A relational turn for sustainability science? Relational thinking, leverage points and transformations

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ABSTRACT

In sustainability science, revising the paradigms that separate humans from nature is considered a powerful ‘leverage point’ in pursuit of transformations. The coupled social-ecological and human-environment systems perspectives at the heart of sustainability science have, in many ways, enhanced recognition across academic, civil, policy and business spheres that humans and nature are inextricably connected. However, in retaining substantialist assumptions where ‘social’ and ‘ecological’ refer to different classes of entity that interact, coupled systems perspectives insist on the inextricability of humans and nature in theory, while requiring researchers to extricate them in practice – thus inadvertently reproducing the separation they seek to repair. Consequently, sustainability researchers are increasingly drawing on scholarship from the ‘relational turn’ in the humanities and the social sciences to propose a paradigm shift for sustainability science: away from focusing on interactions between entities, towards emphasizing continually unfolding processes and relations. Yet there remains widespread uncertainty about the origins, promises and challenges of using relational approaches. In this paper, we identify four themes in relational thinking – continually unfolding processes; embodied experience; reconstructing language and concepts; and ethics/practices of care – and highlight the ways in which these are being drawn on in sustainability science. We conclude by critically discussing how relational approaches might contribute to (i) a paradigm shift in sustainability science, and (ii) transformations towards sustainability. Relational approaches foster more dynamic, holistic accounts of human-nature connectedness; more situated and diverse knowledges for decision-making; and new domains and methods of intervention that nurture relationships in place and practice.

1. Introduction

We face a daunting array of sustainability challenges, where crises of biodiversity loss, climate change and food insecurity deepen, and inequality, poverty and political polarization abound (Steffen et al. 2015; Hamann et al. 2018; Leach et al. 2018). The ways in which we understand and enact our situatedness in the world are vital dimensions of these challenges (Plumwood 1993; Latour 2004; Folke et al. 2011). While many of us might intuitively agree that our experience reveals a dynamic, interconnected world of constant change, formal Western thought remains heavily indebted to modernist or ‘substantialist’ paradigms that aim to bring order to experienced complexity by identifying the static, foundational ‘substances’ or ‘entities’ imagined to underpin it (Meske 2008). Such paradigms, by insisting on categorical differences between humans and the world around them, have generated a string of influential dichotomies and bifurcations, including society-nature, human-nonhuman, mind-matter, subject-object, and representation-reality, to name but a few (Castree 2003a). Modernist paradigms and their embodied forms and tools have of course been useful in improving many aspects of human-wellbeing, but have also been widely implicated in unsustainable pathways (Raudsepp-Hearne et al. 2010). Examples range from command-and-control approaches to natural resource management (Holling and Meffe 1996), to the policies of the green revolution (Lansing et al. 2017), to instances of ‘green-grabbing’ (Fairhead et al. 2012). A leverage points perspective, inspired by systems theorist Donella Meadows, suggests that challenging and transcending paradigms is a means of initiating transformations towards sustainability (Meadows 1999; Abson et al. 2017). In contrast to the reductionism of modernist, substantialist approaches, such alternative paradigms and practices are likely to be ‘generative’: receptive to complexity and ambiguity, aware of researchers’ participation in the phenomena they describe, and committed to ethical, deliberative participation in practice (van Kerkhoff 2014; Stirling 2010; Norström et al. 2020).
Over the past 20 or so years, the transdisciplinary field of sustainability science has provided a fertile space in which to generate alternative paradigms better suited to addressing complex sustainability challenges (Clark and Dickson 2003). Central to the development of sustainability science has been the articulation and use of complex coupled systems perspectives, including social-ecological, socioecological, human-environment, and coupled human and natural systems (Kates et al. 2001; Kates 2010; de Vries 2013). While these perspectives each have their differences, they have commonly sought to transcend modernist paradigms by conceiving of humans and nature as interconnected within hybrid systems (Liu et al. 2007). Such approaches tend to view the concepts ‘social’ and ‘ecological’ as referring to different types of substance, entity, or component, that subsequently interact to produce emergent social-ecological outcomes (Berkes et al. 2003; Levin et al. 2013; Schlüter et al. 2019). Collectively, complex systems perspectives have prompted a greater recognition of the interdependence of humans and nature within academic, civil, policy and business spheres (Fischer et al. 2015; Österblom et al. 2017; IPBES 2019). In recent years, systems perspectives have begun to locate many sustainability challenges in a collective human failure to cognitively recognize our inextricable material connections with the world around us, arguing that we need to ‘reconnect’ to the biosphere (Folke et al. 2011) or nature (Ives et al. 2018). The leverage points perspective, emerging from complex systems thinking and recently (re) articulated as a distinct approach in sustainability science (Fischer and Riechers 2019), has proposed human-nature connectedness as a key research topic and ‘domain of leverage’ in pursuit of sustainability transformations (Riechers et al. in press).

Yet at the same time sustainability researchers have increasingly suggested that complex systems perspectives remain captive to paradigmatic assumptions that implicitly reproduce a separation between humans and nature (Raymond et al. 2013; Hukkinen 2014; Cooke et al. 2016; Sala and Torchio 2019). For instance, while social-ecological systems (SES) perspectives have emphasized relations and interconnectedness between components, they still generally use the concepts of ‘social’ and ‘ecological’ to refer to two foundational types of entity or substance that can ultimately be parsed (Liu et al. 2007). In the philosopher Bruno Latour’s (1993) words, coupled or hybrid systems tend to be conceived as ‘mixes of two pure forms’. Systems perspectives, therefore, remain heavily influenced by the substantialist assumptions of modernist paradigms (Altman and Rogoff 1987; Emirbayer 1997; Kaaronen 2018). This leads to a situation where researchers adopting such approaches, while insisting on the inextricability of humans and nature in theory, are required to systematically extricate them in practice – thus inadvertently reproducing the separation they seek to repair (e.g. Ostrom 2009; Resilience Resilience Alliance 2010). For example, Ostrom’s (2009) social-ecological systems framework advances institutional analysis by introducing ecosystem dynamics, but breaks down common resource problems into resource units, resource systems, governance systems and users, before linking them back together. While subsequent research has emphasized the need to better incorporate ecological dynamics (Vogt et al. 2015) these endeavors remain a work in progress (Schlüter et al. 2019). Not only does this separation of ecological and social limit the ways that sustainability researchers can represent the complexity and inextricability of humans and nature they experience in empirical field studies, but also – and more importantly perhaps – risks perpetuating the same kinds of ineffectual and inequitable interventions fostered by modernist approaches (e.g. Haider et al. 2018b; Dacks et al. 2019).

Sustainability scientists are therefore increasingly engaging with research associated with the ‘relational turn’ in the humanities and social sciences, as a means of revising substantialist assumptions and better capturing the complexity of human-nature connectedness (Darnhofer et al. 2016; Gillard et al. 2016; Stenseke 2018; West et al. 2018, 2019b; Lejano 2019; Hertz et al. 2020; Darnhofer 2020; Walsh et al. 2020; Mancilla Garcia et al. 2020a, 2020b). The relational turn does not refer to a single, unified approach, but rather describes a broad shift in scholarship across multiple disciplines, encompassing many distinct commitments, theories and ideas (e.g. Emirbayer 1997; Murdoch 2006; Coole and Frost 2010). Speaking very broadly, relational approaches do not seek to ‘cut through’ our experience of continual change to find foundational entities underneath, but rather view this experience as the core of existence (Mesle 2008). The term ‘experience’ here does not refer simply to human mental representations of an external material world, but rather to the embodied engagement and responsiveness between all things (human and otherwise) in holistic situations – of which representation is but one possible aspect (Murdoch 2006, p. 197). These holistic situations represent momentary instantiations of continually unfolding processes and relations (Mesle 2008). From relational perspectives, the enduring objects that we generally perceive as substances or entities – bodies, trees, rocks – are reconceived as temporary convergences, stabilizations or ‘events’ within flows of dynamic relationships that already encompass what we tend to think of as ‘human’ and ‘natural’ aspects (DeLanda 2006, p. 28; Debaise 2017). This inverts the substantialist ideas still found in complex systems.
thinking; rather than processes and relations being derivative of entities, they are constitutive of entities (Muraca 2011). Consequently, concepts such as ‘social’ and ‘ecological’ are understood not as referring to foundational types of substance, but as tools that we use to make sense of our experience and act in the world (Wagenaar and Cook 2011). Practically, relational approaches suggest that researchers carefully trace the empirical relations in their context of study, and attempt to explain concepts such as ‘social’ and ‘ecological’ rather than assume them (Latour 2005). The hope is that this leads either to more rigour and clarity around existing concepts or, as Mancilla García et al. (2020a) note, to the development of new, non-dualistic concepts such as de la Cadena’s (2015) ‘earth beings’ or Haraway’s (2016) ‘cyborgs’. Hertz et al. (2020) suggest that a ‘paradigm shift’ in coupled systems thinking from substantialist to relational assumptions can help overcome dichotomies and dualisms between humans and nature, better conceptualize complexity, and generate novel governance, management and policy approaches towards sustainability.

Nevertheless, despite growing interest and engagement with relational approaches among sustainability scientists, there remains widespread uncertainty about the origins, promises and challenges of working with relational thinking. Conceptual work on paradigms is difficult at the best of times, and especially so given the transdisciplinary, action-oriented nature of sustainability science. While there is growing recognition of the importance of philosophy and methodology in transdisciplinary sustainability and conservation research (Miller et al. 2014; Moon et al. 2019), there remain widespread fears – often among natural and applied social scientists – of getting ‘bogged down’ by philosophical debates in crisis situations where, it is argued, urgent action is needed instead (Tallis and Lubchenco 2014). Meanwhile, philosophically oriented humanities and social science scholars may feel trepidation at the thought of engaging with the interventionist aspects of sustainability science (including leverage points and transformation), because they are well aware of the ethical ambiguities and dangers of ideas translated too readily into action (Feola 2015; Clark et al. 2016). In sustainability science, these tensions and positionalities play out in decentered institutional contexts where researchers are expected to shift fluidly between roles and disciplines, and where participants in research teams may have quite different training, agendas and expertise (Haider et al. 2018a). It is therefore vital that sustainability scientists do not only present primary empirical or theoretical work, but also reflexive scholarship that explores how such research is being produced, in order to contribute to more rigorous and productive transdisciplinary practice (McGowan et al. 2014; Mahmoud et al. 2018).

In this paper, we contribute to this lacuna by tracing why and how sustainability scientists are engaging with relational thinking; presenting some personal experiences from our own research projects; and critically reflecting on how relational thinking might contribute to sustainability transformations. Our aim is not to articulate a specific relational approach to complex systems research or sustainability science more broadly – this task is being conducted by others (Weinbaum 2015; Lejano 2019; Hertz et al. 2020; Mancilla García et al. 2020a). Rather, we aim to produce a useful synthetic and reflexive piece that identifies the many different ways in which sustainability scientists are drawing on relational thinking. Framing our contribution in terms of this special issue on human-nature connectedness as a leverage point for sustainability transformations is useful for two main reasons: firstly, it allows us to continue to infuse the literature on human-nature connectedness with relational approaches (building on Cooke et al. 2016; Raymond et al. 2017a); and secondly, a leverage points framing pushes us to articulate the implications of relational approaches for action. We begin the paper by briefly characterizing coupled systems perspectives on connecting humans and nature. We show that by maintaining the separate but linked categories of ‘humans’ and ‘nature’, or ‘social’ and ‘ecological’, sustainability researchers have generated rich insights and have been able to do significant, potentially transformative, socio-political work. At the same time, however, they are finding it increasingly valuable to rethink these categories. We then introduce the relational turn, identify four key themes in the relational literature – continually unfolding processes; embodied experience; reconstructing language and concepts; and ethics/practices of care – and trace how sustainability scientists are connecting to these themes in different ways. As a group of sustainability researchers with a common interest in relational approaches, we include examples from our own research to highlight our various histories, motivations and ways of operationalizing relational thinking, and to reflect on the challenges and possibilities of developing more relational approaches to sustainability research. We conclude with a critical discussion of how relational approaches might contribute to (i) a paradigm shift in sustainability science, and (ii) wider transformations towards sustainability.

2. Connecting humans and nature in sustainability science

While research on sustainability-related issues has a long history (Bettencourt and Kaur 2011), ‘sustainability science’ as a distinct field emerged in the late
1990s as a means to (re)connect science to the political agenda for sustainable development (NRC 1999; Kates et al. 2001). The field was defined around three core philosophical commitments: (i) a recognition that ‘the challenge of sustainable development is the reconciliation of society’s development goals with the planet’s environmental limits over the long term’ (Clark and Dickson 2003, p. 8059); (ii) an awareness that humans and nature are interconnected and an accompanying focus on ‘complex, closely-coupled, human-environment systems’ (Kates 2010, p. 18), and (iii) a focus on problem-driven and use-inspired transdisciplinary research practices capable of ‘linking knowledge and action’ (van Kerkhoff and Lebel 2006). Contributions to sustainability science have since come from a wide range of disciplines and fields including ecology, engineering, development studies, land-change science, resilience thinking, ecological and environmental economics, geography and many others (Bettencourt and Kaur 2011). Kajikawa et al. (2014) have identified transdisciplinary clusters around topics such as environmental systems, energy systems, transportation systems, and water systems. Looking across such topics it is possible to identify a number of key research themes, including: the connections between ‘human’ and ‘natural’ entities; the complex nature of these connections including tipping points and cross-scale interactions; the roles of worldviews, values, and notions of stewardship; and attempts to nurture transformations and transitions to more sustainable configurations (Clark and Dickson 2003; Lenten et al. 2008; Kates 2010; Levin and Clark 2010; Horcea-Milcu et al. 2020).

The coupled systems perspectives that sit at the heart of sustainability science have served to shift conceptualizations of human-nature connectedness from dichotomies to dualisms: categories of ‘humans’ and ‘nature’ are no longer considered disconnected and mutually exclusive, but interconnected parts of holistic systems. Nevertheless, dichotomies remain in research practice, as researchers adopting systems perspectives are generally required to identify system components as either ‘human/social’ or ‘natural/ecological’ (Ostrom 2009; Schoon and Van der Leeuw 2015). Guidance for identifying each component tends to rely on instinctual, taken-for-granted classifications. For example, Liu et al. (2007, p. 1513) suggest that natural components consist of ‘ecological variables (e.g. landscape patterns, wildlife habitat, and biodiversity)’, and human components consist of ‘human variables (e.g. socioeconomic processes, social networks, agents, and structures of multi-level governance)’. The connections between components are often conceived in terms of actions such as resource use, extraction, monitoring and management (Liu et al. 2007; Schlüter et al. 2019), but can also include a range of ‘cultural’ or ‘intangible’ aspects (Daniel et al. 2012). For instance, Ives et al. (2018) identify material, experiential, cognitive, emotional and philosophical connections between humans and nature. As Abson et al. (2017) note, researchers adopting systems perspectives differ on whether they view these categories as constitutive of a particular perspective (epistemic), or as the reality of the world itself (ontological). In practice, these distinctions often merge, even in the same paper. For example, Fischer et al. (2015, p. 145) present social-ecological systems as a ‘useful analytical frame’ before suggesting that the feedbacks within social-ecological systems ‘underlie the capacity of the biosphere to sustain human progress and development’. This oscillation between epistemology and ontology is important as it is integrally related to the practical, performative effects of systems paradigms in policy and practice (Stirling 2016).

By retaining familiar categories within a dualistic paradigm, and strategically shifting between epistemology and ontology, researchers adopting coupled systems approaches have been able to do significant, potentially transformative, socio-political work (e.g. Rockström 2010; Morsetto 2017). Fischer et al. (2015) note that social-ecological systems approaches have been useful for (i) fostering recognition of the links between human well-being and ecosystem integrity within academia, policy and business, (ii) improving collaboration and communication between scientific disciplines and between science and society, (iii) fostering methodological pluralism as a means of addressing sustainability problems, and (iv) influencing major policy frameworks to consider social and ecological aspects. Indeed, many sustainability scientists working with social-ecological systems framings would readily acknowledge that they are still working with dualisms, but suggest that retaining familiar concepts – while at the same time challenging and expanding their meaning – is strategically useful in pursuing practical change in a wider world that still largely expects and operates on the basis of them (an approach that postcolonial theorist Gayatri Spivak (1990) describes as ‘strategic essentialism’). While it might seem to systems researchers slightly far-fetched, even amusing, to suggest that the language of social-ecological feedbacks, thresholds, and cross-scale interactions represents ‘a language that power understands’ (Handler 1991, quoted in Castree 2003b, p. 206), it is nonetheless the case that research employing these concepts has obtained much greater high-level policy and business resonance that other attempts to challenge modernist dichotomies (e.g. Häyhä et al. 2016; Österblom et al. 2017).

These common formulations and strategies in systems perspectives will likely continue to generate rich insights and contribute to progressive change within particular contexts, situations, and agendas – but
there are also good reasons for sustainability scientists to interrogate them closely. Rapid movement between epistemology and ontology without regular clarification can lead to the naturalization of concepts, where the concepts we use to navigate the world (human/social, natural/ecological) become mistaken for the world itself. This is what process-relational philosopher Alfred North Whitehead refers to as the ‘fallacy of misplaced concreteness’ (e.g. Daly 1987). Thompson (1997) suggests that this fallacy can serve to (i) foster dogmatism by preventing the revision of abstractions in a dynamic, changing world, (ii) limit creativity by prompting the rejection of different perspectives and approaches, (iii) obscure the normativity and inherent selectiveness of abstractions, (iv) distance research from concrete particulars and desensitize researchers to their experiences of real-world situations. Moreover, studies have increasingly questioned the ability of dominant strategies in coupled systems research to nurture truly transformative change (Schneider et al. in press; Walker and Cooper 2011). For instance, Nelson (2014) and Braun (2015) suggest that the policy and business resonance achieved by concepts like natural capital, ecosystem services, and science-based targets, represents the ‘capture’ of the transformative promise of complex systems research by neoliberal and new public management institutions, actors, and agendas, that are inherently resistant to transformative change. It is therefore vital that sustainability researchers continually interrogate the concepts used to navigate complexity and foster change, in order to better capture empirical experience and articulate truly transformative socio-political-ecological possibilities (Johnson and Lidström 2018).

Sustainability scientists are, increasingly, revisiting and revising ideas of distinct ‘human’ and ‘natural’ entities in pursuit of realizing central commitments to complexity, human-nature interconnectedness, and transformation. Major recent assessments of coupled human and natural, socio-environmental, and social-ecological systems research have, as Mancilla Garcia et al. (2020b) point out, highlighted the need to better integrate ‘social’ and ‘ecological’ aspects at conceptual, methodological, and disciplinary levels (Fischer et al. 2015; Turner et al. 2016; Kramer et al. 2017; Guerrero et al. 2018). Indeed, our own experiential evidence suggests that sustainability researchers are increasingly wondering how they should identify social and ecological components in their empirical cases, when everything seems inextricably social and ecological at the same time. (One strategy is to adopt the language of coupled systems in a broad sense as indicative of human-nature inextricability and complexity, without strictly adopting conventional systems methodologies per se). At the same time, others have begun conversations about the inextricable relationships between research paradigms, practices and prescriptions for action, with the aim of fostering multiple approaches to nurturing transformative change (Feola 2015; Blythe et al. 2018; Scoones et al. 2020). Cutting across these efforts, a growing number of sustainability scientists are drawing on relational thinking to identify the paradigmatic substantialist assumptions still prevalent within complex systems approaches, and revise them along more dynamic and processual lines – with the aim of developing paradigms of human-nature connectedness more suited to navigating the sustainability challenges of the 21st century (Table 1).

3. A relational turn for sustainability science?

Relational, process-based philosophies and approaches are present across the academic spectrum, including in physics (Prigogine 1980) and biology (Nicholson and Dupré 2018). Most prominently, perhaps, they have been adopted and articulated over the past three decades in what has become known as the ‘relational turn’ in the humanities and social sciences, in order to counter substantialist dichotomies (e.g. human-nature, mind-matter, structure-agency) and to emphasize the role of materiality in social and cultural life (thus providing a counterpoint to more radically constructivist ‘post-modernist’ work). This latter aim has given rise to closely associated terms including ‘new materialism’ and the ‘ontological turn’ (Pellizzoni 2015), as well as ‘more-than-human’ and ‘posthuman’ perspectives (Panelli 2010). Scholarship associated with relational thinking now spans a dizzying number of disciplines and fields, including human geography (Whatmore 2002; Castree 2003a, 2003b; Murdoch 2006; Jones 2009), sociology (Emirbayer 1997; DeLanda 2006; Dépelteau 2018), science and technology studies (Latour 1993, 2005; Law 2007), psychology (Hartig 1993; Mitchell and Aron 1999; Clarke et al. 2007), policy studies and public administration (Cook and Wagenaar 2012; Bartels and Turnbull 2019); Indigenous studies (Martin and Mrraboopa 2003; Bawaka Country et al. 2013); social and political theory (Coole and Frost 2010; Bennett 2010), political ecology (Swyngedouw and Heynen 2003; Jarosz 2011), organization studies (Langley and Tsoukas 2017), environmental humanities (Heise et al. 2017), and many more. While there are many resonances between these expressions of relational thinking, each is situated within – and responds to – the particular concerns and histories of its respective field, and so uses ‘relationality’ to perform distinct kinds of conceptual and empirical work.

Relational and complex systems thinking have close and somewhat interwoven histories, terminologies, and current uses, which can make the
Table 1. Modernist, complex coupled systems, and relational research paradigms (amended from Altman and Rogoff’s 1987). We have added illustrative references from sustainability science where applicable; note that authors cited may work between multiple paradigms. The modernist characterization is derived from caricatures presented in complex systems and relational work (i.e. what these latter paradigms define themselves against); the lack of citations should therefore not be taken to mean that modernist commitments are entirely absent from sustainability science (see, for example, Asafu-Adjaye et al. 2015). The three paradigms presented here are only intended to reflect the ideas discussed in this paper, and are not the only paradigms operative within sustainability science.

| Paradigms                        | Ontology                                             | Dynamics                                      | Human-nature connectedness                      | Role of researcher                                      | Significance of concepts/language                        | Proposals for transformative change                     |
|----------------------------------|-------------------------------------------------------|-----------------------------------------------|------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------|
| Modernist                        | Separate human and environmental entities with interactions between them | Interactions between entities cause linear change (time is backdrop to events) | Dichotomous: Humans are separate to nature and use it to satisfy material needs | Separate and detached from observed phenomena; objective | Correspondence: Concepts/language reflect the world | Human mastery and control of nature                      |
| (Mechanistic)                    |                                                       |                                               |                                                |                                                          |                                                          |                                                          |
| Complex coupled systems          | Distinct human and environmental entities that interact to form emergent wholes | Reciprocal, cross-scale interactions between entities produce non-linear change, tipping points (time is backdrop to events) | Dualistic: Humans are connected to nature in various ways but cognitive abilities separate them to some extent | Ambiguous: Part of observed phenomena, but strive to maintain degree of objectivity | Ambiguous: Paradigms, frames and mental models affect the world, but role of concepts and language unclear | Stewardship, reconnection to nature                        |
| (Organicist)                     |                                                       |                                               |                                                |                                                          |                                                          |                                                          |
| Relational                       | Holistic assemblages composed of reciprocally constituted aspects | Change is integral to assemblages, which are constituted within continually unfolding processes (time is inherent to events) | Non-essentialist: Humans are nature and vice versa, through concept of embodied experience in holistic situations | Non-correspondence: Concepts/language help to make the world (performative), and need to be interrogated and re-built | Non-correspondence: Concepts/language help to make the world (performative), and need to be interrogated and re-built | Ethics/practices of care                                  |
| (Transactional)                  |                                                       |                                               |                                                |                                                          |                                                          |                                                          |

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significance of a relational turn for sustainability science difficult to grasp. For example, systems thinking often contrasts itself with modernist approaches on the basis of its ‘relational’ focus on the interactions or reciprocal feedbacks between entities (Bodin et al. 2011; Schulz and Martin-Ortega 2018), while in return many relational approaches have drawn inspiration from complex systems principles of indeterminacy, uncertainty and contingency (Hayles 1999; Scoones 1999; Braun 2015). Writing in psychology, Altman and Rogoff (1987) suggest that while both paradigms aim to provide holistic and dynamic analyses, systems approaches operate within ‘organicist’ worldviews that portray distinct entities interacting to produce emergent wholes; whereas relational approaches operate within ‘transactional’ worldviews and move away from distinct entities altogether to portray reciprocally constituted aspects unfolding in broader assemblages (see also Aldrich 2008; Selg 2016). It is these latter ideas, developed through engagement with process-relational (Whitehead 1978), pragmatist (Dewey 1958), and post-structural philosophy (Deleuze and Guattari 1988), that have enabled relational approaches to build on insights from complex systems approaches while also more directly countering substantialist assumptions, and that seem particularly useful for sustainability science.

In this section, we identify four research themes in the literature associated with the relational turn, and show how researchers are increasingly drawing on them in sustainability science. This is an ambitious undertaking in limited space, and some caveats are needed. We recognize that there will be any number of possible and useful ways of synthesizing the relational turn (e.g. Walsh et al. 2020), and that our identified themes and descriptions barely touch on the richness and diversity of the literature. We also recognize that each theme may not be unique to relational thinking, and that researchers may arrive at similar understandings by drawing on other theories and paradigms (see, for instance, Sala and Torchio’s (2019) discussion of dialectical approaches). And we emphasize that sustainability scientists are engaging with these themes to different degrees, for different reasons: the sustainability research we highlight does not necessarily adopt a strictly relational approach in entirety. These complexities reflect the dilemmas faced by researchers seeking to engage with relational thinking in transdisciplinary sustainability science: how to do so in ways that are simultaneously creative, rigorous, constructive and impactful (e.g. Haider et al. 2018a)? To give the reader a sense of how some of these dilemmas are being navigated in practice, we include text boxes tracing our own research experiences, including our motivations for adopting relational thinking, our ways of operationalizing it, and our reflections on the research process. These are not intended as ‘textbook examples’. We do not wish to present a naïve picture of relational thinking as the solution to all problems, but rather to maintain a sense of the critical challenges, doubts, and ambiguities we have experienced in our work. Mindful of John Law’s (2004) call to embrace ‘mess’ in complexity-based research, we hope that recounting our experiences contributes to ongoing learning and reflection. We aim to provide a characterization that is heuristically useful while also conveying the complexity of this unfolding research landscape (Figure 1).

3.1. Continually unfolding processes

Relational ontologies – understandings about the nature of reality – suggest that the world exists in a perpetual state of ‘becoming’, composed of dynamic unfolding processes and relations (Whitehead 1978; Connolly 2011). Relational thinking does not reject the idea of entities per se – indeed, many aspects of the world appear to us as relatively stable and predictable – but rather reframes our understanding of them (DeLanda 2006). Whereas modernist approaches propose that entities are distinct and essentially static, and systems approaches that entities are distinct but move and interact with each other, relational approaches suggest that what we perceive as entities are themselves already constituted by movement (Ingold 2011). For instance, what we experience as a (relatively) stable human being is produced through the temporary convergence of various processes (breathing, cell renewal, occurrence of thoughts) that unfold through the formation of relationships within the surrounding world (Ingold 2004; Hertz et al. 2020). This applies from complex organisms like humans ‘all the way down’ to genes and molecules (Meslé 2008; Nicholson and Dupré 2018). In relational thought, entities are therefore understood as ‘events’ (Debaise 2017): temporary nodes, stabilizations or patterns of relations, produced within dynamic intersecting processes (DeLanda 2006). Because these processes already encompass what we might think of as ‘social’ and ‘ecological’ aspects, it makes little sense to designate the entities produced within them as either social or ecological. Relational thinking, therefore, has significant implications for key concepts conventionally used to distinguish between social and ecological phenomena, such as ‘agency’. In reframing ideas of agency away from purely cognitive-reflective abilities, and towards ‘the capacity to affect and be affected’ (Deleuze and Guattari 1988, p. 127), relational thinking expands agency beyond the human (Whatmore 2002) and distributes it within relational networks, assemblages and configurations (Latour 2005).
Sustainability scientists are increasingly drawing on ideas of unfolding processes and relations to illustrate the complexity of human-nature connectedness. Most prominently, Bodin et al. (2011, p. 8) invoke the relational sociology of Emirbayer (1997) and others to articulate a ‘social relational approach to natural resource governance’ rooted in quantitative social network analysis. However, while such efforts have powerfully highlighted the complex spatial webs of interdependence that characterize human-nature connectedness and influence governance outcomes, they have placed less emphasis on the dynamic temporal processes that (re)produce network configurations, and have so far tended to stay within substantialist understandings of distinct social and ecological nodes (Sayles et al. 2019). Meanwhile, in parallel development, others have drawn on Emirbayer’s work, along with Latour (2005), Dépelteau (2018), Deleuze and Guattari (1988), and others, to develop rich conceptual and qualitative accounts of human-nature connectedness from ‘deep’ relational perspectives that collapse distinctions between ‘human’ and ‘natural’ entities, for instance in relation to farms and farmers (Darnhofer et al. 2016; Darnhofer 2020) and agricultural systems more generally (Dwiartama and Rosin 2014; Darnhofer et al. 2019). Bringing together the quantitative, spatial emphasis of network analysis with the conceptual development of the latter studies is a promising research pathway for sustainability science (Lejano 2019; Sayles et al. 2019). The work of Mancilla Garcia et al. (2020a, 2020b) and Hertz et al. (2020) to articulate a process-relational approach to complex systems research provides a rich conceptual basis for such efforts, with the potential to contribute significantly to research priorities around human-nature connectedness, complex dynamics, and issues of scale.

3.2. Embodied experience

Relational approaches posit that, in worlds of continual becoming, the nature of ‘existence’ or ‘being’ lies in experience (Mesle 2008). In substantialist paradigms that separate the human mind from the material world, experience is reduced to an individual, subjective, cognitive phenomenon (see, for instance, Latour’s (1999) characterization of Descartes’ ‘mind-in-a-vat’). However, in relational approaches, which locate humans fundamentally in the material world, this notion of private cognition is only one possible aspect of experience – which is understood more broadly in terms of our embodied engagement within the social, material and technological aspects of holistic, unfolding situations (Wagenaar and Cook 2011). Indeed, it is because of the collective and material aspects of experience that, even in a world of constant flux, everyday life can usually proceed more or less unproblematically (Cook and Wagenaar 2012). Consequently, relational approaches view human subjects not as pre-given independent entities, but rather as...
Prior to my PhD in sustainability science, I had completed an undergraduate degree in Human Ecology and a Master of Science in Ecosystem Services. I had also worked for two years on a research project exploring how municipal authorities in southern Sweden were implementing ecosystem services concepts in their planning and decision-making processes. I first became interested in relational thinking when I encountered sociological and anthropological accounts of human-nature relationships (e.g. Latour 1993; Ingold 2000). I was intrigued by the idea that perception and direct experience constitute a relational state prior to bifurcation of subject-object, and I was especially interested in how this affects our views and policy-making around non-human nature. I have incorporated these ideas into my work as contrasting perspectives to the conventional ideas of value and human-nature relationships in ecosystem services assessments.

**Operationalization**

I collaborated with another researcher to explore how citizens in southern Sweden described their recreational experiences in nature and the implications for conceptualizing values in cultural ecosystem services assessments (Figure 2). My colleague conducted eight focus groups with 54 participants who regularly spent time in nature. To analyze the data I adopted Charmaz’s (2006) ‘grounded theory’ approach, where categories are generated from the empirical data rather than pre-existing theory, and coded the transcripts for the ideas, notions and metaphors that the participants themselves used to both articulate their experiences and express those experiences in terms of “values of nature.” Rather than viewing participant experiences and articulations of value as representative of their “innate values” or “mental properties,” I viewed them as products of their embodied engagement with the world and their exchanges with focus group colleagues and interviewers. I found that the participants expressed their experiences in terms of emotional relationships with nature, including nature’s ‘movement,’ ‘authenticity,’ and ‘magic,’ and found it difficult to describe in words the values they held in relation to the environment. This sits in stark contrast to current preference-based cultural ecosystem services valuation methods. The methodology allowed me to reveal the qualitative and relational characteristics of meanings and values of place-based human-nature relationships, and how participant responses can be interpreted as ‘resisting’ attempts to categorize and standardize their experiences within dominant logics (Stålhammar & Pedersen 2017).

**Reflection**

I struggled to justify the significance of my work, as I came to feel that my choice of a relational approach to interpret my data – as with any paradigm – was somewhat arbitrary. My findings served as a critique of the dualist conceptions of value that have permeated ecosystem services assessments to date. I still find this critique valid, but I also see that this outcome was somewhat predetermined by my methodological starting point. If I had adopted a substantivist approach, I would have probably found dualistic human-nature connections instead. I consequently found it difficult to justify my findings based on ontological claims, even though I interpreted my research participants’ descriptions of value as relational in kind. This suggests to me that when adopting relational methodologies, it is important to question the appropriateness of adopting an ontological starting point in that particular research context, and to remain reflexive about how and why you are using a relational approach. It was also challenging to identify the implications of my findings for policy and practice. I wondered whether relational ideas could be effectively translated to inform policy or planning, given that these domains still seem to be influenced primarily by mechanistic and interactionist worldviews (Altman & Rogoff 1987). I emphasized the need for management frameworks to be more receptive and adaptive to accommodate for relational perspectives. I later learned that while larger scales of planning such as comprehensive planning are governed by reductionist logics, local scales of urban design may be more likely to incorporate multiple perspectives. My findings and similar studies could thus be useful for urban designers that are interested in lived experiences of human-nature relationships.

**Figure 2.** Young people going for a recreational walk in a national park in southern Sweden. Photo: Sanna Stålhammar
Box 2. Practices of adaptive ecosystem management in Australia (Simon West)

**Motivation**
I studied literature and law before my PhD in sustainability science, and was therefore sensitized to the roles that perspective and experience play in knowing the world. Yet I struggled to see how I might be able to contribute to what seemed to me like a science-dominated transdisciplinary field. I loved the complex systems ideas I encountered, especially the emphasis on the inherent partiality, uncertainty and indeterminacy of knowledge. After a while, however, I also noticed that these ideas were not necessarily fully developed in relation to the production of complex systems knowledge itself: there seemed to be an occasional tendency to fall back into modernist ideals of the distanced, objective scientific observer providing ‘non-negotiable’ facts about the world ‘out there.’ It seemed to me that bringing in humanities and social science ideas about how knowledge is generated through active, embodied participation in the world (rather than simply distant observation of it), might be useful in sustainability science for better capturing both complexity and human-nature connectedness.

**Operationalization**
I became interested in adaptive management (AM) as an applied field, informed by complex systems thinking, where scientists were proactively engaging in the world and informing management and policy. A colleague put me in touch with a group of scientists working on an AM project in an Australian national park and I accompanied the scientists on one of their field trips, helping out and observing them as they worked (Figure 3). I paid close attention to the situation the scientists found themselves in, the challenges that arose, and their attempts to resolve these challenges satisfactorily. I wrote observational field notes, and then interviewed the scientists afterwards. I used Cook and Wagenaar’s (2012) relational theory of practice – initially developed within policy studies – to produce a coding scheme, and then applied this to the data. I adopted this deductive approach because I found relational thinking difficult, and I wanted to use some existing concepts that would help me to stay on track and avoid ‘slipping back’ into received, substantialist ways of making sense of what was happening. I ended up producing a detailed, descriptive account of how the scientists drew on their embodied experiences, judgment and improvisational abilities – in the continually unfolding processes of the field – to produce a usable AM framework for the park management authority (West et al. 2019a).

**Reflection**
I found it ethically and practically difficult to describe the actions of the scientists using a different paradigm to those that the scientists themselves were using. Positivist epistemologies, often paired with mechanistic and organismic worldviews, portray experience, judgment and improvisation as subjective aspects to be removed from scientific practice, so highlighting the presence of these aspects risked suggesting that the group were ‘bad scientists’ (even though, to me, they seemed to be doing a very good job). The relational approach of Cook and Wagenaar, however, enabled me to portray these ‘subjective’ aspects as valuable resources in the scientists’ efforts to produce rigorous, usable knowledge for management – while at the same time revealing the contingent, partial nature of that same knowledge. I also worried about the implications of my work: would it have any practical benefits? However, the scientists told me that my manuscript had helped them to think differently about their work and the value of scientific practice. This seemed to indicate the potential value of relational approaches for nurturing change, including, in an AM context, different kinds of workplace training, greater collaboration between scientists and managers, and new roles and purposes for science. Finally, I found it difficult to publish the manuscript. I was told by an applied ecology journal that the paper was not sufficiently grounded in ecological science, and by an STS journal that the paper was not appropriate because it sought to “improve management” rather than simply describe science. I eventually succeeded with a new journal dedicated to interdisciplinary, relational work on people and nature.

Figure 3. Scientists working on an adaptive management project in an Australian national park. Photo: Simon West

reveal and revise residual substantialist assumptions about human-nature connectedness, as found in concepts such as cultural ecosystem services, sense of place, and reconnecting to the biosphere. For example, Raymond et al. (2017a, 2017b) draw on James Gibson’s affordance theory, initially developed in psychology, to articulate an embodied approach to human-nature connectedness that recognizes the ‘dynamic relations between mind, body, culture and environment’, and use this to counter dualisms between the ‘mental’ and ‘material’ in cultural ecosystem services and sense of place research. Similarly, Stålhammar and Pedersen (2017) adopt Charmaz’s (2006) grounded approach to show how citizens’ articulation of ‘cultural values’ are relationally constituted through experience and dialogue, rather than expressive of inherent preferences (Box 1). Meanwhile, Cooke et al. (2016) argue that common tropes of human-nature disconnection presuppose two distinct entities that can be (dis)connected, and draw on Tim Ingold’s dwelling perspective – initially developed in anthropology and human geography – to articulate an embodied approach that, in situating humans in and of the world, prompts a shift in language from reconnecting to ‘re-enacting’ the biosphere. On a complementary research trajectory, others have taken up the epistemological implications of experience and relationality to
highlight the embodied practices of science and governance in relation to sustainability issues (Box 2; Ernstson and Sörlin 2013; Stirling 2016; West et al. 2019a).

3.3. Reconstructing language and concepts

Relational approaches suggest that language and concepts do not refer to essential categories of existence, but are tools that enable us to capture and compare different aspects of experience and navigate the world (Cook and Wagenaar 2012). Therefore, language does not simply reflect the world but actively intervenes in and shapes it – it is ‘performative’ (Butler 1988). Language is therefore vital when it comes to understanding and responding to complex sustainability challenges. Indo-European languages have evolved within substantivalist paradigms and are predicated on the notion of static entities with derivative relations. The process sociologist Norbert Elias (1978, p. 111–12) notes:

“Our languages are constructed in such a way that we can often only express constant movement or constant change in ways which imply that it has the character of an isolated object at rest, and then, almost as an afterthought, adding a verb which expresses the fact that the thing with this character is now changing. For example, standing by a river we see the perpetual flowing of the water. But to grasp it conceptually, and to communicate it to others, we do not think and say, “Look at the perpetual flowing of the water”; we say, “Look how fast the river is flowing.” We say, “The wind is blowing,” as if the wind were actually a thing at rest which, at a given point in time, begins to move and blow. We speak as if a wind could exist which did not blow. This reduction of processes to static conditions, which we shall call “process-reduction” for short, appears self-explanatory to people who have grown up with such languages.”

In the West, we are so steeped in process-reduction that it is almost impossible to avoid working with substance-based concepts like ‘society’ and ‘nature’. Relational thinkers have made various suggestions for developing more dynamic accounts. Latour (2005) recommends that instead of invoking received concepts to explain phenomena (e.g. the suggestion that the human components of coupled systems are the ‘human variables’), researchers should trace empirical relations to explain the concepts (e.g. identifying what constitutes the ‘human aspects’ in particular situations). Barnes (2010) encourages us to resist the urge to classify and categorize, and remain open to the world’s indeterminacy or ‘ontic vagueness’. And Law and Lin (2010) recommend researchers to ‘cultivate disconcertment’ by engaging with different metaphysical traditions, thus revealing the particularities of and possibilities for changing one’s own paradigm.

In sustainability science, Mancilla Garcia et al. (2020a) draw on the pragmatist philosophy of William James to propose ‘radical empiricism’ – paying close attention to grain of experience and resisting categorization – as a method for researchers to generate concepts that can better capture ‘the constitution of the social and the ecological’. Others have taken more deductive approaches, drawing on existing relational theories and terminologies to revise substantivalist interpretations of key concepts. For instance, Boonstra (2016) draws on the process sociology of Norbert Elias and Johan Goudsblom to challenge the notion of power as a purely human or social variable, and develops the example of fire as an expression of ‘social-ecological’ power. Similarly, Woroniecki (2019) uses Kabeer’s (1999) processual theory of empowerment to expand notions of power within climate adaptation research from an individual attribute or structural force towards a networked social-ecological achievement (Box 3). Meanwhile, still others have looked beyond academia to the distinct metaphysics of Indigenous, agricultural, and other place-based communities, to develop biocultural approaches rooted in culturally relevant categories beyond dualistic ‘social’ and ‘ecological’ entities (Box 4; Caillon et al. 2017; Sterling et al. 2017; Merçon et al. 2019; Haider et al. 2019b).

3.4. Ethics/practices of care

Many expressions of relational thinking suggest that rethinking the world in terms of processes and ‘becoming’ is an interventionist, transformative project (Stengers 2010; Clark 2014; Pellizzi 2015). For example, Darnhofer (2020) suggests that if categories are not inherently fixed, then it becomes possible – even obligatory – to rethink them in ways that nurture more ethical and sustainable ways of living and doing. Ethical discourses in the relational turn have centered on fostering notions of ‘care’ (Puig de la Bellacasa 2015). Tronto (1993, p. 103) describes care as: ‘everything we do to maintain, continue and repair our “world” so that we can live in it as well as possible. That world includes our bodies, our selves, and our environment, all of which we seek to interweave in a complex, life-sustaining web.’ In a relational sense, care is not simply an emotional sentiment in the individual human mind, but an embodied, collective and reciprocal practice involving humans and nonhumans. For instance, Bawaka Country et al. (2013, p. 186) draw on Yolnu Aboriginal Australian understandings of ‘Country’ – in which humans are understood as inextricably constitutive of particular places – to note that ‘in caring for Country, humans care for themselves; in caring for humans, Country cares for itself’. Caring well involves practical work, affect and affectability (captured in the ideas of ‘caring about’ and ‘taking care of’), and active political engagement (Puig de la Bellacasa 2015). Relational conceptions of care also reflect back on the
Box 3. Empowerment and nature-based solutions in Sri Lanka (Stephen Woroniecki)

Motivation
Before my PhD in sustainability science I studied ecological science and social-ecological resilience, and worked for the United Nations Environment Programme’s World Conservation Monitoring Centre on climate change and biodiversity, including ecosystem-based adaptation and REDD+. As I began my doctorate I was optimistic about the role of so-called ‘nature-based solutions’ (NBS) in transformations to sustainability. I wanted to examine claims that NBS were holistic and inclusive interventions capable of delivering transformative social-ecological change in pursuit of the Sustainable Development Goals (SDGs). There was (and still is) little critical evaluation of these claims, which to me implied a simplistic notion of how social change occurs, and a sense that ‘green’ is inherently fair. I chose empowerment as a lens to critically evaluate NBS because I was eager to work with power relations in a constructively critical way to inform transformation processes. Empowerment represents an important goal (e.g. SDGs 5, 10 and 16), and, as a concept, seemed able to capture people’s own meaningful expressions of agency and make visible the relationships that matter to them in a changing world, such as denials of rights to water security. Empowerment is also provocative in challenging the privileged position of the researcher, especially in the postcolonial settings of many NBS interventions. Focusing on empowerment in NBS provided a window into a particular instance of human-environment relations.

Operationalization
I identified two ecosystem-based adaptation (EBA) projects in Sri Lanka as examples of NBS that claimed to target the needs and priorities of marginalized, vulnerable groups and to deliver social change (Figure 4). Making use of a cooperation agreement with the University of Ruhuna, I recruited several local research assistants and together we adopted a variety of qualitative methods to explore the context and content of the projects, including participatory focus groups, narrative interviews, key informant interviews, and feedback workshops. In searching for theoretical resources to analyze the subsequent data, I noticed that empowerment is sometimes presented in adaptation research as an attribute or capacity of individual people, thus enabling empowerment to be delivered unproblematically through capacity-building interventions. I was therefore excited to come across Kabeer’s (1999) processual theory of empowerment, informed by feminist theory, where empowerment is presented as an unfolding, inherently unpredictable process of change that involves the indivisible aspects of resources (biophysical and symbolic), agency and achievements. This enabled me to develop a more dynamic approach to empowerment that cut across conventional distinctions between ‘social’ and ‘natural’ components. I developed a set of deductive codes from Kabeer’s theory oriented around processes and relations and used these to interpret the data, before holding feedback workshops to check and revise my findings with participants. In keeping the concepts of ‘society’ and ‘nature’ from being fixed too soon as objective categories, a relational approach provided me space to develop a more open-ended account of EBA interventions that revealed the central role of subjectivity in change processes (Woroniecki 2019).

Reflection
A relational approach to empowerment enabled me to demonstrate the contested nature of EBA processes, showing how the stakes were different for different actors. I showed that, rather than being unproblematically ‘fair,’ EBA projects tend to empower certain powerful agents (e.g. ecologists or government agencies) to manipulate ecosystems in order to bring about benefits to certain groups (e.g., ‘dependent,’ ‘vulnerable,’ ‘passive’ villagers, especially women). While EBA projects are intended as holistic responses to intertwined crises, current research and practice often fails to question the deeper roots of vulnerability caused by social inequalities. Overall, a relational approach was useful in many respects, but in highlighting social relations, processes and power. I still find myself rethinking the role of ecosystems in mediating climate change. I found it difficult to hold both the nuance and political complexity of empowerment theories with the more-ecologically-explicit nature-based approaches. This highlights the problem of trying to create a relational, holistic lens if the associated complexity becomes unworkable and blinding.

Figure 4. A motorcyclist rides across the earth bund of a semi-natural Elangawa reservoir in Sri Lanka. In Galgamuwa, Kurunegala district, the United Nations Development Programme is leading a project designed to restore Elangawa as ‘nature-based solutions’ to water insecurity worsened by climate change. Photo: Stephen Woroniecki

practice of research itself: because the act of rethinking the world is an inherently political task, researchers should acknowledge that their own articulations of ‘good care’ are never neutral, and engage in ‘careful’ research practice attentive to possible and unpredictable effects (Mol 2008; Tironi and Rodriguez-Giralt 2017). A growing number of sustainability researchers are drawing on relational conceptions of care to (re)articulate desirable responses to sustainability challenges (Jackson and Palmer 2015; Jax et al. 2018). Care has been identified as a central, animating force in stewardship, differentiating notions of stewardship in sustainability science from conventional approaches to management and governance (Enqvist et al. 2018). West et al. (2018) use dwelling, sense of place and biocultural perspectives to articulate a relational conception of care in stewardship – emergent from social-ecological phenomena; embodied and practiced; and situated and political – supportive of interventions that foster close, ongoing and
generative relationships between people and their environment. In a more general vein, West et al. (2019b) develop a model for research-practice engagement in sustainability interventions that evokes notions of care in everyday practice. Meanwhile, Briassoulis (2017a, 2017b) draws on DeLanda’s (2006) assemblage theory, notions of ‘socioecological fit’, and complex systems thinking, to develop the notion of ‘response assemblages’: non-reductionist, context and time-specific responses to socioecological degradation. Finally, Chan et al. (2016) critique the focus in environmental and sustainability policy on the dichotomy between intrinsic and instrumental values and suggest that more effective interventions will respond to a new class of ‘relational values’ derivative of the relationships that people have with the environment, characterized by notions of care, identity and belonging. The concept of relational values has since generated a rich literature including work that draws on the process-relational philosophy of Whitehead (Muraca 2016), as well as work that continues to operate largely within substantialist paradigms (Klain et al. 2017). This variety demonstrates both the current salience of ‘relationality’ in sustainability science and the challenges faced by researchers in engaging productively with it (Stålhammar and Thorén 2019).

4. Discussion: relational thinking, leverage points, and transformations

The intersections of relational thinking and sustainability science thus represent increasingly rich and dynamic research areas. But what is the wider significance of this work? On the one hand, leverage points perspectives suggest that challenging and transcending the paradigms that separate humans and nature is one of the most powerful ways of nurturing transformative change (Riechers et al. in press; Meadows 1999; Fischer and Riechers 2019). But on the other hand, relational thinking can feel complicated and esoteric, and the practical implications are not always self-evident. Indeed, Seibt (2018) notes that because the conventional tools and approaches in western philosophy are substantialist, process-relational thinkers face a dual task: firstly, they need to develop new schemes of understanding, and secondly, they need to articulate why these schemes help to better achieve the aims of philosophy. Sustainability researchers adopting relational thinking face a similar challenge in explaining how their work contributes to: (i) better understandings of human-nature connectedness, and (ii) more effective and equitable interventions in pursuit of transformations (e.g. Kates et al. 2001; Clark and Dickson 2003). In this Discussion, we identify and critically discuss three broad, potentially transformative opportunities generated by relational approaches, relevant both within sustainability science and for policy, practice, activism, and other avenues of change.

4.1. Relational approaches generate more holistic, dynamic analyses of human-nature connectedness

The focus in relational approaches on empirical situations, experiences, practices and events – characterized by Hertz et al. (2020) as a shift ‘from nouns to verbs’ – has helped researchers to invest their accounts of human-nature connectedness with greater dynamism and movement. For example, although in our own case studies (Boxes 1–4) we generally adopted pre-existing categories at some point, an attentiveness and openness to unfolding situations ‘in the field’ enabled us to use these categories more sensitively and flexibly. In the social sciences and humanities, relational thinking has served to draw attention to the ‘material’ and ‘environmental’ aspects within what we conventionally think of as ‘human’ and ‘social’ life. In sustainability science the situation has been reversed: relational thinking has so far brought more appreciation of the traditionally ‘human’ and ‘social’ aspects within the ‘environmental’. See, for instance, Stephen’s focus on empowerment (Box 3), Jamila’s emphasis on ritual (Box 4), and Sanna’s and Simon’s attention to experience and dialogue (Boxes 1 and 2). Working both directions, relational thinking thus draws attention not only to how humans and nature are ‘connected’, but how they ‘interpenetrate’ (Marston et al. 2005). This is to say that the empirical experience we capture with the concept ‘human’ is also captured with the term ‘nature’, thus serving to collapse the distinction between the two (e.g. Sala and Torchio 2019). So while the term ‘human-nature connectedness’ is useful as a provisional shorthand to indicate the topic at stake to a wide audience, it remains rooted in substantialist assumptions: relational approaches suggest that in order to better highlight the complexity of human-nature connectedness we need to develop alternative terms.

The tension of working within and around common terminologies reflects the broader politics of ideas implicated in a potential ‘relational paradigm shift’ for sustainability science. The movement to develop the concept of ‘relational values’ has used strategic ambiguity around the meanings and implications of relationality to, among other things, ensure greater social science and humanities contributions to the Intergovernmental Panel on Biodiversity and Ecosystem Services (IPBES; Chan et al. 2018). This strategy has been very effective, and the relational values literature has already generated valuable
Box 4. Biocultural practices and development interventions in Tajikistan (L. Jamila Haider)

**Motivation**
I worked in international development before becoming a sustainability researcher, implementing programs in the Pamir Mountains (Tajikistan) designed to alleviate poverty by increasing production of marketable crop varieties. Pamiri farmers, traditionally selected and retained certain crops like the red wheat Rashtak over centuries, even millennia, for their taste, vitality, spirituality, landscape function, and nutritional properties. With these crops grew traditions, languages, rituals, even a body calendar synchronized with seasonal landscape changes. But many development programs have ignored these relationships, introducing ‘improved’ wheat seed varieties for production alone, gradually eroding biocultural diversity. As a practitioner and then researcher in Tajikistan, I had also used resilience assessments and the social-ecological systems framework to understand differential success in common pool resource management (Haider et al. 2012, 2019a). This felt like a great step towards integrating social-ecological understanding and action. However, the approaches still required separating social and ecological components into columns or quadrants for analysis, which I felt did not adequately represent the holistic worldviews and knowledges of the farmers as embodied in their daily practices. In my work I am motivated by the need to give more space to these knowledges, to help give them power. Local people who live from the land already act in relational ways. It is up to us as researchers or program implementers to better understand these relationships, rather than obscure understanding by breaking them apart.

**Operationalization**
I turned to relational thinking to explore the effects of an improved wheat seed on the biocultural practices around Rashtak Figure 5. Inspired by my previous experiences of developing a recipe book with Pamiri farmers, I decided to use the collection and preparation of food as a social situation for participatory observation (Haider & van Oudenhoven 2018c). Preparing food is an embodied practice and a natural entry point for relational data collection, but analysis remains a challenge. While grounded, inductive approaches are well-suited to expressing *in situ* relationships and concepts, I felt my analysis should connect to broader frameworks in sustainability science to make my findings more comprehensible, generalizable and action-oriented for development practice. I therefore used Norgaard’s (1994) coevolution framework to code my data. The co-evolution framework proposes dynamic relations between five nodes – technology, values, organisation, environment, and knowledge – that in turn shape the nodes themselves. I centered my analysis around a specific ritual (Saatpom, a special pomade for Persian New Year) and articulated the relations between nodes as biocultural practices: sowing (seed), harvesting (grain), and celebrating (using flour). Focusing on practices enabled me to develop a novel relational analysis that moved away from isolated social-ecological entities and helped to reconstruct a language oriented more around relations (Haider et al. 2019b).

**Reflection**
I struggled initially to understand the nature of the ‘nodes’ and ‘relations’ in my case. The co-evolution framework could be seen as a return to substantivist essentialism, because the ‘co-’ implies the existence of foundational entities that subsequently interact. However, I came to view the nodes more as temporary anchors within continually unfolding processes, and attempted to maintain their dynamism. For example, the improved seed variety, classified as a ‘technological node,’ was constituted by sets of (industrial and genetic) relations that have in turn influenced and become enrolled within (agricultural and ritual) relations in the Pamir landscape. Another challenge was to publish the final article. Sustainability science journals considered the piece too long and descriptive, and anthropology-oriented journals found that the broader conceptual framework obscured micro-level processes. Despite these challenges, I feel that my work opens up significant transformative possibilities. Firstly, using food and a coevolutionary framework as a way to understand relationships highlighted the importance of more embodied and less immediately tangible livelihood values: sharing, reciprocity, hospitality and respect between people and landscape. These are important for more sustainable pathways because they underpin existing, adaptive and transformative practices. Secondly, focusing on daily practices within broader analytic frameworks enabled voices that would otherwise be ignored to speak to, and potentially challenge, dominant paradigms.

![Figure 5. Women bake bread in a traditional tandoor oven using the red wheat Rashtak, now only cultivated in one village, to perform a ritual in Bartang Valley in the Pamir Mountains. Traditional seeds and their associated cultural practices have been lost, partly because of rural development interventions. Photo: Jamila Haider](image-url)
insights, contributions to policy, and interdisciplinary collaboration. Yet ambiguity – which, it should be noted, is also present in this paper – brings two primary risks: firstly, that the term ‘relational’ rapidly becomes a buzzword used to justify very different approaches; and secondly, that relational thinking becomes a ‘social science concern’ in ways that substantially undersell the potentially transformative contributions of relational thinking to all areas of sustainability science. We, therefore, see a need to better articulate distinctly ontological and epistemologies (e.g. Hertz et al. 2020; Mancilla Garcia et al. 2020a), and in particular to explore the implications of relational philosophy across methods (mathematical models, ethnography, network analysis), data (quantitative, qualitative), and traditional domains (economic, ecological, technological). As a meta-philosophy, relational thinking offers exciting opportunities to reformulate existing practices and processes across all areas and modes of inquiry towards better appreciation of complexity (Nicholson and Dupré 2018).

4.2. Relational approaches generate more empirical accounts of knowledge production, prompting more situated and diverse knowledges for decision-making

Relational thinking frames knowledge as a product of our practical engagement in the world, and draws attention to the purposes and commitments, tools and concepts and empirical experiences that shape this engagement. Relational approaches, therefore, suggest that all knowledge is ‘contingent’ (could be otherwise – but by no means anything) and ‘situated’ (reflective of the context in which it was produced). This framing has helped sustainability researchers explore knowledge practices as diverse as the production of quantitative ecological science (Box 2) and the generation of cultural values (Box 1), in ways that avoid dichotomies between either subjective values or objective facts. In fostering close attention to the ways in which knowledge is made, we found that relational thinking enhanced our awareness of the partiality of our own approaches (Box 1). Relational thinking thus provides an effective means of better realizing complex systems commitments to the partiality and uncertainty inherent within all knowledges, and the value of drawing on multiple knowledges in decision-making (Tengö et al. 2017). While this may result in greater reluctance among researchers to make unitary, blanket recommendations to policy and practice, it is important to note that relational approaches are not less ambitious than generalizing perspectives when it comes to intervening for sustainability, but more ambitious: relational thinking compels sustainability scientists to take the complexity of the world seriously in addressing concrete, real-world problems (Box 4).

Yet the embrace of multiple knowledges in relational thinking generates its own dilemmas, challenges and ambiguities. For example, how to reconcile multiplicity with calls for a paradigm shift in sustainability science? Indeed, Braun (2015, p. 5) suggests that some relational work fails to reflexively apply such principles, and finds itself suggesting that ‘the world is marked by indeterminacy and contingency, except when it comes to theories of indeterminacy and contingency!’ We recognize this danger, but note that, contrary to connotations of a totalizing force, paradigm shifts in practice tend to be halting, partial and variable in their effects (e.g. González-Márquez and Toledo 2020). The greater presence of relational thinking in sustainability science seems particularly useful at a meta-philosophic level, providing the conceptual tools for different approaches to better recognize and situate themselves relative to one another in transdisciplinary contexts (e.g. by incorporating relational ideas, researchers adopting positivist methods might re-frame their work as useful for particular purposes, rather than arbitrating universal truths). A relational turn in sustainability science might, therefore, be better thought of as nurturing a ‘paradigm-opening’ rather than a ‘shift’ per se. Nevertheless, it is precisely these kinds of ideas that have seen proponents of relational thinking accused by adherents of traditional forms of realism, whether in the 1990s ‘science wars’ or the contemporary ‘post-fact’ era, of dangerously loosening the rules for assessing knowledge claims in ways that limit the abilities of researchers to contribute to socio-political change (Latour 1999; Sismondo 2017). Farrell (2020) usefully shows that both traditional realists and purveyors of so-called ‘alternative facts’ continue to draw on the dichotomous formulations of modernism for their political salience. But the persistence of such arguments indicates that relational approaches in sustainability science will need to convincingly demonstrate that they (i) help to make stronger, more empirical claims about the credibility, relevance and legitimacy of different knowledges (scientific and otherwise), and (ii) serve to improve processes to support transparency, critical reflection and ethical deliberation at the research–practice interface.

4.3. Relational approaches generate new domains and methods for sustainability interventions that nurture relationships in place and practice

In recognizing that paradigms are implicated within material systemic configurations, both relational thinking and complex systems approaches imply that research
within and across paradigms is unavoidably political (Clark 2014; Fischer and Riechers 2019). The emphasis in relational thinking on the common ‘plane of immanence’ within which relationships are continually (re) made has helped sustainability researchers to articulate new approaches to intervention (Pellizzoni 2015, p. 8). Across our cases (Boxes 1–4), we each found that relational thinking helped us to make previously underacknowledged and undervalued aspects of the world visible and valued. This, in turn, suggests new domains for intervention that cut across traditional sectors: for instance, the role of ritual in biocultural landscapes indicates the value of investing and supporting culture to achieve biodiversity and development goals (Box 4). Some might conclude that the resistance to categorization and the emphasis on situatedness mean that attempts to ‘operationalize’ relational thinking contradict its core message (e.g. Lövbrand et al. 2015). In our experience, however, relational thinking draws attention to the substantialist assumptions that inform conventional notions of ‘operationalization’ and associated terms like ‘implementation’, ‘intervention’ and ‘impact’ (West et al. 2019b). In the sense of informing practice, relational thinking seems eminently operationalizable. For example, notions of intervention might shift from unitary, definitive actions conceived and delivered from the perspective of a ‘judging observer’, to provisional contributions to ongoing processes and practices from that of a ‘careful partial participant’ (Christie 2013; Brattland et al. 2018). Again, it is worth pointing out that this stance is not less but more ambitious: it requires attentiveness and commitment, and does not preclude ‘big interventions’ but suggests that they are conceived and enacted in light of unfolding relationships in place and practice.

Nevertheless, context is vital in determining the transformative work that paradigms do. While a shift in perspective towards relational assemblages does appear to open up exciting possibilities in contexts where the standard view is that of interacting entities, we have each found that relational approaches make it difficult to articulate what kinds of relational configuration should be considered better or worse. As Cooke et al. (2016, p. 840) note, notions of ‘moving along with the world as it transforms itself’ can stymie the development of an explicitly critical, normative stance. This is problematic because such commitments then become implicit and difficult to contest (Blythe et al. 2018). While in this paper we have emphasized the differences between relational and complex systems thinking, others have highlighted their similarities – suggesting that in emphasizing the complexity of human-nature relationships without corresponding theories of politics, both are susceptible to ‘capture’ by ideologies that seek to maintain rather than transform the drivers of unsustainability (Pellizzoni 2015; Swyngedouw and Ernstson 2018). The argument is that, in continuing to critique outdated forms of modernism, both complex systems and relational approaches fail to grasp how their core tenets have already been incorporated into neoliberal (Guerry et al. 2015) and neo-modernist agendas (Asafu-Adjaye et al. 2015) – a tension captured in the science-based targets network’s promise to corporate actors to ‘future-proof growth’ (https://sciencebasedtargets.org/). This highlights the risk that relational approaches might open-up paradigms within sustainability science, but fail to contribute to transformative social-ecological change in the world at large. We suggest that it is important for relational forms of sustainability science to develop multiple political possibilities by drawing on, for example, critical social-ecological commons scholarship (Nelson 2014), post-foundational political theory (Swyngedouw and Ernstson 2018), and ethics of care and stewardship (West et al. 2018).

5. Conclusion

In this paper, we have addressed calls in sustainability science to develop more holistic accounts of human-nature connectedness in pursuit of sustainability transformations (Riechers et al. in press; Ives et al. 2018). We have argued that, while the complex coupled systems perspectives that sit at the heart of sustainability science continue to produce rich insights and nurture progressive change in certain contexts, they remain captive to substantialist assumptions that potentially limit their transformative abilities. We have shown that sustainability researchers are increasingly drawing on literature from the relational turn in the humanities and social sciences as a means of countering the current bias towards distinct ’human’ and ’natural’ entities and better situating such nodes within continually unfolding processes and relations. By emphasizing that these processes are at once what we might think of as ‘social’, ‘ecological’, ‘political’ and ‘technical’, relational approaches have helped sustainability researchers to develop non-dualistic accounts of human-nature connectedness that better reflect the complexity of human experience – perhaps constituting a relational turn for sustainability science. We have identified three broad transformative opportunities generated by relational approaches: (i) more holistic, dynamic analyses of human-nature connectedness, (ii) more empirical accounts of knowledge production that prompt more situated and diverse knowledges in decision-making, and (iii) new domains and approaches for sustainability interventions that nurture relationships in place and practice. Realizing these opportunities will require attention to several critical issues: extending the methodological implications of relational thinking across computational and statistical methods and quantitative data; demonstrating the value of relational thinking in improving research-practice arenas; and articulating the political possibilities of relational thinking. Relational approaches to sustainability science, adopted critically and reflexively, provide a promising pathway towards productive inquiry and intervention in a complex world.
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