Organizations in the making: Learning and intervening at the science-policy interface

Abstract

This paper synthesizes recent insights from geography, science and technology studies and related disciplines concerning organizations and organizational learning at the science-policy interface. The paper argues that organizations do not exist and evolve in isolation, but are co-produced through networked connections to other spaces, bodies and practices. Furthermore, organizations should not be studied as stable entities, but are constantly in-the-making. This co-productionist perspective on organizations and organizing has implications for how geographers theorize, study and intervene in organizations at the science-policy interface with respect to encouraging learning and change and in the roles we adopt within and around such organizations.

Keywords

I Introduction

Work in human geography has long strived both conceptually and in practice to understand the nature of organisations and organisational change. Enduring debates have concerned the relative importance of the actions of individuals compared to pre-determination by organisational structures, and the relative roles played by processes internal or external to formal organisational structures in bringing about organisational change. Such conversations, played out in this journal and others, have been related to organisational bodies as diverse as NGOs or charities (e.g. Conradson, 2003), activist groups (e.g. Pickerill and Chatterton, 2006), public sector bodies (e.g. Pelling et al., 2008), international monitoring organisations (e.g. Bulkeley, 2005) and private businesses (e.g. Dixon 2010). Geographers have more broadly approached the study of organisations and processes of organisation with attention to a range of cross-cutting themes, for example gender (e.g. McDowell ,2008), globalization (e.g. Larner and Laurie, 2010), inclusion and representation (e.g. Langford and Higgs, 2010) and concern for non-humans (e.g. Morris and Holloway, 2008). Through such work, and consistent with developments in related disciplines like science and technology studies (STS), geographers have begun to challenge taken-for-granted assumptions about the nature of organisations and the appropriate way for academics to engage with and study them. This paper explores the development of these novel perspectives with a particular focus on learning and reflexivity as mechanisms of organisational change and responsiveness.

One particular category of organisations which has been of interest to many geographers is that of organisations operating at the science-policy interface (e.g. Chilvers and Evans, 2009; Demeritt and Lees, 2005; Doubleday, 2007; Doubleday and Wynne, 2011; Eden, 2009; Hinchliffe, 2001; Holifield, 2009; Kearnes and Wienroth, 2011; Mahony, 2013; Owens, 2011; Owens et al., 2006). Organisations in this highly active and contested sphere have become interesting to

geographers, STS scholars, and others, both due to the rising prominence of science policy issues from climate change to genomics in public life, but also because they face potentially novel and unprecedented organisational challenges (Felt and Wynne, 2007; Gottweis et al., 2007) which challenge conventional assumptions about organisations and change. In developing new perspectives on organisations in-the-making in this paper, it is particularly important to focus on organisations at the science-policy interface for three main reasons, each of which account for different ways in which geographers and other academics interact with such organisations.

First, the subject of organisations and organising at the science-policy interface has become an important area of *study and theorizing* in and of itself in geography, STS, and cognate disciplines. For the purposes of this paper we further distinguish between two overlapping approaches to this area of research. On the one hand is a range of studies that develop conceptual insights and in-depth analytical/interpretive accounts of organisations, networks and change at the science-policy interface (e.g. Gieryn, 1995; Guston, 2001; Hinchliffe, 2001; Jasanoff, 2005a; Owens, 2010). On the other hand this area of research is also associated with bourgeoning studies by geographers and other social scientists that attempt to intervene in developing new organisational practices and making modes of organizing at the science policy interface more 'effective', responsive, adaptive, and reflexive. This includes, but is not limited to, work on: adaptive co-management (e.g. Olsson et al., 2004); adaptation and resilience (e.g. Pelling et al. 2008); sustainability transitions (e.g. Lawhon and Murphy, 2011; Rotmans and Loorbach, 2008); environment, technology and risk assessment/appraisal (e.g. Schot and Rip, 1997; Sinclair et al., 2008; Stirling, 2008); anticipatory governance and responsible innovation (e.g. Anderson, 2007; Owen et al. 2012); and practices of public participation and inclusion (e.g. Chilvers, 2009; Davies, 2006; Pain, 2004).

Whilst the bulk of this paper will be focused on this first mode of academic engagement with organisations at the science-policy interface, there are two further important reasons for taking this substantive focus, both of which are deeply intertwined with ongoing debates over geography's public and policy relevance (e.g. Ward, 2005, 2006). The second reason, then, is that geographers have increasingly been motivated to *engage with* organisations at the science-policy interface, through roles in advisory bodies (e.g. Owens, 2011) or being called upon as 'experts' (e.g. Eden, 2005), by undertaking joint research projects or research on behalf of policy organisations (e.g. Woods and Gardner, 2011), through debate and argumentation (e.g. Wynne, 2011) or developing approaches to empower and include marginalized groups (e.g. Burgess, 2005). The third reason is that all geographers *work within* organisations at the science-policy interface, such as universities, learned institutions, academic journals, grant-giving bodies and even academic disciplines. Furthermore, academic geographers increasingly find themselves implicated in and enrolled into this interface under the seemingly unstoppable rise of the neoliberal university (e.g. Dowling, 2008), impact agendas linked to research funding structures (e.g. Demeritt, 2010; Kearnes and Wienroth, 2011) and audit cultures of research assessment (e.g. Pain et al., 2011, 2012; Richards et al., 2009; Slater, 2012); prevailing conditions which have been the subject of increasing comment, critique and study within geography and beyond. Thus the perspectives elaborated on organisational learning and interventions in this paper are relevant to the work of all geographers, not only those whose explicit research focus is on organisations at the science policy interface.

Long-standing conventional perspectives on organisations and organisational change have emphasized the stability, coherence, and boundedness of organisational structures. Here change is conceptualised as the result of a mode switch, from one steady state to another, through rational hierarchical management. Management studies was a prominent discipline in developing and

promoting such perspectives (e.g. Fiol and Lyles, 1985; for a summary and critique see Boje et al., 2012), which have widely been taken for granted and tacitly endorsed in disciplines from policy studies to economic geography (e.g. Berry, 1967; for a summary and critique from the perspective of economic geography see Barnes, 2001). This understanding of organisations and organisational change has also been associated with a set of approaches to normatively intervening in organisational structures. These interventions tend to focus their efforts exclusively internally to any given organisation, whilst the interveners assume that change will normally be driven from the top down by leaders and managers, and aspire to engendering mode switches or definitive breaks in organisational culture (e.g. Schein, 1995; Chess and Johnson, 2006).

The emerging set of approaches to understanding organisational learning and change which this paper details, greatly contrast with this conventional view, emphasizing the networked and therefore unbounded nature of organisational structures, and the messiness of organisational practices associated with both change and stability. This move has been strongly influenced by work in geography and STS. Ongoing conversations between the disciplines have led to the adoption of STS concepts and ideas in geography – for example the influence of actor-network theory on geographers' thinking about space (e.g. Barry, 2006; Murdoch, 1998) or the emergence of sub-disciplines like 'geography of science' (e.g. Powell, 2007) – and the corresponding transferal of geographical ideas into STS work as part of geography's contribution to the wider 'spatial turn' in the social sciences (Thrift, 2002). These perspectives have also been complemented by emerging work in interpretive policy studies (e.g. Gomart and Hajer, 2003), and also an increasingly critical vein of management/organisation studies (e.g. Schatzki, 2006). It would be an exaggeration to claim that there has been a widespread and coherent move across social science in perspectives on organisations, but these novel approaches have been significant in recent geographical work and hold important implications for geographers studying, intervening in or working within organisations at the science-policy interface.

The paper begins in the next section by tackling pressing questions about the nature of organisations, concerning the assumed stability yet apparent dynamism of such forms. Such realisations have corresponded with the breakdown of modernist assumptions about organisational management and control, in the face of empirical evidence and the multiple challenges confronting organisations at the science-policy interface. This leads to a discussion in section III of how these emerging understandings of organisations in-the-making open up new ways of conceiving and thinking about organisational learning and change. Section IV then discusses the implications of these new perspectives on organising for interventionist strands of research and ambitions to promote organizational learning and reflexivity. In the final two sections (V and VI) we reflect on the implications of the central argument made in this paper for future work in geography and STS concerning organisations and organisational change, with specific reference to new theoretical insights, methods of study, interventionist strategies, and the everyday work of geographers at the science-policy interface. The paper develops a co-productionist approach to understanding organisations, organisational change and interventions, which draws upon and contributes to understandings of key geographical themes, including space, practice and networks.

II Organisations in the making

In the latter decades of the twentieth century organisations operating at the science-policy interface began to be confronted with the related challenges of addressing issues of uncertainty, risk,

ignorance and ambiguity, in their everyday routines and working practices (Felt and Wynne, 2007). Furthermore, during this time such organisations, like research councils, scientific advisory bodies or environmental activist groups, have experienced a growing intertwining of science and society (Chilvers, 2012). This is manifested, for example, in: ever more frequent knowledge controversies over objects of governance like diseases, emerging technologies or climate change (e.g. Brown, 2009); the growing difficulties of containing 'scientific' issues within institutional boundaries and scientific definitions of the problem (e.g. Gottweis et al., 2007); and the enrollment of an increasingly diverse set of actors in science policy processes (e.g. Felt & Wynne, 2007). Such developments have unsettled and therefore reconfigured entrenched relations between state, science and citizens (Doubleday and Wynne, 2011; Irwin and Michael, 2003); suggesting that old models and understandings of the role of the organisations mediating between science and society might no longer be relevant or useful.

Developments in science policy have led to calls for new institutional arrangements which build the resilience necessary to deal with uncertainty and institutional ambiguity (cf. Gottweis et al., 2007). Furthermore, deep and far-reaching change in organisational cultures and assumptions which goes beyond merely altering procedures and mechanisms, has been advocated (Jasanoff, 2003). Two related organisational innovations which have been consistently called for in this regard are: the greater involvement of external actors such as stakeholders or lay-publics in organisational knowledge creation and decision-making processes (e.g. Wynne, 1996); and the promotion of organisational learning, reflection and reflexivity (e.g. Jasanoff, 2003).

The study of such organisations[1] has been advanced by several identifiable 'turns' or developments which have influenced and been influenced by geography and STS. Drawing on the work of Latour, Callon and others in developing Actor-Network Theory (ANT), there has been a shift in focus in geography and related disciplines from fixed and predefined entities to looser and more flexible networks, which contain both human and non-human elements (e.g. Callon et al., 2009). In studies of organisations this has motivated a shift away from a focus on purely internal organisational trends and changes to an awareness of broader trends and influences, external to any given organisation (e.g. Irwin and Michael, 2003). Furthermore, this conceptual work helps to explain empirical observations of how issues and actors often transcend what are assumed to be stable organisational boundaries and definitions (cf. Doubleday and Wynne, 2011). This also highlights the importance of informal networks within and around organisations in influencing organisational processes (e.g. Pelling et al., 2008), in contrast to assumed rational and problem-solution oriented organisational management.

In the context of such networks at the science-policy interface, civil society actors, publics and other stakeholders have increasingly been enrolled in practices producing organisational knowledge. This occurs through a variety of channels, including: formal invited public participation processes (e.g. Chilvers, 2009); 'uninvited' social protest (e.g. Leach et al., 2005); the rising visibility of environmental and scientific issues in public life and the media (e.g. Gottweis et al., 2007; Hagendijk, 2004); and, in some cases, the impulse to outsource or devolve science policy work to

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[1] The terms 'organisation' and 'institution' will be used interchangeably in this paper, reflecting the terminology used in the original literatures being referred to. Whilst some authors suggest conceptual differences between the two terms, usage of the terms tends to reflect disciplinary trends – for example, 'organisation' is used more often in geography whilst 'institution' is more common in STS – rather than an underlying difference in meaning.

market research bodies, 'quangos', businesses and others. Environmental and science politics also increasingly takes place outside formal political institutions, through new articulations of and struggles over meaning and morals (Hulme, 2009). As actors and ideas become more mobile, and organisational boundaries more porous, understanding cross-learning and influences between organisations and different groups or networks operating at multiple scales becomes significant (cf. Bulkeley, 2005).

Yet ANT approaches have been critiqued by geographers and other practice theorists from interpretive policy analysis and organisation studies for their metaphorical and topological limitations in the context of studying organisations (e.g. Conradson, 2003). Whilst they help the researcher to conceive of a diverse and changing network of things which make up a particular organisation, they imply that this network is two dimensional as ANT cannot adequately account for the power and politics which are so important in understanding how organisations change and operate (e.g. Béland, 2006; Jasanoff, 2005b). Purely networked visions of organisations ignore intersubjective spaces of affect within organisations (Conradson, 2003) and so were found lacking in terms of explaining the significance of embodied emotion within organisational processes (e.g. Lorino et al., 2011; Schatzki, 2006). Emotion, power and politics have been brought back into the study of organisations in part through reference to an emerging body of work, coming from geography but with clear STS influences, described as more-than-representational theories (e.g. Lorimer, 2005; Whatmore, 2006). This literature also seeks to engage with the material and spatial elements of phenomena like organisations (e.g. Beyes and Steyaert, 2012; Dale, 2005), and has the conceptual resources to also recognise organisations as practiced, performative and of the (banal) everyday

The final important turn in recent work in geography, STS and related disciplines concerned with the new perspective on organising, has been the move towards a focus on procedures and dispositions over outcomes, and a conviction that the phenomena studied should be conceived of as being in a constant process of becoming rather than as fixed entities (Gieryn, 1995). This development has supported and enabled the more specific turn towards processes and practices, strongly displayed in work in STS and geography. The practice turn helps to bridge old dualisms between grand structures and individual agency, dynamism and stability, single events and long term trends, and human and non-human. The notion of 'co-production' as developed by Sheila Jasanoff (Jasanoff, 2004) has played a particularly significant role amongst this body of work, elaborating how identities, institutions, discourses and representations can be mutually constructed, and highlighting the intrinsic relationship between ways of knowing and ways of governing (e.g. Mahony, 2013). This notion has a transformative effect on how key geographical concepts such as space, practice, networks and power are understood, and supports the view of organisations as entities in-the-making rather than stable objects.

These disciplinary developments strongly challenge conventional beliefs about the nature of organisations outlined in the introduction, most significantly the assumptions that organisations are clearly bounded and can be rationally managed through central hierarchical control, evolving as a result of internal knowledge management processes. The new attention to processes and contingency in STS (e.g. Irwin, 2008) suggests a way of viewing organisations as objects constantly in the process of becoming – dynamic, multiple, performative and open-ended – resulting from networks of different practices of organising and knowing (Beyes and Steyaert, 2012; Jasanoff, 2004). By recognising the practiced and performative nature of organisational routines, structures and objectives social scientists have been able to capture not only the potential for dynamic and

sudden organisational change, but also the apparent solidity and stability of such forms as part of the everyday (e.g. Gherardi, 2009).

III Rethinking learning

These more dynamic accounts of organisations in-the-making have important implications for the ways in which geographers and other social scientists conceive of and study organisational learning and change. The strengths of earlier studies undoubtedly lay in explaining stabilising organisational processes of socialization, routinization and standardization (Jasanoff, 2005b). The networked, practiced and co-produced picture of organisations developed in the previous section corresponds with emerging perspectives on organisational learning, which will be explored in this section. The first movement takes studies of organisational learning beyond the 'knowledge management' approach, where learning is understood to consist of the communicating and ordering of knowledge whilst organisational structures remain immutable or change incrementally. Second, organisational learning need no longer be assumed to be a uni-directional phenomenon, but rather it may be possible to follow eddies, changes in direction or multiple directions through a particular set of organisational practices. Third, organisational learning should not only be understood as the result of internal processes and hierarchical management, rather organisational knowledges and practices can be co-produced with and through networks incorporating external spaces, bodies and processes.

The concept used most commonly and interchangeably with organisational learning is the label 'knowledge management' (e.g. Argote and Miron-Spektor, 2011; Levitt and March, 1988), emphasizing that the primary role of all organisations is to acquire and organize knowledge. The relationship between learning and knowledge has been left largely unexamined, in part because the terms are commonly elided in STS, geography and related literatures. In one of the most prominent texts on organisational learning Argyris and Schön (1996) offer a relatively broad definition of knowledge as consisting of understandings, know-hows, techniques and practices, though the precise relationship between these components of knowledge and processes of learning is assumed rather than explained.

The challenging of the knowledge management paradigm is well illustrated by Susan Owens' account of the role of the Royal Commission on Environmental Pollution's (RCEP's) advice in the decision by the UK government in 2003 to adopt a 60% carbon dioxide emissions reduction target for 2050 (Owens 2010). The RCEP was an archetypal boundary organisation (Guston 2001; Owens 2010), bringing together a range of academics, including several geographers, with expertise in environmental science and policy and closely advising government departments. Owens (ibid.) argues that the learning induced by the RCEP's advice was not only the result of knowledge transmission but also resulted from a complex of non-cognitive dimensions and factors which were both structural and contingent, related to the framing of knowledge and advice as well longer term trends, interests and political processes. She elaborates that knowledge itself was neither central nor epiphenomenal in this process, and was taken up and used in response to other factors, such as other changes in the energy system, the lack of a government energy policy at the time, genuine concern about the potential impacts of climate change and the need for the UK government to differentiate itself from the policies of the United States.

STS work has also functioned to vastly broaden and question conventional understandings of knowledge (e.g. Bloor, 1976; Gooding, 1990). The consequence of opening up the black box of scientific knowledge was the implication that there could be other kinds of knowledge situated

within different settings which might have something valuable to contribute to science policy contexts. The idea of situated knowledges (e.g. Haraway, 1991) also resonated with geographical work, and both geographers and STS scholars have been concerned with engaging lay (i.e. non-expert) knowledges to provide alternative accounts and destabilize hidden power relationships (e.g. Burgess, 2005; Wynne, 1996).

Work in STS, policy studies and organisational management has drawn on the distinction made by scientist and philosopher Michael Polanyi, between tacit and explicit features of knowledge (e.g. Parson and Clark, 1995). The term explicit knowledge captures that which can be verbalized and written down; the things that we can know consciously and are able to impart to others. In contrast tacit knowledge is that which cannot be verbalized or easily transmitted; rather it is intangible, contained within bodily practice and can only be acquired through the act of doing (e.g. Levitt and March, 1988). Whilst work elaborating the nature of knowledge has been productive, the over-emphasis on knowledge as something static and to be stored has been critiqued as an 'epistemology of possession' (Cook and Seely Brown, 1999) which might also devalue tacit parts of knowledge. This approach to knowledge can be rehabilitated by a complementary 'epistemology of practice' (Cook and Seely Brown, 1999), which focuses on the process of *knowing,* where knowing is defined as something beyond tacit knowledge which tries to capture the aspect of active human interaction with the social and physical environment (Cook and Seely Brown, 1999; Argote and Miron-Spektor, 2011). Thus, it is the 'generative dance' between various forms of knowledge and knowing, which leads to deeper organisational learning and innovation (Cook and Seely Brown, 1999).

This notion of learning as a generative dance between forms knowledge and knowing challenges the assumed uni-directionality of many accounts of learning. The knowledge management understanding of learning is also an example of the overwhelmingly cognitive emphasis of conventional approaches to organisational learning, which neglects to account for the material technologies, environments and emotional, living bodies intimately involved in organisational processes and concerns. One of the most common ways of bridging the distinction between the cognitive and social aspects of learning, and challenging associated teleological and linear assumptions, is offered by Lave and Wenger's concept of 'communities of practice' which emphasises the situated and participative aspects of learning (Lave and Wenger, 1991). They describe how a community emerges around a specific practice, within which shared understandings can develop about the nature of the practices and the identities of the practitioners themselves; therefore, to learn is to become encultured within and identify with a particular group (Seely Brown and Duguid, 1991). This approach highlighted the need to understand the contexts and settings of learning (Sbarcea and Martins, 2003). Within the communities of practice literature, participation in practice is considered to be an epistemic principle of learning (Yakhlef, 2010), challenging the conventional assumption that knowledge and learning operate separately to embodied practice and experience (Seely Brown and Duguid, 1991).

This approach to learning, which has already had a strong influence on approaches in the STS literature, can be usefully developed in light of moves within geography (e.g. Whatmore, 2006), STS (related to the ANT theorists, e.g. Callon et al., 2009), anthropology (e.g. Cameron, 2012), and related disciplines (e.g. Dale, 2005) to rehabilitate a form of socio-cultural materialism. These disciplinary developments responded to concerns with the discursive emphasis in much of social science around the turn of the twenty-first century, where the material environment was relegated to playing a passive role as a canvas for human ideas (Whatmore, 2006). This intellectual project was

also twinned with observations of the significant role played by material objects, assemblages and spaces in guiding policy and organisational development.

Thus learning can be conceptualised as a productive process, involving the active generation of knowledge and ways of knowing, enabled and constrained by material, social, affective, imagined and political elements. This framework draws on the suggestion that learning is knowledge construction rather than acquisition (Gooding, 1990), involving putting (situated) knowledge back into contexts in which it has meaning (Seely Brown and Duguid, 1991). Learning represents not only knowledge generation and engagement in practice, but also the reordering of new and existing knowledge into new categories of understanding, routines and structures; creating hybrid knowledges and reframing organisational problems (Boyd and Osbahr, 2010). This element is similar to what earlier typologies have designated as double-loop (e.g. Argyris and Schön 1996) or reflective (e.g. Felt and Wynne, 2007) learning, emphasizing how deeper learning can lead to a redefinition of organisational problems, tasks and challenges.

Furthermore, early STS studies of scientific discovery and invention have stressed the need to account for the conceptual and material failures, as well as the successes, within learning processes (cf. Bloor, 1976; Gooding, 1990; Gorman, 1997); highlighting both the uni-directionality and uni-vocality of learning (cf. Jasanoff, 2005b). As implied by the concept of a 'generative dance' between knowledge and knowing (Cook and Seely Brown, 1999), learning might further be conceptualised as movement. This view, where movement might not only be physical, but emotional, cultural or ideological, captures embodied and affective elements of learning (e.g. Argote and Miron-Spektor, 2011) and also hints at further factors influencing which elements of environment and experience are taken-up or ignored within learning processes. An intersubjective and dynamic theory of organisational learning would also emphasize the significance of both actor attributes and institutional influences in learning processes, accepting the potential for divergent perceptions of learning processes and outcomes (Pelling et al., 2008).

Thus, the assertion that organisational learning is not a necessarily a linear process is closely linked to an understanding of the diverse influences which feed into any given learning process, belying attempts to attribute such developments to rational central organisational control alone. Accounts of organisational learning have rarely explicitly engaged with politics and power (for notable exceptions see Béland, 2006 and Owens, 2010), making it possible that changes occurring to satisfy powerful interests or to fulfill strategic goals may naïvely be taken as evidence of a positive process of organisational learning. Yet power and politics could also be conceptualised as a part of learning or as closely interacting with learning processes leading to organisational change (e.g. Béland, 2006; Doubleday and Wynne, 2011; Owens, 2010). Embedded routines and organisational cultures and assumptions can prevent further learning and experimentation (e.g. Levitt and March, 1988) and positively discourage broader reflection or reflexivity (Wynne, 2006). On the other hand, several studies have found evidence of subtler relational influences on organisational processes from external events, practices and understandings (e.g. Bickerstaff et al., 2010; Pallett and Chilvers, 2013). This also raises the possibility that learning processes will be experienced and interpreted differently by different organisational actors, according to the nature of their involvement and prior assumptions and understandings.

IV Intervening for learning and reflexivity

The reflexive understanding of learning developed in the previous section, as well as the understanding of organisations as networked, practiced and co-produced (as outlined in section II), has implications for how normative interventions to promote organisational change, learning and reflexivity are imagined, designed and carried-out. Indeed, following the co-productionist idiom it is important to recognise that simply the act of studying and understanding organisations in a different way has implications for forms of action, even in the absence of directed interventions. Institutional reflexivity has been advocated as a necessity in contexts, such as those at the science-policy interface, which are characterized by antagonism and public debate (e.g. Wynne, 1993), uncertainty and ambiguity (e.g. Braun and Kropp, 2010), and the involvement of an increasing range of actors and interests (e.g. Chilvers, 2008). Yet it has also been pointed out that institutional reflexivity itself might be considered an impossible paradox (Lynch, 2000): institutionalising processes, on the one hand, work to stabilize and harden structures and routines; whilst processes contributing to reflexivity would, on the other hand, seek to promote flexibility and responsiveness, or even to destabilise established structures or assumptions. This seeming paradox is tied up with broader debates about the nature of and possibilities for reflexivity, but is also contingent on how one understands organisations.

Within geography and STS there has been much debate over the precise definition of reflexivity and its implications for research and practice. A common approach to reflexivity in the social sciences has been to focus on the role and identity of the researcher, and to emphasize the need to pay attention to one's own position and assumptions (e.g. England, 1994; Maxey, 1999). In STS this perspective has developed into an argument for the recursive re-application of STS standards and modes of study to assess the epistemic, practical and moral dimensions of STS work itself (e.g. Hamlin, 1992; Lynch and Cole, 2005). Wynne has criticised such an approach for being inward-looking and self-indulgent, advocating a more demanding conception of reflexivity defined as 'systematic processes of exploration of the prior commitments framing knowledge' (Wynne, 1993: 321). Reflexivity is therefore concerned with understanding the limitations of knowledge (Wynne, 1992) and involves recognising the complex historical construction of knowledge and the interaction between scientific objects and society (Wynne, 2005). This notion of reflexivity also corresponds more closely with the understanding of organisations as being outward looking, networked and contingent as advanced above.

Similar critiques have been leveled at understandings of reflexivity within the literatures elaborating reflexive modernization. On an organisational level it has been argued that the approach was concerned only with the breadth of inputs to decision-making processes – what might be referred to as *reflectivity* – to the detriment of an emphasis on the breadth and openness of outputs (Smith and Stirling, 2007). Approaches within this literature have also promoted a broader definition of reflexivity as accounting for non-linearity and indeterminacy (Lash, 2003), recognising that organisational change does not occur against some stable set of co-ordinates (Beck et al., 2003), and allowing for the open-endedness of management processes (Loorbach, 2010).

The dynamic, multi-directional and multi-vocal perspective of organisational learning advocated in the previous section might seem to have much in common with understandings of reflexivity. Here the distinction between learning and reflexivity rests not on the relative complexity or open-endedness of the processes, but their reference to particular processes and developments, or to the broader characteristics of the assemblage of organisational practices respectively. In this context, it might not be pertinent to refer to reflexive organisations but rather to characteristics or a disposition of *reflexiveness,* or the identification of reflexive processes. Related to organisations at

the science policy interface, such tropes could include capacities to: address and express uncertainty and ambiguity; respond to public reason and discourse from diverse sources; attend to unexpected events or organisational failures; promote reflection on organisational assumptions; or connect organisational actors and practices to broader external processes.

In one sense organisations at the science-policy interface can be considered to be always already reflexive, as they are in a constant state of interacting with and responding to alternative practices, bodies and understandings. However, the STS scholar Andy Stirling has argued that a truly reflexive system of governance requires intentionality and awareness that all bases for action are contingent and constructed, in part on the very commitments to the interventions which they inform (Stirling, 2006: 230). In the context of organisations operating at the science-policy interface, he argues for the need for both reflection, contributing to an understanding of the range of implications of a particular decision, and reflexivity, which would council humility and pluralism in the face of unavoidable contingencies and indeterminacies (ibid.). He sees the relatively successful attempts by academic and policy advocates to promote approaches such as precautionary regulation (e.g. Wynne, 1992) and participatory deliberation (e.g. Fiorino, 1990; Wynne, 1996) as reflective organisational innovations; whilst, for him, moves to push public engagement 'upstream' of technology development (e.g. Wilsdon and Willis, 2004), constructive technology assessment (e.g. Schot and Rip, 1997) and transition management (e.g. Rotmans and Loorbach, 2008), again prompted primarily by interventions by academics, constitute reflexive organisational innovations.

Human geographers have been primarily involved in projects which Stirling would categorise as reflective innovations, particularly around promoting interventions aiming to empower marginalized groups within existing organisational structures and to promote practices of public participation within relevant decision-making structures (Burgess, 2005; Chilvers, 2009; Pain, 2004). Here influences from political ecology and development studies have been significant. Yet, approaches drawing on adaptive and transition management, drawn upon in a range of cases from water governance (Steyeart and Ollivier, 2007) to environmental assessment (Sinclair et al., 2008), have also influenced geographical work, most notably in Pelling et al's (2008) study of attempts to promote social learning in interactions between a local dairy farmers group, the British Environment Agency and the Welsh Assembly. In this study the authors drew attention to the tacit and often informal and invisible practices and relationships which constituted the organisational network under study which were central in both prompting and providing space for broader reflection outside of the organisations' stated remits.

It could be argued that most of these interventions have fallen short of their promise, in part due to their own lack of reflexivity about the assumptions and conditions underlying their justification (cf. Stirling, 2008 for a critique of upstream public engagement). This is linked to deeply entrenched organisational cultures and assumptions about the nature of the world, such as teleological notions of science and progress, which have been observed in key government and scientific organisations (Bickerstaff et al., 2010; Stirling, 2008). But more broadly, with the exception of some of the adaptive management work, they represent attempts to permanently change and solidify organisational structures – albeit attempts which have led to what are widely perceived to be positive organisational and operational improvements at the science policy interface – rather than adopting a more fluid, adaptive and even experimental approach which would be more in-keeping with the conviction that organisations are networked entities constantly in-the-making. Furthermore, as highlighted in the previous section, any attempt to intervene in organisational routines, structures and practices requires engagement with and attempts to understand the thick

complexes and entanglements of material, social, affective, imagined and political elements, with multiple linkages to other organisations and organisational spaces.

V New directions

Approaches taken in recent geographical work suggest future directions in which to take these insights on organisations and organisational change, whether at the science-policy interface or more generally, with implications for theory, methods of study, and the design of interventions. Rooted strongly in 'more-than-representational' approaches, Beyes and Steyaert (2012) have laid out an agenda for bringing space back into the study of organisations. Following Lefebvre they conceptualise space as an active force bound up in processes of organising and knowing, which they label 'spacing'. This highlights the performative nature of space and redirects research towards a focus on embodied apprehensions of this performance and studies of particular organisational 'events' (Beyes and Steyaert, 2012). This approach strongly challenges traditional conceptions of clearly bounded spaces and entities (cf. Bulkeley, 2005; Callon and Law, 2004), and the conventional casting of space as a passive backdrop upon which societal events are played out (Soja, 1989).

Organisational practices both create and are shaped by organisational spaces. Such spaces have been theorized as relational, embodied and provisional, continuing to change over time in response to diverse influences and networks (Conradson, 2003). As they are neither stable nor passive it is appropriate to focus mostly on the doing or practicing of organisational space (ibid.). Drawing on Lefebvre, Dale theorises that organisational spaces contain the overlapping aspects of: spatial practice – producing and reproducing space; representations of space – as imagined by planners and managers; and representational space – as lived by those within the organisation (Dale, 2005). As such, these spaces cut across formal organisational structures (Pelling et al., 2008), containing both material objects and fleeting affective elements (Conradson, 2003). It is precisely this malleability which can help to explain how organisations engage with problems around risk and uncertainty (cf. Pelling et al., 2008), as well as coping with external shocks.

As well as drawing upon lessons from the adaptive governance literature Pelling et al's (2008) study drew upon the concept of organisational spaces to theorise the existence of so-called 'shadow spaces' within and around formal organisational structures. These spaces form around the development of private, informal relationships between organisational actors, allowing these individuals and subgroups to experiment, imitate, communicate, learn and reflect on their actions, in a way that is not permitted within more formal spaces (Pelling et al., 2008). Consequently such spaces offer a place of bounded instability where novelty can emerge but with a sense of continuity with earlier institutional innovations (ibid.). Whilst the formal/informal distinction made in this conceptualization is an important one in understanding organisational learning, there are other dimensions of organisational spaces which should be considered, for example: public/private; general/particular; internal/external; diverse/homogenous; or short-lived/long-term. Thus this approach offers one way in which geographers can engage actively and empirically with the spatial dimensions of organisations in the making without taking organisational structures or their spaces for granted.

Another conceptual device for dealing with learning as a contested and ambiguous phenomenon is the notion of imaginaries. Sociotechnical imaginaries have been defined as collectively imagined forms of social life and social order, reflected in the design and fulfillment of specific projects at the national level (Jasanoff and Kim, 2009), whilst Taylor's (2002) definition of

imaginaries captures the ways in which people imagine their social existence at multiple possible scales. Such a notion is able to express how learning might have a particular thrust or direction, resulting from power-infused complexes of practices, emotions, bodies and objects in an organisation or organisational space, loosely associated with a particular vision of the future. But this direction is not deterministic or assumed to be linear, as imaginaries might also evolve and change as the organisation does. Competing accounts of organisational processes could be analysed as being potentially illustrative of dominant, competing or fragmented organisational imaginaries, which are both shaping and being shaped by learning processes.

Perhaps more fundamentally, the perspectives outlined in this paper also represent a challenge to the very notion of the science-policy interface, though this object has been important in framing much relevant work in geography and STS (including this paper). We have sought to engage with this challenge by adopting a co-productionist framework, which allows us to speak of a singular interface between the domains of science and policy without presenting the distinction between the two as natural or fixed. However, what has been under-emphasized thus far in this account is the potential for actors to simultaneously labour in spaces on either side of this interface through multiple identities and practices, and the multiplicity of potential interfaces involved in the co-production of the domains of science and policy. Furthermore, the blurring and hybridity between these two worlds in practice has been noted by geographers (e.g. Mahony, 2013) and STS scholars (Irwin and Michael, 2003). Though some geographical work has begun to engage the messy and multiple nature of the science policy interface (e.g. Hinchliffe, 2001; Lane et al., 2011; Mahony, 2013; Owens, 2010), we anticipate that this dimension could be productively extended in further work.

Related to these theoretical innovations, work in geography and STS offers guidance in dealing with new research design and methodological challenges for researchers, as well as suggesting that a new approach to conducting organisational interventions is necessary. Firstly, if we are to take seriously the conviction that organisations are not fixed, immutable entities, it raises a set of issues about the role of the researcher. The researcher can no longer aspire to be completely detached from and external to the organisation or organisational space being studied. Rather the presence and conceptual and physical labour of the researcher will be an active component of organisational practices, involved in producing the very objects under study.

Following from the commitment to understanding learning as multi-directional and multi-vocal, contributions from both STS and geography have counselled researchers not to assume organisational structure and regularity, and therefore to orient their research solely towards the search for coherent and comprehensive explanations (e.g. Law, 1994). Rather this insight encourages researchers to ask what is being suppressed or excluded where objects appear to be stable, and to instead seek out organisational surprises, failures and disagreements (cf. Garud et al., 2011; Gross, 2010).

The affirmation of the epistemic value and significance of practice as well as knowledge also has implications for methodology. Firstly it implies the need for humility on the part of the researcher (e.g. Law, 1994), which could be expressed by treating organisational actors as co-researchers rather than mere research subjects. The blurred distinction between knowledge and practice also hints at the potential empirical benefits of conscious organisational interventions orchestrated by the researcher and others. Though action-research approaches have often been used instrumentally and based on fixed assumptions about the nature of organisations (Burnes, 2012) there are possibilities for more reflexively engaged social scientific work in emerging calls for

experimentation with ethnographic methods (e.g. Marcus, 2007). The experimental interventions introduced by Matthias Gross into ecological restoration projects in order to try to encourage learning and reflexivity and foster openness to surprises and uncertainties, are an example of the potential benefits of such an approach; both empirically for one's research and practically for the organisations studied (Gross, 2005).

Another useful methodological approach to the study of and engagement with organisations can be found in the 'messy methods' advocated by authors utilizing more-than-representational theories in geography. Messy methods do not conform to traditional methodological accounts, rather they are designed to destabilize the relationship between researched and researcher, and to access the emotive, fleeting, banal and sensuous aspects of practice and learning (e.g. Beyes and Steyaert, 2012; Lorimer, 2005; Lorino et al., 2011; Whatmore, 2006). STS scholar John Law's 'modest sociology' also adopts the label of messy methods which he describes as a reflexive and symmetrical approach to studying contingent and partial processes of social ordering (Law, 1994). One example of what this might look like in practice is the transdisciplinary approach to flood risk science attempted by Lane et al. (2011), which initiated experimental engagements between natural and social scientists and citizens *in situ*. This approach allowed the researchers to harness, produce and negotiate a network of distributed expertise and hybrid knowledges, which challenged conventional understandings and narratives (ibid.).The significance of this project is that alongside operating as a conventional data collection technique, the researchers very explicitly experimented with their methods of knowledge making in order to understand the diverse effects of these methods and to enable them to reflect on the bases of their knowledge claims.

Related to both imaginaries and action-research approaches, the concept of storytelling has been developed in studies of organisational management and development (e.g. Gabriel and Connell, 2010), more-than-representational approaches (e.g. Anderson and Holden, 2008), and in geography more broadly (e.g. Cameron, 2012). The use of or focus on storytelling as a methodology would help to capture the open-endedness of organisational learning processes (Cameron, 2012) as well as revealing diversity and difference between the experiences of different actors (Anderson & Holden, 2008); thus linking personal experience to broader contexts (Cameron, 2012) and reflecting the contested and ambiguous nature of learning (cf. Jasanoff, 2005b). Stories, as opposed to narratives, have been defined as heterogeneous assemblages of various practices, memories and materialities (Lorimer, 2003), thus are equipped to take account of the material and practice-based elements of organisational learning emphasized in the last section. From the perspective of conducting engaged research in organisations, the creation and telling of stories may also further promote learning as they encourage reflection and mutual learning (Gabriel and Connell, 2010) and thus have the potential to move or affect people, or lead to the creation of new collectivities (Cameron, 2012). Their openness to different interpretations makes stories potential boundary objects (Star and Griesemer, 1989), able to provide a common language for interaction between diverse groups but also to link together different organisational spaces.

These methodological insights apply equally to conscious attempts to intervene in organisations, which even in the adaptive and anticipatory governance literatures have tended to be designed with a model of a coherent machine-like organisation in mind. In the context of the more organic and messy view of organisations advocated above, interventions to promote organisational change are likely to have to utilize a more diverse set of measures which are targeted across organisational practices and structures, as well as operating outside apparent organisational boundaries. This contrasts with the controlled and isolated interventions which have been

attempted in the past. For example, the notion of 'responsible innovation' has recently been promoted by academics (e.g. Owen et al. 2012) and policy actors (including at the European level as part of the forthcoming Horizon 2020 research funding programme) as an organisational intervention for dealing with the uncertainties and inequalities associated with scientific and technological innovation. Thus this new intervention has implications for the operation of research councils like the EPSRC, which now has a responsible innovation framework[2], universities, private companies and advocacy groups. In order to avoid this approach merely becoming an instrumental 'add-on' to existing formally understood organisational routines and structures, as arguably the 'upstream engagement' initiatives became, the academics invested in the project are likely to have to target multiple organisational practices and spaces, and draw upon informal social networks and relationships as well as engaging with formal structures. Furthermore, within such endeavours, attempts to understand organisational practices and spaces are likely to be co-extensive with attempts to intervene and change them.

VI Conclusions on research and practice

This paper has introduced several important features of the recent literature on organisations and organisational learning, with specific reference to the science-policy interface and a focus on the past, current and potential contributions of geographical work in this field. A picture of organisations as externally networked, responsive and actively being co-produced with other phenomena through practice and contestation has been advanced, prompting a perspective on organisational learning which emphasizes multi-directionality, multi-vocality and a multiplicity of different potential influences and elements. This emerging picture of organisations at the science-policy interface has also had important implications for long-running debates about organisational or institutional reflexivity, challenging the assumed stability and rational management of organisations in many accounts. Furthermore, recent work in geography on organisational spaces and spacing, alongside several key methodological innovations offers inspiration for future work on organisations at the science-policy interface, and invites the questioning of the notion of the science-policy interface itself.

In the space that remains we will seek to sketch out further implications and possibilities for the engagements of geographers and other social scientists with organisations at the science-policy interface, through: seeking to *study* and *theorize* them; offering *advice* and *criticism* as experts; or *working within* such organisations. Possible foci in the future study and theorizing of organisations at the science-policy interface and other kinds of organisations might include: further considering the relationship between organisational spaces and practices; elaborating the relevance of the notion of imaginaries for understanding organisations and organisational learning; empirical studies of how particular organisations respond to failures or surprise events; and experiments with more interventionist action-research type methods in organisational research, which acknowledge an organic rather than machine-like model of the organisation.

With regards to approaches to intervention and reflexivity, in this paper we have attempted to move beyond seemingly intractable debates in geography and STS about the nature of and potential for institutional reflexivity by suggesting a more systemic focus on reflexive processes. Thus future research in this area could productively consider: what reflexive processes might look

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[2] http://www.epsrc.ac.uk/research/framework/Pages/framework.aspx [last accessed 01/11/2013]

like in particular organisational contexts; how different organisational actors and networks creatively wrestle with uncertainties in determining which actions to take, what the result will be and how to interpret these responses (cf. Bastrup-Birk and Wildemeersch, 2011); or exploring mechanisms for promoting reflection and reflexivity in organisational interventions and representations (cf. Stirling 2006; Chilvers, 2012). The failure of previous attempts to induce organisational change and reflexive learning can in part be explained by the adherence to conventional assumptions about organisations as stable, bounded entities and the co-option of interventions by organisational actors and others into instrumental procedural fixes which fall short of the initial promise (cf. Kearnes and Weinroth, 2011). A vital focus for future research and engagement therefore will be to explore how the novel and emergent perspecitves on organisations and organisational change described in this paper can be used in the development of new forms of normative intervention which embrace the plurality, diversity and messiness of organisations instead of resting on the old assumptions of coherence and rational control.

In contexts where geographers and social scientists are in the position of offering expert advice and criticism to organisations at the science-policy interface, the perspectives on organisations and organisational learning offered by this paper are also significant. Perhaps the most important insight to bear in mind, is that organisational decision-making and change rarely results from rational and hierarchically managed processes alone, and therefore academic experts need to be aware that advice, no matter how sophisticated its delivery is, is unlikely to be taken up in the manner that would straight-forwardly be expected. In light of this recognition, academic experts should give advice in the context of a broader awareness of multiple possible entry points, channels and processes within (or even outside of) any given organisation (cf. Wynne, 2007); and if possible they could even take opportunities to experiment with different modes of advice-giving in order to reflect on the results. Furthermore, in these circumstances it is also necessary to recognise the implicated-ness of ourselves, our expertise and our knowledge in the organisational processes and decisions we are seeking to inform and alter. Insights on the multi-directionality and vocality of learning would also suggest the importance of having a deep understanding of power relations within any given organisation; and perhaps even developing strategies for managing these circumstances, particularly through the development of close and trustworthy relationships with key individuals, not necessarily only those at the top of the stated hierarchy.

The final and perhaps most challenging mode of academic engagement with organisations at the science-policy interface, is perhaps our often unthinking and unreflective involvement within them, from universities to research councils and academic disciplines. This raises questions about the extent to which any individual can be fully aware of the impact of their own practices and understandings in both creating and contesting broader organisational structures, routines and assumptions. The argument we have made in this paper could be read pessimistically as suggesting that conscious internal or external initiatives to promote organisational change, learning or reflexivity are unlikely to unequivocally bring about the intended consequences, or may at least have diverse unintended consequences. On the other hand, a recognition of the often diverse openings and sources of influence around any given organisation could be freeing and potentially empowering, for academics wishing to strategically intervene in, experiment with and adapt organisational practices and structures.

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