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Article

Boundary speak in sustainability studies: Computational reading of a transversal field

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Abstract

This article discusses the role of language in the collaboration between science, policy, and society. Combining computational methods of corpus linguistics (manifold learning) with sociological field theories, we analyze approximately 30,000 articles that were published in the field of transdisciplinary sustainability studies. We show that the field oscillates between deliberative and technocratic vocabularies and can therefore be characterized as a transversal field. We conclude that researchers who collaborate in science–society interstices are thrown into a semantic pluralism that cannot be boiled down to a common language. For transdisciplinary research practice and corresponding science policies, this involves trade-offs between generating a homogenous language and a collaborative appeal; between creating a stable creole and a situated semantic plurality. A corresponding theoretical viewpoint and science policy approach should be based on a pluralist view on the science–society–policy interplay.

Key words: science–society–policy interplay; trading zone; computational methods; transdisciplinary sustainability studies; sociological field theory; deliberation and technocracy

Recent science and innovation policies commonly challenge the notion of the scientific ivory tower. This challenge comes with semantic and communicative intricacies. When scientific research is supposed to be democratized (Lövbrand et al. 2011), co-produced (Pohl et al., 2010), or even anticipatory, reflexive, inclusive, and responsive (Stilgoe et al. 2013), a broad collaboration between policy makers, researchers, and stakeholders is usually seen as good practice. In planning, facilitating, or practicing these collaborations, the experience of being misunderstood or misunderstanding is the daily bread and butter. Key terms in science and innovation policies—for instance, responsibility or transdisciplinarity—may be understood very differently depending on the participants of a research endeavor. In this article, we investigate whether language is becoming more plural and hybrid when 'emergent spaces' in science and innovation policy proliferate (Rip et al. 2012). In other words, we study if the ivory tower is being replaced by a tower of babel.

The proliferation of inter- and trans-disciplinary languages has far-reaching consequences for the relationship between policy making, the sciences, and democratic publics; organizations such as state agencies, universities, and industries are assigned multifaceted roles in facilitating scientific practice and inter- and trans-disciplinary exchange (Lezaun 2007; Bogner 2012). In consequence, they may struggle to define the values, procedures, or boundaries that distinguish desirable from undesirable forms of expertise and public involvement (Halffman, 2005). Researchers in turn, especially when oriented toward innovation policy in state institutions or private partners, are confronted with various logics of legitimacy (McLevey 2015) and immersed in a multi-referential struggle for credibility (Kinchy and Kleinman 2003). Recent literature even anticipates a hybridization of political values—for instance, when deliberative dialogues and conventional forms of policy advice are interlinked—thus calling into question the interrelationship of contradictory terminologies, and even the role of the sciences in democratic life and policy making (Levidow 1998; Felt and Fochler 2010; Voß and Amelung 2016). Thus, inter- and trans-disciplinary languages imply a high degree of semantic ambivalence and normative ambiguity. It is not easy to delineate overarching governance principles and normative tensions cannot be annihilated only by defining evaluative criteria. This ambiguity also relates directly to the wide-spread ambition that research is supposed to contribute to a sustainability transformation. In contrast, '[S]cience may be in oscillation or ambivalence rather than in revolution or transition' (Hackett 2005).

In this article, we investigate the lasting semantic ambivalence and normative ambiguity of the field of transdisciplinary sustainability studies with a computational analysis of 29,992 research articles. In this field, which sets out to tackle socioecological problems by means of involving non-academics in scientific research (Kates et al. 2001), the regulation of science–society interstices is a particularly pressing challenge: Should decision makers in science and policy insist on clear-cut definitions and a discursive homogenization in order to lay out a transformative orientation for future research? Should researchers, when studying or navigating a pluralistic research landscape, look at inter- and trans-disciplinary languages as a peripheral anomaly, or as the new normal? These questions also indicate that the analysis of interstices between research, policy, and society requires methodological caution. Too quickly, policies of stakeholder involvement and transdisciplinary procedures invoke a uniform view that implies that inter- and transdisciplinary collectives need to agree on a 'common language' (as discussed by Gertrude Hirsch Hadorn on the International Transdisciplinarity Conference 2017). On a different level, sociological field theorists claim that emerging fields of research and/or practice will eventually be dominated by 'a common understanding' (Fligstein and McAdam 2012; Ganzevoort and Van den Born, 2020). Especially when using the large datasets, it is tempting, but premature, to reiterate this interpretative closure. The sociological and practical perspective on transdisciplinary communication, which we propose, stands in stark contrast to a reductionist view that favors either semantic homogenization or dualistic differentiation as the most probable trajectories for (trans-)disciplinary languages. By combining computational methods with sociological field theory, we unravel the pluralist languages that are likely to emerge when academic researchers are opening up to diverse collaborations. Being practically involved in collaborations with citizen groups and policy makers (Herberg 2020; Molinengo and Stasiak 2020), we want to caution against the hope for a common language that defies the complexity of science–society interactions. Based on computational and field theoretical insights, we claim that transdisciplinary scholarship can be seen as a transversal field that coordinates and, by means of creating cross-cutting dialects, potentially establishes cross-field languages.

This argument entails a conceptual and methodological contribution. Conceptually, we follow Terry Shinn's characterization of transdisciplinary research as a 'transversal field'. That is, transdisciplinary researchers 'stand "in-between" orthodox professions and bodies, and are thereby interstitial' as Shinn has observed in reference to the popular notions of a Mode-2 Science and the Triple-Helix model (Shinn 2002). Methodologically, we want to show that the computational methods of corpus analysis can be used to analytically depict, construct, and reflect upon 'transversal fields'. The algorithm we created supports and visually expresses the sociological notion of social fields as a non-reductionist perspective, thus stressing the boundary-spanning character of transdisciplinary languages. Moreover, our findings suggest a practical challenge for practitioners in the realm of science and innovation policy and sustainability research, while stressing the necessity to deal with transdisciplinary pidgin in a pluralist and pragmatic way.

We follow an iterative storyline: First, we propose a perspective derived from science and technology studies (STS), the sociology of fields and computational humanities. Second, we present a close reading of transdisciplinary sustainability studies in order to derive our argument about its transversal structure while laying out the terms that, in our view, represent deliberative and technocratic tendencies. In a third step, we derive a computational approach that is suited to account for the relational and contingent boundaries of transversal fields. Fourth, we present a distant reading of transdisciplinary research based on the previous close reading. Based on computational analyses, we sketch a transversal field that stretches across deliberative and technocratic terms. Finally, we argue that transdisciplinary research may best rely on a pragmatic take on semantic pluralism.

1. Toward a relational and computational view on language in transversal fields

The purpose of our theoretical and empirical exploration is mainly methodological in nature. We want to establish analytical tools to pinpoint the spatiotemporal dynamic of inter- and trans-disciplinary research strands, while highlighting the ambiguous language they engender. In the following, we therefore present and integrate key learnings from STS using the sociology of fields and the computational study of intermediary languages. From the combined methodology, we propose a relational perspective on recent science and innovation policies that stresses the boundary-spanning character of inter- and trans-disciplinary research.

First, there is lasting ambiguity in defining the languages that facilitate transdisciplinary collaboration. This implies a fine line between pluralistic communication and semantic control. Collins et al. (2007), building on Galison's (1997) 'trading zone' concept, suggested that there are four pathways possible for collaborative vocabularies to navigate the need to define a common language on the one hand and the necessity to accept plural vocabularies on the other. First, a 'full-blown creole' represents a homogeneous inter-language (Collins et al. 2007); second, an enforced and heterogeneous inter-language, which can emerge through force and social exclusivity, as in the example of slavery; third, the overwhelming homogeneity of cultural hegemony leading to a subversive trading zone; and finally, interactional expertise and the boundary function of objects, leading to a 'fractionated trading zone'. These typologies show that the structuring of ambiguity is difficult to analyze. Qualitative interviews may reveal contrasting standpoints (Felt et al 2016), but the emergence of an inter- and trans-disciplinary language that is based on manifold research endeavors, for instance in innovation studies, is difficult to trace. Which methodological perspectives and tools can help to pinpoint the spatiotemporal dynamic of transdisciplinary languages? Which practical lessons can be drawn in cases where these dynamics manifest a lasting semantic ambiguity? Given the high complexity of transdisciplinary languages, how can researchers and policy makers distinguish between the more or less valuable pathways of transdisciplinary collaboration?

Second, recent advances in the sociology of fields have highlighted the boundary-spanning nature of many social fields, coining the notion of transversal fields (Shinn 2002; Herberg 2019; Witte and Schmitz 2019). This trend directly speaks to the practical question of defining transdisciplinary languages because the cited authors essentially argue against a reductionist view that assumes that social or scientific fields are necessarily dominated by a homogeneous discourse. Their shared vantage point is Pierre Bourdieu's sociology of fields, which essentially sees societies as the dynamic totality of inter-subjective struggles in and across social fields. To articulate a corresponding analysis, Bourdieu's field theory has proven its value in STS (Hess 2011). Social space, in his view, is structured by a multi-dimensional tension, by poles that rule each field and poles that are dominated (Bourdieu 1998). Each field has autonomous and heteronomous poles in which stability and change come

either from inside, outside, or both. Amidst this complex social space, groups of organizations and individuals can be located and exposed to appropriate stimuli and constraints, while struggling to communicate their role or to compete for scarce goods (Bourdieu 1998). The misguiding assumption, however—that one may deduce too quickly from the fields perspective—is a tendency toward interpretative closure (cf. Vandenberghe 1999; Martin 2014). A dominant language or resource would, in this view, rule the space between academia, policy, and society. This viewpoint would result in a uniform understanding of what is specific to heterogeneous collaboration; transdisciplinary efforts would, in tendency, be thought of as a precursor to a new discipline. The sociologists Fligstein and McAdam (2012), for instance, in their synthetic view of field theory and social movement studies, assume that a 'shared understanding' is a necessary condition to even recognize that one is confronted with or involved in a field. The most prominent critique against this orderly projection came from early Actor Network Theorists (cf. Hess 2011, 2013) assessing the monopoly of a particular set of classifications. The henceforth prototypical approach in STS: A field's vocabularies are not stabilized by their homogeneity, but rather by the mutual connectivity of heterogeneous compounds (Galison 1997; Kagan 2009). In this tradition, STS researchers have used field theories to show the robustness of ambiguous constellations in environmental policy and research, thus highlighting how unconventional collaborations are facilitated by vocabularies that cut across the otherwise differentiated landscape of science, policy, and society (Shinn 2002; Kinchy and Kleinman 2003; Hess 2014). In line with Terry Shinn, you can correspondingly speak of 'transversal fields' that entail a semantic challenge:

> Sociotechnical innovations and inter- and trans-disciplinary collaborations are often characterized by a 'lingua franca, which is transverse, allowing otherwise distinct and distant occupational specialties to communicate effectively, thereby somewhat reducing the otherwise rampant consequences of ultra-postmodern specialization and fragmentation' (Shinn 2005).

A transversal field, in this view, 'transcends the pale of integration and differentiation by implementing the[ir] complementarities' of various fields (Shinn 2005). In contrast, a cross-cutting intelligibility is created by funneling ideas and data 'from countless quarters' and 'across countless boundaries' (Shinn and Joerges 2002), thus providing for a language that is reflexive of, and responsive to, a pluralistic scientific landscape. In respect to the question of language and power, this means that defining a boundary-crossing language is not necessarily an attempt at either taking control or reducing disciplinary autonomy.

Third, given the above insights, the role of language in transversal fields needs further scrutiny because it is rather vague how the reflexivity and responsiveness of transdisciplinary research languages works. It is important to not confuse ambiguity with chaos: The introduced focus on transversal fields does not mean that these discourses, which mingle in the interstices between research and policy, are necessarily fluid and arbitrary. Kinchy and Kleinman argue that long-established discourses like value freedom or utility shape collaborations across environmental and political fields of action, and are reliable and 'powerful resources in debates over the appropriate boundaries of science' (Kinchy and Kleinman 2003). It follows that, with regard to language in collaborative research, hybrid vocabularies traverse academic fields of practice while nevertheless following certain patterns (Bourdieu 2002). As Bourdieu writes: 'It is in the intermediate positions of social space [...] that the indeterminacy and objective uncertainty of relations between practices and positions is at a maximum [...]' (Bourdieu 1998). Intermediary languages in this view are the discursive basis for boundary-spanning practices. In summing up these three aspects, we argue that the current proliferation of inter- and trans-disciplinary research requires a relational methodology that is able to conceptualize and map such transversal fields. This also is a cautionary note against introducing a homogeneous closure by means of sociological analysis or transdisciplinary engagement.

1.1. Beyond measuring the 'fieldiness' of science in society

In the fourth aspect, we propose that computational methods may help social researchers map out the internal and external structures of loosely organized fields and to account for their relational and contingent boundaries. It is important to not read this as an empirical claim alone. Instead, digitized records of research (or other practices) entail a perspective that challenges the connections that social researchers and theorists draw between empirical data and theoretical concepts (Marres and Moats 2015). Computational methods are, in this context, characterized by a 'methodological uncanny' according to Marres and Gerlitz (2016): '[...] it is not necessarily clear, which analytic purposes digital tools may serve, what research objectives they may align with or what disciplinary agendas they enact'. A cautionary approach to this entwinement of digital objects and perspectives is warranted in our case, because we use computational methods to study transdisciplinary research in an interdisciplinary way.

Early computational approaches in STS have proactively endorsed the alignment of sociotechnical perspectives, methods and objects. This, however, often comes with ontological slippages (cf. Marres 2017). Steve Woolgar, for example, in his warning against enthusiastic views of digitization, has seen the same processes as evidence of a sociotechnical world (Woolgar 2002). Actor–network theorists have even fostered computational approaches as a provocation to the 'lazy eyes' of sociological research, which they see as either too detailed or too broad (Venturini and Latour 2009). Computational methods, they argue, reveal a fluid distinction between observed structures and singular data points (Latour et al. 2012). STS scholars thus have interpreted digitization processes in a way that verifies the ontological reality of their style of theorizing. One is tempted to objectify concept of networks, systems or fields through computational visualizations, thus measuring what we call the 'fieldiness' of society.

This cautionary note implies the following two shifts in our practical and theoretical approach to computational analysis. First, computational methods can themselves be used as an exploratory and reflexive toolkit to challenge conventional depictions of inter- and transdisciplinary boundaries. This implies an experimental entwinement of humanist and scientific methods (Marres 2017). In writing this article, we therefore start with a close reading in a hermeneutic tradition, which is followed by a distant computational reading. As a result, we contrast homogenizing representations in transdisciplinary literature with computational visualizations of the same literature in order to highlight multiple vocabularies. The conceptual caution, moreover, suggests an explorative iteration between generating hypotheses and data, analyzing outcomes, and theorizing results (Marres and Weltevrede 2013; Marres and Moats 2015). This means in our case that the theory of fields informs our methodological decisions—for example, in vocabulary selection, or in

assuming several poles in the field—which are then translated into computations across a vast dataset. In line with what Passi and Jackson called a 'rule-based (as opposed to rule-bound)' practice, our computational work engages in a constant trade-off 'between formal abstraction and mechanical routinization on the one hand, and discretionary action and empirical contingency on the other' (Passi and Jackson 2017). Our interdisciplinary team of authors engages in a dialogical re-adjustment of theoretical as well as computational premises and outcomes. The resulting visualizations are used to question the sociological idea that one language will eventually dominate the field (Fligstein and McAdam 2012).

Altogether, the ontological openness of computational analysis can facilitate a study of transdisciplinary research based on sociological field theory. Yet, there is a risk to reiterate a homogenizing theory of fields by computational means. This study, therefore, opts for a generative and iterative approach in which our qualitative observation and subjective insight in sustainability studies, the manipulation of the corpus, and the programming are tightly linked to our theoretical vision of the blurry boundaries between and within scientific research fields. The following section presents the qualitative insights that inform our computational approach.

2. A close reading of transdisciplinary sustainability studies

Especially, but not exclusively, in German-speaking academia the field of sustainability studies is turning to transdisciplinarity as its preferred mode of conduct. Transdisciplinarity in this context refers to joint efforts of various disciplines, as well as to collaboration with non-academic 'practice partners' (Jahn et al. 2012). Transdisciplinary sustainability studies has thus been suggested as an intermediary between epistemic cultures that span disciplines and practitioner communities (Clark and Dickson 2003; Kates et al. 2001). With diverse roots in ecology, anthropology, regional planning, education, environmental politics, and sociology, sustainability study is an emerging research area, which is directed at scientific and public audiences to address the ever louder debates concerning climate change, resilience, vulnerability, and socioecological justice. Scholars in this field are involved in a semantic struggle to bring into the world their preferred models of transdisciplinary collaboration with policy makers and their publics. This insight can be constructed on the basis of the three following close readings. On this basis, we obtain a variable definition and a set of guiding questions for a consecutive distant reading through corpus linguistic methods.

First, the normative framework of sustainability has received much attention but remains ambiguous. 'Sustainable development' historically emerged as a diplomatic term. Since the Rio Conference in 1992, this term has, to varying extents, been used to refer to economic growth and environmental protection, business efficiency, and ecological sufficiency, as well as technological fixes and convivial lifestyles (Hays 1989; Torgerson 1995; Dryzek 2013). More recently, we argue that, similarly to the broader sustainability literature, both deliberative and technocratic notions of research and policy also pervade the transdisciplinary literature. One strand in sustainability debates can be seen as technocratic (Fischer 2017; Luke 1999), or as Dryzek (2013) states, as an 'administrative rationality'. A few main assumptions are that 'nature subordinates to human problem solving', 'people subordinate to the state', and experts and managers control the state (ibid.). The technocratic tradition of thought culminated in a policy and scholarship approach called 'ecological modernization' (Jänicke 2008; Mol and Sonnenfeld 2014), which in policy making was prominently endorsed as the underpinning of the German 'Energiewende' (orig.: energy transition; Hajer 1995). Problems in this tradition are seen as external to the actors that help to solve them (Maniglier 2019; Osborne 2015). In social and epistemic terms, the perspectivism of problem definitions in practical research is resolved through 'problem decomposition' (Jaeger and Scheringer 1998). Schmidt appeals in the same text for a deliberative approach, seeking to combine an 'unwanted (initial) state, a desired (final) state, and a barrier that stands in the way of the transformation of the initial state to the final state' (Schmidt 2011). The actors that help to solve a problem are often referred to as stakeholders, that is, as 'persons that, besides their expertise, also have an interest in shaping some aspect of reality because they [...] are a part of it' (translated by the authors; Niederberger and Wassermann 2015). These are groups 'influenced by and with an ability to significantly impact [...] the topical area of interest' (Glicken 2000).

In another strand, sustainability debates were always influenced by a wide range of emancipatory theories of change (Dryzek 2002; Guha and Martínez-Alier 2013). While 'environmental concern [was] being integrated into corporate planning and innovation strategies', activist groups prospered in the 1990s (Jamison 2001). Until recently, their language relied on traditions in enlightenment philosophy (Harlow et al. 2013), social critiques against technodeterminism (Martínez-Alier et al. 2010), systems theory as a holistic concept of nature (Lovelock 1995), participatory methodologies (Irwin 1995), postcolonial thought (Shiva 1993), or seeking collective agency in novel modes of research such as citizen science (Ganzevoort and Van den Born 2020). Deliberative understandings of collaborative research highlight its nonlinear nature and contradict a functionalist understanding of collaborative problem solving. The definition of a problem is entwined with the social context that brings it about, and that can be reconfigured in order to enable solutions. As Schmidt (2011) states: 'Therefore, the notion of problem can be regarded as a reflexive term that calls for an explication of who is considering what as a problem and why.' Thompson Klein (2004) argues that 'transdisciplinarity is a context-specific negotiation'.

Second, we argue that the two strands do not necessarily function in a dualistic mode. In contrast, they represent a transversal relationship that is responsive to the normative ambiguity depicted above. This can be seen in the fact that the visions of transdisciplinary scholarship vary greatly within the discourse and re-combine deliberative and technocratic elements. Despite placing 'common language' and 'disambiguation of terms and concepts' among the quality indicators in transdisciplinary research processes (Bergmann 2013), 'a broadly accepted and used research framework for transdisciplinarity—with the accompanying consistent use of language and terminology—has not yet been fully established.' (Pregernig 2006; Hirsch Hadorn et al. 2009; Brandt et al. 2013). Felt et al. (2016) identified three institutional visions about the desirable structure of transdisciplinary research: the 'linear translation model', a 'delimited neutral arena', or a 'temporary shared epistemic arena', with which interviewed scholars identified. In the first concept, societal actors are seen as a necessary source of information, while scientists are framed as bearers of authority and epistemic certainty. The second model is more integrative as 'scientists and societal actors are [...] conceptualized as the gatekeepers of their respective territories'. Finally, 'knowledgeable agents' can also be seen as coming from both worlds to collectively reflect, learn, and 'coevolve' in

order to 'coproduce answers' and engage in 'joint knowledge production' (Felt et al. 2016). The different understandings vary in the way they relate the responsibilities of policy making and research and cannot be clearly categorized as either deliberative or technocratic. In terms of language, a very heterogeneous cultural repertoire becomes apparent that sustainability scholars use to facilitate and describe transversal collaborations.

Third, transdisciplinary scholars actively employ highly hybridized terminology to suggest methodological innovations. This shows how transdisciplinary languages are themselves a reflection of a fragmented landscape of science–policy–society interactions. Some of those innovations visibly combine deliberative and technocratic notions. They vary in their tendency to transcend conventional disciplines, in their appeal to participation, in solving the so-called real-world problems, and finally in the aspiration to a 'unity of knowledge' (Pohl and Hirsch Hadorn 2006). In the context of the United Nations research program 'Future Earth', for instance, Hadley Kershaw has shown that 'co-production' refers to both public dialog and to the instrumental strategy of raising public acceptance (Kershaw 2018). However, there is an acute awareness of this ambiguity and in that sense transdisciplinary scholars are highly reflexive. This is expressed in the many meta-level publications on the meaning of transdisciplinary research: Indeed, among the many collaborative research endeavors, few have been as thoroughly reviewed as transdisciplinary sustainability studies (Kates et al. 2001; Clark and Dickson 2003; Bettencourt and Kaur 2011; Spangenberg 2011; Brandt et al. 2013). One of the dominant characteristics identified in all reviews and across all models refers to the idea of scientific disciplines collaborating with nonscientists (Wickson et al. 2006). The aim is to gather the knowledge that is necessary to solve complex, political problems (Pohl and Hirsch Hadorn 2006). Against this described background, it is not surprising that the literature is populated by conciliatory notions of research that also highlight the value of collaboration. Visual representations of transdisciplinarity, for instance the widely acknowledged ISOE model (Institute for Social-Ecological Research) expresses the aforementioned multireferentiality (Jahn et al. 2012): It essentially represents a circuit model to connect science and society; that is, feedback loops between binary flows of information input and output in both 'scientific' and 'societal discourse' are interconnected by a collaborative process that ties together the diverging systems of research and policy. Teeming with models and visualizations borrowed from systems analysis and other traditions of technocratic thought, the dominant figures in the literature are complimented with deliberative motifs and dialogical principles.

According to these insights, ambiguity in transdisciplinary studies is characterized by diverging preferences of shaping the field, is underpinned by both deliberative and technocratic vocabularies, and, finally, is depicted by scholars using hybrid models that intertwine those vocabularies.

2.1. Terms and questions for a distant reading of transdisciplinary sustainability studies

Transdisciplinary scholarship can be seen as a transversal field that coordinates and, by means of creating cross-cutting dialects, potentially establishes cross-field languages. On a secondary level, it becomes apparent that the language used to discuss this intermediary space is itself challenged by the multiplicity of reference points. Against this backdrop, Terry Shinn has critically assessed how transdisciplinary literature often relies on the 'prepackaged thinking' that does not thoroughly reflect its transgressing character (Shinn 2002). In the following, we discern a set of terms that represent the deliberative and technocratic tendencies observed in the close reading and that are very common in the assessed literature and at academic events which we attended in the last 5–10 years. These terms represent a stable, and in that sense 'prepackaged', repertoire for transdisciplinary scholars. Their applicability and analytical use are further validated in a distant reading presented in section four.

On the dimension of agents, scholars diverge in their vocabularies, with some preferring the term 'partner' and others 'stakeholder'. Although the latter is often seen as instrumental with regard to a particular purpose, a partnership is seen as a more recursive relationship with varying goals and ways of meaning-making. Although sustainability studies have a long tradition of discussing technocratic processes, focusing on policy making and modernization processes, other scholars tends to discuss dialogical modes of doing politics and may focus on communities rather than the state. One more overarching term that captures these differences is the notion of transformation, going back to Polanyi and others, which has recently gained prominence. On the other hand, the ecological modernization debate, which in turn largely drove the energy transition debate, arguably features the term 'transition' rather than the 'transformation' (Hölscher et al. 2018). This difference can also be captured by bifurcating 'modernization' and 'transformation' terminologies. A corresponding policy-oriented terminology may, moreover, tend to discuss 'governance' formations in a technocratic fashion, while deliberatively oriented contributions are more likely to discuss issues of 'democracy'. Knowledge as a central focus in collaborative research may also be viewed very differently, for instance when referring to 'evidence' or 'uncertainties'.

Altogether, the terms employed for processes of knowledge generation, collaboration, or political practice vary within a field in which multiple understandings of collaborative research exist. On a social dimension, the notions for agents, change processes, the role of policy making, and decision processes can vary greatly in sustainability studies. On an epistemic dimension, there is a broad and often unclarified relationship between knowledge production, the underlying problematic, the normative basis, and public audiences that characterize transdisciplinary research. Table 1 depicts these dimensions and suggests terms that illustrate contrasting understandings.

Table 1. selected terms and associated technocratic and deliberative vocabularies used in the following computational analysis (asterisks are used to capture grammatical variations in the computational reading process)

Semantic dimensions	Technocratic vocabularies	Deliberative vocabularies
Agents:	Stakeholder	partner
Driver of change:	State	communit*
Notion of change:	Transition	transformation
State agency:	regulat*	reform*
Decision process:	Policy	dialog*
Modus of change:	moderni*	transform*
State formation:	Governance	democrac*
Knowledge:	Evidence	uncertaint*
Problematic:	Solution	problem
Normative basis:	Justice	effective*
Temporal politics:	Procedure	process
Spatial politics:	National	local

Based on our close reading, it may be hypothesized that sustainability studies takes on a transversal structure (Shinn 2002). We argue that publications and even scholarly careers do not fit into neat categories or even dualisms, but move along multifaceted dimensions depending on their situated purpose and audience. From this perspective, the academic journals, institutes, or scholars in transdisciplinary sustainability studies use and intermingle contradictory languages that reflect the fragmented landscape of science–policy–society interactions. The discussion thus far has raised three guiding questions that are helpful in studying these hypotheses:

- which notions of politics and research are most characteristic of the literature?
- to what extent do deliberative and technocratic vocabularies structure the field of sustainability studies?
- how do publications in sustainability studies journals entwine the(ir) vocabularies?

First, the corpus can be investigated with regard to the most characteristic terms and concepts. Second, with regard to the use of deliberative or technocratic vocabularies in the articles, we investigate whether the vocabularies would structure as expressed in the first hypothesis so that articles neatly fit into one camp, or whether there is a more fluid distribution. Third, we study the corpus from the perspective of journal articles, which may either entwine or clearly focus on distinct vocabularies.

3. Computational methodology

The proliferation of transdisciplinary languages also is an empirical challenge. How to trace and depict the highly fragmented discourse of transdisciplinary research? The computational methodology applied in this article was developed in a research project that tackled these larger questions (Leuphana University, 2015–9). The theoretical and methodological approach presented here builds on the collaboration with an interdisciplinary research and development team called the Digital Innovation Group as well as the computational infrastructure and training at the so-called Laubichler Lab based at Arizona State University. In this collaboration, the computational turn in the humanities and social sciences was discussed as one possible way to navigate and study a highly fragmented discourse of sustainability. We sought to build exploratory tools of theorizing the ambiguity of sustainability and turned to computational methods where a hermeneutic research approach could be combined with the empirical study of large corpora of academic literature (Peirson et al. 2016). In the project, researchers from the humanities, media studies, and social sciences would translate concepts such as the notion of transversal fields into computational methods, while being in close dialog with digital humanities experts and programmers. One result of this interdisciplinary collaboration is presented here, essentially arguing for a more exploratory combination of sociological theory and computational mapping techniques. Following an exploratory approach, we suggest that the methodology and its results are not seen as representative of the assessed corpus, but rather as theoretical tools that help to conceive of the fragmented and ambiguous nature of science–policy–society interactions.

The text corpus behind the computations presented here comprises 29,992 articles published between 1968 and 2018 from ten scientific journals that were rendered machine readable using technical infrastructure at Arizona State University's Laubichler Lab (Fig. 1). The inclusion of articles into the corpus continued until the end of the first half of 2018. All but the three smallest journal components were downloaded through Elsevier's applications programming interface or from Elsevier's Scopus servers. We chose these journals to represent a significant part of the broader academic discourse on sustainability, engaging more thoroughly with aspects of transdisciplinarity. Furthermore, experienced researchers at Leuphana University's Institute for Ethics and Transdisciplinary Sustainability Research and the Institute for Advanced Sustainability Studies were consulted to ensure the choice of journals appropriately reflected the field. By exploring the formation of the field of 'transdisciplinary sustainability science' through modeling the usage of certain vocabularies in the corpus, we aim to empirically test and refine the theoretical interpretation proposed above. This corpus represents an interdisciplinary construction; in other words, there is some bias involved in journal selection and the technical text-cleaning procedures. Systematic literature review methodology is often subject to similar limitations.

Proceeding on this basis facilitates a more inductive hermeneutic strategy than commencing with an aprioristic search-string for retrieving the subsequently analyzed corpus, or else choosing a single journal to represent a complex research agenda. For one among the many recent examples of the search-string method, which also discusses transdisciplinary sustainability studies, see Brandt et al. (2013); for a review of ecosystem services research, see Abson et al. (2014) and Rau et al. (2018).

3.1. Introduction and reflection of manifold learning as an interdisciplinary method

The modeling technique that was chosen to better understand the transversal field of sustainability studies arises from the theory of manifold learning, a form of nonlinear dimensionality reduction of large datasets. It is based on algorithms that embed heterogeneous (here: technocratic and deliberative) vocabularies as multidimensional variables within a more general stochastic model of the overall corpus. More technically, manifold learning is an approach useful for reducing the dimensionality of data that lie on a manifold contained within an abstract high-dimensional space. This approach is appropriate because we aim to measure the semantic distances of individual research articles according to the quantitative occurrence of those vocabularies. It is indeed possible to interpret each vocabulary as a specific topic, and we recognize that Topic Modeling could have been used to check the degree to which our vocabularies actually correspond to topics modeled through statistical Latent Dirichlet Allocation. However, manifold learning was specifically developed for retrieving and visualizing a dataset's field-like geometric structure, making it more relevant for the sociology of field's perspective introduced above.

In the present case, the two 12-dimensional transdisciplinary vocabulary vectors (Table 1) are used to calculate a 24-dimensional manifold fixed in the corpus. Each of the approximately 30,000 articles composing this corpus thus represents a single point on the manifold, forming a highly complex structure requiring dimensionality reduction methods for its visual analysis. Using eigenvalues, the algorithm discretely approximates the nonlinear geometric structure of the original 24-dimensional manifold and represents it as a two-dimensional scatter plot. As such, this structure can be understood as depicting semantic relationships among the scientific articles comprising the corpus, where points close to one another on the original multi-dimensional manifold (i.e. articles that employ quantitatively

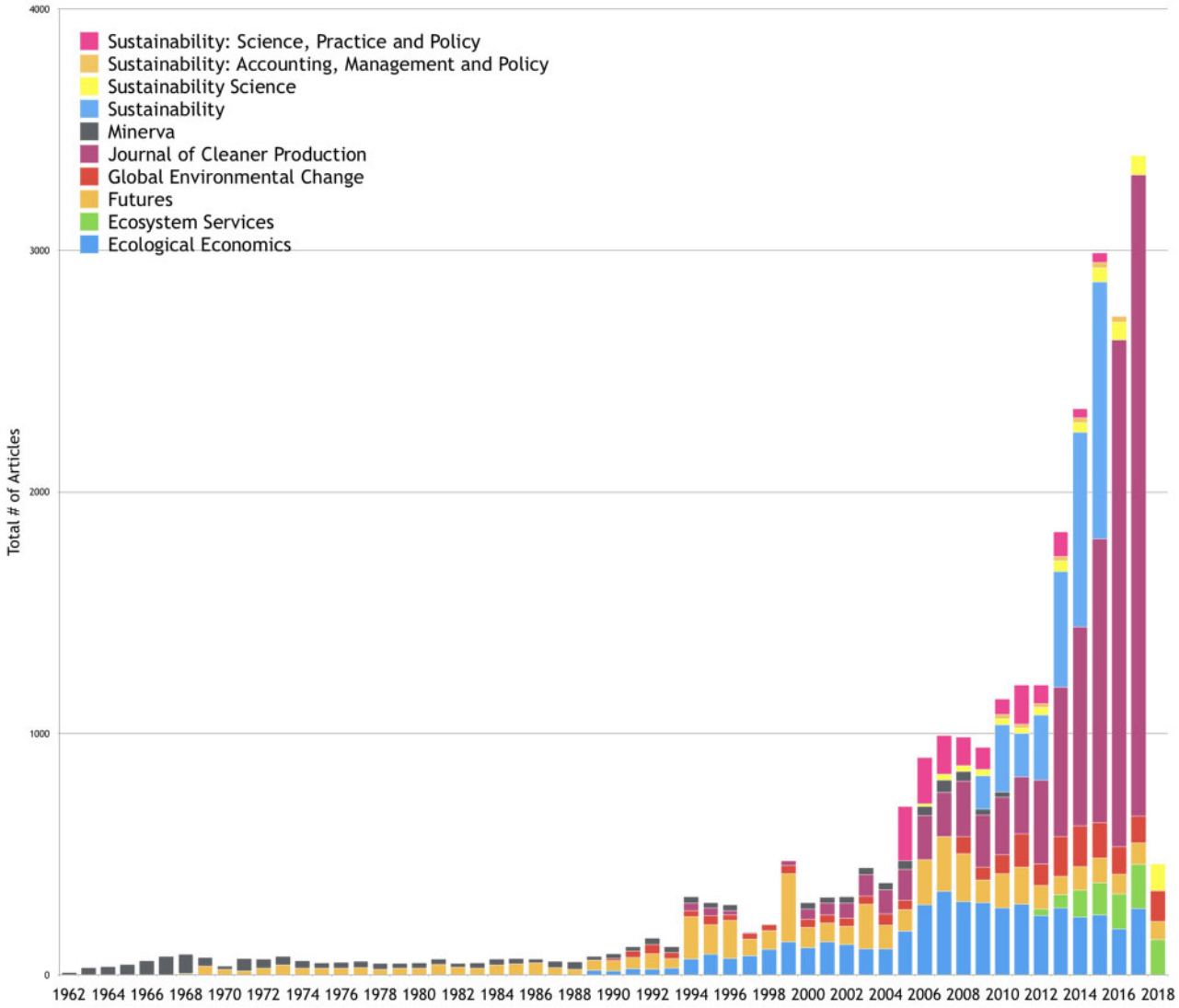

Figure 1. Stacked bar chart depicting the number of articles per journal per year incorporated into the corpus.

similar terminology) will also be close in the two-dimensional graph. At the same time, the calculation creates clusters of terminologically similar articles by preserving local distances in the original data through minimizing a cost function on the approximation graph.

The method of manifold learning used here, isometric feature mapping (Isomap), uses a three-step algorithm to: (1) determine which points are neighbors on the high-dimensional manifold; (2) estimate the geodesic distances between all pairs of points on the manifold, to create a neighborhood graph; and (3) construct a low-dimensional representation of the data in a Euclidean space, preserving the intrinsic geometry of the manifold (Tenenbaum et al. 2000). Isomap can be seen as an extension of the classical techniques for dimensionality reduction, principal component analysis (PCA) and multidimensional scaling (MDS), but has the key distinguishing feature of being able to identify nonlinear structures present in complex datasets. Although PCA and MDS are guaranteed to identify the structure of data in *linear* subspaces of high-dimensional input space, they are often unable to identify the presence of *non-linear* structures (Tenenbaum et al. 2000), making Isomap a more robust method for assessing more complex datasets such as the corpus analyzed here.

Our approach in applying the method of manifold learning to this Corpus was experimental by design and a first step into developing the methodology. The basic principle of the methodology is dimensionality reduction. It is a frequent challenge in the natural sciences and is used, for example, to compute gene regulatory networks in genetics and other more quantitative research. In this article, we show that the same method can indeed be applied to more qualitative datasets in the social sciences to produce valuable insights. There are, however, some key lessons that were learned along the way.

First and foremost, it is critical to choose the vocabulary based on qualitative insights; that is, a close reading as presented above. As the manifold is calculated based on the total counts of all keywords in each article relative to article length, it will (and should) look fundamentally different if alternative words are selected. The results presented here therefore do not define the structure of the entire Corpus; they merely reflect some of many semantic relationships among articles in the field which can be articulated with this methodology. Naturally, these vocabularies should reflect the questions formulated in the research design and should have a basis in the literature. In this study, we assumed that the semantic space of transdisciplinary research is transversal, therefore, selecting and

interconnecting keywords that we knew to be polarizing in the field. That the resulting manifold (Fig. 4a and b) reflects this polarization as well as transversal relationships (Fig. 6a and b) is less an affirmation of a polarized space, but an affirmation of the semantic diversity of the field. Further experimentation with alternative vocabularies would likely yield new insights regarding the transdisciplinary literature in addition to those uncovered in this analysis.

Second, while manifold learning provides useful visualizations of semantic relationships contained within the Corpus, it could be pushed further. For example, the articles identified as being 'most' technocratic or deliberative in the manifold could be selected for more qualitative scrutiny. The top 100 articles from either pole could be analyzed based on content, expertise and field of authors, year of publication, and so forth. Such a qualitative analysis could add greater depth to the discussion of fields. In addition, future developments of this method could also include more preprocessing of the corpus, especially in terms of stop word removal, that is, removal of commonly used words such as 'the', 'a', 'an', 'in', etc. As the frequencies of occurrence of each keyword in this study were calculated relative to the total number of words in each article, stop word filtering was deemed to be unnecessary. Instead, it was assumed that the proportion of stop words per article would be relatively equal. That the vocabularies were qualitatively predetermined serves as a further argument for not removing stop words in this analysis.

4. A distant reading of transversal vocabularies

4.1. Insight I: Distinct vocabularies

In our close reading, we have identified deliberative and technocratic vocabularies that characterize and intermingle in the transversal field of sustainability studies. A distant reading based on manifold learning shows that the selected terms are very different in their meaning for the entire corpus. As depicted in Fig. 2, the terms 'state', 'policy', 'national', and 'process' are most frequently used, comprising on average ~52 per cent of the total counts of the all of the twenty-four terms per article. The terms 'regulat*', 'solution', 'communicate', 'problem', 'effective*', and 'local' also appear relatively frequently, accounting for nearly another 30 per cent of the total counts of all terms per article. All other terms occurred relatively infrequently across all articles in the corpus.

The two vocabularies thus represent clearly defined variables for further analysis of transdisciplinary sustainability studies' as a dynamic field. The question remains, however, to what extent do deliberative and technocratic vocabularies represent the selected papers? Corresponding to the close reading above, scholars in the field actively argue about how the field of transdisciplinarity itself should be structured in order to effectively leverage and communicate its collaborative methodologies (Max-Neef 2005). Indeed, with respect to the second research question, addressing the most characteristic terms in vocabularies of respective poles, a clear tendency can be seen in the data. As shown in Fig. 3, the vocabularies in the corpus do cluster, with particular terms standing out as much more representative of one cluster than the other. Most notably, the deliberative strand is characterized by the terms 'local', 'process', and 'communit*'. The technocratic strand, in contrast, does not feature those terms very prominently, but rather centers around the terms 'national', 'policy', and 'state', terms that are in turn rather marginal in the deliberative strand. This contrast is depicted more clearly in Fig. 3, which highlights how distinctly the selected terms characterize either of the strands. The indicated values represent the relative occurrences of each vocabulary term within the top 100 'deliberative' or 'technocratic' journal articles. The top 100 articles for each vocabulary (200 articles in total) were selected based on the highest ratio of deliberative or technocratic terms in the document relative to total word frequencies in the document and were subsequently organized in decreasing order.

4.2. Insight II: The space in between technocratic and deliberative poles

In our understanding of transversal fields, the strong fragmentation of sustainability studies and respective vocabularies can be seen as addressing, or responding to discursive structures in neighboring fields; they traverse semantic and disciplinary boundaries based on transdisciplinary research as a responsive medium. Another question therefore addresses the structural dynamic between the distinct vocabularies identified above, by assessing how the selected papers

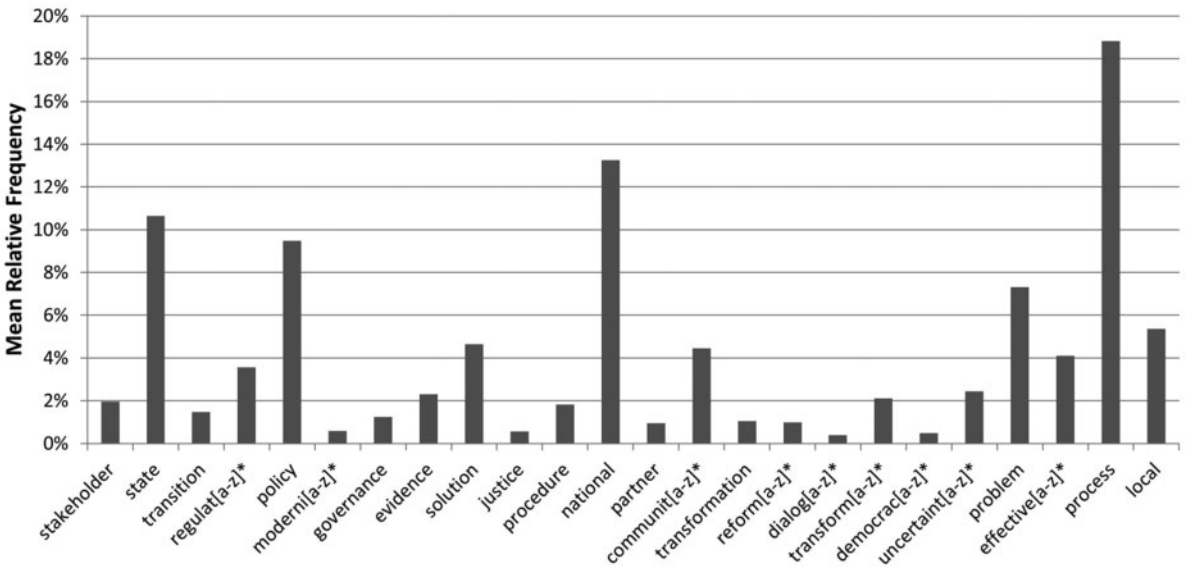

Figure 2. Relative frequencies of individual vocabulary terms per document, averaged across the entire corpus (i.e. the term 'process' comprised on average ~19 per cent of the counts of all terms in the vocabulary per article across the entire corpus).

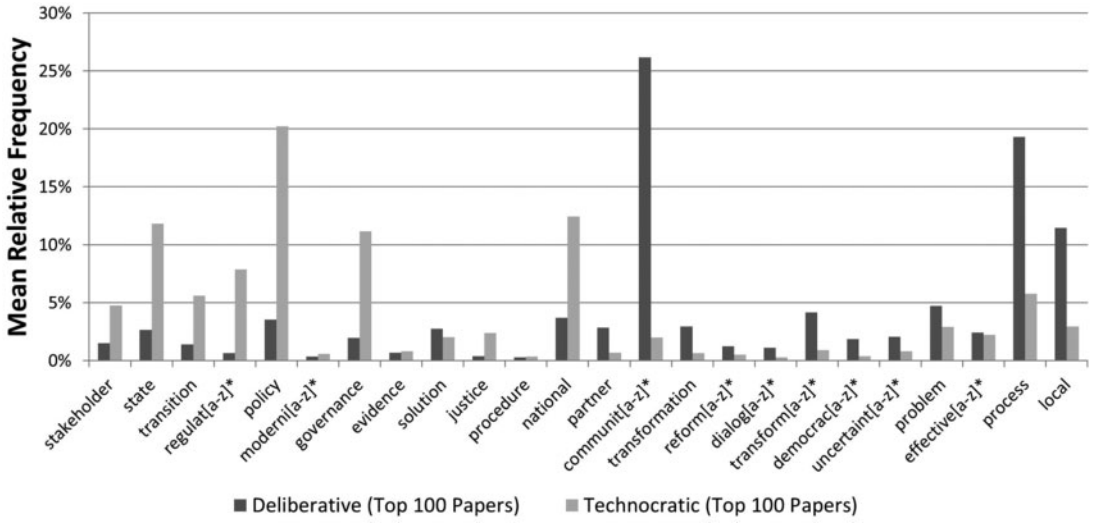

Figure 3. Relative frequencies of individual vocabulary terms per document for the top 100 most deliberative and top 100 most technocratic papers.

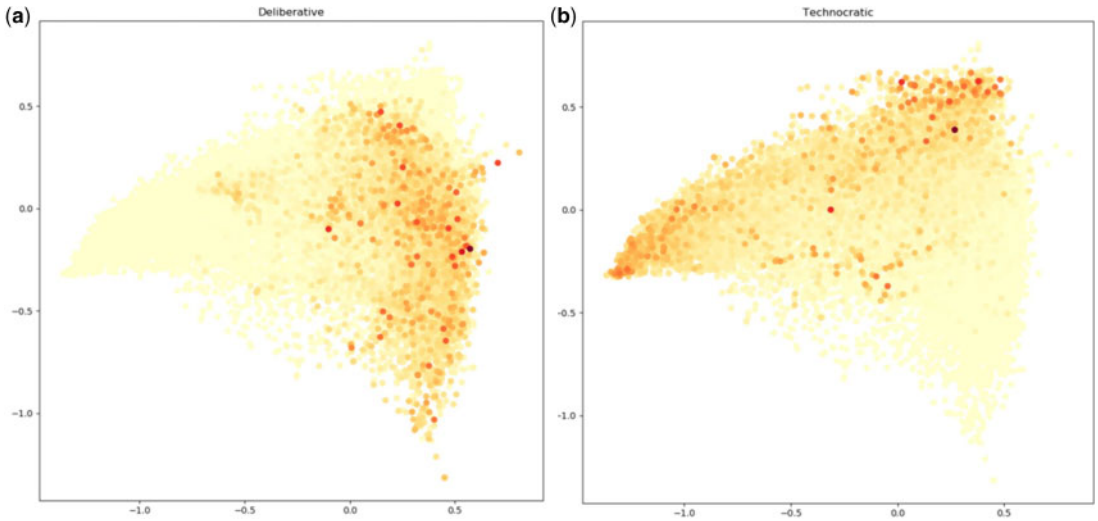

Figure 4. A two-dimensional representation using Isomap embedding of the 24-dimensional manifold constructed using the frequency of counts of all terms. Each dot represents one article in the Corpus. Darker colors indicate articles with higher frequency of deliberative (left panel) or technocratic (right panel) terms relative to respective document length. Numerical values on the axis represent the relative relationships of the articles to one another, but do not inherently have meaning.

entwine their deliberative and technocratic vocabularies. Figure 4 a and b show how the top 100 technocratic and deliberative articles each can be seen as poles that shape the field of transdisciplinary sustainability studies. Interestingly, there is considerable space between the two poles, but the articles with the highest frequency of technocratic terms are clustered together separately from those articles with the highest frequency of deliberative terms. Furthermore, the more deliberative articles tend to be spread more evenly along the deliberative pole of the manifold, whereas the technocratic articles appear to be more closely clustered in two distinct regions. In this depiction, academic articles on sustainability studies are structured as stretching along and interconnecting the deliberative and technocratic vocabularies. Given the strong intermediate area and the overlap of vocabularies this insight suggests a transversal structure of transdisciplinary sustainability languages, as can be illustrated in a more detailed manner based on the following results.

The most interesting aspect is that the interstices between the two poles is also highly populated. Based on the fields perspective, the data poles are interpreted as having a structuring effect on semantically hybrid publications, with semantic mixtures occurring relatively frequently in the field. Both aspects can be illustrated based on two variations of the computational methods used previously: When selecting 100 papers that represent the in-between spaces (i.e. those closest to the median term frequencies of deliberative or technocratic terms), they in themselves seem torn between deliberative and technocratic terms. As opposed to the clear dominance of deliberative or technocratic terms found in papers residing at the vernacular poles, papers that compose the spaces between both poles have very similar proportions of the same six main terms: 'process', 'national',

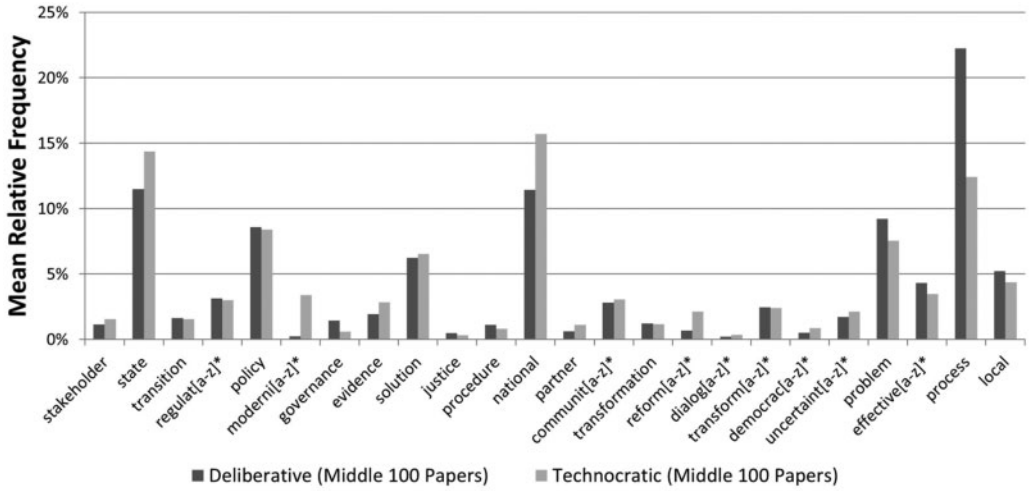

Figure 5. Relative frequencies of individual vocabulary terms per document for the middle 5 deliberative and middle 100 technocratic papers, based on the 100 papers closest to the median term frequencies of the deliberative and technocratic vocabularies.

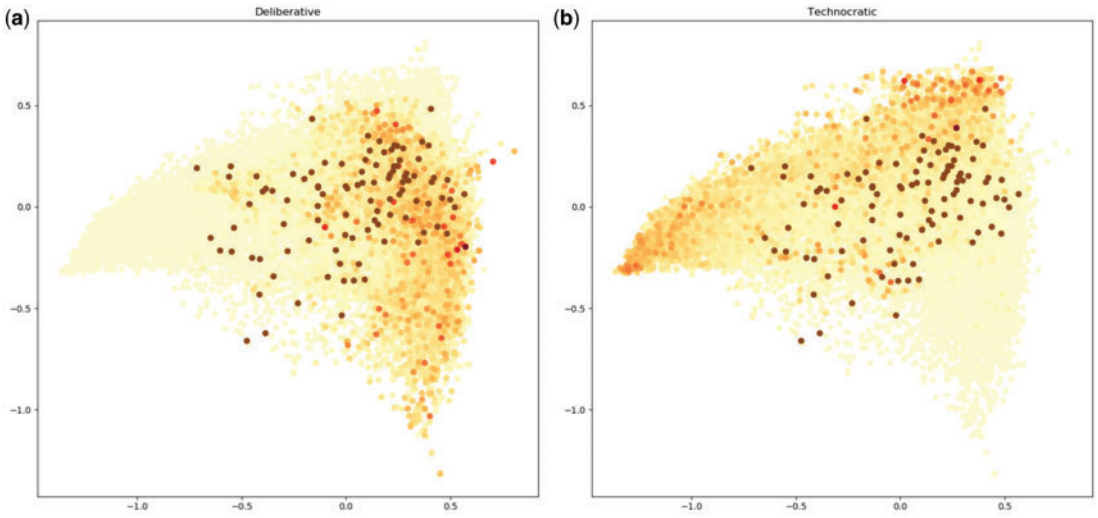

Figure 6. (a and b) Two-dimensional depiction of the higher-dimensional manifold, as with Fig. 4. Brown dots represent the middle 100 papers, closest to the median frequency of deliberative or technocratic terms relative to respective document length.

'state', 'problem', 'policy', and 'solution'. Four of these terms are from the technocratic vocabulary and two from the deliberative set (Fig. 5). This highlights the existence of a common vernacular traversing the two poles, which draws upon the two vocabularies but selects the broader terms among them.

Mapping the 100 median-ranked articles onto the previous Isomap shows how populated the area between the technocratic and deliberative poles of the field is (Fig. 6). Interestingly, in contrast to our close reading of the many attempts at defining what transdisciplinary research is, our distant reading suggests a more fluctuating structure. Despite disagreements regarding transdisciplinary understandings, the selected articles actually tend to oscillate between deliberative and technocratic vocabularies.

On the basis of a field theoretical approach toward relational dynamics in collaborative research, we therefore refer to the literature of transdisciplinary sustainability studies as being a transversal field (Shinn 2002, 2005). In contrast to current field sociological work (Fligstein and McAdam 2012), the emerging transdisciplinary arena is not structured by a battle to impose a 'shared understanding' or even a common language. Rather, our close reading of the literature and the empirical results suggest that the emerging linguistic practice within transdisciplinary sustainability studies bears signs of significant acceptance for plurality. This illustrates 'a kind of nonimperial traveling or visiting', which George Steinmetz envisions for a transdisciplinary form of sociology, crossing borders 'without any imperial intent' (Steinmetz 2007). This emphasizes the need to discuss and potentially overcome the ideal of finding a common language.

5. Controlling for a common language? Pathways of boundary speak

During the rise of environmental research agendas in the 1980s and 1990s, Samuel Hays (1989) and others observed how professionalized environmentalism became 'a middle ground [. . .] to control the

focus of the discourse' of sustainability (Torgerson 1995). From our analysis, this struggle to assume an in-between position persists in current sustainability studies literature. In line with Hackett's remarks about risk and identity in science, one can conclude 'that there [. . .] may be enduring, endemic tensions along cultural axes that characterize science and that exert continual pressure and admit no universal resolution' (Hackett 2005). Because of a highly diffuse language concerning transdisciplinary science–society relationships, the role of discursive power in sustainability studies is not well captured as being synonymous with coercion as Collins et al. (2007) suggested with regard to collaborative research in general. If, however, the field is not predominantly structured by a battle to control definitions of transdisciplinarity, how may we understand the complex relations of politico-epistemic power and semantic ambiguity in transdisciplinary vocabularies? The following discussion sheds light on various pathways to deriving conclusions from our results. Each of those pathways implies a candid trade-off that is crucial in order to maintain transdisciplinary openness and public significance.

First, a trajectory of homogenization may seem promising for the sake of clarity and policy relevance in a national context (Halffman 2005). Searching a common language or even shared glossaries may inspire a methodological debate about transdisciplinary scholarship. However, this would be at odds with regard to the interactional practice of transdisciplinarity. Along this line, transdisciplinary scholars such as Brandt et al. (2013) postulate that their field of practice 'should not seal itself off by trying to establish its own scientific glossary and procedures'. Instead, the approach should try to use as simple a language as possible, shared by many disciplines and with results ultimately also understandable by civil society' (Brandt et al. 2013). Moreover, institutes or scholars who were to seek a simplified language and unified methodology would also jeopardize the communicative benefit of what Pierre Bourdieu as coined 'semantic elasticity' (Bourdieu 1998). That is, the persistence of a pluralistic and dynamic language in transversal fields may provide 'a basis for the plurality of visions of the world which is itself linked to the plurality of points of view' (Bourdieu 1998). Transdisciplinary languages in our view remain multi-referential and may always be challenged even when homogenized. In a more practical vein, this means that a pronounced 'semantic elasticity' provides for the cross-cutting resonance of transdisciplinary research (Bourdieu 1998). If homogenized, transdisciplinary invitations to collaborate would gain clarity, but they would likely lose appeal to potential collaborators.

A second possible trajectory is the notion of translation. As opposed to homogenization, translation implies a more intermediary form, and resonates with Collins et al.'s (2007) notion of 'interactional expertise'. Certainly, as often acknowledged in the transdisciplinary literature, discipline-specific concepts are difficult or hardly possible to translate (Hirsch Hadorn et al. 2009). If, nonetheless, transdisciplinary scholars saw themselves as translators, they may focus on learning many languages and creating corresponding academies of transdisciplinary research. Yet, while learning the tacit skill of witty translators and executing this skill in collaborative research arenas, transdisciplinary scholarship in itself may jeopardize the internal discussion about methodologies of collaboration and knowledge integration. In that sense, translation may implicate a greater professionalization, but may also lose intellectual and methodological fruitfulness.

Third and fourth, attempts at translation may evolve into some form of pidgin or creole, both implicating an implicitly colonial form of semantic power. Pidgin 'usually designates a contact language constructed with the elements of at least two active languages' (Galison 1997); it is 'an interim tongue, based in partial agreement on the meaning of shared terms' (Thompson Klein 2003). For a pidgin form to emerge, 'regular contact between the language communities involved'[. . .], a general necessity for cross-communication, and 'the absence of a widespread inter-language' is needed (Schinckus and Jovanovic 2013). In the model by Collins et al. (2007), pidgin can be seen as an expression of a 'coerced inter-language'. Because of its history in colonialism where pidgin emerged as an adoption of foreign languages into one's native tongue, the political legitimacy of pidgin languages is contested. When applied to transdisciplinary research, this approach moves away from agreeing on existing disciplinary vocabularies and suggests coming up with new, alternative terms and definitions that are not anchored in the communicative patterns of any concrete discipline. The role of transdisciplinary scholars may, however, also imply the responsibility to mediate. Mediation often brings with it the risk of reiteration, so that asymmetric relations between dominant and subaltern languages are stabilized.

Creole, referring to what was originally a pidgin form but has since become an established language, is the fourth and the most comprehensive semantic trajectory of transdisciplinary research. Among a community of speakers, this complex variation of pidgin can fulfil the function of a soundly established native language (Galison 1997; Hirsch Hadorn et al. 2009). However, creole is not simply the most perfected form of homogeneous collaboration as implied by Collins et al. (2007). The word creole is, for example, used to designate the language(s) of people of Caribbean and African descent in colonial and ex-colonial countries. For scholars, transdisciplinary creole means that they may see themselves in control of semantic interconnections. This role does not rely on a stable, let alone neutral ground either. After all, 'the longer a collaboration goes on, the greater the number of hybrid expressions that may be created and a hybrid culture may also emerge around this' (Hirsch Hadorn et al. 2009). Moreover, in order to stand in as a warden for a shared language, transdisciplinary scholars would need some form of power, be that trust or even a political mandate, endowed by actors in other fields. The legitimacy of transdisciplinary scholars would thereby be elevated, and may evolve into authoritative roles. However, there is an absolutist tendency involved in hammering out and controlling for a 'common language', which may result in the overshadowing of site-specific pidgins. This role somewhat shares the regulatory burdens and pitfalls that are comparable to state agencies governing various provinces (cf. Steinmetz 2007).

These four pathways of boundary speak can inform individual scholars who navigate site-specific collaborations while seeking to unfold their own intellectual and methodological pathways. Institutes that long for transdisciplinary openness, or research grants that seek to bolster science–society interaction, should be equally wary to protect the plurality of engaged research, so as to remain responsive to heterogeneous concerns and political situations.

6. Toward a pluralist view on the science–society–policy interplay

In this article, we traced a tendency within the academic literature on transdisciplinary sustainability studies to simultaneously refer to both deliberative and technocratic notions of the science–society interplay. As discussed theoretically and reaffirmed empirically by means of computational corpus linguistic methods, the language of transdisciplinary sustainability studies is structured by a transversal

field that productively interconnects and combines technocratic and deliberative vocabularies. What does our methodological and conceptual proposal mean for future research?

Our perspective on innovation and science policy is based on a relational theorization of pluralistic scientific landscapes. Bourdieu's concept of social fields is an appropriate vantage point as it is useful to understand the intermediary and emergent role of language in collaborative endeavors (Bourdieu 1991). However, this insight does not necessarily involve a definitional dominance of one language in inter- and trans-disciplinary research. The constellations in which collaborative research takes place can be more appropriately regarded as transversal (Shinn 2002). Finally, methods in computational social science can be employed to theorize and explore fragmented and emergent discourses in science policy and innovation, while highlighting their transversal character. Altogether, the computational reading of sustainability studies as transversal field shows that is fragmented, but that practitioners can rely on established patterns of discourse that carry habituated assumptions about the science–policy–society interplay.

The computational methods implemented in this study were determined to be specifically valuable for exploring the existence of distinct vocabularies and cross-cutting structures in transdisciplinary fields of research. One operational next step with this method would be to use Topic Modelling to map not only the clusters of the keywords selected in this study, but also to determine other keywords that might improve definitions of the variables, that is, refine the vocabularies. Such an expansion of scope would provide a deeper overview of the heterogeneity of vocabularies and discourse, but it would also require more preprocessing of the corpus, for instance by means of so-called stop-words. More broadly speaking, the computational approach is not without risks. Critics fear that corporate data sidelines sociological data (Savage and Burrows 2007), that a mechanistic view of society may be re-emerging (Adolf and Stehr 2015) or that routinely generated datasets undermine social theory (Levallois et al. 2012). To address these concerns, current STS approaches highlight the experimental connection with social theory (Marres and Gerlitz 2016), so that computational methods are 'used to develop a problem', not to contain it (Moats and McFall 2019). Our study shows that this is fruitful when describing the multiplicity of inter- and trans-disciplinary languages, which characterize many areas of science and innovation policy. The concept of transversal fields, which does not presume defined boundaries, facilitates an abductive approach to the science–society interplay. In this manner, the computational exploration of traversing inter-languages avoids homogenizing viewpoints, while not assuming that data speaks for itself.

With regard to normative questions about inter- and transdisciplinary research, the discussed insights thrust an empirically grounded debate about the desirability and feasibility of a 'common language'. As opposed to voices advocating for the common ground as a desired trait of the transdisciplinary approach, we argue that—due to the interstitial nature of such collaborative endeavors—the efforts surrounding transdisciplinarity should not concentrate on creating a new form of scientific Esperanto. Instead, transdisciplinary scholarship is embedded within a field of tensions, and thus thrown into a pragmatic take on semantic pluralism. This would imply trade-offs between homogenization and collaborative appeal; translation and intellectual fruitfulness; site-specific pidgins and balancing semantic power; and finally, between a stable creole and a situated semantic plurality. If, in contrast, either technocratic or deliberative notions came to dominate transdisciplinary research, the resonance of outward-going research endeavors would likely decrease. Transdisciplinary or interdisciplinary researchers, in that sense, could run the risk of trading semantic control at the cost of societal relevance and intellectual risk-taking.

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Conflicts of interest

The authors declare no conflicts of interest.

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