Hertz, T., and F. Bousquet. 2025. Knowledge that affects: an assemblage approach. Ecology and Society 30(1):27. https://doi.org/10.5751/ES-15734-300127

Research, part of a Special Feature on The Coproduction of Conflicts in Environmental Sustainability: Concepts, Methods, and Ethics

Knowledge that affects: an assemblage approach

Tilman Hertz [1] and *Francois Bousquet* [2]

ABSTRACT. There is consensus in the field of sustainability science that co-production of knowledge is needed to generate knowledge that is useful for addressing matters of concern. The field has made important advances, particularly focusing on developing strategies and principles that ensure the effective co-production of knowledge. Although these lay necessary foundations, less attention has been paid to the question as to what exactly is meant to "happen" in such processes. What is meant to happen, we argue, is that such processes generate knowledge that affects, by which we mean that it triggers an experiential intensity. Although affect ultimately underlies all kinds of knowledge (e.g., representational, such as discourse, or embodied, such as habits), different kinds and contents of knowledge affect (or not) participants of co-production processes in different ways. This paper thus argues that paying attention to affect in knowledge co-production increases the likelihood that it will be acted upon. To illustrate this point, we conceptualize knowledge as an assemblage generated through processes of knowledge co-production. We argue that for knowledge to affect, it must align the different kinds of knowledge mobilized in the process with the concrete experiences of those meant to act on it. In this paper, we particularly focus on the representational, discursive kind of knowledge, often of scientific nature, which continues to dominate processes of knowledge co-production, and explore alignment dynamics with the affective. In particular, we argue that applying methods and techniques that give room to the multimodal and multisensory nature of affect in co-production processes can support such alignment. We argue that the picture of knowledge co-production that emerges from our work as a potentially open-ended process of assembling is adequate for engaging with complex sustainability concerns in a world in constant becoming.

Key Words: *knowledge co-production; affect; assemblage; representation*

INTRODUCTION

> *We may be aware of a truth, yet until we have felt its force, it is not ours.*
>
> Arnold Bennett

The last years and decades have seen an increase of assessment reports about the state of the global environment. Each subsequent assessment depicts an even more dire situation. Yet, these assessments do not trigger action that matches the challenge. The reasons for this are manifold, ranging from the "wickedness" of the issues (i.e., that there are no optimal solutions and thus prioritizing a particular action is challenging) to the complexity of the issues (e.g., because of the intertwinedness of climate, biodiversity, and poverty reduction), or simply a lack of financial means to address these challenges. In addition to this (non-exhaustive) list, scholars have also explored how language used and framing of environmental problems play a crucial role in determining action or inaction (Toivonen 2022). Related to this, Stoknes, for example, discusses inaction in the face of climate change and identifies several psychological barriers preventing action from realizing (Stoknes 2014). Among these is the suggestion that climate change needs to "feel personal, near and urgent." When scrolling through the various environmental assessments one notes that the language often remains highly abstract. "Abstract" can mean two things: (1) generalizations that are decontextualized and disconnected from actual experience (Whitehead 1925), and/or (2) jargon proper to a particular knowledge community that appears opaque to others (Kuhn 2012) and that presents itself as cognitively inaccessible. In line with Stoknes (2014), we observe that this abstract language has the potential to create a distance between climate change and those who are meant to act on it. That the resulting knowledge is experienced as abstract is often said to be characteristic of a traditional model of knowledge production according to which there is a unidirectional flow of information from researchers to knowledge users. This model risks leading to a knowledge/action gap (Leichenko and O'Brien 2019).

To address this gap, scholars have developed a variety of strategies, many of which center on approaches to the co-production of knowledge (see Orlove et al. 2022 for an extensive overview). Among such strategies figure, for example, the Mi'kmaw concept of "two-eyed seeing" (Bartlett et al. 2012), "braided knowledge" (Bartlett et al. 2012), "weaving" (Sidik 2022), "boundary work" (Gieryn 1983), or "trading zone" (Galison 1997), to name just a few. To ensure that such strategies are operationalized in the most effective way and serve the various purposes of co-production (Chambers et al. 2021), researchers have proposed principles for knowledge co-production (e.g., Clark et al. 2016, Norström et al. 2020, Orlove et al. 2023) and articulated corresponding policy instruments (e.g., Orlove et al. 2023). Embarking on knowledge co-production processes along those lines can thus provide the conditions that allow "embracing a learning attitude as well as experimenting with knowledge, action and capacity building processes in pluralistic and integrated ways" (Caniglia et al. 2020:98) in view of producing usable or actionable knowledge. We conceive of the usability of knowledge alongside West et al. (2019:549) in terms of its utility within a particular life world and consider it being "determined by the unfolding relationships within which it is invoked." That these relationships are continuously unfolding means that usability is emergent to the very process of unfolding and therefore is "inherently multi-dimensional and unpredictable" (West et al. 2019:549).

Underlying these strategies is a recognition of knowledge as relational and situated (Ingram 2013, Klein et al. 2024), that is, as situated and becoming meaningful through the relations that knowledge holders have with one another and their surroundings.

[1]Stockholm Resilience Centre, Stockholm University, Sweden, [2]CIRAD, UMR SENS, F-34398 Montpellier, France

Put differently, relational knowledge is not only about content but also about how this content "originates as a result of relational processes that are shaped by procedural, emotional, structural, and context-dependent characteristics" (Brugnach and Ingram 2017:35). Accordingly, the process of knowledge production is also situation-specific, resulting from complex and synergetic social interactions (Brugnach and Ingram 2012, Brugnach 2017).

However, despite these strategies and despite the recognition of knowledge as relational, many processes of co-production continue to be dominated by a representational kind of knowledge of technical/scientific nature (Turnhout et al. 2013, Goldman et al. 2018, Turnhout et al. 2020) that is often based in Western worldviews and not adequate for all contexts (Yua et al. 2022). The reasons for this are without doubt manifold, ranging from persisting power dynamics that give scientific knowledge particular authority vis-a-vis other knowledge systems to issues around time and availability of different participants (Wyborn et al. 2019, Turnhout et al. 2020), and research is currently ongoing to rigorously explore how the outcomes of co-production processes connect to specific designs, activities, and situations (see, e.g., Seiferth et al. 2024).

In this paper we join this discussion and hypothesize that for knowledge to be usable in the sense defined above by West et al. (2019), it needs to affect those who are meant to act on it, that is, it needs to trigger an experiential intensity, very much in the way Arnold Bennett puts it in the opening quote of this paper. Accordingly, we argue that one of the reasons for the disconnect between knowledge and action is that the affective dimension of knowledge is disregarded for the benefit of an overemphasis on a form of knowledge that focuses solely on representationalist content. This is in line with recent calls by scholars, such as Nightingale et al., who call for "affective knowing": "Rather than relying exclusively on 'hard' scientific data as means to 'tame' uncertainty and unknowability, we need *affective knowing* to transform current inaction and promote effective [...] action" (our emphasis; Nightingale et al. 2022:7). What we hypothesize is that while stipulating principles and corresponding policy instruments for co-production of knowledge is certainly necessary, we believe that by being attentive to the affective their successful implementation can be enhanced.

This presents the key contribution of the paper. We present here a conceptualization of the process of knowledge co-production that is aligned with our focus on affects. This, on the one hand, does justice to the relational understanding of knowledge (Brugnach and Ingram 2017) and, on the other hand, enhances the implementation of strategies for knowledge co-production (e.g., Clark et al. 2016, Norström et al. 2020, Orlove et al. 2023). For this we turn to assemblage theory as developed by Deleuze and Guattari (1987) and propose to conceptualize knowledge as an assemblage. At the core of assemblage theory lies the notion of affect, an experiential intensity, which is emergent to an assemblage. Conceptualizing knowledge as assemblage serves three purposes that we develop briefly below.

First, conceptualizing knowledge as an assemblage allows the rendering of different knowledge systems without putting into question their ability to make truthful claims (Hacking 1999) thus safeguarding against charges of relativism. It thus allows giving equal consideration to diverse knowledge systems that is a point so central to the work of key actors and institutions in the field, such as IPBES (Díaz et al. 2015). Indeed, not only is knowledge diverse in terms of its content but it also comes in multiple kinds. There is, of course, representational knowledge, by which we mean knowledge that is expressed via language, symbols, or images and among which we situate the scientific one, that is, the discursive and representations-based knowledge of environmental assessments discussed above. But there is also embodied knowledge (Merleau-Ponty 2010, Shapiro 2019) that is situated in the body as well as expressed via the body and is often tacit and pre-discursive. Both kinds can in principle be rendered with an assemblage approach: Words can affect just as images or gestures can. But this does not necessarily mean that they always do. Some words, for example, might be specific to a particular knowledge system and only intelligible within its bounds and thus struggle to affect when introduced in knowledge co-production processes involving several knowledge systems. Second, we propose an onto-epistemological process of assembling knowledge that we call alignment and that has the potential to generate knowledge that *affects* across different knowledge systems. For this paper, we take the specific case of representational knowledge of scientific nature that continues to dominate processes of knowledge co-production (Turnhout et al. 2013, Goldman et al. 2018, Turnhout et al. 2020) and reflect on an *alignment* between, on the one hand, knowledge that is coded via scientific representations and, on the other hand, the affective, that is, how those who are meant to act experience particular knowledge in connection with their concrete life-worlds. Alignment would thus mean that knowledge that is coded via certain representations also affects, that is, triggers an experiential intensity (the "force" from the opening quote of this paper). This is because it can be invoked from "within" how those who are meant to act experience their life-worlds. Finally, the third purpose of this paper is to reflect on what all of this could mean for those who are engaged in or facilitate processes of co-production. For an assemblage approach to realize alignment (within principles and policy mechanisms structuring knowledge production processes), Brugnach and Ingram (2017) have highlighted that those involved (e.g., scientists) need to be knowledge brokers and meaning managers instead of simply being those who transfer knowledge. What matters is a negotiation (Ortiz-Przychodzka et al. 2023) where participants to the process have their habitual ways of thinking challenged (Fazey et al. 2005). This can be done in many different ways, mobilizing different kinds of knowledge (Tengö et al. 2014), and we here specifically highlight the role and importance of affect. What is important for processes of alignment is to go beyond the "dead abstraction of mere fact" toward the "the living importance of things felt," to borrow a phrase from Alfred North Whitehead (Whitehead 1968:15). Thus, we argue that those who are involved in such processes mobilize interactive, multimodal, and multisensory methods and approaches that are attuned to "liberating" affect—where by multimodal we refer to different ways in which the content of knowledge (of different kinds) can be expressed, as part of which different senses can be mobilized. In this context, arts-based methods and approaches have especially been put forward because of their capacity to affect in many ways (Heras et al. 2021). We exemplify this by drawing on our own experience of an ongoing research project around vulnerability and adaptation of a multifunctional landscape to climate change, where we highlight the combination of relational

interviewing (Hydén 2014, Fujii 2017) and diverse forms of participatory theater (Berchon and Bousquet 2021). The former helps to engage with affects at the individual level, which subsequently serve as input into the collective knowledge production process. We argue that such an open, dynamic, and collaborative process of knowledge production can enable the kind of self-reflective stance required to ensure that processes of knowledge production across different knowledge systems "matter" to those involved (Paschen and Ison 2014).

The paper is structured as follows. We first elaborate what we mean by "representation" and "affect," respectively, and trace how these have been applied in the literature around cognition. We argue that recent work on cognition hints at an assemblage approach that we then introduce alongside several concepts, such as material-discursive practices, perspective, event, and affective surplus. We do not claim to always strictly use those concepts in the way that the authors who have introduced them intended them to be used, but rather, at times, adapt them to serve our argument. This ensemble of concepts constitute a framework for studies of knowledge based on a much-needed notion of "affective knowing" (Nightingale et al. 2022). We conclude this manuscript with demonstrating the relevance of our approach by reporting on our empirical work from an ongoing research project around vulnerability and adaptation of a multifunctional landscape to climate change in Southern France.

REPRESENTATION AND AFFECT

A representation is a mental entity that *refers to* reality. In this quality representations engage with reality via concepts that code it. A representation is thus productive and refers to a particular way of referring to reality that makes it intelligible, which in turn means that through them bodies become determinate as bodies (we use the term "body" here as the most general designation of "things," be they material and/or ideational). Traditionally, representations have been evaluated with respect to properties such as consistency, truth, or accuracy. More precisely, it is to what is captured in the relation between representation and reality that properties like consistency or truth apply.

The relation between representation and reality has traditionally been seen either as *corresponding* to reality or as constructed, in which case it is seen as *cohering* with a wider system of other, connected representations. But both of these traditions share the same representationalist assumptions in that both mediate our access to the material world. Where they differ, philosopher Karen Barad notes, "is on the question of referent, whether scientific knowledge represents things in the world as they really are (i.e., nature) or objects that are the product of social activities (i.e., culture)" (Barad 2007:48), a point she attributes to philosopher Joseph Rouse (Rouse 1996). Taking a correspondence with reality-stance might only allow for limited modification of representational content because representations are meant to "mirror" reality. "Learning," of course, is possible, and there are examples of scientific revolutions that have changed representations radically, but this remains rather an exception. Similarly, when it comes to coherence, the demand that a representation coheres with the totality of available representations places strong limitations on modifying the content of representations.

Introducing "affect," on the other hand, allows going beyond representationalist or coherence accounts of the relation between a representation and reality. Affect refers to the moment when bodies meet, which we call an event, that is, an event of experience. Affect refers to the force or qualitative sensation of an experience that cannot simply be expressed via quantitative measures (e.g., as a size or motion could). Affects are not states, but variations that occur within events. Spinoza defines them as variations in one body, caused by another body, or as that by which the power to act is increased or decreased (Spinoza 1985). Deleuze and Guattari build on Spinoza's definition of affect as an ability to affect and be affected: It is "a pre-personal intensity corresponding to the passage from one experiential state of the body to another and implying an augmentation or diminution in that body's capacity to act" (Deleuze and Guattari 1987:xvi). In this quality, as O'Grady and Shaw mention, "affects function as ways in which bodies make sense of, express themselves within and performatively shape different spatially and temporally bound situations." They emanate "from the reciprocal relationships we hold with other bodies and the material circumstances with which we interact" (O'Grady and Shaw 2023:518).

The "pre-personal" part of affects that Deleuze and Guattari identify refers to the idea that affects ultimately underlie all coding, that is, all fixing of reality into determinate bodies via representations. Put differently, although affects may manifest via representations, they refer, fundamentally, to pure potential and becoming, and some scholars have identified similarities with Bergson's "elan vital" that refers to "the vital impetus or force that propels life forward from its beginnings and through all its varieties and forms" (Robinson 2009:224). How do representation and affect relate? Whereas representations code reality, which means that bodies become determinate via representations, affects refer to how the ability of bodies to affect and be affected varies within concrete interactions. Therefore, how a particular body is represented at any particular moment is the result of how the body is experienced within encounters (Cabello 2024). For instance, the same place can be represented in radically different ways, depending on how encounters by different actors have shaped it (Ingold 1993, Schama 1996). Accordingly, corresponding knowledge about it will reflect the unique ways in which problems are framed, priorities set, scales considered, etc. (Brugnach 2017). The picture that emerges from the dynamic, interactive, and co-constitutive relation between representation and affect points to the relational character of knowledge highlighted above as well as to a potential co-existence of a multitude of different, even mutually exclusive ways of knowing. At the same time, knowledge is "open": As indicated previously, affects are becomings, which means that affects have the potential to go beyond what is captured by representations. Therefore, a representation cannot always exhaustively capture how an affect will play out in events, what Uhlmann refers to as "fluid identity" (Uhlmann 2022:167).

OVERVIEW OF COGNITION APPROACHES AROUND REPRESENTATION AND AFFECT

This section engages with theories of cognition that describe the process by which one acquires "knowledge and understanding through thought, experience, and the senses" (as defined by Oxford Languages). We focus on cognition because, in order to understand under what conditions knowledge affects, it is not enough to focus solely on whether knowledge is true (which is the main focus of correspondence and coherence theories of

representation); we must also consider how actors acquire understanding about it (which is the main focus of cognition). Thus, whether representational knowledge does or does not affect is intimately tied to cognitive processes. Cognition is thus a precondition for the affect of representational knowledge to realize. The two major approaches to cognition are symbolic and connectionist. For the former, representations pre-exist and are the main concept that cognitive rules operate on, whereas for the latter, they are emergent from "a largely unconscious process in which many pieces of information are combined in parallel into a coherent whole...the result of mentally balancing many complementary and conflicting pieces of information until they all fit together in a satisfying way" (Thagard 2000:3). According to this latter view, identities and worldviews do not pre-exist but rather emerge from these relationships (Homer-Dixon et al. 2013). As O'Brien and Milkoreit note, "a simplified but useful way to conceptualize cognition is to conceive of minds as complex systems or networks of interdependent concepts ('mental representations'). In this model of cognition as belief systems, meaning is not inherent in a particular concept but emerges from the relationships between them and the way information flows (i.e., 'is processed') within this specific network structure" (O'Brien and Milkoreit 2022:133).

Although for these two approaches cognition "happens" in the brain, some scholars have moved away from the idea of the brain alone processing information to one that reconnects brain and body, representation and action, cognition and the environment. Through concepts of enaction, situatedness or distributed cognition, cognition emerges from the interactions between the brain, the body, and the environment (Lakoff and Johnsen 1999, Semin and Smith 2002). As Hutchins notes, "what evolves is not the brain alone, but the system of brains, bodies, and shared environments for action in interaction....Careful attention to the microstructure of interaction from the distributed cognition perspective leads to a reconceptualization of the individual-environment relationship and suggests that this newly conceived relation has important implications for the way we confront many sorts of cognitive and anthropological problems" (Hutchins 2006:395). In brief, cognition is considered not only to be located in the body of a human processing information or in the network of connections between entities but is produced by dynamic interactions between all of these. Such an approach sees cognition as distributed and emergent.

ASSEMBLAGE APPROACH GROUNDED IN PERSPECTIVISM

Having introduced the notions of representation and affect, as well as how these are discussed within the scholarship about cognition, we come back to the core concern of this paper: understanding the process by which knowledge comes to affect. For this, we noted above that the focus should lie not only on the relation of representations with reality (the domain of truth) but also on the process by which such knowledge is acquired (the domain of cognition). The previous section provided arguments for cognition being situated, and if we combine this insight with insights of a more philosophical nature about truth being historically and socially situated and dynamic (Hacking 1999), we begin to see a picture around affect and diversity of knowledge systems emerge. However, precisely because of knowledge being historical and socially situated, different bodies of knowledge can be radically different, even alien to each other and thus fail to affect when exchanged over.

It is here that we introduce the notion of assemblages. To operationalize the notion of "being alien" we bring together bits and pieces from different sources: First, from Gilles Deleuze and Félix Guattari we take assemblages that they introduce as part of various works, but especially in their seminal work *A Thousand Plateaus* (Deleuze and Guattari 1987). Second, from Karen Barad, from whom we take the notions of intra-active material-discursive practices enacting perspectives (or, in her words, "cuts") according to which reality becomes intelligible (Barad 2007). We further make a distinction between assemblages and perspectives, and argue that assemblages are perspective-dependent. Cognition, we argue below, is the property of a meaning-giving perspective, that is, a product of a way of engaging with (and enacting) reality, engagement which is material as well as discursive. We then conceptualize knowledge as an assemblage and see affect as the product of an assemblage that is dependent on a particular perspective. This accounts for the radical diversity of (truthful) knowledge, that is, for the diversity of knowledge assembled on the basis of the same perspective (which might imply that knowledge is commensurable) as well as diversity of knowledge assembled on the basis of different perspectives (which might imply incommensurability; see also Hertz et al. 2024).

Assemblages

Assemblages are introduced by philosophers Gilles Deleuze and Félix Guattari (1987). Assemblages are a response to dominant attempts to understand reality by reducing the complexity of our (social-ecological) world via generalizations (Srnicek 2007, Holland 2013). Details matter, and they do so profoundly, and assemblages are ways and means to tackle complexity "head on" (Srnicek 2007). An assemblage is a collection of radically heterogeneous bodies, or things (ideas, norms, concepts, instruments, people, etc.) that organize into emergent "doings." Ghoddousi and Page define an assemblage as "the coming-together of human and non-human 'things' that take on an emergent agency. By agency, we mean the ability to do something, to affect and be affected" (Ghoddousi and Page 2020:3). We experience, learn, and gather knowledge about the world in very different ways, and the assemblages responsible for this equally take different forms, a book being as much an assemblage as a demonstration, a piece of art, a disaster, or an ecosystem service. Put differently, knowledge (that affects) is not only assembled as part of representational kinds of knowledge, such as textbooks or manuals, but can also manifest as embodied (Merleau-Ponty 2010, Shapiro 2019). Assemblages that are embodied affect in different ways and are assembled as part of different bodies than textbooks or manuals are; see, e.g., Verlie's (2019) "climatic-affective atmospheres" or Neimanis and Walker's (2014) "weathering." This wide variety of assemblages also points to the variety of ways in which assemblages can affect.

Assemblage theory adopts a pragmatist stance where what something "is" is defined by its place in the assemblage, that is, by *its capacity to affect and be affected.* In this sense what something "does" defines what something "is." Deleuze and Guattari note, "we know nothing about a body until we know what it can do, in other words, what its affects are, how they can or cannot enter into composition with other affects, with the affects of another body, either to destroy that body or to be destroyed by it, either to exchange actions and passions with it or to join with it in composing a more powerful body" (Deleuze and Guattari 1987:257).

For the specific case of representational knowledge, an assemblage approach thus defies correspondence or coherence accounts by making the representational content of bodies dependent on the assemblage those bodies take part in, and any one body simultaneously takes part in many assemblages (see Box 1). Thus, for assemblage theory, a representation (a lake as part of the spirit of place, the lake as a reservoir) neither corresponds to reality nor strictly coheres with other representations. Both of these (correspondence and coherence) potentially place strong demands upon a representation in that what something is is defined by the relation of correspondence or coherence. For assemblage theory, instead, the capacity to affect and be affected by bodies within assemblages defines the representational content of bodies.

Box 1: Examples of different assemblages on the basis of the same perspective.

The value of an assemblage approach can be exemplified by showing how it can be mobilized for rendering radically different assemblages. For example, some landscapes are said to have a certain "spirit." We take such a "spirit" to emerge from a particular arrangement of heterogeneous elements such as ideas, scents, visions, spaces, patterns, practices, mountains, lakes, colors, contrasts, metaphors, stories, flora, fauna, etc., specific to the landscape in question. But these elements are diverse and it is easily imaginable how each of them could "do" different things when part of different assemblages. Consider, for instance, a water body such as a lake being part of the landscape. The lake might then manifest differently when part of a "spirit of a place" assemblage, a "biodiversity" or a "water resource" assemblage. The former assemblage might organize around institutions that aim to protect cultural/natural heritage, whereas the others might organize around biodiversity conservation or water management institutions, respectively. As part of the former, the lake might evoke beauty; as part of the intermediate, it might manifest as a habitat for a diversity of species; and for the latter, it manifests as a water reservoir. The representational content of the lake differs as part of the different assemblages.

Assemblages are perspective-dependent

Assemblages are proper to perspectives. Perspectives are ways of engaging with reality, that is, practices that *condition* how reality is experienced. That an assemblage is perspective-dependent means that we distinguish it from being observer-dependent. A subject, or observer, *belongs* to a perspective, is a product of a perspective, and experiences the world via the conditions imposed by that perspective (Mancilla Garcia et al. 2020). The philosopher Karen Barad extends the concept of discursive practices to include the material as an active participant in the making of meanings. For her, "theoretical concepts are not ideational in character but rather specific physical arrangements" (Barad 2007:139). A perspective is thus defined by the entire array of intra-active material-discursive practices (Barad 2007, Orlikowski and Scott 2015) through which the life-world of a subject (including itself) becomes determinate. Put differently, it is via material-discursive practices that the very bodies that constitute our lifeworld become determinate. That the material and the discursive are intra-active means, as Barad notes, that "the relationship between the material and the discursive is one of mutual entailment. Neither is articulated/articulable in the absence of the other; matter and meaning are mutually articulated. Neither discursive practices nor material phenomena are ontologically or epistemologically prior. Neither can be explained in terms of the other. Neither has privileged status in determining the other" (Barad 2003:822). The term "human" has a material counterpart, that is, a body with which it intra-acts, just as it intra-acts, for example, with everything that is non-human. The term "natural resource" might be an example of such a non-human that also has a variety of materialities with which it intra-acts. The examples could go on indefinitely, and all of these constitute the entire array of material-discursive practices performing reality.

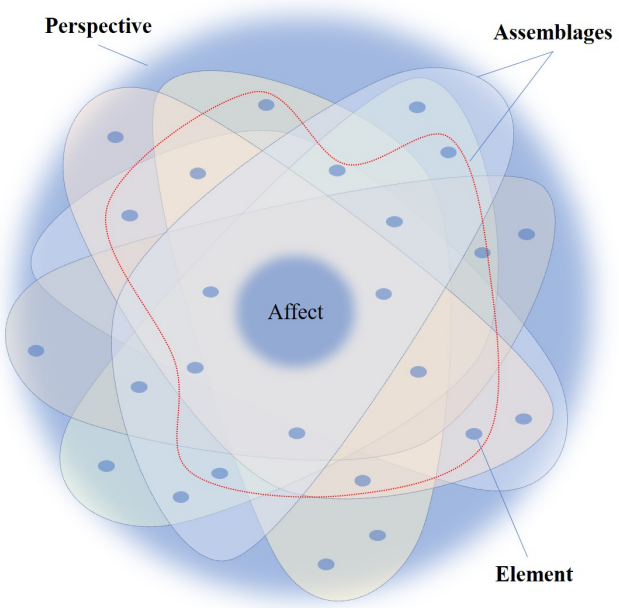
Perspectives can, in principle, perform reality in very different ways; see Box 2 below. At the same time perspectives can also be shared, in as much as material-discursive practices are shared. In other words, one could conceive of a perspective as a "space," that is, a shared but also always contested space of intelligibility. In turn, countless assemblages can be compatible with any one perspective. That an assemblage is perspective-dependent means that its capacity to affect is also perspective-dependent. Although it is true that pure affects, that is, pure intensities, escape any conditioning or coding (Shouse 2005), we argue that for the most part affects are channeled via perspectives and therefore the capacity of an assemblage to affect can be said to be perspective-dependent. In this sense affects are not dependent on a subject for their existence but rather are dependent on a perspective. Figure 1 depicts the terms introduced so far, elements/bodies, assemblages, perspectives, and affect.

Ultimately, an assemblage approach dissolves the distinction introduced at the beginning of the last section (between the nature of the relation of a representation with reality and the process by which we acquire knowledge about it) as being two fundamentally distinct realms or fields of study. The capacity to affect that is proper to assemblages is perspective-dependent, which is another way of saying that (truthful) knowledge is always historically and socially situated (Hacking 1999). In its meaning-giving ability, perspectives thus condition cognition, that is, the process by which knowledge is acquired. Put differently, what a body is and what it does cannot be disassociated from the process of acquiring knowledge about it because in the process one needs to mobilize (historical and socially evolved) material-discursive practices proper to perspectives. Thus, the framework presented in this paper is onto-epistemological (Barad 2007). This does not lead, however, into relativism (Duvernoy 2016) nor is it incompatible with productive accounts of studying causal relations (Rouse 2002) or the generation and mobilization of (radically) different types of evidence as part of co-productive processes (Caniglia and Russo 2024). Table 1 in Appendix 1 summarizes our discussions of the assemblage approach and attempts to situate it within the wider field of knowledge co-production.

Box 2: Examples of different assemblages and perspectives

Assemblages are rendered according to the conditions set and defined by perspectives. Perspectives perform, that is, condition the experience of the world via fundamental distinctions realized by material-discursive practices. For example, as part of Western practices of engaging with landscapes (e.g., agriculture, sports, residence, etc.) humans tend to become determinate as separate from and above nature (Böhme et al. 2021). This is very different from how many practices around the world enact reality (West et al. 2024). For example, the Andean practice of "in-ayllu" discloses communities and the mountains they live on as "Earth Beings" as inseparable (Cadena 2015). As another example, Apgar et al. report from the spiritual practice of the Guna peoples of Panama where all things and beings are disclosed as one system, a "whole-system view [that] emphasizes a fundamental connectedness and relationship, and promotes continued reflection on identity and purpose in the world" (Apgar et al. 2015:45). In turn, assemblages are assembled in accordance to how reality is enacted by perspectives, that is, assemblages draw on elements that thus become determinate. Accordingly, it is not only the case that within different assemblages the representational content of a particular body differs, as that could still be accounted for according to a same perspective (see Box 1), but more radically, that bodies themselves might become determinate in different and perhaps incommensurable ways as part of different perspectives. Here, differences between assemblages cannot be rendered, discussed, and compared by reference to the same perspective.

Fig. 1. Visualizing an affect, elements, assemblages, and a perspective. In practice, it is rarely the case that elements only take part in a single assemblage. When a new assemblage organizes and produces a particular affect (red line), such as a knowledge assemblage around a particular issue, it mobilizes elements that are also part of other knowledge assemblages. This does justice to the fact that knowledge is often enmeshed, that is, blending different kinds of knowledge, embodied, representational, etc., and stemming from different engagements with a particular issue. This also explains why knowledge can at times be incoherent or conflictual.



The interplay between stability and change: how assemblages "become"

The term assemblage not only refers to an existing formation. Indeed, whereas in English assemblage is most commonly used as a noun, the original French term *agencement* refers to both, a noun as well as a verb (DeLanda 2016). As McHugh notes, it "simultaneously denotes both an existing social formation and the continual process of assembling and reassembling that formation" (McHugh 2018:2). One can think of the process of assemblage formation as bodies continually meeting in events of experience that determine their capacity to affect and be affected: This capacity to affect and be affected simply *is* the representational content of bodies. Thus, for assemblage theory, representations *emerge* from *how* bodies affect each other within an assemblage. The relation between affect and representation is thus a pragmatic one in that what something does defines what something is and it is that which gets coded in a representation. In turn, and more fundamentally, bodies themselves become determinate as part of material-discursive practices that make up a perspective and that allow for different representations of a same body (see the example of a water body in Box 1).

Fundamentally, the experience of bodies and their capacities are conditioned and this conditioning is potent: With Thrift we note that "events must take place within networks of power which have been constructed precisely in order to ensure iterability [capacity to be repeatable across different contexts]" (Thrift 2007:114).

Networks of power, as we interpret them here, refer to the power that is inherent in representations and perspectives when conditioning events of experience. Such networks form, for example, around institutions for water management or biodiversity conservation that condition the experience of bodies in different ways.

However, we argue that while the capacity of bodies to affect and be affected manifest within representations as coded, affects also have the potential of going beyond this coding. In other words, the process of assembling harbors (ontological) openness/becoming. In what follows we explore the process of affects going *beyond* the coding of representation and perspectives. Indeed, Thrift also notes that "the event does not end with these bare facts. The capacity to surprise may be latent, but it is always present" (Thrift 2007:114). Put differently, "the event can be connected to potential, possibility, experimentation." It is here that affects come into play, notably when encounters between bodies produce a "surplus" *beyond* the codings offered by representations and ultimately perspectives, and which refers to a manifestation of ontological potential. By ontological potential we mean that novel capacities of bodies to act emerge, what Thrift relates to the Deleuzian "virtual": The generation of "doings" in practice (Thrift 2007).

In case the representational content of a body is "fixed," such as when a representation is seen as *corresponding* to reality (e.g., as part of a scientific practice that aims at providing a value-neutral "mirror" of reality) or as *cohering* with a wider system of other representations (e.g., as part of practices where the meaning of representations needs to cohere with each other), "surplus" might find it hard to enter an event. This is because the networks of power that are inherent in these practices *code* the experience of a particular body via a representation. Learning, of course, can take place, but processes of learning, the argument goes, tend to occur from "within" distinctions that are already set by perspectives, and underlying it is the idea that knowledge is cumulative. The process of assembling allows going beyond such distinctions and tracks how mutually incompatible ways of experiencing can coexist. The process of assembling is thus fundamentally onto-epistemological, that is, it blurs the distinction between what reality is and how we come to know about it. Encounters thus harbor the presently non-existent, the outside-of-language, beyond what is possible to imagine on the basis of what elements currently are and do.

The process of assembling and reassembling that is proper to assemblages involves continuous interactions between bodies, and this process has the potential to generate affective surplus which may perform bodies in ways that ultimately might even question the fundamental distinctions made by perspectives, see Box 3 for an example.

Box 3: Example of the becoming of an assemblage and a perspective.

Consider a picturesque landscape in France that the governing body aims to protect by obtaining the label "Grand Site de France," which refers to special landscapes regulated by the French law of May 2, 1930, concerning the protection of natural monuments and sites of artistic, historic, legendary, or picturesque character. Each of the Grand Sites de France has its own distinctive "spirit" (https://www.grandsitedefrance.com/en/the-grands-sites). In the process of assembling the "spirit" of the landscape, repeated encounters with officials, residents, artists, ecologists, anthropologists, activists, etc., might generate surpluses. Accordingly, the waterways of the landscape might transform from being seen as a source of irrigation to become something different, much like its mountains and mosaic-patterned valleys. This is aligned with the idea that the representational content of the same body can vary but still be rendered according to the same perspective (Box 1). However, when saying that surplus has the potential to change perspectives, we are referring to those affective surpluses that dismantle or question the very way distinctions are made by perspectives, rather than to differences that are compatible with those distinctions. This refers to a process of assembling generating experiences of the "spirit" of a landscape, which might lead to feelings of a sense of place — that is, of being "part" of the landscape to the point where one might speak of a novel subjectivity emerging. For example, experiencing how the bodies of a landscape (including one's own) stand in such complex relationships that they can be said to be inextricably intertwined might imply that thinking in terms of individual bodies is not applicable any more. In this sense, surplus changes the material-discursive practices that shape a perspective. This perspective, in turn, conditions experience according to such a novel subjectivity that may conflict with a modern political imaginary (Grove and Pugh 2018), which views humans as separate from and above nature (Böhme 2022).

ALIGNING AFFECT AND REPRESENTATION

The affect encoded in many environmental assessments does often not realize in ways that trigger adequate action. The knowledge conveyed by these assessments appears abstract, technical, or too general to relate to the concrete life worlds of those who are meant to act on it. Indeed, despite strategies for co-production of knowledge and despite the recognition of knowledge as relational, many processes of co-production continue to be dominated by a representational kind of knowledge of technical/scientific nature (Turnhout et al. 2013, Goldman et al. 2018, Turnhout et al. 2020). Ghoddousi and Page refer to this as a situation where the affective potential of an assemblage does not materialize. Especially when detached from immersive engagement with particular contexts and issues, "assemblage geographies sometimes remain purely speculative, descriptive, abstract or conceptual, failing to deliver any political potentials" (Ghoddousi and Page 2020:6). This does not mean that affect (i.e., the affect that is coded as part of global assessments) is not "there." It *is* as the affect is *pre-personal* and coded via the networks of power that are proper to perspectives and representations. If affect does not realize this could mean one of two things: that knowledge on the basis of the same perspective is incompatible (Box 1) or the knowledge exchanged over perspectives is incommensurable, meaning that cognitive processes could not operate as intended (Box 2).

But how then *could* strategies for the co-production of knowledge deliver the political potential that Ghoddousi and Page (2020) mention and that can perhaps generate the kind of knowledge that has the potential to affect? It is here that we introduce the notion of "alignment" that we take to realize aforementioned potential: alignment between what we call, on the one hand, the "representational" and, on the other hand, the "affective" dimensions of knowledge. "Alignment" is proper to the onto-epistemological process of assembling mentioned earlier and refers to the process by which an affect can be brought to realize. The process of continuous encounters proper to the process of assembling implies openness (i.e., how bodies are coded is open and not predetermined), and it is precisely because of this openness that a "going beyond" the networks of power that stabilize representations, and potentially perspectives, becomes possible. What could thus be assembled via such a process of alignment is a knowledge assemblage that affects. Those encounters could be random, spontaneous, and unpredictable but they could also be deliberately facilitated as part of transdisciplinary processes of knowledge co-production.

Although encounters can be diverse in kind, we specifically highlight the potential of arts-based encounters for aligning the representational and the affective. For example, arts-based

methods seem particularly relevant for processes of co-production involving not only different knowledge assemblages but also different, perhaps incommensurable perspectives. This is because purely discursive encounters and exchanges aimed at bridging those differences cannot take place without losing the original meaning and significance of what is exchanged over (Cadena 2015). Arts-based methods, on the other hand, strive "to engage with sustainability questions beyond rational ways of thinking," fostering new ways of experiencing the complexity of systems (Heras et al. 2021:1879), thus potentially building spaces between those who are "walking together in a world of many worlds" (West et al. 2024:1; Cadena and Blaser 2018). In arts-based encounters, affective surplus can be generated, leading to the representational content of what is exchanged over being adapted, re-interpreted, changed, or contextualized (Tsoukas 2018) so that corresponding affects can be brought to realize. For example, there is no one right or correct conceptualization of vulnerability to climate change (Füssel 2007), instead vulnerability takes on very different meanings in different assemblages and perspectives. Arts-based encounters serve thus, on the one hand, as a means to communicate the "living importance of things felt" (Whitehead 1968:15) of how participants in the process experience vulnerability, and, on the other hand, as a tool for co-producing a common understanding of vulnerability specific to a particular process of knowledge co-production.

As part of the process of encounters across different perspectives, the material-discursive practices enacting them (the perspectives) might be modified – partially at least. One could think of this process as the opening up of a "space of intelligibility" that emerges at the intersection of different perspectives. This space creates a space for affects to realize even when they "come" from different perspectives. Accordingly, cognitive processes can operate, and affect that was hitherto inaccessible can actualize as part of new assemblages. We see the local space of intelligibility as a space of local coherence between perspectives in the sense that O'Brien and Milkoreit give to the notion of coherence: Coherence is context-dependent and complex, meaning that the network components activated in a particular situation give rise to coherent thoughts given the contextual setting and stimuli [....] This enables the existence of contradictory or inconsistent beliefs within a person's mind over time and across different contexts" (O'Brien and Milkoreit 2022:133).

KNOWLEDGE THAT AFFECTS: AN EMPIRICAL DEMONSTRATION IN THE MAKING

In this section we show how we have applied (or rather are in the process of applying) the framework developed in the earlier sections of this paper. We draw on an ongoing research project about the adaptation of a multifunctional lake landscape to climate change (https://projetprada.wordpress.com). We align with others in seeing a landscape as having multiple meanings (see, e.g., Germaine and Gonin 2024). As a landscape is shared, vulnerability and adaptation to climate change presents itself at least partly as a collective challenge (Wannewitz and Garschagen 2022).

An assemblage approach to vulnerability to climate change conceives of vulnerability as an "event," i.e., it is about the experience of vulnerability where the assembled bodies are disclosed in their capacity to affect and be affected by climate change. According to what was said earlier, this experience is channeled through the networks of power inherent in the perspectives that agents inhabit. For some, vulnerability simply has a different focus. Some might see the lake at the center of the landscape as a source for irrigation, whereas others might see the lake as a place for sport activities. Although here the focus of what is vulnerable is clearly different for both, the lake is enacted in some way or other as a resource that needs to be protected (see also Box 1). For others, difference arises because vulnerability is made sense of within different perspectives. For example, a perspective that enacts the landscape as identity-giving and relationally constituted conditions very different knowledge about vulnerability than a more distanced perspective, e.g., from the prefecture of the department that enacts the landscape and lake as a critical water resource for drinking water, irrigation, and firefighting. Here it is not only that the focus of vulnerability is different, but more fundamentally that the landscape itself becomes determinate in ways that are not necessarily comparable with each other, adding perhaps an additional layer of complexity to the process (see also Box 2).

To engage with this diversity in view of generating knowledge that affects we applied methods and approaches that allowed us to get as close as possible to Whitehead's "living importance of things felt" (Whitehead 1968:15). For this, we focused on relational interviewing (Hydén 2014, Fujii 2017, Mancilla Garcia et al. 2024) that we enacted via a combination of walking interviews (Evans and Jones 2011) and playback theater (Fox 1982). This allowed us to engage with affects at the individual level that subsequently serve as input into a collective knowledge co-production process where we plan to apply forum theater (Berchon and Bousquet 2021). Below we elaborate briefly on both.

As part of a relational approach to interviewing (Hydén 2014, Fujii 2017, Mancilla Garcia et al. 2024) we asked agents who are engaging with the landscape to take us to a place of specific importance to them and let them speak, centered around three topics: (1) Who are you, what is your history with the landscape, and why is this landscape important to you? (2) What "is" the landscape to you (teasing out specifically respective categories to experience with and that reveal foci, times, and spaces of relevance)? and (3) What are the big transformations you see coming? At times, a group of actors improvises a scene based on what has been heard and felt about the agent's affective relationship with the landscape. This kind of theater (playback theater; Fox 1982) is particularly well-suited because, first, it amplifies affect and gives it "back" to the agents, who feels that what they shared is valued; and second, because agents notice that through the (improvised) performance, actors take risks and become vulnerable, which contributes to building trust between the agents and the research team. This trust is essential to explore (together) the affective relationship of agents to the landscape. Through this, the underlying assemblages producing this affect manifest in all their diversity, which is the basis for understanding the transformations they are subject to as well as the role that the impacts of climate change play.

This is where the project stands right now (as of November 2024) and we will embark on the collective process of knowledge production soon. We plan to apply forum theater, which is a

participatory form of theater where boundaries between actors and spectators are dissolved in the exploration of concrete real-world problems (Berchon and Bousquet 2021). It provides participants with "the opportunity to experience and act in a multisensorial and multimodal way while reflecting deeply and critically on their experiences" (Sappa and Barabasch 2020:44). Next to including a wide variety of agents engaged in the landscape, we particularly aim to include climate impact scientists. Thus, setting up an initial scene reflecting the concrete experiences of different agents around vulnerability to climate change gathered as part of the relational interviews, will force climate scientists to engage with this concreteness. In a sense, the scientist will need to begin with and engage with that concreteness, take it on its own terms, and thus introduce representational knowledge of scientific nature accordingly. It is through such an engagement that the affect encoded via such representational knowledge can realize. This explains our interest in multisensorial and multimodal methods and approaches, where by multimodal we refer to different ways in which the content of knowledge of different kinds (e.g., embodied or representational) can be expressed, as part of which different senses (sight, sound, smell, taste, touch) can be mobilized. This opens up a wide variety of ways to engage with representational knowledge and broadens the possible ways and means in which representations and the affects they code can be explored in a collaborative, participatory fashion. The affective surplus generated in the process allows collecting "new insights on experiences, which is the basis for generating new understandings and enlarging the boundaries of possible actions" (Sappa and Barabasch 2019:44), driving the onto-epistemological process of "alignment" described in the previous section and leading to actionable adaptation action.

Although we think that our approach and method combination has so far generated interesting results, we recognize limitations. A first limitation relates to the selection of participants. As we did not want to define collaborators upfront but rather conceived of the research processes as an open and dynamic process, we let ourselves be guided by encounters and followed connections that formed in these encounters. This, as many noted, harbors the risk of neglecting certain groups at the expense of others (Parker et al. 2019). We tried to connect with different groups having different relationships with the place (retirees, people living from e-tourism, farmers developing different types of agriculture, fishermen, people working for public agencies, fishermen, etc.) but indeed, there are certain groups, such as the youth under 25 years old, which we did not manage to engage with to date. Similarly, as two researchers from the social sciences and environmental humanities, we would have liked to engage more with the role of the non-human in the construction of knowledge assemblages (Stark and Roffe 2015). But because we were hesitant at first to steer the attention of our collaborators into a certain direction we refrained from doing so, and we are currently considering encouraging collaborators to explore manifold and diverse connections whenever making referrals. As to the playback theater performances, we do see limitations, too; especially, we see that there is a constant tension between, on the one hand, affective expressions of collaborators and, on the other hand, institutional settings collaborators find themselves in—and perhaps potential conflicts that arise from the interaction of the affective and the institutional. It is our hope, however, that the forum theater performances will balance this out, as long as we can address power imbalances across participants that might lead to some controlling how the play unfolds (Turnhout 2020).

CONCLUSION

We believe that an assemblage approach presents a useful and novel perspective on how knowledge production processes could play out so that the corresponding knowledge affects. Although the approach shares many characteristics with other approaches that are often mobilized in such processes, such as approaches to experiential learning (see, e.g., Moon 2004), there are also important differences. Whereas approaches to experiential learning focus by and large on the individual human subject (that is, they take the subject for granted), the perspective-dependence of assemblages and the productive role that affects potentially have to change those very perspectives, decentralizing the subject. This means that an assemblage approach can potentially conceptualize processes of knowledge production that do not need to comply with or be expressed in accordance with familiar distinctions of modernity, such as subject/object, social/ecological, or humans/nature, paving the way for transformative processes that are not just palliative but deep and radical (Morrison et al. 2022). But for this, many challenges remain. In particular, how to address power dynamics that persist in knowledge co-production processes, despite attempts to the contrary, and which continue to give authority to scientific, representationalist knowledge (Turnhout et al. 2020)? Although we do not have an answer, we would like to deliberately leave open the question of whether addressing power dynamics is necessary for affect to manifest, or conversely, whether affects are a way for addressing those very dynamics. We encourage more research in this direction.

Acknowledgments:

This research was supported by the Swedish Research Council for Sustainable Development, Formas (Grant number 2021-00943). We thank Elodie Fache and Guido Caniglia for inspiring discussions.

Data Availability:

Data/code sharing is not applicable to this article because no data and code were analyzed in this study.

LITERATURE CITED

Apgar, M. J., W. Allen, K. Moore, and J. Ataria. 2015. Understanding adaptation and transformation through indigenous practice: the case of the Guna of Panama. Ecology and Society 20(1):45. https://doi.org/10.5751/ES-07314-200145

Barad, K. 2003. Posthumanist performativity: toward an understanding of how matter comes to matter. Signs: Journal of Women in Culture and Society 28(3):801-831. https://doi.org/10.1086/345321

Barad, K. 2007. Meeting the universe halfway: quantum physics and the entanglement of matter and meaning. Duke University Press, Durham, North Carolina, USA. https://doi.org/10.2307/j.ctv12101zq

Bartlett, C., M. Marshall, and A. Marshall. 2012. Two-Eyed Seeing and other lessons learned within a co-learning journey of bringing together indigenous and mainstream knowledges and ways of knowing. Journal of Environmental Studies and Sciences 2:331-340. https://doi.org/10.1007/s13412-012-0086-8

Berchon, A., and F. Bousquet. 2021. Théâtre-forum de la complexité: en mouvement, entre soi et le monde. Chronique sociale, Lyon.

Böhme, J., Z. Walsh, and C. Wamsler. 2022. Sustainable lifestyles: towards a relational approach. Sustainability Science 17:2063-2076. https://doi.org/10.1007/s11625-022-01117-y

Brugnach, M. 2017. The space in between: where multiple ways of knowing in water management meet. Journal of the Southwest 59(1-2):34-59. https://doi.org/10.1353/jsw.2017.0005

Brugnach, M., and H. Ingram. 2012. Ambiguity: the challenge of knowing and deciding together. Environmental Science & Policy 15(1):60-71. https://doi.org/10.1016/j.envsci.2011.10.005

Brugnach, M., and H. Ingram. 2017. Ways of knowing and relational knowledge. In E. P. Weber, D. Lach, and B. Steel, editors. New strategies for wicked problems: science and solutions in the twenty-first century. Oregon State University Press, Corvallis, Oregon, USA.

Cabello, V. 2024. Tales on co-response-ability in times of environmental polarization. Ecology and Society 29(4):22. https://doi.org/10.5751/ES-15662-290422

Cadena, M. de la. 2015. Earth beings: ecologies of practice across Andean worlds. Duke University Press, Durham, North Carolina, USA.

Cadena, M. de la, and M. Blaser, editors. 2018. A world of many worlds. Duke University Press, Durham, North Carolina, USA.

Caniglia, G., C. Luederitz, T. Von Wirth, I. Fazey, B. Martín-López, K. Hondrila, A. König, H. Von Wehrden, N. A. Schäpke, M. D. Laubichler, and D. J. Lang. 2020. A pluralistic and integrated approach to action-oriented knowledge for sustainability. Nature Sustainability 4:93-100. https://doi.org/10.1038/s41893-020-00616-z

Caniglia, G., and F. Russo. 2024. How is who: evidence as clues for action in participatory sustainability science and public health research. History and Philosophy of the Life Sciences 46:4. https://doi.org/10.1007/s40656-023-00603-5

Chambers, J. M., C. Wyborn, M. E. Ryan, R. S. Reid, M. Riechers, A. Serban, N. J. Bennett, C. Cvitanovic, M. E. Fernández-Giménez, K. A. Galvin, et al. 2021. Six modes of co-production for sustainability. Nature Sustainability 4:983-996. https://doi.org/10.1038/s41893-021-00755-x

Clark, W. C., L. van Kerkhoff, L. Lebel, and G. C. Gallopin. 2016. Crafting usable knowledge for sustainable development. Proceedings of the National Academy of Sciences 113 (17):4570-4578. https://doi.org/10.1073/pnas.1601266113

De Landa, M. 2006. A new philosophy of society: assemblage theory and social complexity. Continuum, London, UK.

Deleuze, G., and F. Guattari. 1987. A thousand plateaus: capitalism and schizophrenia. University of Minnesota Press, Minneapolis, USA.

Díaz, S., S. Demissew, J. Carabias, C. Joly, M. Lonsdale, N. Ash, A. Larigauderie, J. R. Adhikari, S. Arico, A. Báldi, et al. 2015. The IPBES Conceptual Framework – connecting nature and people. Current Opinion in Environmental Sustainability 14:1-16. https://doi.org/10.1016/j.cosust.2014.11.002

Duvernoy, R. J. 2016. "Pure Experience" and "Planes of Immanence": from James to Deleuze. Journal of Speculative Philosophy 30(4):427-451. https://doi.org/10.5325/jspecphil.30.4.0427

Evans, J., and P. Jones. 2011. The walking interview: methodology, mobility and place. Applied Geography 31(2):849-858. https://doi.org/10.1016/j.apgeog.2010.09.005

Fazey, I., J. A. Fazey, and D. M. A. Fazey. 2005. Learning more effectively from experience. Ecology and Society 10(2):4. https://doi.org/10.5751/ES-01384-100204

Foudriat, M. 2019. La co-construction: une alternative managériale. 2e éd. Presses de l'École des hautes études en santé publique, Rennes.

Fox, J. 1982. Playback theater: the community sees itself in drama in therapy. I. R. Courtney and G. Schattner, editors. Drama Book Specialists, New York, New York, USA.

Fujii, L. A. 2017. Interviewing in social science research: a relational approach. Routledge, New York, New York, USA.

Füssel, H.-M. 2007. Vulnerability: a generally applicable conceptual framework for climate change research. Global Environmental Change 17(2):155-167. https://doi.org/10.1016/j.gloenvcha.2006.05.002

Galison, P. 1997. Image and logic: a material culture of microphysics. University of Chicago Press, Chicago, Illinois, USA.

Germaine, M.-A., and A. Gonin. 2024. Experiencing the landscape: landscape agency in a multifunctional valley after dam removal on the Sélune River, France. Ecology and Society 29 (1):23. https://doi.org/10.5751/ES-14868-290123

Ghoddousi, P., and S. Page. 2020. Using ethnography and assemblage theory in political geography. Geography Compass 14(10):e12533. https://doi.org/10.1111/gec3.12533

Gieryn, T. F. 1983. Boundary-work and the demarcation of science from non-science: strains and interests in professional ideologies of scientists. American Sociological Review 48 (6):781-795. https://doi.org/10.2307/2095325

Goldman, M. J., M. D. Turner, and M. Daly. 2018. A critical political ecology of human dimensions of climate change: epistemology, ontology, and ethics. WIREs Climate Change 9(4): e526. https://doi.org/10.1002/wcc.526

Grove, K., and J. Pugh. 2018. Adaptation machines, or the biopolitics of adaptation. Pages 110-124 in J. Bohland, S. Davoudi, and J. Lawrence, editors. The resilience machine. Routledge, New York, New York, USA. https://doi.org/10.4324/9781351211185-8

Hacking, I. 1999. The social construction of what? Harvard University Press, Cambridge, Massachusetts, USA. https://doi.org/10.2307/j.ctv1bzfp1z

Heras, M., D. Galafassi, E. Oteros-Rozas, F. Ravera, L. Berraquero-Díaz, and I. Ruiz-Mallén. 2021. Realising potentials for arts-based sustainability science. Sustainability Science 16:1875-1889. https://doi.org/10.1007/s11625-021-01002-0

Hertz, T., T. Banitz, R. Martínez-Peña, S. Radosavljevic, E. Lindkvist, L.-G. Johansson, P. Ylikoski, and M. Schlüter. 2024. Eliciting the plurality of causal reasoning in social-ecological systems research. Ecology and Society 29(1):14. https://doi.org/10.5751/ES-14806-290114

Holland, E. W. 2013. Deleuze and Guattari's A Thousand Plateaus: a reader's guide. Bloomsbury Academic, London, UK. https://doi.org/10.5040/9781472547989

Homer-Dixon, T., J. L. Maynard, M. Mildenberger, M. Milkoreit, S. J. Mock, S. Quilley, T. Schröder, and P. Thagard. 2013. A complex systems approach to the study of ideology: cognitive-affective structures and the dynamics of belief systems. Journal of Social and Political Psychology 1(1):337-363. https://doi.org/10.5964/jspp.v1i1.36

Hutchins, E. 2020. The distributed cognition perspective on human interaction. Pages 375-398 in N. J. Enfield and S. C. Levinson, editors. Roots of human sociality. Routledge, London, UK. https://doi.org/10.4324/9781003135517-19

Hydén, M. 2014. The teller-focused interview: interviewing as a relational practice. Qualitative Social Work 13(6):795-812. https://doi.org/10.1177/1473325013506247

Ingold, T. 1993. The temporality of the landscape. World Archaeology 25(2):152-174. https://doi.org/10.1080/00438243.1993.9980235

Ingram, H. 2013. No universal remedies: design for contexts. Water International 38(1):6-11. https://doi.org/10.1080/02508060.2012.739076

Jodelet, D., editor. 2003. Les représentations sociales. Seventh edition. Presses Univ. de France, Paris, France.

Klein, A., K. Unverzagt, R. Alba, J. F. Donges, T. Hertz, T. Krueger, E. Lindkvist, R. Martin, J. Niewöhner, H. Prawitz, et al. 2024. From situated knowledges to situated modelling: a relational framework for simulation modelling. Ecosystems and People 20(1):2361706. https://doi.org/10.1080/26395916.2024.2361706

Kuhn, T. S. 2012. The structure of scientific revolutions. Fourth edition. University of Chicago Press, Chicago, Illinois, USA. https://doi.org/10.7208/chicago/9780226458144.001.0001

Lakoff, G., and M. Johnson. 1999. Philosophy in the flesh: the embodied mind and its challenge to Western thought. Basic Books, New York, New York, USA.

Leichenko, R. M., and K. L. O'Brien. 2019. Climate and society: transforming the future. Polity, Cambridge, UK.

Mancilla Garcia, M., T. Hertz, and M. Schlüter. 2020. Towards a process epistemology for the analysis of social-ecological system. Environmental Values 29(2):221-239. https://doi.org/10.3197/096327119X15579936382608

Mancilla García, M., C. Abunge, S. O. Bandeira, C. Cheupe, D. J. Combane, T. Daw, E. M. Drury O'Neill, T. Hertz, M. Mubai, N. Muthiga, et al. 2024. Exploring a process-relational approach to qualitative research methods for sustainability science. People and Nature 6:1512-1523. https://doi.org/10.1002/pan3.10667

McHugh, I. 2018. The narrative of assemblage (and the assemblage of narrative). TEXT 22(Special 51):1-13. https://doi.org/10.52086/001c.25583

Merleau-Ponty, M. 2010. Phenomenology of perception. Routledge, London, UK. https://doi.org/10.4324/9780203720714

Moon, J. A. 2008. A handbook of reflective and experiential learning: theory and practice. RoutledgeFalmer, Abingdon, UK.

Morrison, T. H., W. N. Adger, A. Agrawal, K. Brown, M. J. Hornsey, T. P. Hughes, M. Jain, M. C. Lemos, L. H. McHugh, S. O'Neill, et al. 2022. Radical interventions for climate-impacted systems. Nature Climate Change 12:1100-1106. https://doi.org/10.1038/s41558-022-01542-y

Neimanis, A., and R. L. Walker. 2014. Weathering: climate change and the "Thick Time" of transcorporeality. Hypatia 29 (3):558-575. https://doi.org/10.1111/hypa.12064

Nightingale, A. J., N. Gonda, and S. H. Eriksen. 2022. Affective adaptation = effective transformation? Shifting the politics of climate change adaptation and transformation from the status quo. WIREs Climate Change 13(1):e740. https://doi.org/10.1002/wcc.740

Norström, A. V., C. Cvitanovic, M. F. Löf, S. West, C. Wyborn, P. Balvanera, A. T. Bednarek, E. M. Bennett, R. Biggs, A. De Bremond, et al. 2020. Principles for knowledge co-production in sustainability research. Nature Sustainability 3:182-190. https://doi.org/10.1038/s41893-019-0448-2

O'Brien, K., and M. Milkoreit. 2022. Climate politics and social change: what can cognitive and quantum approaches offer? Pages 127-152 in J. D. Derian and A. Wendt, editors. Quantum international relations: a human science for world politics. Oxford University Press, Oxford, UK. https://doi.org/10.1093/oso/9780197568200.003.0007

O'Grady, N., and D. Shaw. 2023. Disaster reparations? Rethinking disaster recovery through the politics of affect. Geographical Journal 189(3):514-525. https://doi.org/10.1111/geoj.12526

Orlikowski, W. J., and S. V. Scott. 2015. Exploring material-discursive practices: exploring material-discursive practices. Journal of Management Studies 52(5):697-705. https://doi.org/10.1111/joms.12114

Orlove, B., N. Dawson, P. Sherpa, I. Adelekan, W. Alangui, R. Carmona, D. Coen, M. Nelson, V. Reyes-García, J. Rubis, et al. 2022. Intangible cultural heritage, diverse knowledge systems and climate change. Page 103. White Paper I, ICSM CHC, Charenton-le-Pont, France.

Orlove, B., P. Sherpa, N. Dawson, I. Adelekan, W. Alangui, R. Carmona, D. Coen, M. K. Nelson, V. Reyes-García, J. Rubis, et al. 2023. Placing diverse knowledge systems at the core of transformative climate research. Ambio 52:1431-1447. https://doi.org/10.1007/s13280-023-01857-w

Ortiz-Przychodzka, S., C. Benavides-Frías, C. M. Raymond, I. Díaz-Reviriego, and J. Hanspach. 2023. Rethinking economic practices and values as assemblages of more-than-human relations. Ecological Economics 211:107866.https://doi.org/10.1016/j.ecolecon.2023.107866

Parker, C., S. Scott, and A. Geddes. 2019. Snowball sampling. SAGE Research Methods. https://doi.org/10.4135/9781526421036831710

Paschen, J.-A., and R. Ison. 2014. Narrative research in climate change adaptation—exploring a complementary paradigm for research and governance. Research Policy 43(6):1083-1092. https://doi.org/10.1016/j.respol.2013.12.006

Robinson, K., editor. 2009. Deleuze, Whitehead, Bergson. Palgrave Macmillan UK, London, UK. https://doi.org/10.1057/9780230280731

Rouse, J. 1996. Engaging science: how to understand its practices philosophically. Cornell University Press, Ithaca, New York, USA. https://doi.org/10.7591/9781501718625

Sappa, V., and A. Barabasch. 2020. Forum-theatre technique to foster creative and active problem solving: a resilience-building intervention among in-service teachers. Journal of Adult and Continuing Education 26(1):43-60. https://doi.org/10.1177/1477971419842884

Schama, S. 1996. Landscape and memory. Vintage Books, New York, New York, USA.

Seiferth, C., M. Tengö, and E. Andersson. 2024. Designing for collective action: a knowledge co-production process to address water governance challenges on the island of Öland, Sweden. Sustainability Science 19:1623-1640. https://doi.org/10.1007/s11625-024-01531-4

Semin, G. R., and E. R. Smith. 2002. Interfaces of social psychology with situated and embodied cognition. Cognitive Systems Research 3(3):385-396. https://doi.org/10.1016/S1389-0417(02)00049-9

Shapiro, L. A. 2019. Embodied cognition. Second Edition. Routledge, London, UK.

Shouse, E. 2005. Feeling, emotion, affect. M/C Journal 8(6). https://doi.org/10.5204/mcj.2443

Sidik, S. M. 2022. Weaving Indigenous knowledge into the scientific method. Nature 601:285-287. https://doi.org/10.1038/d41586-022-00029-2

Spinoza, B. de. 1985. The collected works of Spinoza. Princeton University Press, Princeton, New Jersey, USA.

Srnicek, Nick. 2007. Assemblage theory, complexity and contentious politics: the political ontology of Gilles Deleuze. Thesis. University of Western Ontario, London, Ontario, Canada.

Stark, H., and J. Roffe, editors. 2015. Deleuze and the non/human. Palgrave Macmillan, Houndmills, Basingstoke, UK.

Stoknes, P. E. 2014. Rethinking climate communications and the "psychological climate paradox." Energy Research & Social Science 1:161-170. https://doi.org/10.1016/j.erss.2014.03.007

Tengö, M., E. S. Brondizio, T. Elmqvist, P. Malmer, and M. Spierenburg. 2014. Connecting diverse knowledge systems for enhanced ecosystem governance: the multiple evidence base approach. AMBIO 43:579-591. https://doi.org/10.1007/s13280-014-0501-3

Thagard, P. 2000. Coherence in thought and action. MIT Press, Cambridge, Massachusetts, USA. https://doi.org/10.7551/mitpress/1900.001.0001

Thrift, N. J. 2007. Non-representational theory: space, politics, affect. Routledge, London, UK. https://doi.org/10.4324/9780203946565

Toivonen, H. 2022. Themes of climate change agency: a qualitative study on how people construct agency in relation to climate change. Humanities and Social Sciences Communications 9:102. https://doi.org/10.1057/s41599-022-01111-w

Tsoukas, H. 2018. Complex thought, simple talk: an ecological approach to language-based change in organizations. Pages 78-100 in J. Shotter and H. Tsoukas, editors. Philosophical organization theory. Oxford University Press Oxford, UK. https://doi.org/10.1093/oso/9780198794547.003.0003

Turnhout, E., T. Metze, C. Wyborn, N. Klenk, and E. Louder. 2020. The politics of co-production: participation, power, and transformation. Current Opinion in Environmental Sustainability 42:15-21. https://doi.org/10.1016/j.cosust.2019.11.009

Turnhout, E., M. Stuiver, J. Klostermann, B. Harms, and C. Leeuwis. 2013. New roles of science in society: different repertoires of knowledge brokering. Science and Public Policy 40 (3):354-365. https://doi.org/10.1093/scipol/scs114

Uhlmann, A. 2020. Affect, meaning, becoming, and power: Massumi, Spinoza, Deleuze, and neuroscience. Pages 159-174 in A. Houen, editor. Affect and literature. Cambridge University Press, Cambridge, UK. https://doi.org/10.1017/9781108339339.009

Verlie, B. 2019. "Climatic-affective atmospheres": a conceptual tool for affective scholarship in a changing climate. Emotion, Space and Society 33:100623. https://doi.org/10.1016/j.emospa.2019.100623

Wannewitz, M., and M. Garschagen. 2023. Collective adaptation to climate change. Current Opinion in Environmental Sustainability 61:101248. https://doi.org/10.1016/j.cosust.2022.101248

West, S., L. J. Haider, T. Hertz, M. Mancilla Garcia, and M.-L. Moore. 2024. Relational approaches to sustainability transformations: walking together in a world of many worlds. Ecosystems and People 20(1):2370539. https://doi.org/10.1080/26395916.2024.2370539

West, S., L. van Kerkhoff, and H. Wagenaar. 2019. Beyond "linking knowledge and action": towards a practice-based approach to transdisciplinary sustainability interventions. Policy Studies 40(5):534-555. https://doi.org/10.1080/01442872.2019.1618810

Whitehead, A. N. 1925. Science and the modern world: Lowell lectures, 1925. Macmillan, New York, New York, USA.

Whitehead, A. N. 1968. Modes of thought. Free Press, New York, New York, USA.

Wyborn, C., A. Datta, J. Montana, M. Ryan, P. Leith, B. Chaffin, C. Miller, and L. Van Kerkhoff. 2019. Co-producing sustainability: reordering the governance of science, policy, and practice. Annual Review of Environment and Resources 44:319-346. https://doi.org/10.1146/annurev-environ-101718-033103

Yua, E., J. Raymond-Yakoubian, R. A. Daniel, and C. Behe. 2022. A framework for co-production of knowledge in the context of Arctic research. Ecology and Society 27(1):34. https://doi.org/10.5751/ES-12960-270134

Zurba, M., M. A. Petriello, C. Madge, P. McCarney, B. Bishop, S. McBeth, M. Denniston, H. Bodwitch, and M. Bailey. 2022. Learning from knowledge co-production research and practice in the twenty-first century: global lessons and what they mean for collaborative research in Nunatsiavut. Sustainability Science 17:449-467. https://doi.org/10.1007/s11625-021-00996-x

Appendix 1.

Concept/ Approach	Traditional knowledge co-production approach	Knowledge co-production according to an assemblage approach
Knowledge co-production	Knowledge co-production is defined as "a voluntary, formalized process by which two or more individuals (or players) reach agreement on a definition of reality (a representation, a decision, a project, a diagnosis) or a way of doing things (a solution to a problem)" (Foudriat 2019 - our translation). Main focus: Developing principles and corresponding policy mechanisms for co-production of knowledge that is usable (Clark et al. 2016) and explore "how different actors can adhere to, enact, and embody those principles in action" (Zurba et al. 2022: 461).	An assemblage approach explores what should happen in such agreement between individuals so that the knowledge generated affects which is a condition for knowledge to be actionable. Main focus: Enhancing the generation of knowledge that affects. The principal focus is not on defining and enacting principles but on processes of assembling and onto-epistemological processes of alignment that have the potential to generate affect.
Representation	The field of knowledge co-production is wide and diverse so it is not clear to what extent a shared definition of representation exists. Often a representation has an explicitly social dimension (Jodelet 1989) and is considered to be a form of knowledge, socially elaborated and shared, contributing to the construction of a reality common to a social entity. While the emphasis lies on construction - and thus coherence accounts of the relation between representations and reality - the field also acknowledges correspondence and pragmatist accounts. Implicit commitments to particular accounts of the relation between representation and reality have consequences for co-creation processes (see section on "representation and affect").	While traditional accounts of knowledge co-production are uncommitted to a particular view on the relation between a representation and reality, an assemblage approach takes a specific view on representations: They emerge within assemblages conditioned by perspectives. An assemblage approach takes an explicitly pragmatist approach whereby what something is (i.e. how it is represented) is defined by what it does (defined by its position/role in the assemblage).

Affect	The concept of affect as that which changes "a body's capacity to affect and be affected" is rarely used. If anything the concept is discussed alongside other concepts such as emotions that are mobilized for building trust or enhancing engagement or and/or decision making of participants involved in processes of co-production. Affect thus mostly manifests via emotions and is restricted to / a property of human subjects. It is about how emotions change humans capacity to affect and be affected in processes of knowledge co-production.	Affects are not a property of the human subject but of that which produces human subjects (and all other bodies) in the first place: representations, assemblages, perspectives. Affects lie at the heart of the pragmatist dynamics: On the one hand, affects is coded, for example, via representations, on the other hand, the notion of affective surplus defies coding by representations and allows changing how a body is represented. What bodies are and do is thus not fully fixed by representations but can change in affective encounters. This capacity for change, this openness, is key for whenever processes of alignment need to bridge different ways in which representations, assemblages, perspectives code experiences of participants of co-production processes.
Relations	The field of knowledge co-production is wide and diverse so it is not clear to what extent a shared definition of "relation" exists. Often, co-production approaches are interactionist. This means that bodies are taken to pre-exist as bodies before entering into relation with other bodies.	An assemblage approach takes relations to be performative which means that they fully constitute the bodies they relate. Affects can only do what they do (onto-epistemological process of alignment) if relations (which are encounters that realize) are considered to be performative, meaning that the way in which bodies become determinate can (radically) change.
Perspectives/ Assemblage	The notion of perspective is usually seen as the point of view of participants in the knowledge co-production. Participants render knowledge drawing on representations from a particular perspective. Perspectives are also referred to as e.g. worldviews. This reflects the discussion on representations above: A traditional view remains uncommitted as to the ontological status of perspectives - as something that mirrors reality (e.g. some form of entity realism) or as something that coheres with an existing body of beliefs (social constructivism). The notion of	An assemblage approach takes an explicit stance regarding perspectives. A perspective is not something a human subject "has" and that it can simply change. Rather, human subjects (just like all bodies) are products of the material-discursive practices that make up perspectives. Perspectives generate intelligibility of life-worlds and thus condition knowledge assemblages and the representations they draw on.

assemblages is largely absent in the literature on traditional co-production.