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RESEARCH ARTICLE

Epistemic outsiders: Unpacking and utilising the epistemic dimension of disruptive agency in sustainability transformations

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Abstract

Disruptions (systemic disturbances) are crucial to initiate and accelerate sustainability transformations of large-scale social systems (be they socio-ecological, socio-technical, or socio-institutional). Their emergence, characteristics and effects strongly relate to the role of agents who aim to disrupt and transform the status quo, and which thus possess what we call disruptive agency. In this paper, we highlight the epistemic dimension of disruptive agency in social transformations, first by conceptualizing disruptive agents as epistemic outsiders with respect to the social system that they intend to disrupt and transform, and second by connecting this conceptualization to notions of belief, social practices, social networks, discourses, or institutions. We identify five advantages of this approach. Firstly, it informs and conceptually enables various promising interdisciplinary avenues to explore and potentially influence transformative change towards sustainability. Secondly, an epistemic conception of disruptive agency offers a key for an integrated analysis of the individual and collective levels of agency involved in sustainability transformations. Thirdly, the notion of epistemic outsiders conceptually connects agent positions across system boundaries that are understood to be of crucial importance for sustainability transformations respectively (e.g., "niche innovators" or "regime intermediaries") but which lack an integrated understanding. Fourthly, an epistemic perspective additionally highlights the changing requirements and challenges resulting in two principal stages of transformations unfolding over time, namely before/after a new epistemic layout is shared by a majority of agents. Finally, the above features allow to derive and conceive of new intervention formats and strategies.

Author summary

What can *I* do to change society for the better? How can *I* contribute to a more sustainable world? It often seems like there is only so much that individual humans can do to change

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entire societies. The question of how human agency relates to ample social transformations lies at the heart of our paper. Our hope is that, by looking at the epistemic dimension of agency in societal transformations, we can learn more about how sustainability transformations can be developed and supported, both at an individual level and at a collective level. By 'epistemic' we mean the way people think about themselves and about the norms, rules, and standards that they are ready to follow. Our contention is that every agent-driven societal transformation is enabled by people who have a diverging set of beliefs from the system that they try to dislocate. They are *epistemic outsiders* to that system, as we call them. By looking closer at epistemic outsiders and at the epistemic dimension of social change, we hope to better understand how agents can drive sustainability transformations. Thus, we note that one of the tacit aims of epistemic outsiders aiming at sustainability transformations is to change the minds of the people composing the status quo–the epistemic layout of the reference system, as we call it. We aim to better understand how this can happen by combining our epistemic reading of societal transformations with existing research on the topics of belief change, networks, discourses, institutions, and social practices. This allows us to cut across different levels (from individuals to collectives) at which transformative processes occur and connect different strands of research that otherwise are approached separately.

1 Introduction

In an urgent call for sustainability transformations, societies across the globe face the challenge of shaping path-deviant and rapid systemic change. Ecological boundaries and tipping points force us to acknowledge that planetary justice and well-being require accelerating deep transformations in our current energy, transportation, housing, food, or health systems [1,2]. Correspondingly, we also witness the emergence of more and more examples of individuals and collectives actively striving to disrupt and change the way our societies operate. This can be schoolchildren skipping classes and demanding climate action (e.g., Fridays for Future movement [3,4]), scientists pushing for new modes of knowledge co-production [5], or activists blocking busy highways (e.g., the Last Generation movement [6]). While these are highly visible forms of human agency aimed at sustainability transformations, they are however neither the only ones nor necessarily the most effective and efficient.

Transformative change occurs through an intricate interplay of external pressures and opportunities, structural shifts and disruptions, as well as emerging novelties–all of which facilitated by particular forms of agency. Understanding how human agents contribute to such complex transformation dynamics has thus formed an important focus of a large and diverse body of literature. This has provided conceptual and empirical insights regarding the distinctive role of various types of "change agents" and their agency in system transformations [7,8,9,10,11]. On the one hand, high importance has been attributed to actors outside the mainstream that create innovation niches in which alternative system configurations of limited scale and scope are trialled. In such contexts, the protagonists follow values, goals, rules and practices that differ substantially from those of the prevailing regime [12,13,14,15]. On the other hand, also agency exercised by certain incumbent actors within the mainstream has been recognized to be crucial if providing, e.g., opportunity spaces for niche actors or direct support, as well as contributing to regime destabilization. Similarly, such *action outside the rules* of the established regime is seen to be essentially motivated by not sharing the prevailing worldviews [16,17]. In all of these cases, change agents are therefore seemingly acting from a position of an "outsider" to the system they would like to see transformed.

Against this backdrop, the goal of our paper is to offer an integrated perspective on *disruptive agency* in transformations that can provide new insights into their particular dynamics, but also suggest novel intervention strategies aimed at steering transformations towards sustainability. In order to bridge between various actor typologies that have been developed to understand and illustrate the relevance of particular agency forms for sustainability transformations [7,18,19,20], which are usually analysed and interpreted separately, we propose the concept of "epistemic outsiders" as an overarching ontological category that characterizes *all forms* of disruptive agency directed towards transformations. By so doing, we aim to enable more agile analytical approaches and interventions that connect between the role of individuals and collectives, thereby also addressing relations across agency levels, system boundaries and transformation phases, and the problem of scaling innovations [21,22].

In what follows, we will first lay down the ontology assumed throughout the paper (section 2). We will then present our perspective on the *epistemic* dimension of transformation and disruptive agency (section 3). Finally, we will discuss ways in which this epistemic reading can enrich understandings of and intervention strategies for sustainability transformations by invoking four prevalent schools of thought in related scientific debates (social practice theory, network theory, discourse theory, and institutional theory) as well as the psychology of mental constructs (section 4).

2 Ontological assumptions

In this section we set out the ontological assumptions we adopt regarding the nature of *social systems*, the *transformation* of social systems, and *disruptive agency* as a basic condition for social system transformations. We also reflect on the fundamental importance of *normativity* in such processes. These conceptual prerequisites will allow us to subsequently identify and elaborate on the role of the epistemic dimension in transformation dynamics.

2.1 Social systems

For understanding social systems, we refer to Anthony Giddens' structuration theory ([23]; see also [24] with a view to transformations). According to Giddens, a social system is a patterned spatiotemporal set of interrelationships existing between agents (individuals, groups, or organizations) acting in institutional, technical, and ecological contexts. Their interrelationships are governed by rules, norms and standards that constitute the *structural properties* of the social system. The structures inform *individual and collective agency*, stipulating, e.g., how to relate to each other and to the environment, what technology to use and how, or what social behaviours to accept and in which circumstances, etc.

Following Giddens, structures imply a *duality* in the sense that while structural properties do enable and constrain agency, they simultaneously also depend on their continuous reproduction through agents. For a social system to maintain a particular configuration most agents must therefore follow the rules, norms, and standards specific to that system. In turn, this entails that when the share of deviating agents rises above a critical threshold, social systems can start to destabilize and potentially become reconfigured or even transformed entirely. Deviant thinking and acting of individuals or collectives thus needs to be understood as a fundamental precondition for any deeper change in social systems.

2.2 Transformations and disruptions

While incremental changes happen all the time in all social systems, *transformations* refer to nonlinear change processes that fundamentally alter the structures and practices that characterize a given system [25,26]. This particular type of systemic change dynamic depends on

numerous coevolving factors (social, economic, ecological, cultural, institutional, technological, etc.) that together create *disruptions* of the system. According to a well-known definition from the socio-technical system literature [27, p.119], disruption is "[. . .] a high-intensity effect in the structure of the sociotechnical system(s), demonstrated as long-term change in more than one dimension or element, unlocking the stability and operation of: incumbent technology and infrastructure, markets and business models, regulations and policy, actors, networks and ownership structures, and/or practices, behaviour and cultural models". To this understanding we need to add two important twists: Firstly, we acknowledge that disruptions do not *always* lead to a change in the structural properties of the system, even if they interfere with them. A system may just as well return to its baseline configuration after the disruption ends (depending on its resilience). Secondly, we add an *epistemic* dimension by recognizing that the interferences with the structural properties of the system cannot be generated by the disrupted system itself. Therefore, we consider an event (or a chain of events) *E* a disruption of the reference system *R* if and only if (i) *E* is a high-intensity *interference* with the structural properties of *R* and (ii) E is *unanticipated and unplanned* by *R*. Disruptions thus represent major windows of opportunity for leveraging transformations, but they require epistemic positions from "outside" of the system, i.e., not derived from its rules, norms and standards—an important point that we will expand on in subsection 3.3.

With a view to the temporality of change we have to note that transformations imply acceleration and unfold rapidly compared to the established pathway. Social systems are dynamically stable, i.e., changes happen continuously either as a result of adaptation or simply because incremental shifts are stipulated by the rules of the system. Even structural properties can be changed over a very long period of time through incremental steps without this constituting a transformation: Those changes have been anticipated and planned, but not elicited by a disruption. Consequently, in order to deal with the grand challenges of the Anthropocene, disruptions can offer an important lens to explore options for purposively accelerating and scaling up transformations.

2.3 Disruptive agency

We assume a basic conception of agency as "the ability to act with intention–as opposed to just reacting" [19, p.279]; cf. [28,29,30,31]. As noted above, we assume that social structures are continuously recreated by individual and collective action, while the intentions behind individual action are in turn influenced by social structures. Therefore, it is always uncertain how independent and deviant the agency of actors within a social system can be, given how much they are influenced by path dependencies, socialization, social pressures etc.

With a view to transformations, this demands to specify and distinguish forms of agency that are explicitly driven by the *motive* to transform the reference social system, i.e., to create purposive disruptions. Admittedly, one may also imagine agents who aim to disrupt *without* pursuing any aspirations in terms of transformation, but although such cases could exist and also contribute to transformation dynamics, they lack plausibility and provide little justification for further theorising. Therefore, we define *disruptive agency* as the ability to act with the intention of disrupting a social system *in order to transform it*. Arguably, actors pursuing transformation strive to produce destabilization and deeper change in the system instead of tacitly following its rules as the majority of conformists does. Correspondingly, the literature on sustainability transformations has identified diverse types of actors who exercise such disruptive agency, labelled, e.g., "forerunners", "niche innovators", "institutional entrepreneurs" or "knowledge brokers", and who significantly influence the transformation dynamics observed [19,32,10]. While differing in their respective role, these actors share an underlying motive of

system transformation informed by epistemic and normative orientations and their intertwining. Hence, before expanding on the epistemic dimension in section 3, we need to also account for normativity in disruptive agency and social system transformations.

2.4 Normativity

Transformations of social systems can happen in any direction. Hence, the pursuit of transformations by design apparently raises fundamental ethical questions that require societal deliberation. Also, a normative concept like "sustainability" that may seem to be supported by a broad (inter-) societal consensus in fact remains (and must remain) subject to contestation regarding its particular normative postulates when it comes to the grand challenges of the Anthropocene [33,34,35]. Nevertheless, the processes and dynamics we aim to unpack here in principle apply to any transformations of socio-technical, socio-ecological and/or socio-institutional systems, independent from the value propositions they embrace. In this, we do acknowledge that actors' compliance with or deviance from established rule systems for the sake of transformations (i.e., disruptive agency—not delinquents escaping the rule of law) is also driven by particular *normative* orientations. Therefore, we subsequently address the crucial role of normativity in two ways: First, we situate values and normative claims in the context of broader belief sets that underpin the structuration of social systems (section 3). Second, in the light of the grand challenges we adopt the normative stance of sustainability asking for new insights and strategies for intervention that our approach can offer (e.g., regarding the need to overcome the reluctance of incumbents to change, the need for building networks of change, etc.) to help accelerate deep and path-deviant change (section 4).

3 The epistemic dimension of transformations and disruptive agency

As outlined above, we are interested in human agents who aim to disrupt and transform an unsustainable social system. Having recognised the important role such agents play in sustainability transformations, our aim is to further illuminate how their agency, responsibility and ethical concerns can be instrumental in fostering disruptions. In this paper, we do not aspire to present an exhaustive framework to capture how transformations occur, or of all the mechanisms through which agents contribute to transformations. More modestly, we want to highlight the existence of an *epistemic dimension* in this which is largely overlooked or only implicit in the common approaches used to study sustainability transformations. Acknowledging for and analysing this dimension, however, can benefit new understandings of sustainability transformations, as well as different forms of intervention (see section 4). There are three claims that circumscribe our epistemic reading of transformations and disruptive agency:

a. The transformation of a social system involves a modification of the *epistemic layout* of that system.

b. The agents who attempt to disrupt and transform a social system are *epistemic outsiders* to that social system. In turn, agents reproducing and stabilizing the system can be considered epistemic insiders.

c. Drawing on their perspective as epistemic outsiders, *disruptive agents* aiming for social system transformation always strive to alter the epistemic layout of that system.

In what follows we explore each of these points. We will first introduce the concept of an epistemic layout of a social system (section 3.1), which will then help us define epistemic outsiders more sharply (section 3.2). We can then show that various types of disruptive agents can

be conceptualized as epistemic outsiders (section 3.3). This will allow us to revisit the basic mechanisms of social system transformations, this time having an epistemic reading in mind (section 3.4).

3.1 Epistemic layouts of social systems

So far, we assumed a fairly traditional ontology of social systems that contains two categories (in the same vein as structuration theory; [23]): (i) agents and their agency and (ii) the structural properties of social systems. In what follows, we want to highlight a third ontological category, which contributes to the structuration of social systems and thus helps explain how a social system is created and perpetuated: (iii) the *epistemic layout* of a social system.

Consider any socio-technical system such as the energy or transport system as an example. Call this system *X*. The current configuration of *X* is shaped by a set of beliefs about the values, the aims, the hierarchy, the expectations, etc.–in other words, the rules, the norms, and the standards (or "grammar"; [36, p.340])–that underlie the working of the system. *X* functions the way it does because, presumably, its stakeholders accept these beliefs (expressed, e.g., in regulations, policies, markets, contracts, signs) and have confidence that other agents composing the system also accept these beliefs and act based on them. On the one hand, these are *structural beliefs* about the rules, norms, values, and standards of the system. On the other hand, these are also *relational beliefs* regarding the behaviour of others (i.e., if I don't do this, another agent will react in that way, etc.).

All these beliefs together constitute the epistemic layout of *X*. Were the agents composing the system holding alternative beliefs, the social system would be very differently configured. How we interact with each other is based on our beliefs about rules of interaction and on our beliefs about what others believe about those rules of interaction. In this sense, our social systems are "republics of beliefs" [37]–a notion also inspired by game-theoretical considerations about social conventions and law-abiding behaviour [38,39].

Of course, people don't simply decide *ex nihilo* about an epistemic layout they want to support. People are born and socialized in particular social systems (be it a family, a community, a religion, a nation or capitalism), such that their structural and relational beliefs regarding that system are passed on to them in the process of socialization. This reflects the relation between social structure and agency: The epistemic layout of a social system is part of the deep structuration process of that system (see Giddens [23]). This enables a social system to perpetuate itself. That being said, it is also possible for people to *change* their beliefs based on new experiences or evidence. If sufficiently many people do so, the epistemic layout of the system changes as well, making it possible for the system to become transformed. This leads us to further explore the possibility of particular agents *deviating* from a given epistemic layout.

3.2 Epistemic outsiders

In this paper we introduce the conception of *epistemic outsiders* understood as those agents who disagree with some or all of the rules, norms and standards constituting the epistemic layout of a social system. In other words, epistemic outsiders "fail" to hold the structural beliefs corresponding to the reference system. Formally, we define an epistemic outsider in the following way:

> Supposing that $N = \{p, q, r \ldots\}$ is the set of all structural propositions corresponding to the reference system *R* (describing the rules, norms and standards of *R*), an agent *A* is an epistemic outsider to the system *R* if *A* disagrees with at least one of the propositions from the set *N*.

A few observations are in place. Firstly, for *A* to disagree with one of the propositions from *N*, say *p*, is for *A* to have doubts about *p* or to believe that not-*p*. This applies both to when *A* is merely an individual or when *A* is a group, as groups can presumably also hold beliefs [40]. It goes without saying that *A* can be an epistemic outsider to *R* while at the same time being an insider to another reference system, say *S*. Agents normally belong to several social systems simultaneously (*A* might be part of a family, of a company, of a political party, etc.).

Secondly, epistemic outsiders can be differentiated by degrees, depending on how many normative propositions underlying *R* the agent disagrees with and how essential they are. Supposing that *A1* disagrees merely with *p*, while *A2* disagrees with all the propositions from set *N*, *A2* is more of an epistemic outsider to *R* than *A1*. Also, if *p* represents a core value the degree of being an epistemic outsider is higher than if it refers to a behavioural rule, for instance.

Thirdly, focusing on the concept of epistemic outsiders allows to draw parallels between agents occupying very different positions regarding the reference system. In particular, those who play an active role within the system, engaging in its institutions and practices and reproducing them, and those who are not part of this process but relate to it from the system's environments. We therefore suggest acknowledging for *endogenous* and *exogenous outsiders*. Both are agents who disagree with at least some of the key tenets of the reference system, but whose distinct position regarding the system implies different options for taking action in order to address tensions between the epistemic layout and their own deviant belief sets. For instance, in the sustainability transformations literature endogenous outsiders are sometimes framed as "forerunning" incumbent actors or certain types of intermediaries ([10,16], see also section 3.3). Looking back at the socio-technical system example from above, an exogenous outsider to *X* can be environmental NGOs or civic initiatives who criticise the current energy/transport system without having any concrete influence on its development.

Finally, we are of course aware that the term 'outsider' as such has also been used and defined in many different ways. One could speak about institutional outsiders as those individuals who do not formally belong to a reference institution. Or about marginalized outsiders as those who are discriminated against or refused access to resources and privileges. Nevertheless, we are focusing here on defining what it means to be an outsider s*trictly from an epistemic point of view*, acknowledging that these different understandings often overlap and constitute one another.

3.3 Disruptive agents as epistemic outsiders

Considering the notions introduced above it seems plausible to assume that all agents usually associated with disruptions and transformative action are also *epistemic outsiders* to the social system they intend to transform. There are two arguments we employ in order to substantiate this claim: (i) conceptually, based on the definitions of disruption, disruptive agency and epistemic outsiders presented above; (ii) interpretatively, drawing on sustainability transformations literature and its findings regarding disruptive agents.

The first argument recognises that, for an agent or a cluster of agents to non-arbitrarily (that is, on purpose, and not by accident) attempt to disrupt a social system *R*, it must be the case that these disrupting agents are epistemic outsiders to *R*. This can be reconstructed as follows:

Premise 1. Agent-driven disruptions to a reference system *R* are planned by the agents who initiate them.

Premise 2. In principle, such agents could be either epistemic insiders to *R* or epistemic outsiders to *R*.

Premise 3. However, agent-driven disruptions cannot be planned by epistemic insiders to *R*.

Therefore, agent-driven disruptions to a system *R* are planned by epistemic outsiders to *R*. As defined above, disruptions are unanticipated and unplanned interferences with the structural properties of *R*. This means that planning such interference cannot be part of the shared set of beliefs of the epistemic insiders of *R*.

The second argument is based on a scoping review of the literature on sustainability transformations, which suggests many different conceptions of transformative agents and their agency. Despite the fact that these different types of change agents are not informed by the concept of epistemic outsiders as we present it here, such an understanding is somewhat inherent to them. A prominent example forms the concept of niche, as proposed in the Multi-Level Perspective (MLP) [12,13,36], or the Strategic Niche Management (SNM) framework [36,41]. Niches are conceived as "protected spaces" that are kept free from the institutional constraints and path dependencies of the dominant socio-technical regime. They allow agents to develop their own rationalities, institutional structures and technologies with the goal and the potential to change or disrupt the "paradigmatic core" [42, p.1] of the status quo specific to a given sector. In these frameworks the agency required for change has essentially been located inside niches and in their interactions with the regime. Furthermore, the niche concept has also been broadened to capture social innovation contexts in which civil society agents (such as civic initiatives, activist groups, non-governmental organizations) try to initiate transformative change from below [14,43,44]. In this sense, niche actors can well be interpreted as epistemic outsiders to the systems they strive to transform.

Also various conceptions of entrepreneurship have become quite influential in this literature. For instance, "institutional entrepreneurs" try to transform institutions through identifying opportunities, mobilising stakeholders, and leveraging resources [45,46]. "Social entrepreneurs" focus on business undertakings with the goal of creating social and ecological value and innovations instead of mere economic profit in a strict sense [47,48]. Following this strand, more specific concepts such as "sustainable entrepreneurship" [49,50] or "ecopreneurship" [51,52] were developed. In the context of the MLP, Antadze & McGowan [53] propose to call agents who aim at disrupting the existing system through "questioning normative rules at the landscape level that support the regime in question" [53, p.2] "moral entrepreneurs". All of these entrepreneurial agents try to initiate and facilitate change on the basis of their own perspectives and practices which deviate from the norm. This characterises them as epistemic outsiders trying to shape a more desirable mainstream according to their views. Yet, the entrepreneurial metaphor focuses more on the specific activities agents do or the skills they require, less on their deviating belief systems or their general relation to the prevalent reference system (as an epistemic perspective would do).

Similarly, the crucial role of intermediaries in transformation processes, acting at the various interfaces of reference systems and niches, has received increasing attention [54]. They are facilitators, networkers, mediators or brokers who establish links and translate between stakeholders, thus playing an interesting role regarding the epistemic insider/outsider dichotomy. While incumbent actors are usually depicted as inhibiting institutional change and thereby slowing down transformative processes [55,56,57], certain individual incumbents may also act as regime intermediaries who effectively foster emerging transformations by influencing niche-regime interactions. Niche intermediaries in turn support niche formation and amplification, connecting between niche agents but also towards the regime [58,59]. Intermediaries thus share an epistemic outsider position but can form part of both the reference system (endogenous) or niches (exogenous) in some way, which appears to be crucial for creating disruptions.

It appears that all of the specific agent types so far identified as necessary driving forces behind system transformations can be understood as epistemic outsiders, questioning or rejecting the essential structural propositions of a given social system. From our perspective, it is this rejection that genuinely enables the disruptive momentum these agents can bring forward. Although not framed in such terms, this is widely recognised in the pertinent literature on the subject. The epistemic reading introduced above thus enables conceptual connections between diverse research strands and a more integrated approach for analysis and interpretation–a perspective expanded on in section 4.

3.4 Changing roles of disruptive agents

Finally, we want to highlight some overarching implications regarding the role(s) of disruptive agents in social system transformations. As noted in section 3.1, such transformations necessarily involve the alteration of the epistemic layout underpinning that system. This requires that sufficiently many agents composing that system abandon their current belief set and adopt an alternative one within a shorter period of time (acceleration).

This is precisely where an understanding of disruptive agents as epistemic outsiders matters. Regardless of their diversity, disruptive agents are characterised by a *shared intention* to transform a reference system because they hold alternative beliefs, including specific normative orientations such as sustainability. Their actions thus implicitly or explicitly pursue the take-up, diffusion and institutionalisation of an alternative belief set in accordance with that normativity, e.g., by creating new imaginaries and narratives, confronting and/or coordinating with other individual or collective actors (both from inside and from outside the system), or enabling joint learnings in experimental settings. In other words, disruptive agents intervene and strive to change social systems in such a way that their epistemic position moves *from outsider to insider* while maintaining their own belief sets.

Therefore, we can distinguish two basic stages in the process of a social system transformation that imply rather different roles and (epistemic) strategies for disruptive agents: (i) The *outsider stage*, when disruptive agents attempt to destabilize the reference system; (ii) The *insider stage*, when disruptive agents act upon successful disruptions and attempt to secure the prevalence of their own belief sets, thus transforming the epistemic layout of the system. Each stage suggests different strategies, tactics and approaches, operating at individual and collective levels–and pointing towards available insights and research frameworks from a variety of scientific disciplines.

4 Epistemic outsiders and sustainability transformations: Interdisciplinary avenues for future research and action

While in section 3 we have referred to social system transformations in general, we will now discuss how an epistemic reading can potentially benefit the understanding and also shaping of transformations with a particular normative orientation, namely towards *sustainability*. Apparently, we make this choice with a view to the urgency of the grand challenges that demand purposive socio-ecological transformations. To this end we will first briefly outline the utility of an epistemic perspective for interdisciplinary analyses that cut across system boundaries, connect individual and collective agency and account for critical stages in such transformations (section 4.1). In the following five sections we will then sketch how the concept of epistemic outsiders can open up promising future research avenues for tackling the complex dynamics of sustainability transformations by providing a fundamental *boundary object*—not only between the specific research strands working on this topic so far (cf. section 3.3) but additionally inviting theoretical approaches to social change that resonate with

sustainability transformation research respectively, but are usually applied separately: psychology of mental constructs (section 4.2), practice theory (section 4.3), network theory (section 4.4), discourse theory (section 4.5), and institutional theory (section 4.6). Focusing on the emergence, roles and impacts of epistemic outsiders across these complementary epistemologies of social change can thus build an interdisciplinary bridge to integrate methods, data and insights. Additionally, each section also sketches resulting options for novel intervention forms and strategies, even if space for a more in-depth elaboration is obviously limited here.

4.1 Mapping disruptive agency across system boundaries, levels, and time

A basic advantage of an epistemic perspective resides in its ability to equally address change processes at individual, inter-personal and collective levels, including at various scales (e.g., household, organization, sector, society). As noted in section 3, the transformation of a social system involves the modification of the epistemic layout of that system, which is shared and reproduced by all individual and collective agents. Correspondingly, disruptive agents may develop actions tailored towards triggering a re-assessment of and change in individual and/or collective belief sets, thus ranging, e.g., from personal conversations, discussion groups or public happenings to media campaigns, large-scale demonstrators or policy pilots. For each of these levels (and partly also their relations), however, there are frameworks and concepts available that can help to explain the particular dynamics of stability/change at play (e.g., in individual behaviour, everyday practices, social networks, discursive or institutional settings), as well as corresponding success factors regarding a normative orientation at sustainability. Tracing the re-/configuration of an epistemic layout across these levels thus sheds light on the dis-/alignment between very different change dynamics responsible for often neglected conflicts and synergies in system transformations. Additionally, the changing role of disruptive agents in the course of a transformation process must be taken into account, focusing especially on the critical transition between the two stages identified above (outsider and insider stage). For instance, moving from awareness-raising activism to co-developing regulation proposals does not happen automatically, but relies on social change processes occurring at different levels.

Therefore, we conceive of sustainability transformation dynamics in epistemic terms by mapping out disruptive agency across system boundaries (endogenous/exogenous), levels (individual to society) and time (Fig 1). In this, the range of theoretical perspectives

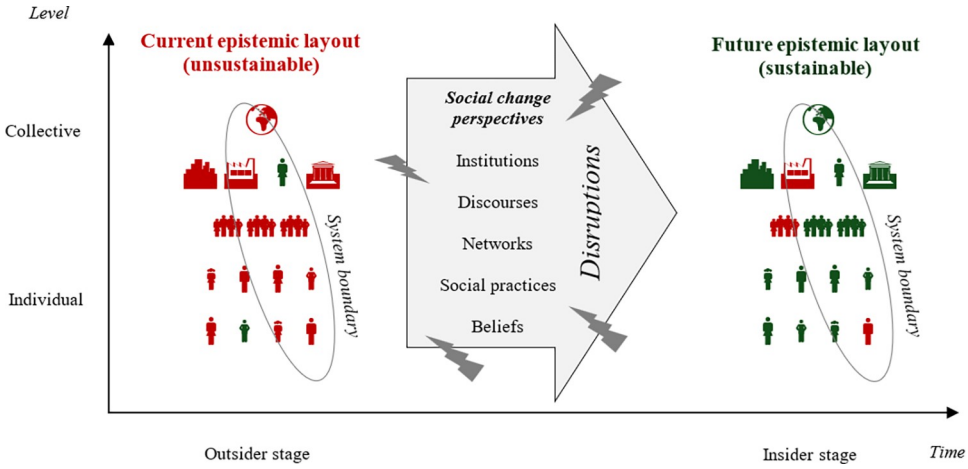

Fig 1. The epistemic dimension of sustainability transformations: Mapping disruptive agency across system boundaries, levels and time.

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represented here remains only indicative and may well be further expanded, even if it does in fact reflect current debates in sustainability transformations research. As a side note we acknowledge that the processes summarized in Fig 1 also apply to cases in which the disruptive agents do not *themselves* initiate the disruptions but harness external disruptions (e.g. pandemics, earthquakes, etc.). In such cases one may equally identify the different positions, levels and stages at which attempts to modify the epistemic layout are made so as to bring about sustainability transformations.

4.2 Beliefs

The psychology of belief change provides important insights and explanations regarding at least two key aspects of transformations and disruptive agency: (i) the reluctance of incumbents to change [60,61]; and (ii) the importance of sense making and bridge building [62,63,64,65]. Especially combining Kelly's [66] theory of personal constructs with a complex systems view on belief structures [67] can be very instructive here.

The notion of personal constructs proposes that every person builds a unique representation of the world by extracting regularities, striving to anticipate events and actively exploring their environment to make sense of their experiences. Characteristically, this works through making distinctions between so-called *elements* (mental representations of real-world objects or people) based on idiosyncratic dimensions, so-called *constructs*, which result in a personal map of the world [66]. These elements and constructs can be added and modified according to the experiences of an individual. Apart from its cognitive component, every element is also assumed to have an emotional component, according to the theory of emotional coherence [68,69]. In general, individuals strive to keep thematically self-contained parts of the construct system coherent to avoid suffering from cognitive or emotional dissonance [70,68,69]. Cognitive and emotional coherence in a system of constructs could be conceptualized as holding as few contradictory beliefs as possible at a certain moment, with less contradictory beliefs indicating higher coherence. This leads the system to stabilize in a state of the best satisfaction of all constraints provided by the different constructs (see [68,69,71] for a view of parallel constraint satisfaction networks).

These theoretical considerations straightforwardly suggest how to examine and interpret the two aspects mentioned above. i) Looking at the need for cognitive and emotional coherence is crucial for understanding *reluctance to change*. Avoiding cognitive and emotional dissonance can hinder an individual to integrate new beliefs (belonging to an alien, outsider position) into their belief system, even if those would be a more accurate representation of the world. The fact that "[i]ncumbent regime actors initially tend to downplay the need for transformation" [72, p.244], or even oppose it altogether [73,74] is partly explained by their reluctance to change their own structural beliefs. Doing so is mentally costly, while the epistemic layout of an existing social system offers both comfort and stability. ii) Disrupting structural beliefs by only doubting or deconstructing them is not enough as beliefs are embedded in a cognitive-emotional network striving for coherence. Presenting *alternative views and narratives* is important to fill the "gap" in the belief system. This explains why the creation of "new social imaginaries" [75, p.1], and the generation of a diversity of new ideas, alternative viewpoints and novel solutions is so crucial. In other words, the outsider perspective needs to be made palpable as a narrative that offers high positive returns and will soon become an insider one. It is also important to note that an overlap in beliefs can facilitate communication between individuals to allow for belief change [67]. Such overlaps can therefore be an entry point or mutual understanding that serves as the foundation of communication. This gives certain agents (endogenous outsiders) an important role in changing beliefs [16,17], as they already share some beliefs with insiders.

Furthermore, the psychology of belief change can also help to operationalize the concept of epistemic outsiders at the individual *and* the social level. On the individual level, internal dynamics striving for cognitive and emotional coherence drive action and communication. On a social level, the forming of group beliefs can be described as a loose coupling of the agents' individual networks of beliefs. This yields collectively coordinated (but individually implemented) belief networks and can cause individual beliefs to partly align with the groups view through shared constructs and valences [67]. It equally offers methods for observing belief systems and their dynamics, not only in Kelly's [66] *repertory grid method*, but also in tools like *cognitive-affective maps* [76].

Having these concepts in mind also allows to think about new ideas for intervention. To overcome the mental cost of belief change, incumbents of unsustainable social systems must be persuaded of the benefits of changing their structural beliefs towards more sustainable ones. This refers not only to *rational* persuasion in order to maintain cognitive coherence, but also to ways of providing *emotional* coherence, given the perceived threats of potential transformations [67]. For instance, socio-spatial intervention formats such as cooperatives or innovation districts that provide for novel social or human-nature experiences and can therefore create emotional responses are plausible options here that address this need. As we will see, other perspectives on social change (like social practices, networks, discourses and institutions) are also instrumental in identifying relevant mechanisms to provide the comfort and stability needed for emotional and cognitive coherence.

4.3 Social practices

Practice theory acknowledges how reality is continuously performed through multiple routinized actions people undertake in their daily lives [77,78,79]. It accounts for an important cornerstone of sustainability transformation processes that has become addressed increasingly in the literature, i.e., it was not recognized from the outset [80,81]. Notably, it also incorporates an epistemic dimension and therefore adds a complementary focus to an analysis of disruptive agency regarding the role of epistemic outsiders in both discontinuing unsustainable social practices and adopting novel and sustainable ones.

Practice theory expands from the premise that social practices are the building blocks of society, and are deeply embedded in cultural, institutional and physical contexts. Shove et al.'s [78] well-known conceptualization of practices as routinized behaviours emerging from interdependent relations between meanings, materials and competences underlines their distinctive role in the formation, perpetuation but also alteration of an epistemic layout. Especially meanings largely correspond to the concept of belief sets as they refer to ideas or symbols reflecting social and cultural norms. But also competences, i.e., the knowledge and skills enabling particular practices share an epistemic dimension.

Routinized actions provide comfort and stability and therefore also cognitive and emotional coherence. However, changing them turns out to form a specific challenge regarding the implicit entanglement of meanings and competences with material settings, objects and tools, which strengthens their obduracy and resistance to change. All practice components are also closely linked to social networks, discourses and institutions since they can contribute significantly to enable or constrain their performance and proliferation.

In order to escape an unjust or unsustainable status quo of a social system, the transformation of practices thus forms another crucial lever. Epistemic outsiders are individuals who can potentially trigger such processes as they develop different meanings and competences compared to those shared in the practice performance of insiders and may also link these meanings/competences to existing materialities and their re-interpretation and re-use, or the design

of entirely new ones. Given their reliance on the prevailing epistemic layout, this task is unlikely to be realized by insiders who will rather prioritize change in the material dimension instead, thereby supporting the widely observed bias towards technological fixes [82].

Therefore, practice-oriented intervention approaches that attend to the epistemic dimension of disruptive agency would seek to dis-/connect between the practice components involved in order to foreground and modify especially the underpinning belief sets. This may entail actions designed to question or disrupt established routines, creating space for a reinterpretation of existing material realities (as in "pop-up" lanes or parks). But this needs to go hand-in-hand with the creation of novel physical-material settings or tools that enable the performance of sustainable practices, linked to corresponding meanings and competences. In this, the epistemic reading allows to also consider the direct influence of related social change dynamics involving social networks and discourses.

4.4 Social networks

The driving role of social networks in sustainability transformations has been pointed out frequently in the literature [83,84,85]. Recent advancements have been made both conceptually [86,87,88] and empirically [89,90,91] that deepen the understanding of their particular role and relevance. Here we want to connect these contributions to the perspective on belief change outlined above to show how the structure of social networks can inform the analysis of an epistemic layout of collectives and social systems as well as efforts to change it towards a more sustainable configuration.

Since humans strive for cognitive and emotional coherence (cf. section 4.2), changing a person's core belief set while maintaining cognitive and especially emotional coherent appears to be a challenging task. In this regard, social networks can prove extremely important. According to insights from the network modelling of social contagion [92,93] the *network structure* plays a crucial role for the quality and success of spreading beliefs, knowledge, behaviours or even practices. The underlying mechanism requires distinguishing between *weak ties* (loose relationships between people such as acquaintances) and *strong ties* (strong relationships between people such as close friends or family) in a network [94]. While weak ties are characterized by great *reach*, strong ties are characterized by *redundancy*. These features–reach or redundancy–are extremely relevant for what type of contagion these networks facilitate best. Weak-tie networks facilitate simple contagions. These are spreading processes that do not encounter resistance (like infection during the Covid-19 pandemic). Strong-tie networks, on the other hand, facilitate complex contagions. A complex contagion is a spreading process that needs to overcome substantial resistance (like the adoption of a new social behaviour).

Considering these different configurations of social networks, the spreading of *structural beliefs* apparently requires *strong-tie* networks. Redundancy and social approval of values, norms, rules, etc. from an agents' strong ties is key for them to accept the appropriateness of those beliefs. Since strong ties exist especially with people one depends on the most, changing one's own structural beliefs is greatly facilitated if new beliefs, e.g., about how to live sustainably are socially approved by these people. This can be expected to most effectively support the persistence of a high level of emotional coherence. Indeed, numerous studies have shown that the influence of redundant strong ties is much more effective in spreading behaviour-determining beliefs than merely weak ties [93,95].

Consequently, from the perspective of disruptive agents striving for sustainability transformations, a suitable strategy for changing belief sets and epistemic layouts would thus be to focus attention and resources not on broad awareness-raising and a wide distribution of information (e.g., by influencers), but on rather tightly knit social networks. Research has also

shown that practices are directly transmitted through social networks [96]. Moreover, changing belief sets in a well-connected trans-/local community or neighbourhood can provoke snowball effects that lead to systemic changes (see, e.g., [97,98,99] for the role of strong ties in the adoption of rooftop photovoltaic technologies).

4.5 Discourses

The study of discourses forms another prominent strand of social change research that is of crucial importance for an epistemic perspective on transformations. Discourses are understood as sets of ideas, concepts, arguments or narratives that are continuously produced and reproduced by agents and through which meaning is given to reality [100]. Obviously, they incorporate beliefs about the values, norms, rules and standards that structure (inter)actions in this social system. Therefore, analysing discourses is very relevant for understanding (i) how the epistemic layout of the *status quo* is perpetuated in practice, (ii) how disruptions occur in processes of belief change, and (iii) how moving to a novel epistemic layout may work out. We will address these topics in turn:

First, the epistemic layout of a social system is to a large extent *produced and reproduced discursively* by the insiders of this social system. For instance, regulations as well as practices and routines are framed and argued for on the basis of the belief sets of the agents who form the system. Thereby discourses continuously shape agents' behaviour in practice but also inform their expectations of what is generally believed in or perceived as normal, as well as how other agents should behave. Taking up Basu's [37] notion of 'republics of beliefs' again, discourses thus form a linguistic and semiotic backbone for their constitution and stability.

Second, in the literature on sustainability transformations the possible impacts of certain 'outsider' agents on a given discourse have been prominently highlighted by Pesch [18]. While using a different notion of outsiders (more as agents outside design and decision-making procedures), he describes their unique discursive agency as their capability to bring new views in, stipulating "out-of-the-box patterns of thinking, thereby creating space for discursive change" (p. 386). In our term this means that they may be able to disrupt discourses perpetuating the status quo by questioning the established framework and bringing in new views. Similarly, also other scholars in this field have explored conceptually and empirically how particular agents are sometimes able to interfere in discourses and modify them [53,101]. In our reading, this refers to epistemic outsiders because they are not bound by the epistemic layout of the reference social system and can therefore view things differently and articulate their perspectives correspondingly.

Third, the importance of shifting discourses for sustainability transformations has already been shown for various empirical contexts such as, e.g., energy and water transitions [102,103,104,105], financial services [106] or urban mobility planning [107]. These studies illustrate how discourses are highly instrumental for the process of providing cognitive and emotional coherence, connecting rational choices and evidence-based orientations with narratives and imaginaries. In the process of transformative change, they can help to reframe the position of epistemic outsiders, placing them at the core of a desirable future system configuration. A transformation is thus complete when alternative discourses supporting a new epistemic layout have become mainstream (i.e., "hegemonic" in discourse theoretical terms).

From the perspective of disruptive agents pursuing sustainability transformations, discursive approaches are therefore highly instructive [75], e.g., for conceiving of frames, tropes and concepts, as well as communication and media strategies. Here, an epistemic perspective adds a crucial success criterion in that such discursive interventions need to consistently focus on the underlying belief sets and their coherence, striving, e.g., to exhibit and critique the

unsustainability of the current system (as in "extinction rebellion") while simultaneously presenting liveable and attractive alternative futures (as in "nature-based solutions").

4.6 Institutions

Institutional analysis is concerned with the influence of social rule structures on processes of societal change and stagnation [108,109]. Studies of sustainability transformations have therefore often recurred to an institutional perspective, analyzing the juridical, administrative, territorial and political fabrics of certain systems to illuminate how these affect system change dynamics, including the role of agency [110,111,112]. The focus often lies on institutional logics which presuppose and purport certain beliefs and behaviours [113,114,74]. In this regard, institutional approaches help to identify Gidden's "duality of structure" in societal realities.

For our perspective here, institutions represent perhaps the most change-resistant sedimentation of belief sets into social structures, compared to practices, networks and discourses. Their establishment requires large amounts of resources and societal coordination. The belief sets institutions incorporate also shape those of the agents acting within them, simultaneously enabling certain actions (in conformity) and constraining others (in deviation). Some authors in sustainability transformation studies also point towards the specific sets of beliefs required to follow and comply with institutions [115,116,42]. Due to this, it is very difficult for most agents to even consider a change in their beliefs or social practices since they are bound by the rewards and sanctions imposed by institutions, as has been shown extensively with a view to institutional lock-ins, i.e., complete stagnation [117,118,119].

With a view to sustainability transformations, it appears that disruptive agency may thus have to rely on two known mechanisms of institutional change: i) Instances of agency typically emerge in the context of *institutional tensions* since these offer opportunities for agents to intervene, thereby inducing change [42,112]. ii) Certain influential key agents who act as endogenous outsiders can use their resources to drive institutional change from within [120,121]. Hence, a belief change of these few agents can have a disproportionate effect on system disruptions. The literature around *institutional entrepreneurship* addresses such issues on a strategic level [122,123,57], but so far largely neglects their epistemic dimension.

A disruptive agency perspective would thus entail to focus on the availability and targeted take up of sustainable belief sets in such (rare) instances of institutional change, considering the role and contribution of epistemic outsiders (including e.g. as advisers, intermediaries or via social networks). It would equally ask for and pursue the (disruptive) appropriation or conception of institutions to embrace and support deviating beliefs while in turn constraining the pursuit of established ones. With a view to the insider stage of transformations, such processes of transformative institutionalization have been discussed extensively in the literature [124,87,125], although without recognising their fundamental epistemic dimension. However, as Haslanger has pointed out, institutional changes most often *follow* the changes that occur in the "cultural technē" [126], referring to what we characterised as an epistemic layout.

5 Conclusion

In this paper, we have proposed an epistemic reading of disruptive agency in social system transformations. It suggests that alterations in the belief sets that structure social systems require a particular type of agents that hold deviant beliefs, at least in part affirming values, rules, norms or practices that *differ* from the epistemic layout of the system. These *epistemic outsiders* play a fundamental role in enabling but also initiating disruptions, which form a prerequisite for systemic change. By concentrating on this role, we have then unpacked what it implies for research on and interventions for *sustainability* transformations, identifying

notions of epistemic outsiderness across a selected range of highly pertinent theoretical approaches to social change dynamics. We justified our normative focus on sustainability and purposive disruption with a view to urgently required socio-ecological transformations while recognising the general applicability of the conceptual approach.

In result, it appears that the notion of epistemic outsiders holds considerable potential both as a genuine conceptual framework enabling new understandings and interpretations of social system change, and as a boundary object for productively integrating existing approaches. More specifically, we recognise the following five advantages of this perspective:

First of all, it generally informs and conceptually enables various promising *interdisciplinary avenues* to explore and potentially influence transformative change towards sustainability. An epistemic reading connects not only between strands within sustainability transformation studies dealing with different forms and conceptions of disruptive agency already. Most importantly, it also points to essential contributions from psychology regarding the understanding of processes of belief change, and in turn relates these to key theoretical approaches to social change (social practices, networks, discourses, institutions). Tracing epistemic outsiders in sustainability transformations across these complementary perspectives thus enables to devise novel interdisciplinary lenses that can further illuminate the complex dynamics of whole system change.

Second and more specifically, an epistemic conception of disruptive agency offers a key for an integrated analysis of the *individual and collective levels* of agency involved in sustainability transformations. From personal mental constructs to social networks or complex multi-level governance settings it allows to scrutinize social change dynamics more seamlessly and across scales by "zooming in/out", recognising the role and relevance of specific epistemic relations between individuals and society at large.

Third and similarly, the notion of epistemic outsiders conceptually connects agent positions *across system boundaries* that are understood to be of crucial importance for sustainability transformations respectively (e.g., "niche innovators" or "regime intermediaries") but lack an integrated understanding. Conceiving of endogenous and exogenous outsiders focuses on their common epistemic grounds rather than on obvious distinctions, suggesting a potentially important role of their mutual awareness, direct interactions and coordinated actions. In particular, this also applies with a view to *multi-system transformations*, i.e., the boundaries or interrelations between *different* social systems (e.g., energy, mobility, housing)–a crucial aspect considering the inter-sectoral character of sustainability challenges.

Fourth, an epistemic perspective additionally highlights the changing requirements and challenges resulting in two principal *stages of transformations* unfolding over time, namely before/after a new epistemic layout is shared by a majority of agents. This adds to a deeper understanding of the different perspectives, needs and strategies of epistemic outsiders and insiders in the course of a transformation, as well as a focus on the critical momentum and movements when roles become inverted (regarding existing phase models, e.g., pre-development, take-off, acceleration, stabilisation [127]).

Last but not least, the above features allow to derive and conceive of new *intervention formats and strategies* as discussed in section 4, tailored to their respective epistemic contributions. It thereby acknowledges a fundamental condition for successful transformations and suggests ways of addressing it in sustainability oriented policy and practice. In particular, thinking of disruptive agency in epistemic terms may be helpful to explore the conflicts and synergies of novel policy mixes (e.g., linking behavioural, organisational and institutional change in the public, private and civic domains) for effective sustainability transformations.

Some caveat seems in place though. We are of course aware that an epistemic perspective can and should not replace other valuable and necessary approaches for analysing and

navigating sustainability transformations, notably those including conceptions of *power and capital*. Rather, it provides a complementary conceptual canvas that enables novel cross-overs towards and between such approaches, considering for instance that each body of literature on social change invoked here already includes strands that explicitly account for both.

Future research approaches in this direction will require suitable research policy frameworks and funding instruments that enable the kind of broader inter- and also transdisciplinary (given the need for stakeholder participation) research on complex sustainability challenges sketched here. While disciplinary piecemeal studies can certainly contribute, this would likely not yield the added value targeted. Correspondingly, both conceptual and empirical studies should focus on gaining novel insights through the latitude of an epistemic approach (across boundaries, levels, stages) by priority.

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