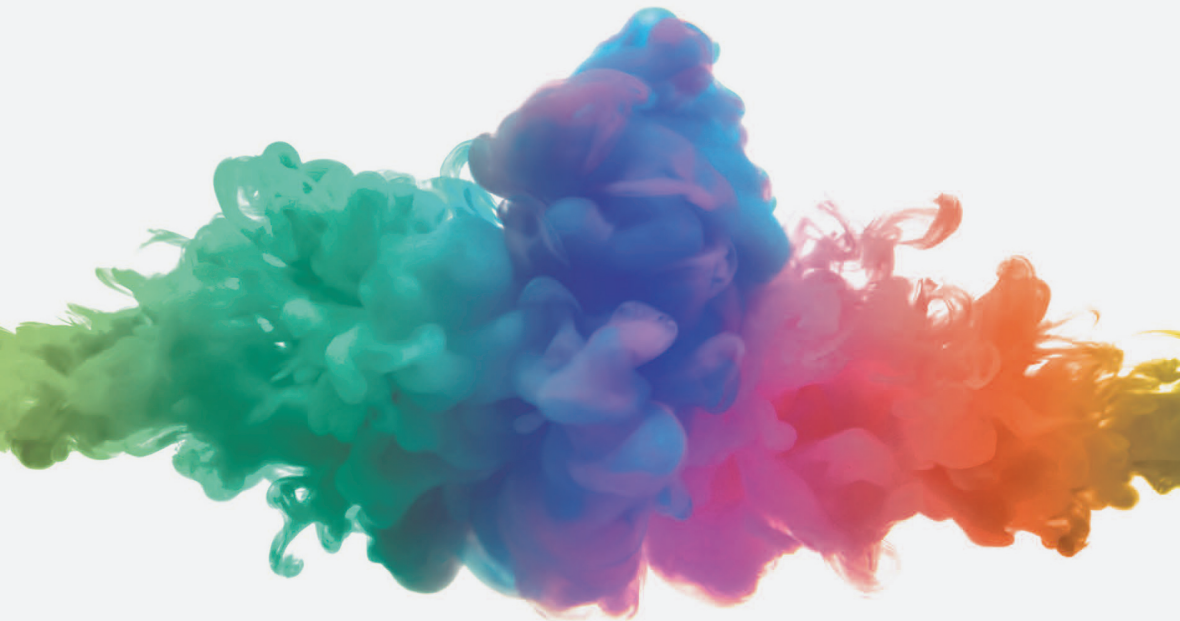
Foundations of Interdisciplinary and Transdisciplinary Research



A Reader

Edited by Bianca Vienni-Baptista,
Isabel Fletcher and Catherine Lyall

FOUNDATIONS OF INTERDISCIPLINARY AND TRANSDISCIPLINARY RESEARCH

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With a Foreword by
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List of Extracts

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List of Acronyms

AAAS	American Association for the Advancement of Science
AHSS	Arts, humanities and social sciences
ECR	Early career researcher
ESRC	Economic and Social Research Council
HEI	Higher education institution
HEurope	Horizon Europe, European Union research and innovation funding programme
H2020	Horizon 2020, European Union research and innovation funding programme
ID	Interdisciplinarity
IDR	Interdisciplinary research
ITD	Inter- and transdisciplinary research
K⋆	Knowledge transfer, exchange, mobilisation
LERU	League of European Research Universities
MSCA	Marie Skłodowska-Curie Action
NGO	Non-governmental organisation
OECD	Organisation for Economic Co-operation and Development
OED	Oxford English Dictionary
PNAS	Proceedings of the National Academy of Sciences of the United States of America
RELU (or Relu)	Rural Economy and Land Use Programme
RMAs	Research managers and administrators
SHAPE-ID	Shaping Interdisciplinary Practices in Europe
SNSF	Swiss National Science Foundation
SSH	Social sciences and humanities
STEM	Science, technology, engineering and mathematics
STEMM	Science, technology, engineering, mathematics and medicine
STS	Science and technology studies
TD	Transdisciplinarity
td-net	Network for transdisciplinary research (Swiss Academies of Arts and Sciences)
TDR	Transdisciplinary research

Glossary

Agonistic Used to describe conflicting attitudes. In this book it describes how researchers might establish a collaboration.

Artefact (artifact) Objects created or built by researchers or artists. Artefacts are useful to learn about a group or a certain situation.

Bricolage The construction or creation of a work from a diverse range of things (objects or ideas). In the humanities, the term is also used when groups borrow objects from others and create new aspects of their identities.

Consilience Principle stating that several sources of evidence in agreement make evidence more robust. Reaching the same result applying different methods should lead to the same answer.

Constitutive This term indicates an essential part of something, that is, a constituent.

Epistemology/epistemic Epistemology refers to the theory of knowledge. It is concerned with questions such as: How do we know things? And if we do, how and when do we know things? Epistemic indicates the relation to knowledge.

Ethnocentrism Mostly used in anthropology, an ethnocentric perspective is the evaluation of other cultures according to preconceptions originating in the standards and customs of one's own culture.

Ethnographic Method used in anthropology to study other cultures by focusing on the scientific description of peoples and cultures with their customs, habits and mutual differences.

Formative (evaluation) Assessment conducted during the development or improvement of a project or activity (in contrast to summative evaluation, which is conducted at the end of an activity).

Fungible Something that can be substituted for something else.

Generative Capable of producing or 'generating' something.

Heuristics Guidelines that can be applied to aid decision making when information is limited.

Ideal-typical Hypothetical mental construct representing a simplified version of reality, enabling comparison with real-life phenomena. An ideal-typical situation is neither 'perfect' nor an average, but an approximation to reality.

Meta-skills Short for 'metacognitive skills', higher-order skills that are applicable across domains and disciplines. An example could be communication skills.

Methodology (vs method) A method is a tool to answer research questions such as the technique used to collect data. A methodology is the rationale for the overall research approach, so it describes the overarching research strategy.

Normative When something (for example, a research finding) is compared with a (social) standard or 'norm'.

Ontology/ontological Branch of philosophy that analyses the nature of being and existence. In the social sciences, questions of ontology link to both epistemology and method since researchers' understandings of social reality affect the theoretical claims they can make.

Performative The concept that language (and by extension, other forms of behaviour) can function as a form of social action and thereby have effects on the world.

Positionality The social and political context that creates an individual's identity in terms of, for example, race, class, gender, sexuality and ability status. Also describes how that identity – derived from a social position – influences their understanding of and outlook on the world.

Positivist Positivism is an empiricist theory of knowledge, which holds that all genuine knowledge is true by definition, or derived by reason and logic from sensory experience ('positive').

Post-normal (science) Describes a problem-solving strategy appropriate in situations of urgency, uncertainty and disputed values, where standard processes of knowledge evaluation (such as risk assessment or cost-benefit analysis) fail. Climate change policy is an example of post-normal science.

Post-structuralism An intellectual movement that emerged in philosophy and the humanities in the 1960s and 1970s. It challenged previous ideas of structuralism, which believe that phenomena of human life are only understandable through their interrelations (such relationships constituting a 'structure').

Reflexive/reflexivity The capacity of an individual (often a researcher) to reflect on how their place in society has influenced their beliefs and behaviour, particularly when trying to make sense of their research data (see also 'Positionality').

Tacit Tacit knowledge is knowledge that has not been written down, codified or otherwise made explicit, making it difficult to communicate to others.

Wicked problem A problem that cannot readily be solved. There may be no single solution due to incomplete, contradictory and changing requirements, and the effort to solve one aspect of a wicked problem may reveal or create others.

1

Understanding Interdisciplinary and Transdisciplinary Research

Chapter overview

Several different labels – inter-, multi- and transdisciplinary research, collaborative research and team science – are used to describe research across disciplines and sectors of society. These labels are often specific to particular contexts, for example transdisciplinary research is predominantly used within sustainability science and team science within medical research. This can create confusion and make it more difficult for those from outside these fields, such as arts, humanities and social sciences researchers and creative practitioners, to get a foothold in these projects.

Julie Thompson Klein was one of the key theorists of interdisciplinarity and transdisciplinarity.[1] In her chapter from the 2017 *Oxford Handbook of Interdisciplinarity* (Extract 1.1) she examines typologies of interdisciplinarity, identifying patterns of consensus and new developments. The importance of this piece lies in the way Klein identifies similarities and differences among multidisciplinarity, interdisciplinarity and transdisciplinarity. Klein's explanation of the historical development of ideas about interdisciplinarity and transdisciplinarity provides the reader with a detailed and nuanced framework for understanding different models of collaborative research.

In their influential article, Andrew Barry et al (Extract 1.2) analyse three interdisciplinary fields that span the boundaries between the natural sciences or engineering, on the one hand, and the social sciences or arts, on the other. The fields are: (1) environmental and climate change research; (2) ethnography in the IT industry; and (3) art–science collaborations. The authors reflect on interdisciplinarity from an innovative perspective, elaborating on three logics that influence collaborative research: the integrative-synthesis, subordination-service and agonistic-antagonistic modes of collaboration. The subordination-service mode, in particular, has

been an influential model in critical accounts of collaborations between the natural and social sciences.

Our third set of extracts comes from an article by Philip Lowe et al (Extract 1.3), which reviews some of the key challenges for those trying to produce more impactful social science by engaging strategically with natural scientists. These authors argue that effective engagement depends on overcoming basic assumptions that have structured past collaborative interactions. The article is based on their participation in a major research programme that examined the different assumptions underlying knowledge claims in collaborations between social and natural scientists. As their main contribution, the authors draw out the lessons for social and natural science in cross-disciplinary engagements. Extract 1.3 examines the authors' account of the different motivations for undertaking interdisciplinary research.

Finally, Lisa Lau and Margaret Pasquini's article (Extract 1.4) uses data from a series of interviews with lecturers and students (mostly from the Department of Geography at Durham University) to discuss attempts to bridge gaps between the sciences and the social sciences, and between the social sciences and the arts. This material is a good example of the specific complexities that interdisciplinarity entails when integrating dissimilar disciplines. We have extracted a section describing interviewees' differing understandings of interdisciplinarity and of geography, which illustrates some of these complexities – for example, how a researcher sees their current discipline can have an important influence on their willingness to engage with other disciplines.

EXTRACT 1.1

Klein, J.T. (2017) 'Typologies of Interdisciplinarity: The Boundary Work of Definition', in R. Frodeman, J.T. Klein and R.C. Dos Santos Pacheco (eds) *The Oxford Handbook of Interdisciplinarity* (2nd edn), Oxford: Oxford University Press, Chapter 3.

3.2. Interdisciplinary Integration and Collaboration

The OECD definition of ID was wide, encompassing any interaction ranging from "simple communication of ideas to the mutual integration of organizing concepts, methodology, procedures, epistemology, terminology, data, and organization of research and education" (in Apostel 1972, p. 25). Simple communication, though, does not entail key traits that Burns and Lattuca argue constitute ID. Integrated designs prioritize focusing, blending, and linking. In education for instance, courses achieve a more holistic understanding of a cross-cutting question or problem by combining historical and legal perspectives on public education or biological and psychological aspects of human communication (Burns 1999,

pp. 11-12; Lattuca 2001, pp. 81-83). Scope varies though, ranging from narrow to wide or broad ID depending on the number of disciplines involved and the compatability of their epistemological paradigms and methodologies.

Many believe that ID is synonymous with collaboration. It is not. However, heightened interest in teamwork to solve complex intellectual and social problems has amplified the connection while fostering greater attention to the interaction of cognitive and social integration. Degrees of cooperation differ, though. In Boden's concept of shared ID groups tackle aspects of a complex problem. Yet, collaboration does not necessarily occur. In contrast, cooperative ID requires teamwork, exemplified by the collaboration of physicists, chemists, engineers, and mathematicians in the Manhattan Project to build an atomic bomb and in research on public policy challenges such as energy and law and order (1999, pp. 17-19). Differences are further evident in methodological versus theoretical ID.

3.3. Bridge Building versus Restructuring

In 1975 the London-based Nuffield Foundation's Group for Research and Innovation identified two basic metaphors of ID – bridge building and restructuring. Bridge building occurs between complete and firm disciplines, while restructuring detaches parts of several disciplines to form a new coherent whole. A third possibility occurs when a new overarching concept or theory subsumes theories and concepts of several disciplines, akin to the notion of TD (Group for Research and Innovation, 1975, pp. 42-45). Landau, Proshansky, and Ittelson's typology of two phases in the history of interdisciplinary approaches in social sciences illustrates the difference between bridge building and restructuring. The first phase, dating from the close of World War I to 1930s, was embodied in the Social Science Research Council and University of Chicago school of social science. The interactionist framework at Chicago fostered integration, and members of the Chicago school were active in efforts to construct a unified philosophy of natural and social sciences. The impacts were widely felt, and occasionally disciplinary "spillage" led to formation of hybrid disciplines, such as social psychology and political sociology. However, traditional categories of knowledge and academic structures remained intact.

The second phase, dating from the close of World War II, was embodied in "integrated" social science courses, a growing tendency for interdisciplinary programs to become "integrated" departments, and the concept of behavioral science. Traditional categories anchoring disciplines were questioned and boundaries blurred, paving the way toward a new theoretical coherence and alternative divisions of labor. The behavioral science movement, in particular, sought an alternative method of organizing social inquiry rather than tacking imported methods and concepts onto traditional categories. In addition, the concept of "area" posited greater analytical power while stimulating a degree of theoretical convergence also potential in the concepts of role, status, exchange, information, communication, and decision-making (Landau et al. 1962, pp. 8, 12-17).

[…]

3.5. Transdisciplinarity

The recent ascendancy of TD is a prominent development in the history of ID. In the OECD typology, TD was defined as a common system of axioms that transcends the scope of disciplinary worldviews through an overarching synthesis, such as anthropology conceived as the science of humans. Three participants in the OECD seminar differed, though, in elaborating the concept. Jean Piaget treated TD as a higher stage in the epistemology of interdisciplinary relationships based on reciprocal assimilations. Andre Lichnerowicz promoted "the mathematic" as a universal interlanguage, and Erich Jantsch embued TD with social purpose in a hierarchical model of the system of science, education, and innovation (in Apostel 1972). Since then, the term has proliferated. Four major trendlines appear at present.

The first trendline is a contemporary version of the epistemological quest for systematic integration of knowledge. The quest for unity spans ancient Greek philosophy, the medieval Christian summa, the Enlightenment principle of universal reason, Hegelian philosophy, Transcendentalism, the search for unification theories in physics, and E. O. Wilson's theory of consilience. Reviewing the history of TD, Joseph Kockelmans (1979) found it has tended to center on educational and philosophical dimensions of sciences. The search for unity today, though, does not follow from a pregiven order. It must be continually "brought about," Kockelmans emphasized, through critical, philosophical, and supra-scientific reflection. It also accepts plurality and diversity, an underlying value of the Centre International de Recherches et Études Transdisciplinaire (CIRET). The center is a virtual meeting space for a new universality of thought and type of education informed by the worldview of complexity in science.

The second trendline is an extension of the OECD definition of synthetic paradigms. Miller defined TD as "articulated conceptual frameworks" that transcend the narrow scope of disciplinary worldviews. Leading examples include general systems, structuralism, poststructuralism, Marxism, phenomenology, feminist theory, and sustainability. Holistic in intent, these frameworks propose to reorganize the structure of knowledge by metaphorically encompassing parts of material fields that disciplines handle separately (1982, 21; see also Stribos, this volume). In the early twenty-first century a variant of this trendline emerged in North America in the concept of "transdisciplinary science" in broad areas such as cancer research. It is a collaborative form of "transcendent interdisciplinary research" that creates new methodological and theoretical frameworks for analyzing social, economic, political, environmental, and institutional factors in health and wellness (see Hall et al., this volume).

The third trendline is akin to critical ID. Transdisciplinarity is not just "transcendent" but also "transgressive." In the 1990s, TD began appearing more frequently as a label for knowledge formations shaped by critical imperatives in humanities, critiques of disciplinarity, and societal movements for change. Tracking the history of ID in Canadian Studies, Jill Vickers (1997) linked TD and "antidisciplinarity" with movements that reject disciplinarity in whole or in part, while raising questions of sociopolitical justice.

Examples include women's, native/aboriginal, cultural communications, regional, northern, urban, and environmental studies. Antidisciplinary positions have also moved beyond the academic sphere, favoring materials in ways dictated by students' own transdisciplinary theories, cultural traditions, lived experience, and connotations of "knowledge" and "evidence."

The fourth trendline prioritizes problem solving. It was evident in the late 1980s and early 1990s in Swiss and German contexts of environmental research. By the turn of the century case studies were reported on an international scale and in all fields of human interaction with natural systems and technical innovations as well as the development context. The core premise is that problems in the Lebenswelt – the lifeworld – need to frame research questions and practices, not disciplines. This connotation is strong in projects, such as Global TraPs (Global Transdisciplinary Processes on Sustainable Phosphorus Management), and in groups such as td-net (Network for Transdisciplinary Research). Co-production of knowledge with stakeholders in society is a cornerstone of this trendline, realized through mutual learning and a recursive approach to integration (see also Pohl et al., this volume).

The fourth trendline also intersects with two prominent concepts in the discourse of TD –"postnormal science" and "Mode 2 knowledge production." They stand in striking contrast to the intellectual climate of the 1970 OECD seminar, shaped by the organizing languages of logic, cybernetics, general systems theory, structuralism, and organization theory. Postnormal science is associated with TD because it breaks free of reductionist and mechanistic assumptions about how things are related and systems operate. "Unstructured" problems are driven by complex cause-effect relationships, and they exhibit a high divergence of values and factual knowledge. Hence, they are associated with the concept of "wicked problems" (see Bammer, this volume).

Gibbons et al. (1994) also proposed that a new mode of knowledge production has emerged. Mode 1 is characterized by hierarchical, homogeneous, and discipline-based work; Mode 2 by complexity, nonlinearity, heterogeneity, and TD. New configurations of research are being generated continuously, and a new social distribution of knowledge is occurring as a wider range of organizations and stakeholders contribute skills and expertise to problem solving. Gibbons et al. initially highlighted instrumental contexts of application, such as aircraft design, pharmaceutics, and electronics. Subsequently, though, Nowotny et al. (2001) extended Mode 2 theory to argue that contextualization of problems requires participation in the agora of public debate, incorporating the discourse of democracy. When lay perspective and alternative knowledges are recognized, a shift occurs from solely "reliable scientific knowledge" to inclusion of "socially robust knowledge."

EXTRACT 1.2

Barry, A., Born, G. and Weszkalnys, G. (2008) 'Logics of interdisciplinarity', *Economy and Society*, 37(1): 20–49.

Modes of interdisciplinarity

Much of the heat manifest in debates about interdisciplinarity stems from the potential for polarized judgements about the creative or repressive status of disciplinary knowledge. On one side are those for whom disciplines are generative and enabling, the repositories of a responsible kind of epistemological reflexivity. Marilyn Strathern gives voice to such a perspective when she writes that 'the value of a discipline is precisely in its ability to account for its conditions of existence and thus … how it arrives at its knowledge practices' (2004, p. 5). On the other side are those who see disciplines as 'inherently conventional', 'artificial "holding patterns" of inquiry' sustained by historical casts of mind 'that cannot imagine any alternatives to the current [disciplinary] regime'. In this view the significance of interdisciplinary research lies in the contrast with what are taken to be the more restrictive structures of disciplinary knowledge. Only interdisciplinarity holds out the promise of 'sustained epistemic change' (Fuller, 1993, n.d., pp. 1, 4).

In thinking about the relations between disciplinarity and interdisciplinarity, however, it would be a mistake to contrast the homogeneity and closure of disciplines with the heterogeneity and openness of interdisciplinarity. On the one hand, interdisciplinary research can involve hypostatization and closure, limiting as well as transforming the possibility for new forms, methods and sites of research (Weingart & Stehr, 2000; Strathern, forthcoming). On the other hand, disciplines themselves are often remarkably heterogeneous or internally divided (Galison, 1996b; Bensaude-Vincent & Stengers, 1996). Consider, for example, the differences between theoretical and experimental high-energy physics (Knorr Cetina, 1999) or between computational and laboratory medicinal chemistry (Barry, 2005). Even more radical internal differences exist between physical and human geography (Harrison et al., 2004) and between the sub-disciplines of anthropology (Lederman, 2005). Indeed, disciplines are routinely characterized by internal differences; the existence of a discipline does not always imply the acceptance of an agreed set of problems, objects, practices, theories or methods, or even of a shared language or common institutional structures.

Yet this heterogeneity is not necessarily a source of instability. In one account, 'the disunified, heterogeneous assemblage of the subcultures of science is precisely what structures its strength and coherence' (Galison, 1996a, p. 13). Disciplines exhibit clear inertial tendencies, and differences within them may exist over long periods of time. They may develop ways of translating across and negotiating internal boundaries; or chronic internal intellectual divisions may persist unaddressed through pragmatic working arrangements, or may even be collectively denied. Disciplines should not therefore be regarded as homogeneous, but as multiplicities or heterogeneous unities marked by differences which are themselves enacted in multiple ways (cf. Laclau & Mouffe, 1985,

p. 96). The existence of a discipline does imply a historically evolving and heterogeneous nexus of objects, problems, theories, texts, methods and institutions that are thought to be worth both contesting and defending. The boundaries of a discipline and the form in which it should exist, then, are in question and in play. Disciplinary boundaries and contents are neither entirely fixed nor fluid; rather, they are relational and in formation – dynamics captured by Stefan Collini in a powerful metaphor when discussing the emergence of cultural studies from its disciplinary progenitors: 'Cultural studies is part of the noise made by the great academic ice-floes of Literature, Sociology and Anthropology … as their mass shifts and breaks apart' (1994, p. 3).

Further conceptual ground-clearing is necessary in the face of efforts to define three types of cross-disciplinary practice: interdisciplinarity, multidisciplinarity and transdisciplinarity. Commonly, a distinction is made between multidisciplinarity – in which several disciplines cooperate but remain unchanged, working with standard disciplinary framings – and interdisciplinarity – in which there is an attempt to integrate or synthesize perspectives from several disciplines. Ian Hacking, for instance, sets out the case for multidisciplinarity when he argues for 'collaborating disciplines that need not be interdisciplinary' and that presume a strong disciplinary base in the study of complex objects (Hacking, n.d.). Transdisciplinarity, in contrast, is taken to involve a transgression against or transcendence of disciplinary norms, whether in the pursuit of a fusion of disciplines, an approach oriented to complexity or real-world problem-solving, or one aimed at overcoming the distance between specialized and lay knowledges or between research and policy or 'decision-making in society' (Lawrence & Després, 2004, pp. 398-400). Transdisciplinarity is the term favoured by Nowotny et al. for the Mode-2 knowledge production characteristic of what they term a 'Knowledge Society': thus, '[i]ts reflexivity, eclecticism and contextualization mean that Mode-2 knowledge is inherently transgressive. … [It] transcends disciplinary boundaries. It reaches beyond interdisciplinarity to transdisciplinarity' (Nowotny et al., 2001, p. 89). Whatever their descriptive uses, in general these definitional efforts have not proven generative in analytical terms. As Petts, Owens, & Bulkeley (in press, p. 8) note, the various definitions point to a spectrum: 'at its weakest, interdisciplinarity constitutes barely more than cooperation, while at its strongest, it lays the foundation for a more transformative recasting of disciplines.' We therefore take 'interdisciplinarity' as a generic term for this spectrum, while signalling salient issues from the definitional debate as they arise in our analysis.

How then can we conceptualize the relations between disciplinary and interdisciplinary forms of knowledge? Previous policy interventions and theoretical literatures on interdisciplinarity have tended to assume an integrative or synthesis model of interdisciplinarity, in which the interdisciplinary field is conceived in terms of the integration of two or more 'antecedent disciplines' in relatively symmetrical form (Tait & Lyall, 2001; Ramadier, 2004; National Academies, 2005, p. 26; Mansilla, 2006; Nowotny, n.d.). A major recent study of interdisciplinarity articulates this position clearly:

> In this integrative approach it is proposed that interdisciplinary work should be judged according to the criteria of the 'antecedent disciplines' and the value will be assessed

> in terms of these additive criteria. … In this study we defined 'interdisciplinary work' as work that integrates knowledge and modes of thinking from two or more disciplines. Such work embraces the goal of advancing understanding (eg explain phenomena, craft solutions, raise new questions) in ways that would have not been possible through single disciplinary means. (Mansilla & Gardner, n.d., p. 1)

This model has been performative. In climate change research, for example, it is thought that natural scientific and social scientific accounts of impacts might be integrated into a more general model, with social scientists providing an account of social factors ('society', 'the economy') which impact on climate change and are in turn impacted on by climate change (Jasanoff & Wynne, 1998, p. 3). The development of mathematical models provides one way in which such a synthesis can be achieved. It is worth noting, however, that, far from leading to the formation of new heterogeneous fields, the development of increasingly 'universal' models can lead to new kinds of closure effected through synthesis (Bowker, 1993). While the integrative mode can augur epistemic change, then, it does not guarantee it.

In our view, interdisciplinarity should not necessarily be understood additively as the sum of two or more disciplinary components or as achieved through a synthesis of different approaches. If we take the *integrative-synthesis mode* as a first type, we want to propose two additional ideal-typical modes of interdisciplinarity, both of which figure prominently in our research and which may coexist in some fields. In the second, *subordination-service mode*, one or more disciplines are organized in a relation of subordination or service to other component disciplines. This points to the hierarchical division of labour that characterizes many kinds of interdisciplinarity, an arrangement that may favour the stability and boundedness of component disciplines and inhibit epistemic change. In this mode the service discipline(s) is commonly understood to be making up for or filling in for an absence or lack in the other, (master) discipline(s). In some accounts the social sciences are understood precisely in these terms. They appear to make it possible for the natural sciences and engineering to engage with 'social factors' which had hitherto been excluded from analysis or consideration. Social scientists are expected to 'adopt the "correct" natural science definition of an environmental problem "and devise relevant solution strategies"' (Leroy, 1995, quoted in Owens, 2000, p. 1143, n. 3); or they may be called upon to assess and help to correct a lack of public understanding of science (Irwin & Wynne, 1996). One of the key justifications for funding art-science, particularly in the UK, has been the notion that the arts can provide a service to science, rendering it more popular or accessible to the lay public or publicizing and enhancing the aesthetic aspects of scientific imagery. Ironically, our research suggests that, in the microsocial space of interdisciplinary practice, the hierarchy entailed in the subordination-service mode can be inverted. In art-science, scientists sometimes adopt a service role for artist collaborators, providing resources and equipment to further a project conceived largely in artistic terms (cf. Born, 1995), while in the IT industry engineers may be called into the service of ethnographers.

In the third, *agonistic-antagonistic mode*, in contrast, interdisciplinary research is conceived neither as a synthesis nor in terms of a disciplinary division of labour, but as

driven by an agonistic or antagonistic relation to existing forms of disciplinary knowledge and practice. Here, interdisciplinarity springs from a self-conscious dialogue with, criticism of or opposition to the intellectual, ethical or political limits of established disciplines or the status of academic research in general – a transposition on the plane of the politics of knowledge of Mouffe's (2005) stress on antagonism as constitutive of the political. This does not mean that what is produced can be reduced to these antagonisms. Through this mode we highlight how this kind of interdisciplinary field or practice commonly stems from a commitment or desire to contest or transcend the given epistemological and ontological assumptions of historical disciplines – a move that makes the new interdiscipline irreducible to its 'antecedent disciplines'. We will show, for example, how certain advocates of ethnography in the IT industry seek explicitly to constitute ethnography as a field which may be intellectually antagonistic both to existing sociological approaches to the study of technology (Randall, Harper, & Rouncefield, 2005) and to narrowly scientific and technical understandings of the properties and uses of technical objects and devices (Suchman, 1987; Nardi, 1996; Dourish, 2001).

Prominent in discussions of interdisciplinarity are two further methodological orientations which span the three modes. On the one hand, interdisciplinarity is commonly identified with problem-solving in response to new problems or objects that, it is believed, lie beyond the frame of existing disciplines. But rather than conceive of problems arising *de novo* and demanding interdisciplinary solutions, we should understand them as constituted as interdisciplinary problems relationally through dialogue or dissatisfaction with the problematics proffered by existing disciplines and institutions. The problem-focused, policy orientation of interdisciplinary environmental research, for instance, developed in conjunction with the constitution of multi-dimensional practical and political issues such as GMOs and climate change (Berkhout, Leach, & Scoones, 2005, p. 10). Some have argued additionally for the development of interactive methods involving government officials in research design and execution, thereby bringing research closer to the context of application in environmental policy-making (Turnpenny & O'Riordan, 2007, p. 103). On the other hand, rather than being object-oriented, interdisciplinarity can be practice-oriented in the sense that, where a disciplinary division of labour persists, cross-disciplinary collaboration is idealized as a value in itself, and one that outweighs any particular project (Born, 1995, chs 7, 8; Strathern, forthcoming). Commentaries on art-science, for example, sometimes portray the microsocial collaborative endeavour between artists and scientists as a crucible for creativity and as itself a focal value.

We have suggested that interdisciplinarity takes a range of forms with distinctive effects. While the discourse of Mode-2 alerts us to the importance of accountability in contemporary science policy, in its desire to discern a unitary epochal shift it collapses a number of alternative modes and trajectories of interdisciplinarity. The difference that environmental social science can make to natural-scientific environmental research, or that ethnography can make to computer-science-led design in industry or HCI (human-computer interaction) research, or that art-science collaborations can make to artistic or scientific practices cannot be understood solely in terms of making good an absence of connection to society, a lack of cognizance of users or a lack of public engagement with

science. Rather, for some of their proponents such fields are intended to effect qualitative transformations, experimenting with and establishing new forms of practice that exist in an agonistic or antagonistic relation to, and that may destabilize, existing disciplines and practices. Yet while these kinds of interdisciplinarity cannot be cognized in terms of an additive synthesis of 'antecedent disciplines', and despite agonism or antagonism evident in a critique of disciplinary norms, a central concern of such research may well be strenuously to rebound on those antecedent disciplines, with the aim of reconfiguring their boundaries, objects and problematics.

If the integrative-synthesis mode can augur epistemic transformations, and if the service-subordination mode, with its disciplinary division of labour, does not necessarily afford even this, then what is striking about the agonistic-antagonistic mode is that it is intended to effect more radical shifts in knowledge practices, shifts that are at once epistemic and ontological. Indeed in what follows we propose that the three interdisciplinary fields that we studied evidence a privileged relation between the agonistic-antagonistic mode and the logic of ontology. To demonstrate this it is necessary to employ the framework outlined earlier, and specifically to do two things: first, through an account of the particular genealogies of each field, to indicate how the agonistic-antagonistic mode can only be understood diachronically in terms of a dynamic commitment to superseding prior ontological commitments with a new ontology; and, in doing so, to convey how this dynamic cannot be grasped by attributing a spurious unity. Instead, each interdisciplinary field must be analysed as precisely in play – as a heterogeneous unity or multiplicity.

EXTRACT 1.3

Lowe, P., Phillipson, J. and Wilkinson, K. (2013) 'Why social scientists should engage with natural scientists', *Contemporary Social Science: Journal of the Academy of Social Sciences*, 8(3): 207–22.

Motivations for interdisciplinarity

Among the Relu-funded ecologists, previous experience of interdisciplinary working varied from those who had an extensive history of collaboration with different types of social scientists to those for whom the Relu programme had provided a catalyst to work beyond their own field for the first time. The motivating factors cited by the ecologists map onto our three roles for social scientists.

Public representation was achieved by two mechanisms in the Relu projects: firstly, through the inclusion of social scientists, who necessarily provided a social dimension to the research through their understanding of social, political, regulatory and economic contexts, as well as through their data-gathering methods that allowed access to public views, opinions and knowledge. Additionally, each project was required to include a plan for stakeholder engagement, usually achieved through a set of advisors drawn from

policy circles, community groups, the farming industry or other relevant audiences for the research. In practice, the two streams of public representation became blurred as researchers made creative use of their stakeholder networks through a variety of knowledge exchange activities and data gathering processes, which the social scientists were able to facilitate and analyse.

Several of the projects aimed to incorporate non-academic knowledge into their research, for example, by understanding how local communities perceive the risk of flooding (Lane et al., 2011) or how farmers interpret advice about farmland management and balance this against their own experiential knowledge (Proctor, Donaldson, Phillipson & Lowe, 2012). One of the ecologists described their motivation for working with social scientists:

> Social science plays a key part in our research because our project aims to combine knowledge from local stakeholders, policy-makers and social and natural scientists to anticipate, monitor and sustainably manage rural change in UK uplands. Key to this is linking the social and economic activities of local communities, through management, to the natural processes in upland landscapes. Without understanding these linkages policy prescriptions to influence management decisions may not have the anticipated ecological and social outcomes.

Another ecologist saw this desire to include stakeholder opinions as part of the broader trend of democratising science and breaking down the top-down model of knowledge transfer:

> The project is led by social scientists. The approach is to move away from black and white 'this is the science and this is what you need to do' towards involving the local community in deciding future actions based on good evidence.

The role of social scientists in problem framing became key as Relu funding bids developed, as researchers discovered the difficulty of designing projects from a monodisciplinary perspective and then trying to incorporate social science perspectives as an afterthought. As one ecologist commented:

> It is vital that both ecologists and social scientists have at least some understanding of how the other group thinks and works so some interaction before a project starts is necessary. Trying to respond to a call integrating social science and ecology without some prior interaction will probably result in failure to deliver. Understanding what each group requires of the other is also a key point to resolve at an early stage.

Joint problem framing was seen as critical to developing projects that would approach a key question or set of issues from multiple angles, ensuring a more coherent set of solutions could be delivered. To take one example, a project on organic agriculture aimed to understand the changing nature of agricultural production by jointly exploring both the socio-economic and the ecological factors driving, and being affected by, the uptake

of organic farming. Two key questions were addressed: what causes organic farms to be arranged in clusters at local, regional and national scales, rather than be spread more evenly throughout the landscape; and how do the ecological, hydrological, socio-economic and cultural impacts of organic farming vary due to neighbourhood effects at a variety of scales. As a researcher on the project commented:

> [engaging with social scientists] places the natural science component in a context that will hopefully lead to meaningful policy decisions concerning sustainable agriculture and the multiple benefits that may accrue, only one of which is biodiversity. Without the social science perspective the natural science becomes rather meaningless.

Finally, researchers were motivated to engage in collaboration through a desire to more effectively understand and in some cases, impact upon the broader systems in which their research area was situated. Growing appreciation of the interrelationships between the social and natural dimensions of a problem led ecologists to seek the expertise of social scientists to maximise the utility of their research. In some cases, the expression of these aims came close to the end-of-pipe language of finding new ways to communicate science to non-experts, for example:

> The biological research is very applied with the aim to develop techniques/knowledge that can be applied. However, in the past uptake of such findings has often been poor. If we can better understand the constraints and forces driving farmers then we will be able to develop advice/techniques that fit within these.

However, a more nuanced approach emerged that recognised understanding interconnectedness as a way of doing science better, rather than simply having recommendations accepted more easily:

> It is all very well saying that a certain climate change scenario will lead to X, Y and Z biophysical consequences, but people live in that landscape and will adapt their behaviour to the changing climate in complex and dynamic ways. If we can capture this and understand how likely human responses will feed into the biophysical system, it is possible to provide a more nuanced, integrated and reliable assessment of future change.

These different comments reflect the continuing variation within the discipline of ecology with regards to the role that social science has to play. Within the survey as a whole, when asked how ecologists could more effectively address complex environmental problems, 44% felt that 'dealing more effectively with the social/human dimensions of their work' was what was primarily needed, while 35% felt they had to 'communicate their findings more effectively' and 22% thought the answer was to 'produce better ecological science' (see Lowe et al., 2009, p. 302).

For the social scientists, too, the contextual information provided by their natural science counterparts was invaluable in helping them to form a fuller picture of the problem they were investigating. Two political scientists commented (Greaves & Grant, 2010, pp. 332–333) that in both of the projects on biopesticides and livestock diseases they had been involved in

> the political scientists relied on the technical knowledge of the natural scientists to understand the precise nature of the policy challenges and the options open to the regulatory system to respond to them.

EXTRACT 1.4

Lau, L. and Pasquini, M.W. (2004) 'Meeting grounds: Perceiving and defining interdisciplinarity across the arts, social sciences and sciences', *Interdisciplinary Science Reviews*, 29(1): 49–64.

Our twin testimonies, describing interdisciplinary research spanning different academic spheres of knowledge, reveal that the sense of being an outsider is equally valid whether one is moving into the social sciences from the arts or from the sciences. The discovery of this commonality of experience prompted us to engage with notions of identity: our personal identities, our identities as geographers, our identities as interdisciplinary scholars, both as we ourselves perceived them and, importantly, as we deemed we were perceived by others. To this end, we carried out a series of interviews with fourteen respondents, who were chosen for their connections with and interest in interdisciplinary research. Seven of these were human geographers, five were physical geographers and two were anthropologists (selected for their close connections with geography). The geographers represented all five research groups within the Durham department – cultural and social geography, development studies (this group has since been dissolved), earth surface systems, political economies of geographical change and quaternary environmental change. The positionalities of the respondents greatly influenced their feedback, but in order to preserve their anonymity no further details can be revealed (including data on gender and position within the academic hierarchy). Instead, respondents have been given river names as pseudonyms.

The mention of interdisciplinary research generally brought about a deluge of positive comments. It was described as 'intellectually exciting', 'extremely interesting', 'stimulating intellectually, culturally in all sorts of different ways', 'fantastic, what we really need', 'of enormous value' and 'interesting'. Mississippi mentioned that over the last ten years there had been papers showing that the most productive work is done in marginal, interdisciplinary areas. Paraná said that the presence of interdisciplinary research made the department 'much more exciting, much more interesting, and of a much higher quality as a result of this, because the sparks fly, there is more electricity as a result of it, there's much

more energy'. Interdisciplinary research encouraged people 'to challenge preconceptions' (Jamuna), it meant that 'research was better' (Jamuna) and it was definitely 'the way for the future' (Amazon).

The problem of understanding interdisciplinarity is akin to that of the proverbial onion: as we peel back layer after layer, so numerous complexities are revealed. Despite all the positive comments, because the interviews were designed to allow for individual, personal definitions and conceptions of interdisciplinary research, the respondents may have been talking at cross purposes and on different levels.

On the first level, there was contestation over the terminology. The geographers at Durham work with and from different definitions. Amu Darya felt that 'interdisciplinary' and 'cross-disciplinary' were synonymous, and that 'interdisciplinary' indicated links between two disciplines and 'multidisciplinary' between three or more. Respondents frequently commented that the approach to interdisciplinary research should be team based. Ganges felt that the word multidisciplinary should be used in preference to interdisciplinary because true interdisciplinarity can only be achieved if the partners in a research project work together side by side in the field for a long time. If monodisciplinary partners go into the field separately, and work on their own speciality, as normally occurs, the result is only multidisciplinarity. Missouri persisted in using the word interdisciplinary (which was interchanged with cross-disciplinary), but stressed that people had to work in a team, and that it was only after working in a team for many years that an individual could learn to see from alternative perspectives. Jamuna felt that a research programme can transcend disciplines, but that individuals tend to remain rooted in their specialisms, so 'multidisciplinary' is a more appropriate term. Rhine and Mississippi introduced the idea of 'post-disciplinary' research. A post-disciplinary world was understood to be topic driven (when disciplinary badges are set aside in order to work on a particular topic – such as feminism or post-colonialism – from different angles), and would be dominated by schools of thought rather than disciplines.

On a second level, there appeared to be roughly three camps of thought regarding geography and interdisciplinarity: those who were thinking in terms of links between geography and other disciplines, those who were thinking in terms of links within geography between different geographical research groups, and those who reflected on both. Implicit or explicit definitions of what constitutes interdisciplinary research quite naturally influenced the tenor of interview discussions. This is arguably of some importance: because there is no clear definition or consensual understanding of what constitutes interdisciplinary research, it is therefore not easy for geography to promote or support such work.

If interdisciplinary research is regarded as geography linking with other disciplines, then most of geography should be considered interdisciplinary. A large proportion of physical geographers are biologists, geologists, geophysicists or oceanographers by training. The human geographers are even more diverse as they include economists, philosophers, political scientists, social anthropologists, sociologists and so on. Even those trained as geographers may still have strong links with other disciplines, and indeed some stated that they could quite comfortably transfer to different departments, such as history, politics,

sociology or social anthropology, although most (e.g. Jamuna, Rhine) did not want to because they felt that the geographical dimension was important, and not given enough weight in these other settings.

If, on the other hand, interdisciplinary research is regarded as the exploration of relations between the categories 'natural sciences', 'social sciences' and 'humanities', then the picture becomes a lot more complicated. The words of Rhine provide a good baseline for the discussion:

> People would normally think of interdisciplinary research as Geography and something else, but I consider research within Geography as interdisciplinary anyway, because the key boundary is between social and natural sciences. You can look at this as a boundary or you can look at it as a relationship, if you look at how a lot of social thought has changed over the last 15–20 years, you can see it has developed relationally, so you can see that the social and the natural are mutually constituted, rather than two separate realms between which there is a boundary which you occasionally cross … the more we're pushed into the social construction of the biological, or the recognition of the biological basis of the social, then the more it is difficult to maintain this boundary … In the last few years there has been a lot of emphasis in social science on notions of performance and practice and what people actually do, the embodiment, the embodied character of social life, and the embodied character of natural things, looking at work in the performing arts, dance and dramatology, looking at how you use those in social sciences and increasingly across the social and natural links …

Opinions and inclinations

Although Rhine's opinion was that there are conceptual links between the natural and social sciences and the humanities, it was clear, nonetheless, that few had yet thought about this in any theoretically explicit or thorough manner. The few that had did not all necessarily agree with Rhine's opinion. For example, Mississippi opined that 'No vast intellectual project holds the discipline together', but followed this up with the point that in terms of research funding and resource flows, it is important for human and physical geographers to ally themselves together. The next paragraphs attempt to summarise the attitudes and the opinions of the respondents towards interdisciplinary research, and possible reasons for these. However, it must be borne in mind that the sample size was small, and our conclusions must therefore not be assumed to be representative.

The physical geographers were quite receptive to the idea of combining the approaches of the social and natural sciences, but they were generally thinking in terms of research with a practical implication, carried out to benefit society (e.g. Danube). Areas within physical geography where there seemed to be agreement that interdisciplinary approaches were most appropriate were: environmental management of pollution; the use of remote sensing or Geographical Information Systems (GIS) in resource mapping or in understanding the nature of a resource and its context in the development of the management of this

resource; the application of earth sciences to the understanding of landslides to improve the management of human responses or to determine how different societies should plan to respond to this risk; the multiple views of scientists and scientific policymakers in relation to a particular project; behavioural issues related to how the environment is used; and agriculture and the use of indigenous knowledge in development.

Social scientists with an interest in development also had a practical understanding of why it was useful to combine the natural and the social sciences. Euphrates stated that '…by [interdisciplinary research's] very nature you end up dealing with "more real" issues'. Ganges explained that when working in marginal environments you had to have an understanding of both natural and social causes of problems. For example, even if you were doing plain social science research, you might still need to understand the nature of soils in a particular environment (anthropologists share the same view, as they realise that development must have a holistic approach).

Some of the human geographers appeared sceptical about the real possibilities of linking physical and human geography. Jamuna explained that there are two different models of geography:

> One [model] says that geography historically has attempted to combine two fundamentally very different approaches to research, natural and social sciences, and that in reality geography would be much more comfortable if the two sides went their separate ways … Another model is a unified vision of geography, with geography as an integrated subject with a historical tradition that has something to offer that the two sides on their own wouldn't. I am somewhat sceptical about this, because research has specialised so much, with the majority of research projects there isn't much benefit of being part of an integrated discipline called geography, they would have been fine on their own … The area that is usually mentioned as interdisciplinary is the environmental area, but I have always taken the view that this is a bit of a myth, that the environment is holding geography together, because people who study it, either study it as environmental scientists (so as physical geographers) or as social scientists … Only a small minority of people are genuinely doing both, doing both the environmental science stuff and the social science perspective.

These ideas find echo elsewhere: in discussing the move away from having a single human/physical tutor for the undergraduates as a result of the increase in specialisation, Amu Darya commented: 'I am surprised the subject is still holding together.'

There are two difficulties in making a link between the natural and the social. One lies in the conceptual and theoretical clash. According to Po, natural scientists are positivists, 'they all speak the same atomic language', thus they have a common currency. By contrast, social scientists privilege theory (Yangtze). Yangtze observed that 'post-structuralists have difficulties with something like soil science – it is a theoretical clash', but went on to express the opinion that 'in reality, the positivist/post-structuralist area is very fruitful to work in'.

The second difficulty is that over time, training in geography has changed. So, the difficulty experienced by some in linking the natural and the social could be generational.

Missouri said: 'The old school geographer had a very broad background, but they are disappearing as they get older. The younger colleagues tend to be a lot more specialised, and so in a sense, narrower.' Amazon, a younger colleague, backed this up by giving the example of a senior colleague who had made 'generalism his specialism' and had been able to occupy the common ground shared by physical and human geography, but described him as 'an increasingly rare beast'. Ganges explained that in a 'traditional' geography degree you would have studied both human and physical geography, which made you a 'real' geographer. Those who had only been exposed to human or physical geography did not qualify as 'real' geographers.

So, a number of respondents did not see interdisciplinary research as anything new, at least in the geographical context (Rhine, Paraná, Missouri, Yangtze). Geographers, even though they tend to specialise in either physical or human geography, have been exposed to both sides, so they have 'split personalities' (Paraná). They may be 'schizophrenic, but this is an asset because they can see what is on the other side of the boundary and they do not perceive it as threatening' (Paraná). Rhine stated that geography had always done interdisciplinary research; Rhine had always done interdisciplinary research. This sentiment was echoed by quite a few others: they had been trained in interdisciplinary approaches, so they saw no difficulties in combining different viewpoints or methodologies. It is curious that these contradicting viewpoints go largely unacknowledged by members of staff. It is almost as if staff do not wish to admit the existence of a marked divide between human and physical geography, a divide that was nevertheless noticed by undergraduate students as it manifested itself even during lectures, in sardonic allusions by both physical and human geographers to the comparative dullness of the 'other' side of geography. This divide could at least in part stem from the heated debate in the literature, and within and between geography departments, as to what geography really is, what it has to offer and where it is going in the future.

There exist varying degrees of allegiance towards geography as a discipline at Durham. There are those who view geography in a rather negative light. Mississippi stated that 'Some people go moist eyed and weepy about geography as a discipline but for me they are all tweed and beard. It's rather sad', and concluded that there was no justification for geography on the intellectual level. There were two coherent definitions of geography, one to do with 'where things are and how they got there', which was 'dull beyond words', and the other to do with 'the orchestration of processes in space and time', which did not justify a distinct discipline. However, in practice the existence of geography as a discipline could be justified because other disciplines simply ignored the orchestration of processes in space and time, whereas geography allowed the importance of space and time to be reasserted. Others also felt the lack of a coherent justification holding geography together. Jamuna explained: 'I have affection for geography because I've studied it all my life, but I don't make a fetish out of geography for the sake of geography' (however, the statement was qualified by making it clear that the issue whether geography should be a unitary discipline depends on whether one is discussing this matter at undergraduate or research level).

Paraná's position was slightly different, coming from an advocate for physical and human geography remaining within one department: 'Staying together keeps departments going

because they are constantly prodding each other, and it is a process of cross-fertilisation. Evolution shows that mixing genes makes the product stronger.' Rhine also felt confident about geography as a discipline, and felt along with other colleagues that a strong case could be made as to what was intellectually distinctive about it, as it examined relations between people, nature and space.

Summary

In conclusion, despite all the generalised positive responses to the idea of interdisciplinary work, this optimism should not be taken at face value. For one thing, respondents did not always share a common definition or understanding of interdisciplinary research, and for another, they had individual definitions or understandings of what geography encompasses. Thus, it can be seen that not only is the definition of interdisciplinarity dependent on positionality, but the definition of geography is equally dependent on the same.

Commentary

Isabel Fletcher

This piece is structured around my route to becoming an interdisciplinary and/or transdisciplinary researcher. Woven into this narrative are explanations of what I found useful or thought-provoking about each of the four sets of excerpts included in this chapter. Much of this reflection involves using these texts to look back at my career because, as I explain below, at the time I was not aware of most of the academic literature on interdisciplinary research (and had never heard the term 'transdisciplinary'), and nor did I think of myself as an interdisciplinary researcher. Instead, I thought of myself as someone who was interested in interdisciplinary topics, such as how to feed the planet and how we understand the relationship between diet and health.

I have an undergraduate degree from the Open University (OU) that I did part-time while working in a range of jobs in the catering industry. The OU course requirements meant that I could study what interested me, and so I took courses across a range of disciplines, including cultural studies, development studies, English literature, gender studies, history of medicine and sociology. I graduated with what I now realise is, in a UK context, an unusually interdisciplinary undergraduate degree – in terms of topics of study and perhaps conceptual frameworks, if not research methods.

I returned to full-time study to undertake a Master's and then a PhD in science and technology studies (STS) at the University of Edinburgh. STS is generally accepted to have developed from the 1970s as an explicitly interdisciplinary field of research analysing science and technology using

approaches derived from older disciplines such as anthropology, history, philosophy, political science and sociology. In my doctoral research I combined approaches from STS with those from history of medicine and policy studies. This might be considered a form of interdisciplinarity, but felt very much part of an existing STS approach that encouraged theoretical and methodological pluralism – a form of 'bricolage' where the researcher assembles the appropriate resources to understand a particular research topic.

At the time I was a PhD student, both European and national funders (such as the Economic and Social Research Council [ESRC] that funded my PhD) were encouraging researchers to undertake interdisciplinary research, especially on complex and policy-relevant social issues – what we would now call challenge- or mission-oriented research – and to engage with those in other sectors – usually described as 'stakeholders' – as part of transdisciplinary research processes. However, despite this encouragement, it was not made clear to us PhD students what interdisciplinary research involved and, in particular, how it was different from the mono-disciplinary model of research that structures universities and other academic institutions. This is one reason why I find Julie Thompson Klein's pioneering work on models of inter- and transdisciplinarity so valuable.[2]

Klein's typology of changing definitions of terms such as 'interdisciplinary' and 'transdisciplinary' provides an overview of the differing ways in which collaborative research has been conceptualised, highlighting the diverse communities of practice that have developed these definitions. This clarity is important because – as we found in the SHAPE-ID research (Vienni-Baptista et al, 2020) – shared definitions of these terms are often taken for granted. This is particularly true of the research policy literature where influential arguments about why and how to conduct such research circulate. This lack of clarity is compounded by the disparate and disjointed nature of the academic literatures on inter- and transdisciplinary and other forms of collaborative research: several different communities of practice have developed their own distinct bodies of literature analysing how to best conduct different forms of collaborative research. These literatures are not well connected to each other or the research policy literature. This causes problems – particularly for newcomers, such as PhD students and early career researchers – because it leads to confusion about what different terms mean in practice: what do interdisciplinary research, transdisciplinary research or team science involve, and how are they different from each other? It also leads to a cycle of 'reinventing the wheel' where the same research problems are rehearsed in the literature without acknowledging that solutions exist in other literatures (Vienni-Baptista et al, 2022).

This piece of Klein's writing (Extract 1.1) is a high-level overview of the topic. In contrast, the final excerpt by Lisa Lau and Margaret Pasquini (Extract 1.4) explores the attitudes of a group of geography researchers to

interdisciplinarity, and here I see parallels between their accounts and my experience of being trained in STS (I am still uncertain whether it can or should be called a discipline). Recently I discovered the concept of a 'portmanteau' discipline (Lyall, 2019: 43), and I think this term captures what is important about fields of research like geography and STS, which have relatively porous boundaries and within which methodological pluralism is accepted or even encouraged. Extract 1.4 also highlights how the internal structure of disciplines influences the ways in which researchers working within it practise interdisciplinarity – for example, do you prioritise partnerships with other geographers, or look outside the discipline for potential collaborators? It shows how analysing interdisciplinarity and the ways in which we practise it entails thinking more clearly about what constitutes a discipline and how individual disciplines differ. Lau and Pasquini's material also demonstrates the different ways in which individual researchers identify (or not) with a discipline, something that these results show is as variable for these individuals as their understandings of interdisciplinarity.

The article by Philip Lowe and his co-authors (Extract 1.3) deals with the empirical, but in a different manner as it uses the Rural Economy and Land Use (Relu) project as a case study to explore why and how to undertake such research. Although the authors label it as interdisciplinary, Relu involved extensive interactions with a range of stakeholders, and now we might describe it as transdisciplinary research. In the excerpt we have selected, Lowe and his colleagues outline some of the reasons why social scientists might want to collaborate with natural scientists. They argue that joint problem framing between these groups was 'critical to developing projects that would approach a key question or set of issues from multiple angles, ensuring a more coherent set of solutions could be delivered' (Extract 1.3). This is very much how I was trained to undertake research, and has become an underlying principle in much policy-oriented research conducted in the UK and elsewhere.

At the same time, Lowe et al also describe some of the processes of collaborative research developed by project members, making the research seem more concrete and therefore achievable for novices. These processes were built into the structure of the project and, the authors argue, are necessary to achieve impactful social science. Refreshingly, despite the success of the Relu project, the authors carefully acknowledge the extra work that collaborative research involved, highlighting some of the main challenges that they encountered. These included differences between quantitative and qualitative research methods, competition between closely related disciplines and contrasting approaches to reflexivity and social critique, all of which I have experienced at some point in my postdoctoral career. When I finally read this piece, I found it reassuring to know that

others, including established researchers, also experienced these issues and found them challenging.

In my postdoctoral career I have worked on a range of topics – always on fixed-term contracts and often for interdisciplinary centres and projects – as well as co-convening a cross-disciplinary network for researchers working on food-related topics (one of my central research interests). This has involved working with other social scientists as well as researchers from the humanities and biomedicine. Some of these projects have involved engagement across disciplines where we learned from each other's perspectives, but, in my experience, this has been rare. More common is an instrumental approach to collaboration where one discipline frames the research project and other disciplines are brought in to address particular research questions and often to undertake specific pre-assigned tasks. The excerpt by Andrew Barry and his co-authors (Extract 1.2) resonates strongly with this postdoctoral experience, and gave me a language to describe my interactions with other disciplines as well as those of other academics in my department who were conducting very similar studies to those described in the case studies. Barry and his colleagues describe three modes (or ideal-types) of collaboration: integrative-synthesis, which was seen as what we should aspire to; subordination-service was something as social scientists aiming to study science and scientists we were warned about (but did not necessarily have the capacity to change on our own); and finally the agonist-antagonist mode was not usually encouraged in the parts of STS that emphasised pragmatic engagement with science and science policy.

I have most often experienced subordination-service modes of interdisciplinarity – not just with colleagues from the natural or biomedical sciences, but also those from other more quantitative social sciences such as economics. This mode of engagement seems particularly common among quantitative researchers working in areas such as sustainability, especially if their work is closely aligned to the natural sciences. Funding agencies encourage large interdisciplinary proposals on high-profile topics such as improving food systems or combating anti-microbial resistance, with the stipulation that project teams include a range of disciplines. However, such encouragement does not always involve providing incentives for all the chosen disciplines to be involved in the important early stages of developing a proposal where the approach to the research is mapped out and the specific research questions are framed. In my experience, this leads to the predominance of subordination-service models of research, where qualitative researchers are still restricted to working on pre-defined topics such as public acceptability, attitudes or ethical implications of new technologies.

Elsewhere (Fletcher and Lyall, 2021), we have argued that it is possible for social scientists to undertake good quality research in such situations. Felicity Callard and Des Fitzgerald (see Extract 3.1) also reflect on this issue and come

to a similar conclusion, arguing that integration is an idealised pipe dream and that we need to take the opportunities on offer from more limited roles or engagement. However, I want to retain the option of greater integration, particularly in the case of challenge-based research. Projects led by natural scientists often frame problems in restricted and often quite technical ways – How do we produce more food? How do we get people to eat better? How do we prevent the 'misuse' of antibiotics? – that unhelpfully restricts the kinds of research questions that can be asked, and therefore undermines the potential of inter- and transdisciplinary research to provide useful knowledge.

Despite a career that has involved working in various interdisciplinary contexts and a long-standing interest in topics that cross discipline boundaries, I do not consider myself an expert in inter- or transdisciplinary research. Only recently, and partly as a result of my participation in the SHAPE-ID project, have I begun to label myself as an interdisciplinary or even transdisciplinary researcher. Reflecting on this reluctance as I write this commentary, I conclude that a large part of it comes from a lack of knowledge – important-sounding pronouncements about the need for collaborative research to solve pressing social problems combined with a lack of information about how to go about these kinds of research made it seem unachievable. The key thing I learned from my participation in the SHAPE-ID project is that there are many different ways of undertaking collaborative research, and that there are different forms of knowledge involved – from the academic specialism of 'research on research' to the mundane knowledge of inclusive daily work practices and the importance of record keeping.

Notes

[1] Sadly, Julie Thompson Klein passed away in January 2023 during the production of this book. She is a greatly missed friend and mentor to many within the interdisciplinary and transdisciplinary research communities.

[2] For an STS researcher whose work focuses on interactions between science and policy, Klein's work also provides a valuable historical perspective on how models of science policy developed in the second half of the 20th century.

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References to figures and boxes appear in *italic* type; those in **bold** refer to tables.

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