Sustainability Science
https://doi.org/10.1007/s11625-025-01717-4

OVERVIEW ARTICLE

Entanglements of knowledge and action in sustainability science: reclaiming reflexivity to embrace the uncomfortable

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Received: 10 January 2025 / Accepted: 15 June 2025

Abstract

The trajectory of the current socio-ecological crises is not improving, motivating several researchers to suggest that sustainability scientists should engage more actively in the transformations our work demands of broader society. Possibilities for action range from placing pressure on powerful economic and political structures through individual advocacy or activism to adopting more reflexive, action-oriented and transdisciplinary approaches in our research. Yet, dominant perspectives at the science-policy-society interface often expect researchers to remain separate from and neutral to the complexities and politics of the 'real-world', particularly in times of geopolitical and economic change, pitting personal motivations and values against those of our work and institutions. As a result, sustainability scientists exist in a 'double reality' , in which they produce evidence supporting the need for transformative change but feel a lack of individual agency to act. In this paper, we aim to explore the uncomfortable space created by this double reality. We first propose that from a (critical) complexity worldview, the complex nature of sustainability challenges deems all research practice as a situated intervention, offering an opportunity for a more nuanced discussion about how sustainability scientists can take responsibility for their position in broader society. From this view, we unpack three sources of discomfort in the entanglements of knowledge and action: the resistance to confronting our own subjectivity in relation to others and our institutions; disorientation from getting lost in pluralism; and the fear of intentional engagement with power and politics. We then suggest that reclaiming the political and provocative roots of reflexivity can better equip researchers and their institutions to deal with the normative, plural, and political complexities that surface at the science-policy-society interfaces, thereby enabling a more critical and action-oriented approach to sustainability science.

Keywords Complexity · Knowledge-action · Reflexivity · Unlearning · Sustainability science · Transformations

Introduction

Despite decades of research and innovation evidencing the urgency of action, scientific efforts so far have not successfully informed or motivated a shift from the current trajectory of the climate crisis, habitat destruction and overexploitation (Gardner et al. 2021; Gardner and Bullock 2021; Thierry et al. 2023). Simultaneously, despite their transformative sustainability agendas on paper, universities have largely avoided positioning themselves as political actors in demanding societal change (Kohl et al. 2022). This apolitical stance may be motivated by fears of losing the perceived credibility of scientific institutions in a world of increasing misinformation, political polarisation and unpredictable shifts to funding and support for research (Bail et al. 2018; Rutledge 2020; Goldman et al. 2020; Levin et al. 2021). In this environment, there is increasing pressure to uphold the

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Published online: 10 July 2025

idea that credible scientific institutions must maintain objective distance from the "real world" by developing independent and value-neutral science (Lacey 1999; Ambrosj et al. 2024). Still, the growing urgency of the socio-ecological crises has increasingly required researchers and academic institutions to produce knowledge about and consider engaging with transformative changes to the systems in which they live and work (Thierry et al. 2023). Some sustainability-engaged scholars have stated that there is enough knowledge about the needed transformative actions, but not enough wisdom to act them in the world (Fazey et al. 2020). Scientific awareness is often decoupled from concrete actions (Dupont et al. 2024).

Amid this changing landscape, researchers are increasingly motivated to participate in and demand action, including by participating in advocacy or activism (e.g., Gardner et al. 2021), engaging in civil disobedience in various ways (e.g., Capstick et al. 2022), participating in media debates, or demanding change directly from their own institutions (Morin 2018; Gardner et al. 2021; Finnerty et al. 2024). Researchers may be even more motivated to do so under threats to academic freedom and the survival of their own research institutions amid political upheavals, financial pressures, media manipulation and anti-intellectualism (Hayes 2021; Motta 2017; Marwick and Lewis 2017). However, despite these shifting pressures, the expectation from academic institutions and other researchers that sustainability scientists will stay neutral and apolitical persists. As of recently, these expectations are no longer implicit: advocacy and activism have been met with controversy in academia, and scholars combining academia with activism can face threats and abuse as well as pressure from their disciplines and peers (Flood et al. 2013). For example, researchers have been, or are in risk of being, fired or losing funding over civic engagement, activism or public support for a political view that counters that of their institutions (e.g., Cornwall 2023; Grossman 2024; Udesky 2024), illustrating the risks for individuals who aim at more radical and political actions for societal change.

This tension between the push to maintain scientific neutrality and the personal desire to act in the face of the socio-ecological crises locks many sustainability scientists in a paradoxical state. Thierry et al. (2023) describe this state as a *double reality*, a cognitive-practice gap, or "*a state of simultaneous knowing and not knowing*" (p. 3), wherein researchers may produce evidence about and even call for transformative changes in their research yet stay detached from action in their institutions and everyday lives. While this tension at the interface of knowledge and action may be new for many sustainability scientists with a background in natural sciences (Clark and Harley 2020), many social sciences and humanities scholars have a long history of viewing knowledge as commensurate with power and have been at the forefront of advocacy, particularly on behalf of marginalised groups, facing similar repercussions (e.g., Flood et al. 2013; Helly 2002). Despite the explicitly normative starting point of sustainability science to work towards and enact transformative changes, the complexity of the question of the entanglements of knowledge and action is evident. Recently, an increasing number of early-career sustainability scientists have demanded for different institutional environments to enable truly transformative research (e.g., Wassénius et al. 2023; Sellberg et al. 2021). These researchers acknowledge the many structural challenges that limit our ability to pursue transformative and reflexive research without adequate institutional resources or support, which places both ethical and practical responsibilities on each individual to do so (Lazurko et al. 2025; Sellberg et al. 2021). Thus, the *double reality* in sustainability science presents an important and persistent challenge that is recognised and has been faced by others yet remains underexplored in our field: a dissonance between the personal, value-oriented motivation of many researchers engaging with the socio-ecological crises and the diverse actions they may each choose to pursue according to those motivations, and the expectations, perceptions, and pressures from their institutions and broader society.

In recent decades, sustainability science has attempted to bridge knowledge and action through the establishment of more integrative and action-oriented scientific paradigms like knowledge co-production and transdisciplinarity (Lang et al. 2012; Fazey et al. 2018a, b; Caniglia et al. 2020), and more recently moving towards transformative transdisciplinary research that even more explicitly concerns co-creating value change and perceives knowledge as inseparable from action (Horcea Milcu et al. 2024; Augenstein et al. 2024). These paradigms represent a shift from a conventional understanding of the relationships between science, policy and society (i.e., as a linear and objective transfer of knowledge with a clear distinction, or a gap, between knowledge and action) toward a more complex and value-laden understanding of knowledge and action as situated in complex 'webs' of relationships, interests, norms and socio-political contexts (van Kerkhoff and Lebel 2015; West et al. 2019; Wyborn et al. 2019). The research community leading the 'transformative turn' of sustainability science adopts this view to weave diverse interests and perspectives of academic and non-academic knowledge holders about options and pathways for deliberate systemic change (Tengö et al. 2017; Fazey et al. 2018a). Experiences within this research community show how challenging it can be to navigate the role of researcher in these more complex entanglements of knowledge production, as they surface the inherent political and ethical dimensions of individual research choices and the diverse and potentially conflicting epistemic, ontological, and ethical starting points for different knowledge holders (Lazurko et al. 2024). Such experiences also show that

it can be challenging to measure and attribute the intended positive impact of co-produced research (Lemos et al. 2018; Jagannathan et al. 2019) and how good intentions are not always enough: for example, a lack of engagement with the power and politics in co-produced research can inhibit the intended transformative change (Mach et al. 2019; Turnhout et al. 2020). Despite these critical advancements in sustainability science, there is evidence that the linear idea of science-policy interface often persists, in which science is perceived to produce objective knowledge input to policy processes, which is simply picked up and used by policymakers (Maas et al. 2022; Karhunmaa 2020).

We observe that this *double reality* can be a prominent source of discomfort for many sustainability scientists, which becomes more pronounced as the socio-ecological crises continue to accelerate. The roots of sustainability science (i.e., ecology and the natural sciences) implicitly value scientific independence and neutrality. As scientists pursuing research within that legacy, we may face moral dilemmas as we feel compelled to take a non-neutral stance within research and our personal lives. Further, for those of us drawing in a wider range of onto-epistemological views and co-producing situated, action-oriented research, the double reality shows how the ambiguous nature of knowledge we experience in work translates to our own lives, generating the feeling that we are getting lost in the ethical and political implications of our choices. Additionally, here we highlight the emerging recognition of the role of emotions in transformation processes (e.g., Brosch and Sauter 2023), which requires consideration of a researcher's perspective that is shaped by our multiple and shifting approaches to our scientific work. In this space, the diverse possibilities for individual actions that may contribute to broader transformation in our personal and professional lives are stalled by the sense that each action must be perfect and reconcile all perspectives and agendas. In this way, we are limited from finding the freedom to leverage our agency to enable and influence these spaces for positive change. Across the board, what we share is the *uncomfortable space* experienced at the intersection of knowledge and action, where we are confronted (albeit in different ways) with our roles within wider society.

We write as two western sustainability scholars who study knowledge processes within sustainability science and science-society-policy interfaces. We were trained in different disciplines: one of us having a background in social sciences before gaining degrees in sustainability science and the other moving from engineering to interdisciplinary environmental research toward transdisciplinary sustainability science. A common theme in our work has been the consideration of reflexivity in sustainability science, which we have both aimed to develop conceptually and empirically. Our approach to this paper - and reflexive research practice more broadly - is an ongoing experiment in embodying a meta-level reflexive attitude to research. In our experience, that is nurtured by both the individual practice of reflecting on how our personal beliefs, positionality, and motivations shape our research questions and methods as well as engaging collaborators and students in collective practices of group dialogue, guided reflections (e.g., in workshops), and facilitated learning tools in which we attempt to mediate the power dynamics between different disciplines and perspectives. Through these practices, we are able to give voice to and make actionable the discomfort of understanding the urgency for action and the limitations of our own work to catalyse sustainability transformations, particularly in ways that align with our values.

As sustainability scientists, we take the view that we cannot shy away from this discomfort and ignore our participation in processes that shape policy and society, as these are at the heart of the action-oriented nature of sustainability science. Further, we suspect that this discomfort will not dissipate without dialogue, as it is intrinsically motivated by our sense of care towards humans and nature and is perpetuated through our growing anxiety as the slow pace of response to socio-ecological crises persists. We also posit that this shared discomfort among scientists affirms that there is an unresolved discussion within our field, which often pits different approaches to sustainability science or generations of scholars against one another. *How do we engage with our research in more nuanced or transformative ways? What deeply engrained ideas do we need to unlearn to engage in wider society? What is the role of our institutions in supporting us in this journey?*

In this paper, we aim to explore the uncomfortable space created by the *double reality* in which many sustainability scientists live and work, particularly amid growing urgency for real-world sustainability transformations. Through this exploration, we hope to establish a shared language for sustainability scientists that helps us understand the sources of our discomfort at the intersection of knowledge and action, and to find a path through them to take responsibility and accountability for our position. To do so, we first adopt a complexity worldview as an inclusive and useful stance from which to discuss the uncomfortable space, which characterises *all* research as a form of intervention due to the complex and ambiguous nature of sustainability challenges ("Framing all research as intervention: The inevitability of and responsibility for action"). We then use this worldview and our personal experiences as transdisciplinary sustainability scientists as a basis for a more nuanced discussion about the sources of the uncomfortable space: the resistance to confronting our own subjectivity in relation to others and our institutions; disorientation from getting lost in pluralism and the fear of intentional engagement with power and politics ("Understanding the uncomfortable space"). This paper began as a reflexive dialogue for us as researchers

grappling with personal tensions at the intersection of knowledge and action. Over time, our ideas coalesced into themes we thought may stimulate the wider sustainability science community. Thus, through iterative processes of dialogue and writing, we attempted to give shape to the sources of discomfort for sustainability scientists during times of crises. This perspective piece presents our shared view, supported by sustainability science and other critical literature, as an offering to spark dialogue about the topic. To this end, we conclude with a call for individuals and institutions to engage in more political forms of reflexivity to embrace the uncomfortable through unlearning, collapse the *double reality,* and enable a more critical and action-oriented approach to sustainability science ("Navigating normativity, pluralism, and politics by reclaiming reflexivity").

Framing all research as intervention: the inevitability of and responsibility for action

Consideration of the role of sustainability scientists at the interface of knowledge and action began with the emergence of sustainability science and was heightened by the introduction of transdisciplinarity and knowledge co-production into sustainability-related research. These paradigms inherently challenge the traditional science-society divide (i.e., that situates researchers as independent and neutral observers) through more action-oriented and integrative science (Lang et al. 2012; Fazey et al. 2018b; Caniglia et al. 2020). This also demands researchers take on new roles beyond that of an expert such as facilitation and boundary management (Hilger et al. 2021; Kruijf et al. 2022). The 'transformative turn' of sustainability science introduced a more critical, justice-oriented perspective to the discussion, offering a more explicitly interventionist view on the role of researchers in the transformations they seek to study (Stirling 2014; Marshall et al. 2018; Blythe et al. 2018). For example, researchers may become "transformative spacemakers" who not only integrate perspectives through knowledge co-production but actively decenter dominant perspectives to surface the often-marginalized perspectives that hold promise for and have a stake in transformation (Pereira et al. 2018). Sustainability science community often differentiates between descriptive-analytical and process-oriented, transformative research, or 'first-order' and 'second-order' research (Popa et al. 2015; Fazey et al. 2018c). The descriptive-analytical researcher seeks to improve knowledge about transformation by analysing problems and proposing solutions, identifying themselves as an independent observer of transformations processes, whereas the transformative researcher aims to improve change from a more interventionist perspective, identifying themselves as embedded in the transformative processes they seek to understand (Lang et al. 2017). These standpoints are not fixed: this dichotomy often manifests as a more fluid and evolving spectrum for each individual researcher in practice as researchers' positionalities and approaches change depending on the questions explored, requiring both methodological and epistemic agility (Haider et al. 2018).

While we identify more closely with the latter view (i.e., of the more interventionist second-order transformations researcher), we recognize the important role of these multiple perspectives, and that situating our discussion of the uncomfortable space within one of these two positions does not satisfy the need to bridge the divides within sustainability science (Lang and Wiek 2021). All of us, no matter our research orientation, can experience the uncomfortable space together (and often when confronted with one another, at different moments and in different contexts), and our identities within these categories are as much a product of our background than a conscious choice. Further, between and beyond these two categories lies multiple spectra of researcher identities informed by different theoretical and methodological orientations as well institutional contexts (Hakkarainen et al. 2023), which are themselves entangled with our experiences as individual people striving for a better world. Thus, we turn away from these binary distinctions and toward a more inclusive meeting point of the *complexity worldview* (Preiser et al. 2021). Complexity has been discussed from various perspectives (Bateson 1979; Rosen 1991; Cilliers 1998), yet there is no unifying theory of complexity (Chu et al. 2003). This is reflected in diverse applications of the complexity worldview to inform sustainability science. For example, the social-ecological systems (SES) perspective characterizes human-natural systems as complex adaptive systems, which highlights characteristics like dynamic relations and complex causality (Levin et al. 2013; Preiser et al. 2018). In contrast, science and technology studies (STS) characterizes change as emergent from complex and *plural* interactions, which highlights the onto-epistemological and performative aspects of complexity (Leach et al. 2010; Stirling 2014).

Despite these differences, this shared complexity worldview offers an entry point for a more nuanced discussion about entanglements of knowledge and action, because it reveals how *all research is intervention*. Critical complexity scholars highlight how "we cannot know complex things completely" (Cilliers 2002) because any claim about a system depends on choices that delineate the boundaries or limits of analysis, which include certain components or perspectives and exclude others (Matthews 2006; Lazurko et al. 2024). Such choices are familiar to a wide range of researchers, from determining the boundaries and assumptions embedded in quantitative models to selecting analytical frameworks for qualitative research. Thus, holistic

knowledge about sustainability challenges is not only impossible due to the subjectivity in these choices: any claims to generate comprehensive or independent knowledge is political and contradictory to the complexity worldview (Sarewitz 2010). In this way, all research becomes intervention, because subjective choices made by researchers delineate and characterise a problem or system in ways that reinforce particular frames of complex sustainability challenges while marginalizing others, and in turn influence action (Turnhout 2018; Turnhout et al. 2020).

In sum, a complexity worldview collapses the divide between knowledge and action by rendering knowledge *as* action and *all research as intervention*. Here we move intentionally from considering knowledge as a noun to a verb, wherein knowledge itself is considered an emergent process (e.g., a process of making normative and empirical boundary judgments) rather than a static outcome or entity that is created and then exists in the world. Discussing our role as scientists from this perspective can help us understand, take responsibility for, and be accountable to our position within broader society.

Understanding the uncomfortable space

When accepting our research is an intervention, we start to recognise the sources of our discomfort. We propose that feelings of discomfort that emerge within the *double reality* may be the result of three overlapping aspects that are at the core of sustainability science: resistance to confronting our own subjectivity in relation to others and our institutions; disorientation from getting lost in pluralism and the fear of intentional engagement with power and politics.

Normativity and resistance to confronting our own subjectivity

Normativity relates to the idea that some intervention, belief, or way of being has been evaluated as preferred or justified. A complexity worldview reveals how normativity is a key element of sustainability science, not only because engaging with questions related to sustainability are motivated by sweeping value judgements (i.e., that the current trajectory is undesirable and societal transformations are required), but also because comprehensive or holistic knowledge about complexity is impossible, as any approximation of complexity includes certain components while excluding others (Midgley 2000; Cilliers 2002; Jackson 2019). Consequently, because any claims to produce holistic knowledge can be considered political (Sarewitz 2010), the subjective choices made by us, the researchers, have a crucial role in determining which elements, perspectives or values are meaningfully included and excluded from our research (Lazurko et al. 2024).

Discomfort often arises when we are confronted with such normativity and the subjectivity of our own perspectives, particularly for those of us with more dominant views that are rarely challenged. Such dominant views are, for example, (post) positivist thinking of the natural sciences or research approaches originating in more prestigious or powerful research institutions. These power dynamics are reflected to varying degrees in science-policy interfaces such as in Intergovernmental Panel on Ecosystem services and Biodiversity (IPBES), that have conventionally been dominated by natural sciences but in which a deeper level epistemological assessment can further reveal patterns and biases towards certain epistemic beliefs over others that are not necessarily discipline-specific (Hakkarainen et al. 2020). These unintended outcomes of international environmental knowledge assessment processes shape the ontological meanings (i.e., the nature of reality) and societal imaginaries (i.e., what change is possible) that get presented in decision-making (Borie et al. 2020).

These issues are often explicitly addressed in relation to working across knowledge systems in co-produced research, where the risk of co-option of often-marginalised knowledge systems (e.g., Indigenous or local) by more dominant (i.e., scientific) systems must be mitigated by a "level of discernment in the use of different ontological and epistemological perspectives, as opposed to defaulting to the loudest perspective" (McIntyre et al. 2023, p. 1963). However, a complexity worldview necessarily reveals how *all* researchers have unique perspectives that influence their research choices and outcomes which, in turn, influence action. The practice of acknowledging positionality is common in many areas of social science and gaining ground in sustainability science too. However, those of us whose perspective aligns most closely with that "loudest perspective" may experience this confrontation as particularly uncomfortable, as we may resist the idea that our research choices are subjective at all, or feel that 'opening up' our mindset may require unlearning deeply embedded epistemic beliefs (Smith 2012; Stein et al. 2020; Goodchild 2021; Chambers et al. 2022).

Disorientation from pluralism

Confronting our normativity is only the beginning of the challenge of navigating the uncomfortable space. There is growing recognition that embracing plural epistemologies, worldviews, and values is important for sustainability science and environmental decision-making to generate more enriched and inclusive understandings of sustainability challenges (Tengö et al. 2017; Pascual et al. 2023). Consequently, our research is situated within a landscape of diverse researchers and societal actors who move from

different understandings of reality and of what constitutes valid or legitimate knowledge.

As the need to embrace plural values and perspectives in research and decision-making has been more widely embraced (Caniglia et al. 2020; Pascual et al. 2021), we may experience more spaces where our individual research perspectives are integrated with many others, some of which we may not understand or agree with. This can be a humbling experience as the limited nature of our own perspectives amid the messiness of sustainability transformation becomes clearer: in other words, we begin to see that the possible means to transform complex systems are based on decision-making at various levels, and every decision made, and action taken is aligned to a particular set of interests or values and involves trade-offs with others (Blythe et al. 2018; Bennett et al. 2019). Further, because transformations in complex systems are emergent (i.e., cannot be predicted or controlled), the outcomes of actions meant to inform or influence the desired trajectory, including our own research, may generate emergent outcomes and unintended consequences, which are seldom documented when we assess research impact (Louder et al. 2021). This lack of an ability to accept and deal with pluralism within ourselves, others, and our institutions allows the uncomfortable space to persist, as we can feel alone and disoriented. In this space, we can struggle to engage in the world with an intention, as we risk becoming lost in the diversity of perspectives, options, and possible consequences of change.

Politics and the fear of intentional engagement with power

Observing and acting within these plural environments can be even more challenging as we begin to observe the associated power relations and the political nature of our work. For example, we begin to recognise that consensus may not always be possible or desirable as it often comes at the expense of the less powerful (Blythe et al. 2018). In this way, navigating and mobilising potential value changes through our research is laden with ethical and politically contested questions, which cannot be avoided (Scoones et al. 2020) and requires having space for discord and dissent in transformation processes (Patterson and Paterson 2024). We have observed that being attuned to these power relations in our own research can cause us to question our own agency and right to pursue change and feel uncertain as to which action is 'best', inhibiting our confidence to move forward with the aspired changes. We can also see that the academic institutions in which we work can be part of entrenched hegemonic neoliberal structures, which may only be motivated to change through advocacy and activism (Gardner et al. 2021; Racimo et al. 2022; Thierry et al. 2023), though these actions may feel (and be) risky amid a shifting political relationship between science and society and the resulting pressure to avoid taking a stance that differs from powerful institutions.

Sustainability science has been criticised for ignoring power and politics and undervaluing the contribution of critical social sciences for clarifying the role of power in persistent sustainability challenges (Stone-Jovicich 2015; Fisher et al. 2022; Deutsch et al. 2023). However, power and politics are not isolated to the research questions and theories we use to understand the world 'out there' and our own institutions, but also extend to our own research questions and methods. In other words, despite the lingering idea of separation of science and politics (van der Hel 2018), sustainability science is a situated intervention that is not only normative and plural, but it is also political (Blythe et al. 2018). For example, the choices of framing (e.g., of a research question or system) have a consequence on real-world action, such as framing nature as a resource or by focusing on technology-led transformations, which are then reproduced in environmental policy and decision-making (Scoones 2016; Biermann 2021; Pérez-Hämmerle et al. 2024). As Turnhout and Lahsen (2022) emphasise: not asking political questions of underlying values, interest and inclusion of voices in our work is itself an equally political choice.

Navigating normativity, pluralism, and politics by reclaiming reflexivity

In this paper, we suggested that a complexity worldview situates a researcher within the mess of complex sustainability challenges, offering all researchers the freedom and responsibility to decide how to take accountability for and act within this position. A question remains: how? We posit that feelings of discomfort persist as normative, plural, and political dimensions of research are not made explicit, and thus many researchers are not supported with the unique training, language, or skills to navigate them. We suggest that reclaiming the political and provocative roots of reflexivity is an important part of the answer and is required to embrace the uncomfortable, collapse the *double reality* and enable a more critical and action-oriented approach to sustainability science.

Reflexivity is not a panacea for "better" sustainability science

Reflexivity is often cited as a crucial capacity for sustainability scientists to navigate action-oriented and integrative research (Popa et al. 2015; Fazey et al. 2018c; Lazurko et al. 2025) and to deal with the complexity of science-policy-society interfaces (Borie et al. 2020; Mäkinen-Rostedt

et al. 2023). Nurturing reflexivity is meant to improve our capacity to navigate the complexities and pitfalls of sustainability science, including acknowledging positionality, dealing with normativity, and working more ethically with plural knowledges and values (Kläy et al. 2015; Moore et al. 2018; Lazurko et al. 2024, 2025). However, despite the promotion of the reflexive turn in the field (e.g., Marg and Theiler 2023) and emerging literature positioning reflexivity as a transformative capacity for sustainability science (Lazurko et al. 2025), mainstream interpretations of reflexivity often position it as a purely academic—and possibly superficial—exercise that lack a concrete connection to real-world action. Consequently, the political roots of reflexivity (i.e., to challenge dominant perspectives and emancipate the marginalised) are lost as these reflective exercises remain comfortably separate from the transformative changes we seek to understand. This misses an opportunity for reflexivity to help sustainability scientists navigate the *double reality* at the entanglements of knowledge and action.

Reflexivity has the potential to provoke us as researchers and our institutions in ways that help us navigate the uncomfortable, by allowing us the humility and openness to navigate normativity, pluralism, and politics in ways that further support the salience and legitimacy of our field. However, as we experiment with operationalising reflexivity in our research, we observe a risk that the transformative potential of reflexivity is diluted as it becomes depoliticised and further perpetuates *the double reality* felt in the space between knowledge and action. For example, Mäkinen-Rostedt et al. (2023) show how, despite multiple reflexive processes and learning outcomes in the IPBES Values Assessment, the academic experts across diverse epistemic worldviews did not reflexively consider their own agency and power to enact transformative change directly. We align with the discussion put forward by Lynch (2000, p. 42) who warned researchers of the emptiness of reflexivity as a privileged academic exercise: "*…there in no particular advantage to 'being' reflexive, or 'doing' reflexive analysis, unless something provocative, interesting or revealing comes out of it*".

The consequences of possible depoliticisation and co-option of reflexivity are significant, as it risks reproducing the assumption of the universality of particular types of knowledges (e.g., western science) and worldviews (e.g., Eurocentric) instead of revealing patterns of power asymmetries between different ways of knowing and marginalised voices, and researchers' responsibility towards the collective (Wijsman and Feagan 2019; Gould et al. 2023). Thus, instead of using reflexivity as an individualist or project-based exercise, namely to improve knowledge production, we call for a more expansive understanding of reflexivity that embraces the uncomfortable (i.e., normativity, pluralism, and politics). In this way, we can start to address the ethical and political consequences of our research on real-world transformative change.

Reclaiming the political and provocative roots of reflexivity

Reclaiming reflexivity involves three important aspects: (1) unlearning deeply held assumptions that contribute to the uncomfortable space between knowledge and action, (2) positioning and politicising our role as researchers within the crises and transformations we seek to understand/catalyse, and (3) allowing ourselves the freedom to *choose* how we want to position ourselves and act. By reclaiming reflexivity, we mean integrating reflexivity back in the real world to target the systemic changes that inhibit more radical sustainability transformations.

A starting point is to unlearn deeply held assumptions about the uncomfortable space between knowledge and action that we may have learned from our cultural backgrounds or through academic training. We follow Chokr's (2009, p. 6) perspective on unlearning as "'*emancipating' or 'liberating' oneself from variously entrenched and often unquestioned ways of thinking, doing and living by radically questioning, criticizing and rejecting the assumptions and premises of much of what one has learned as part of the 'dominant and established system(s) of knowledge*'". This form of unlearning requires us to contemplate and embrace diversity and difference and navigate the context of our work as always situated and dependent on political and context-dependent social practices (Young 1990). Here we can be inspired by and learn from Indigenous scholars who have a long history of challenging the superiority of particular epistemologies (e.g., western science) through decolonising methods and methodologies (Smith 2012; Goven et al. 2015; Jimmy et al. 2019) that actively decenter conventions of western science to generate, validate, and use knowledge from within an Indigenous worldviews and values. To this end, embracing the uncomfortable and navigating the complexities of pluralism requires taking the time to engage in the process of learning how to collaborate with respect. As Freeth and Caniglia (2020) suggest, a "manageable amount of discomfort" is essential for challenging one's assumptions within sustainability science. To support this process, more open-ended methodologies are being tested and developed. One such approach is the use of listening as a methodology to address the politics of knowledge and work with multiple ways of knowing (Branny et al. 2024; Moreno-Cely et al. 2021).

In the efforts of reclaiming reflexivity, it is important to draw on existing ways of thinking about the entanglement of knowledge and action. New materialist feminist thinkers have pushed researchers to engage with their responsibility (or *response-ability*) for and consequences of their research

on humans and other species beyond individual reflexivity (e.g., Barad 2007, 2014, 2008; de la Bellacasa 2017; Haraway 1988; Harding 1993), providing a philosophical entry to reclaiming reflexivity in ways that challenge our research outcomes and the institutional contexts we work in through relational ontology. These scholars have shown the limits of reflexivity as a practice that can produce only the same way of thinking and acting. They have also shown over decades of research and activism how courage is required to maintain a situated, values-oriented stance despite the pressures to align with more powerful and dominant perspectives, particularly in a shifting environment characterised by political pressures, anti-intellectualism and media manipulation. In this way, response-ability implies that resistance can take the form of being attentive, curious, polite, and open to others, based on the idea that we are shaped through our relationships, and because the other is part of us, we hold many possible ways to respond in a world that is always changing (Bozalek and Zembylas 2023).

An alternative concept, diffraction, "*break[ing] apart in different directions*", (Barad 2007, p. 168), is figuratively used to counter more hierarchical forms of knowledge accumulation (i.e., ideas and practices pitted against one another) by instead encouraging a more emergent engagement with multiplicity and recognising partiality of each individual view. This diffractive way of thinking encourages *active* engagement with plural values and knowledges as well as diverse ontologies and beings in the world, or as de la Bellacasa (2017, p. 72) describes "*multiple has to be done*". For Haraway (2000), diffraction as a critical consciousness provides an avenue for methodological sensitivity and situated epistemic practices. However, experimenting with what a diffractive methodology means for sustainability science and how to operationalize it in practice remains underexplored. We suggest that through unlearning and opening our horizons and actively situating ourselves in the world and its becoming, we can enter a more 'ethical space' between perspectives for more integrative sustainability science (Goodchild 2021) and start to unpack and change the assumptions and beliefs that prevent us from acknowledging our ethical responsibility and seeing new pathways to action.

In this way, whilst the complexity worldview speaks language of dominant post-positivist perspectives in sustainability science (e.g., of complex social-ecological interactions and feedbacks, and knowledge as explaining 'reality'), it also echoes the thinking of feminist scholars that firmly *situate* a researcher and knowledge production within the mess of the problems we are studying (e.g., Barad 2007; Haraway 1988). Hence, questions of knowledge production and our being in the world cannot be separated but are constantly reconfigured in relation to one other, highlighting the subjectivity of epistemic practices and our responsibility for the ethical and political outcomes of our knowledge production (Haraway 2008). While we do not claim these different domains of critical research are philosophically and ethically aligned, we refer to them because they affirm the view of knowledge as entangled with action and research as intervention, even from their different philosophical entry points.

Together with unlearning processes, we need to start to position and (constructively) politicise our role as researchers within the sustainability challenges and transformations we seek to understand. If we accept research as intervention (knowledge as action), then reflexivity must also be inherently political, as we need to understand the ethical and political consequences and implications of our individual subjectivity and collective agency. Politicising refers to entering the sphere of the "political" that is contested and involves a plurality of views and values (Mouffe 2005). Diverse political realities affect knowledge (co-)production processes and strategies (Kaljonen et al. 2023). Hence, the baseline for reflexivity should be intentionally attuned to these contexts. In other words, 'politicising' requires us to acknowledge and to an extent embrace the normative/value/ethical judgments underlying our research choices and their implications in the world. However, few doctoral training programs or academic institutions to date support the development of reflexivity, particularly beyond the social sciences (Nagatsu and Thorén 2021). Until these institutions change, many sustainability scientists must develop the skills and capacities to recognise their own subjectivity and situate it from a position of power on their own (Sellberg et al. 2021; Lazurko et al. 2025). In this way, the change starts through individual researchers incorporating critical, and sometimes difficult, discussions of power and positionality into their teaching, supervision and mentoring activities. This requires surrendering to the vulnerability of acknowledging our limited positions and situated views independent of our academic merits or years.

Once we understand our role as researchers as political actors within complex sustainability challenges, we can then embrace the freedom and responsibility to *choose* how we want to act in the 'real world'. Some researchers may use this freedom to embed more critical and reflexive practices into research, helping to emancipate marginalised perspectives that are needed to move toward a more enriched and inclusive understanding of our shared future. These researchers can become more aware of and actively harvest their and others' agency as researchers at the interface of science, policy, and society. Others will choose to support radical transformations in society that are evidenced in or research, such as by getting involved with activism and advocacy or asking for more ambitious action from our own institutions (Dupont et al. 2024). In these cases or any other modes of action researchers choose—we hope this process of active choice allows researchers to feel empowered to engage with the inevitable politics of the 'real world' while staying

critical. We also recognise that enacting our full agency in these contested spaces requires courage, particularly amid external pressures to maintain the status quo or support particular agendas, and is best realised with support from our institutions, fellows and supervisors. Hence, we call for the field of sustainability science to move beyond the artificial divides of descriptive and transformative domains (Lang et al. 2017; Lang and Wiek 2021) to a greater commitment to considering the possibilities and responsibility of each of us to enact the change we are advocating for. Doing so requires radical and systemic social changes, which can only happen if we are willing to question the institutions that are locking us to the current unsustainable trajectory (Temper et al. 2018).

We ask sustainability scientists to embrace their responsibility and agency to leverage societal change through their mandate as a researcher (Racimo et al. 2022) and universities to accept and thoughtfully navigate their necessarily situated and political role as actors at the messy intersection of science and society (Kohl et al. 2022; Thierry et al. 2023). However, amid today's turbulent political landscapes, we are left with further questions: *How does this context reshape the kinds of transformations we can realistically expect from institutions and individuals and the courage required to pursue them? Or does it, instead, make such transformations all the more urgent?* We hope that our contribution in this article offers a provocation for researchers across domains of sustainability science to better understand and empathise with one another in navigating the uncomfortable space together and allow our field to better contribute to transformations to sustainability.

Funding Open Access funding enabled and organized by Projekt DEAL.

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