choose for learning which, at present, are still unknown.

Yet there is not a single or universal definition of social learning. Distinct notions, theories and categorizations of learning exist in economics, psychology and policy sciences. The various approaches tend to assess the 'evidence' for learning based on different grounds. Cognitive and cultural learning perspectives tend to emphasize changes in understandings, assumptions, worldviews and motives, while relational and structural learning approaches tend to stress the creation of new capacities, the redistribution of responsibilities and the creation of long-term patterns of interaction through the transformation or constitution of new institutions. Some approaches also tend to emphasize the role of *processes* like the existence of opportunities for participation, the types of leadership, and modes of facilitation. Others concentrate their attention on *results*, like those of a cognitive, relational or institutional nature. The literature has also distinguished between *learning* and *knowing*, and some of the most promising research efforts today are oriented toward understanding the relationships between knowledge-building, learning and transformative change for sustainability (Blackmore 2007; Jennex 2008; Keen et al. 2005; KLSC 2011; Mostert et al. 2008; Pahl-Wostl 2009; Pahl-Wostl et al. 2008; Reed et al. 2010; SLG 2001; Siebenhüner and Heinrichs 2010; Wals 2007).

This chapter takes an integrative approach. Specifically, the focus here is on *sustainability learning* (Tàbara and Pahl-Wostl 2007), conceived as the complex structural process whereby

changes both in worldviews and in the quality of social-ecological interactions emerge in ways that lead to more robust and resilient ways for humans to relate to the natural world. A transition to sustainability demands profound change in understandings, interpretative frameworks and broader cultural values and of beliefs, just as it demands transformations in practices, institutions and the social structures that regulate and coordinate individual actions and behaviours.

Multiple dimensions, multiple narratives

Given the vast literature devoted to formal theories and models of learning, the focus of the present contribution is limited to the examination of issues of global environmental change and (un) sustainability. I try to move away from any attempt to offer a simplified model or quick recipe for learning that claims to be able to support global sustainability. Similarly, I do not intend to provide an aseptic analysis, free of value judgements. Sustainability is both a descriptive and a normative notion. Normative statements cannot, therefore, be avoided. The approach here is nuanced and reflexive, based on a series of 'vignettes' that aim at grasping, albeit incompletely, the complexity of global environmental change, sustainability and social learning.

Adapt or modify?

In the present age of the Anthropocene, of the Great Acceleration, and of growing intertwined planetary boundaries (Crutzen 2002; Rockström et al. 2009; Steffen et al. 2007) individuals and societies are inevitably required to adapt to a human-altered biophysical environment which has never existed before. In this novel, complex, techno-social-ecological global *system of systems,* many new uncertainties and challenges emerge. The speed and scope of the changes make it difficult for individuals and organizations to reflect upon, react and transform their patterns of behaviour in time. A very common response to this situation is to intensify modification of the 'external' world (instead of ourselves) with further interventions and technologies in an attempt to 'control nature' (Murphy 2009) and whatever is perceived to be outside the most immediate human sphere of action. However, further modifications of the natural world may exacerbate the complexity and interconnections of global social-ecological systems in ways that create greater systemic risks, unwanted consequences and uncertainties, thus posing greater difficulties for future adaptation. Under these conditions, it appears that humankind is inexorably destined to both modify and adapt to a largely unknown and unknowable environment. Decisions on how much human resources and ingenuity should be devoted to one task or the other – or to both – must be taken. Notwithstanding, these decisions cannot depend on one single type of 'objective' knowledge or scientific discipline, as they are inevitably entangled in many normative judgements. Sustainability requires not only being aware of such complexities and uncertainties, but above all developing the necessary normative patterns of knowledge creation and collective behaviour that render serious consideration to these decisions. A precautionary attitude is required to minimize the irreversible loss of options for learning and renewal necessary to guarantee the viability, diversity and quality in functioning of social-ecological systems in the long term. In this process, ethics must be recognized as a central form of collective knowledge and an indispensable component of sustainability learning.

Sustainable developments

One of the greatest complications that we face in the conceptualization and application of the notion of sustainability is that it almost inevitably comes associated with the word 'development'

(Kates et al. 2005). But as Mary Midgley (2011) remarks, it is high time that we rethought the colonial idea of 'development' (in singular); that is, as the inexorable linear fate which all human societies must follow – like caterpillars turning into butterflies. Both sustainability and development are usually understood as socially desirable goals, but the combination of the two may necessitate a reframing of both. The evolution of human societies, with all their diversity and complexities, goes through multiple phases of renewal, destruction and reconstruction.[2] Different social-ecological dynamics may take different trajectories, adopt different patterns of organization, and may behave within different domains or scales in synergetic, independent or contradictory manners. What is then required is the quest for *diverse and open paths of multiple developments*, which embrace the complexity and variety of social-ecological systems and dynamics to ensure the preservation and/or restoration of the necessary, diverse conditions that make both sustainability and development possible in the many contexts in which human action takes place.

Revealing and interfacing processes

Sustainability is a language on its own, with its own vocabulary and grammar, which fundamentally can only be learned and fully understood by practising it. For this new 'language of motives' (Mills 1940) to trickle down, it requires communities of practice (Wenger 1998) as well as of individuals and organizations experienced in specific procedural and integrative competences (Martens et al. 2010; Robinson 2008). To substantiate and validate such 'narratives of hope' embedded in the discourse of sustainability, the creation of spaces for diverse and reasoned interaction between different stakeholders, with the aim of assessing risks, problems and proposing viable solutions, is especially urgent. Improving sustainability can be thought essentially as a question of revealing, understanding and improving social-ecological *processes* in the many spheres in which human action takes place. In this sense, focusing on processes and moving our attention from the question of 'What is the problem?' to 'Who is the problem?' may help improve equity and facilitate the distribution of responsibilities regarding unsustainable behaviours.[3] However, revealing the unsustainability of social practices and institutional arrangements and proposing feasible options for alternative paths of development calls for remarkable personal, transdisciplinary and professional competences. These are not often taught or promoted in science, education or policy, mostly because they do not belong exclusively to any one of them but to all at the same time. Sustainability science has been proposed as one avenue to compensate this deficiency. The new generation of 'sustainability entrepreneurs' needs a full suite of competencies to facilitate transformation and learning, such as: aptitude to translate complexity among different audiences; capacity to integrate different sources of knowledge; and the abilities to lead and create sustainability partnerships and to bridge organizations across different scales and domains of action (Berkes 2002, 2009; Berkes and Folke 1998; Cash et al. 2003, 2006; de la Vega et al. 2009; Jäger 2011; Van Kerkhoff and Lebel 2006; Weichselgartner and Kasperson 2010).

Embracing complexity

In technologically intense societies, the provision of food, health, mobility, communication, education and entertainment is made possible thanks to the existence of highly complex systems, the size, nature and dynamics of which we may not be fully aware (Castellani and Hafferty 2009; Urry 2005). The long-term viability of these systems depends on them having a *structural design* (S), which continually allows for renewal and innovation. This can be achieved by injecting new flows of *energy and resources* (E), which allow the kinetic functioning of the system, by improving the robustness and quality of *information and knowledge systems* (I) to adapt to changing conditions

and by containing the potential negative and intertwined *systemic effects and changes* (C) that the actual functioning of all these systems provoke (the *SEIC model*, Tàbara and Pahl-Wostl 2007). Thus, social-ecological systems are complex systems characterized by many clusters of practices and agents, some partly independent but also mainly interconnected. Agents operating within these systems maintain many simultaneous interdependencies with many other agents and parts of the system. At the same time, such social-ecological interactions respond to forces that produce recursive, cumulative feedbacks on different scales. This tends to create non-linear dynamics where sudden bifurcations, multiple trajectories and regime shifts are possible. The complex nature of these systems is further exacerbated by the fact that different agents may see not only different parts of the system but different systems – depending on the issues at stake and how they relate to a particular subset of agents within the system. A robust definition of social-ecological systems dynamics valid to deal with global environmental change and sustainability is an arduous task and a complex co-production learning process in itself. Hence, in a complex system, the type of learning processes needed to move towards sustainability cannot be fully anticipated. The dynamics and outcomes of learning are largely unpredictable, diverse and subject to multiple contingencies and feedbacks. Embracing such complexities is a first step towards acquiring a more precautionary and open attitude fundamental in the design of long-term viable systems. Individuals living in the increasingly hyper-connected global societies should be bestowed with the necessary capacities, flexibility and degrees of freedom to become aware, adapt to and anticipate the multiple sustainability challenges inherent in the large-scale complex systems integrated into the functioning of the large-scale complex systems in which they develop their daily activities.

Managing common problems

There are numerous uncertainties concerning whether global human societies can be sustained, for how long or under what conditions. On the one hand, in sustainability, not only are the means largely unknown, but also the goals: knowledge-building processes aimed at supporting sustainability are not only goal-driven activities but, mostly, goal-searching ones (Jäger 2011). However, uncertainties are not complete. A wealth of knowledge and practices about what works to improve sustainability is already available. Innovative pathways to prevent negative impacts on the global environment and help restore some of the basic functions of global social-ecological systems have been identified and assessed – so the problem is not of that of lack knowledge but mainly of collective action. For example, collective action theory, as elaborated by Elinor Ostrom (2009, 2010), provides crucial insights into the learning mechanisms that operate in the case of Common Pool Resources as well as in global environmental change. Ostrom underlines the crucial role of polycentric institutional arrangements that allow greater opportunities for experimentation and feedback between different scales of action. While there are no panaceas for managing resources in a sustainable way, some key variables that have been identified include size and productivity of the system, predictability of its dynamics, resource unit mobility, number of users, role of leadership, existing social capital and norms, knowledge of the social-ecological system, importance of resources for users, and the type of collective-choice rules (Ostrom 2007, 2009, 2010).

Learning what not to do

Learning what not to do is a necessary and often neglected component in the improvement of sustainability, in particular for the integrated sustainability governance of complex social-ecological systems. In liberal democracies, such framing is often seen as a threat to the freedom of individuals and corporations rather than as a guarantee for the long-term viability and

quality of the systems in which we operate. Understanding the constraints and opportunities for bringing such framing into science, education and policy discussions, while avoiding simple ideological discussions, is of paramount importance in sustainability learning. There are many examples in which communities and organizations have learned to regulate what *should not be done* to prevent negative consequences of their actions on the systems in which they intervene. Nevertheless, in times of fast emergence and convergence of new technologies (with huge potential for unexpected global environmental change like synthetic biology) and multiple cross-scale interactions, learning what not to do is a particularly challenging task. In order to harness such complex and cascading developments, a high degree of social and institutional innovation is needed. The governance systems that are designed to address such challenges will have to be highly integrative and follow approaches that are sufficiently open, independent and resourceful so as to anticipate and reorient possible unwanted futures in time to avert unwanted consequences. New institutional arrangements should encourage the production of socially and ecologically robust assessments, as well as democratic decision making about which development pathways are to be followed, instead of technologies and vested interests creating path dependencies which have never been publicly deliberated.

Reframing knowledge: an example

Increasing the time and resources spent reflecting on a given complex environmental issue may not lead to the reduction of associated uncertainties. In a related research project carried out in Europe in the mid-1990s, we qualitatively explored how lay people's perceptions of global warming might change following participation in informed deliberation on the issue (Kasemir et al. 2003). One team monitored the learning that occurred within a series of heterogeneously composed meetings in the Barcelona metropolitan area. Thirty-eight participants, divided into five groups, were exposed to a variety of expert and non-expert sources of information. To our surprise, and after long debates that went on for five sessions of two and a half hours each, we found that uncertainties regarding the potential causes and impacts of climate change did not diminish but increased. In fact, many participants declared they had learned a lot about the problem of global warming and, in particular, about how much they did not know about it. At the same time, the number of participants willing to take preventative action also increased (Tàbara 2005). This 'precautionary learning' appears to be a recurrent outcome of many learning processes related to global environmental change and sustainability. A first step in this direction is recognizing the limitations of our knowledge, followed by increased consensus about the need to avoid the worst outcomes derived from our ignorance. Sustainability learning is not simply about 'knowing more', but also about learning about what we don't know, about how we can collectively generate different types of knowledge, and about implementing multiple learning processes able to harness the unexpected and unwanted effects that may arise from our partial and inadequate knowledge and views.

Tools of mislearning and relearning

Models are central tools in the (self-)representation of social-ecological systems. In a similar fashion to games and metaphors, models provide powerful means to convey and communicate complexity. Global dynamics of stocks and flows of information, resources and pollution are very much affected by some of the models created by the social sciences which, in turn, have become major ideological instruments for the re-creation of the world. Tools used in economics, such as the general equilibrium macro-economic models so pervasively used to inform public policies, increasingly are being called into question in the face of mounting intertwined crises.

Not only do many of these models have great limitations in explaining and anticipating ongoing instabilities and turbulences, but also many of their assumptions about human behaviour cannot be tested empirically.[4] An alternative set of tools for explaining, educating and communicating economic behaviours and complex dynamics is now required. In particular, new tools are needed that move away from the pervasive teaching and exaltation of 'perfect competition' towards taking into account the intrinsic complexity of economic interactions and considering the required social-ecological conditions and best strategies for 'perfect global cooperation'. Learning to cooperate, and to understand the conditions for cooperation with 'different others' in concrete social-ecological contexts as a focus of the new economic models, appears to be a necessary task in the present times of cascading global risks and uncertainties.[5]

New learning, identities and power arrangements

Learning leads to the creation of new identities in the same way that the emergence of new identities tends to create new demands for learning. Identities define what is in and out in each person's systems of reference and, in this sense, identities define what is included and excluded from the cognitive and perceptual boundaries in which social action takes place. The creation of identities is parallel to the creation of meaning. Identities and meaning are both relational products in the interaction between individuals and agents in the contexts where people operate. The penetration of the sustainability worldview in science, education and policy may be leading to a broad identity shift in which the motives determining social action may take into account a more extended set of references in time, space and the subjects and objects under moral consideration. In this broader cognitive and moral space, the new references may include not only the rights of present generations but also those of future generations; not solely the rights of those belonging to our own communities and nations but the rights of all people in the world; and not just the rights of humans but also extending respect, compassion and moral consideration to non-human beings and the social-ecological processes necessary to maintain 'life in all diversity' (as stated in the first principle of the Earth Charter). In the current context of global change, the co-evolution of identities with social learning is likely to be accompanied by the development of new rules that allow for novel forms of social-ecological interaction better suited to deal with common problems of unsustainability. As new identities emerge from learning, individuals and organizations may adapt their multiple roles to the new conditions and boundaries of the situation. In some cases, as in the formation of environmental movements, the creation of new identities is a necessary condition – albeit not a sufficient one – for the mobilization of resources and for agents to engage in sustainability transitions (Ilhan 2009; Tàbara and Ilhan 2008). In other cases, obstacles to learning have risen from various resistances to transform present identities that benefit particular interests and the incumbent regime. This is why social learning needs to be understood as a political process, and as a process that is likely to become even more political in the face of escalating dangerous global environmental trends and indeterminacies.

A world of men ... and women

As noted a century ago by Georg Simmel (1911: 234), 'our culture, with the exception of few domains, is mostly a masculine one'. Access to learning and advancements in the literacy of women has yielded massive changes not only in reproductive patterns but also in improvement of standards of living, reduction of violence, and the setting of innovative development strategies all over the world. In some cases, women have been found not only to be more vulnerable to environmental change (Goldsworthy 2010) but also faster in taking adaptive responses than men

(Ongoro and Ogara 2012; see also Shiva 1989). However, in our present times, most decisions related to the (over-)use and (over-)exploitation of natural resources still appear to be mainly taken by men. This pattern is characteristic not only of traditional or tribal societies but is reproduced in many of the opulent societies where most decision boards of key corporations and political parties are still mostly dominated by men. While the influence of women on corporate environmental performance is an issue that requires further research (Terjesen et al. 2009), the exclusion of women's perspectives from such decisions is both a blatant expression of inequality and a situation that prevents the emergence and consolidation of more open and diverse spaces and institutions conducive to reflectivity and social learning. Although it has been several decades since the environmental and feminist movements pointed out the need for women to have a greater role in environmental and resource management decisions (e.g. Rio Declaration and Agenda 21), substantive progress so far has been scant. It would be naive to believe that a world exclusively governed by women would just lead us to sustainability. However, when it comes to living sustainably and to reframing not only the means but also the goals of human development, it is hard to believe that men on their own will ever be able to carry out this extraordinary challenge and to learn what is needed to be learned. A multiplicity of diverse, oftentimes suppressed, perspectives must be truly respected and taken into account.

Our body, our closest environment

Our biophysical body is a primary means of experience and interaction with the external, natural environment. A close examination of the composition of our body reveals that the environment lives as much in our body as our body lives in the environment (Turner 2008; Watts 1970). Our body is a complex system, in some ways separate, but in other ways connected, in time, space and to the rest of chemical elements and living organisms. What happens – or we desire to happen – to our body is not only a manifestation of changes occurring to larger biophysical systems, but also a source of changes which are likely to affect them, too. As such, the body is as much an indicator of global environmental changes as it is a major channel through which we interpret the scope and quality of these changes. Being the closest biophysical environment to our consciousness, our attitudes to our body reflect our attitudes to the natural world, bringing in particular practices and responses. The type of food we eat (and discard in the process), the ideals and aspirations for a perfect or never-ageing body, and the lifestyles we follow, say a lot about the type of daily interactions we maintain with the environment. Social trends such as vegetarianism, slow food or green consumerism may be adaptive responses in the attempt to transform such interactions in a meaningful manner at the very individual, physical levels and to the space where particular experiences can be felt and different options discussed (see Hinton and Goodman 2010). While environmental change has often been understood as processes occurring 'out there', either in another place, time or to other people, increasingly the negative impacts on health, reproduction and quality of life are making people realize that changes are happening here and now, and to our bodies. The new global situation not only poses large threats for human well-being but also gives rise to myriad opportunities for a new social reflectivity on global change and to rethink the role of emerging technologies and consumption.

Meaning, knowledge and ignorance

In relation to environmental change, one can easily see that, while there are many types of knowledge valid to support sustainability, there is only one type of ignorance: that which disregards or denies the need to do something about it and impedes or fails to anticipate and implement the

necessary and efficient measures to cope with it. Nevertheless, in order for individuals and organizations to engage in collective environmental and social action, it has to make sense doing so. Meaning is needed to make sense of the world around us, to transform information into knowledge and to mobilize the resources to deal with the mounting negative environmental trends of today. New information technologies and the greater mobility of humans and goods makes people less dependent on local conditions for obtaining resources and knowledge – while making them increasingly interdependent on the external and global systems. These multiple, interlinked processes erode many of the original collective meanings that gave sense to traditional practices in the use of natural resources. Such traditional collective understandings of humans' ultimate dependence on the biophysical environment may now be crucial in the transition towards sustainability. Whilst the destruction of meanings is relatively easy, their reconstruction can be very difficult – mostly because the social-ecological conditions which gave rise to them no longer exist (Otero et al. 2013). This destruction of meaning is reinforced by a dominant exemptionalist view about knowledge, now commonplace in science, education and policy (Dunlap 2002). That view accepts and promotes a 'placeless' universal knowledge, the validity and robustness of which is not checked against identifiable existing social-ecological systems of reference. Therefore, a key learning challenge of contemporary societies is how to manage both knowledge in an open, plural and socially-ecologically coupled mode, and ignorance, the latter too often associated with particular power arrangements and the pervasive idea that abstract, detached knowledge should prevail over socially-ecologically coupled kinds of knowledge (Tàbara and Chabay 2013). In the present conditions, where many processes of destruction and production of knowledge occur at the same time, meaning has become one of the scarcest resources to support transitions towards sustainability.

Harmonizing social learning processes

In contemporary complex societies, many different learning processes occur at the same time. Learning processes may be complementary and many kinds of collective intelligences are needed for different purposes. Likewise, they may be in competition with other collective learning processes, with learning processes in other domains and/or processes at other levels of action. Moreover, learning processes are distributed unevenly among society. Existing inequalities in social structure remove opportunities for suppressed voices to engage in social learning processes and, therefore, to participate constructively in the building of diverse paths for sustainable *developments*. In order to contribute to sustainability, the emergence of global kinds of knowledge need to respect and pay attention to local sources of expertise and judgement (Hulme 2010). The harmonization and improvement of equity of the multiple processes of systems learning and knowing that need to be developed to cope with global environmental change constitutes a meta-learning process in itself. Environmental and sustainability issues often are framed as problems of 'not knowing enough' and as problems that we would overcome if only we knew 'more' (the knowledge-gap-filling model). However, the challenge for sustainability may be approached in a different way: as the task of selecting, integrating and generating qualitatively different types of knowledge to stimulate the emergence of a diversity of learning processes suited for a variety of problems, purposes and contexts. In many cases, the lack of substantive action does not have to do with the existence of 'incomplete knowledge' but must be found in other psychological, social and political factors. These include processes of sensemaking, ways of framing issues, the lack of adequate incentives, and the unwillingness or inability to generate options and deploy resources to distribute responsibilities in accordance with the new social-ecological situations (Tàbara et al. 2010).

Limits and opportunities for learning

There are, however, many limits to learning. While on the one hand social learning should empower individuals and societies to deal with common problems, on the other learning also leads to new knowledge needs about how to deal the global challenges of unsustainability. Science and technology also display this ambivalent character, being as much part of the problem as the solution. The growing speed of flows of information (but not necessarily in the quality of those flows) poses new constraints on existing institutions, now largely unfit to govern complex dynamics in sustainable ways. In some cases, such as global warming, it will take decades until mitigation measures can produce significant effects on the climatic system, if they are successful at all. In this situation, learning to adapt cannot be avoided (Hinkel et al. 2010). In this 'learning race against time' means not only that we need to learn new ends and means to reorient our actions, but also that we need to implement the attendant measures, practices and institutions in sufficient time ahead to prevent large-scale social-ecological disruptions. Other cognitive and cultural limits to learning and to sustainability need to be overcome. These come from bounded and corporate rationalities and the institutional arrangements created around them (e.g. from property regimes to market mechanisms). The kinds of learning processes, encouraged and implemented in different contexts and organizations, depend on the type of perceptions held about the nature of problems that need to be addressed. As Caldwell (1997) suggests, environmental problems can be conceived as incidental, operational or systemic in character, with explanations and proposed remedies varying according to these different understandings (see Table 21.1).

Many opportunities for social learning towards sustainability remain. Social learning can be facilitated by specific strategies and interventions in education, science and policy. While education at all levels will play a central role, not all educational efforts will encourage the type of systems thinking and acting necessary to boost a transition towards sustainability – nor will the results of such education necessarily materialize in time. The information and communication technology (ICT) revolution is posing phenomenal challenges as well as opportunities to traditional forms of

Table 21.1 Interpretations of environmental impairment (adapted from Caldwell, 1997)

Perceived causes	*Explanations*	*Remedies*
I. Incidental Harmful behaviours occurring in the normal course of human activities	*Errors in judgement* Dereliction, ignorance, carelessness, alcohol and drug abuse	*Exhortation* Ad hoc responses, clean-up campaigns, indoctrination, education and penalties
II. Operational Misdirected policy, flawed programme planning and execution, and bureaucratic intransigence	*Ineffective management* Insufficient or incorrect information, poor morale or operating procedures, avarice and corruption	*Correction* Improved procedures, impact assessments, independent review of proposals, standards, enforcement and incentives
III. Systemic Impairment inherent in technology economic systems; unsustainable and exploitive economic practice	*Built-in hazards* Narrowly focused policies failing to assess full dimensions of environmental consequences; policies based on unwarranted assumptions	*Reorientation* Basic changes in beliefs and behaviour systems; redesigning institutions and development of alternative technologies, elimination of harmful products and procedures

education and public engagement in decision making, both of which are becoming largely obsolete. Yet, ICT may also facilitate new forms of interactions and social-ecological awareness. The development of concrete practices and procedures that contribute to new forms of socially and ecologically coupled knowledge could be a first step in this direction. This, in turn, may require a plurality of hybrid learning processes able to articulate and integrate a diversity of information and knowledge systems, sources and representations – scientific and artistic, local and universal, formal and informal, male and female, young and old – as well as chances for learning from non-human beings and a variety of forms of biophysical systems organization.

Conclusion

The conflation of social and ecological trends into what has been labelled the 'Great Acceleration' is exerting massive pressures on the ways both individuals and institutions operate. Much of the anxiety of present times derives from the need to reorient individuals' undertakings to a largely unknown New World, now mostly driven by the unintended, cumulative and often unwanted consequences of our collective actions. With multiple technologies amplifying the environmental effects of these actions, the current situation requires a profound problematization of the assumptions, values and beliefs used to build our judgements about the future ('the future is no longer what it used to be'). In these turbulent times (Folke and Rockström 2009; Milbrath 1989), many aspirations and ideals are being reformulated, many political boundaries become permeable, inequalities cannot be contained, and simple solutions are not an option. In this fluid context, sustainability learning emerges as a complex process of re-creating our identities, accepting the limits of our knowledge and setting limits to our actions in an age where apparently everything is attainable. As such, sustainability learning can be conceived as the complex process in which more extended and informed meanings are searched for in the creation of new *patterns of social-ecological interaction* that can make the long-term viability of human life on Earth feasible under high standards in the quality of life.

In the face of such large complexities, social learning cannot be avoided. On the one hand, the viability of global social-ecological systems depends on developing open, adaptable and anticipatory governance structures in which agents can become actively engaged in continuous reconfiguration and renewal. This requires flexible and multiple arrangements that preserve social-ecological diversity, allow for sufficient degrees of freedom and avoid the dominance of individual agents who prevent the learning, transformation and adaptation of others. Polycentric designs that encourage multiple cross-scale learning feedback, and bestow greater responsibilities on individuals in managing their resources, appear to be well suited to cope with accelerated global environmental change and unsustainability. In this respect, the restoration or re-creation of multiple social-ecological feedbacks for humans to learn from their aggregated actions and emergent dysfunctions on global and local ecosystems is essential.

But this will not be an easy journey. The institutionalization of practices that can contribute to new forms of social-ecological reflectivity for sustainability is likely to be increasingly contested. For some, embedding reflective practices in education, science and public communication is of paramount importance to anticipate catastrophe and avoid encroaching on impending thresholds of unsustainability. For others, reflectivity is perceived as a danger to their freedom and identities as well as a threat to economic and political interests to whom the present ecological illiteracy serves. Opportunities for social learning, global restoration and renewal of social-ecological systems are there. But at the end, as Freud (1989/1930; see also Tàbara and Giner 2004) asked: Who will win, *Eros* or *Thanatos*? Love or self-destruction? We simply cannot say.

Notes

1 This contribution has benefited from discussions with Carlo Jäger and Ilan Chabay within the EU project of the Global Systems Dynamics and Policy (www.gsdp.eu), the new IHDP initiative on 'Knowledge, Learning, and Societal Change' (www.proclim.ch/4dcgi/klsc/en/media?1913), as well as with Jill Jäger in the context of the EU project, 'Vision RD4SD' (www.visionRD4SD.eu). Responsibility for any biases and errors is the author's. Opinions presented in this chapter do not necessary express those of the cited projects.
2 In the resilience perspective, such evolution has been conceptualized under the ideas of the adaptive cycles and 'panarchy' where the sustainability of social-ecological systems can be analysed according multiple stages of exploitation, conservation, release and reorganization (Gotts 2007; Gunderson and Holling 2002; Holling 2001).
3 Albeit a bit offensive, it has been noted that one very direct but efficient way to convey this message to a variety of scientific, political and public communication audiences is by the use of the expression 'It's the process, stupid!' (rephrasing the famous Bill Clinton 1992 presidential campaign). Focusing on processes rather than only on outcomes can reveal many inconsistencies and unscrupulous behaviours with regard to sustainability, which now go untapped in economics, politics and the organization of present societies.
4 Including those related to the existence of a representative agent, complete or homogeneous information or the tendency towards market clearance. For an introduction, see Beinhocker (2007).
5 Current developments in Agent Based Models (ABM) and complexity economics appear to be promising in this regard (see www.gsdp.eu).

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