TRANSFORMATION IN A CHANGING CLIMATE: A RESEARCH AGENDA

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Abstract

The concept of transformation in relation to climate and other global change is increasingly receiving attention. The concept provides important opportunities to help examine how rapid and fundamental change to address contemporary global challenges can be facilitated. This paper contributes to discussions about transformation by providing a social science, arts and humanities perspective to open up discussion and set out a research agenda about what it means to transform and the dimensions, limitations and possibilities for transformation. Key focal areas include: (1) change theories, (2) knowing whether transformation has occurred or is occurring; (3) knowledge production and use; (4), governance; (5) how dimensions of social justice inform transformation; (6) the limits of human nature; (7) the role of the utopian impulse; (8) working with the present to create new futures; and (9) human consciousness. In addition to presenting a set of research questions around these themes the paper highlights that much deeper engagement with complex social processes is required; that there are vast opportunities for social science, humanities and the arts to engage more directly with the climate challenge; that there is a need for a massive upscaling of efforts to understand and shape desired forms of change; and that, in addition to helping answer important questions about how to facilitate change, a key role of the social sciences, humanities and the arts in addressing climate change is to critique current societal patterns and to open up new thinking. Through such critique and by being more explicit about what is meant by transformation, greater opportunities will be provided for opening up a dialogue about change, possible futures and about what it means to re-shape the way in which people live.

Introduction

Climate change, combined with other global issues, such as a growing population, health, food and water security, inequitable management of resources, and rising consumption in an ever more interconnected world, are posing significant threats to human well-being (Fischer et al., 2012; Kjellstrom and McMichael, 2013; Steffen et al., 2015). Such unprecedented global challenges are contributing to an increasingly complex, uncertain world that we cannot fully understand or control (Sardar, 2010). Like many other contemporary societal challenges, such as obesity and addiction, climate change is a product of three hundred years of scientific and technological advances that have enabled massive extraction of the planets resources and shaped social practices, cultures and trajectories of change (Archer, 2013; Hanlon et al., 2012; Shove, 2010). While scientific and technological advances have produced many benefits, many current global challenges cannot be resolved solely by the same kinds of approaches that created them. Instead, structural, social and cultural changes will be needed across societies, including reconsideration of deeply held beliefs, assumptions, and paradigms, and those about what it means to be human (O'Brien, 2011; O'Brien

and Sygna, 2013). Growing recognition of the need for rapid and substantial change to address contemporary issues like climate change have led to the emergence of the concept of transformation.

The concept of transformation creates both challenges and opportunities. On the one hand, current use of the term is often vague or ambiguous and there is a need for a more rigorous approach to its application (Feola, 2015). On the other, the concept provides important opportunities for raising the stakes and highlighting the need for rapid and extensive societal change in response to global challenges like climate change (O'Brien, 2012). If the latter is the intention, then the concept will be more effective if it is used to stimulate creative thought and help challenge assumptions about the kinds of change needed and how they can be realised.

While there has been extensive consideration of bio-physical dimensions facing the planet, transformation in relation to climate change is essentially a social process (ISSC and UNESCO, 2013). As yet, however, there has been limited critical analysis of the concept. This paper therefore examines diverse themes relating to transformation and outlines a new research agenda for transformation in relation to climate change from the perspective of the arts, humanities and social sciences. The paper is the outcome of a facilitated two day workshop and follow-up activities held by the 'Society Theme' of the Scottish Funding Council's university pooling initiative: the Scottish Alliance for Geoscience and Society (SAGES). The workshop brought together 20 academics from diverse backgrounds (e.g. anthropology, geography, cultural studies, politics, economics, ecology, and environmental science) and those working in knowledge brokering and policy engagement with interest in climate change.

Covering all aspects relating to transformation is beyond the scope of a single paper. We therefore focus on nine key themes (Table 1) chosen because they: (a) have so far received limited attention in relation to transformational change; (b) go beyond technical aspects to wider issues of transformation; (c) critique and open up thinking about the underlying premises and assumptions that need to be considered when engaging with transformation; and (d) cover a breadth of issues relating to how transformation is understood, what needs to be transformed, the processes involved, and the possibilities and human limitations for transformation.

The paper first outlines the concept of transformation used by the authors to frame the rest of the paper. The sections then build on each other, starting with some of the least, and moving towards the more contentious aspects. Each section provides guidance for future research, summarised in the conclusion as a set of new, provocative questions that form the overall research agenda.

Table 1: Key themes related to societal transformation explored in the paper

1. Theories of change to help understand and inform transformation
2. Methods of monitoring and evaluation to help inform when transformation has occurred or is occurring
3. Knowledge production and use for transforming world
4. Modes of governance for encouraging transformation
5. How understanding social justice can assist transformation
6. Overcoming limits to human nature for transformation
7. The role of the utopian impulse for transformation
8. Approaches to new futures
9. Transformation of human consciousness

The concept of transformation

Transformation has been defined in many ways (Feola, 2015). In some cases, emphasis is placed on transformation as being a social process (social transformation), as something goal oriented with purpose (deliberate transformation), or on transitions in society and science and technology relations (social technical transformation and transitions) (Feola, 2015; ISSC, 2012; Markard et al., 2012). Importantly, whether something is considered to have transformed is inherently subjective and relative: What is significant change to one person may not be significant to another. Finding a single agreed definition is therefore not possible and, as for other concepts, may not be desirable (Ison et al., 2013). Instead, the onus needs to lie on those using the concept to be explicit about how they are interpreting and applying it.

We view transformation to be a broad concept that includes social, environmental and technical domains that revolve around three key dimensions: (1) the intensity or quality of the change (depth of change); (2) the distribution of change (breadth of change); and (3) the timeframe through which a change occurs (speed of change). The relevance of these three dimensions in determining whether change is considered transformational is then determined by the issues of concern. For example, a significant or qualitative change may be perceived to have occurred in the beliefs of a single individual. Yet whether this is considered to be transformation also depends on the speed and distribution of that change. In relation to climate change, change in a single individual might not be considered transformational because climate change also requires marked changes (depth) in many aspects, quickly (speed), in diverse aspects like lifestyles, social practices, technological and infrastructure across societies and geographies (breadth). The issue of concern therefore has a bearing not just on how much change is needed for a change to be considered to be transformational, but also how widely and quickly the change needs to occur. As with other concepts (e.g. resilience), invoking the concept of transformation therefore requires users to be explicit about from what, and to what something is being transformed.

The depth of transformation in relation to climate change can apply to many different aspects, social scales and processes. Considering all aspects is beyond the scope of this paper. Some of the key areas, however, might include changes in individuals (e.g. significant changes in their understanding of person-world relationships); institutions (e.g. taking an institution in a fundamentally new direction, with a basic change in character, configuration, structure and outcomes); procedures (e.g. major legal or regulatory reforms that have a significant bearing on society); governance (e.g. fundamentally different ways of governing) economies (e.g. alternatives to those based on assumptions of growth), or processes (e.g. the way something is brought about, such as participatory, inclusive, genuinely led by values that recognise fundamental human-environment relations). Transformation is therefore primarily a social process, albeit while also requiring environmental sustainability at its core. Some of the issues above, such as the need for changes in knowledge production systems, governance systems and social consciousness, are explored in later parts of this paper.

In this paper we also assume that transformation of society to respond to climate change will often require structural and systemic change. This could be transformational change towards improving capacities and dispositions of humans to better manage the behaviour of system dynamics to *retain* feedback structures and processes (Walker et al., 2004) or transformation to *alter* the feedback structures to create fundamentally new system dynamics (Gallopin, 2006). Either of these kinds of change will involve some kind of transition, irrespective of how fast these transitions occur. For example, while rapid transformations in energy production systems to reduce carbon emissions is needed, it would still involve some period of transition to achieve it. This may occur more directly as a step change with a rapid transition or through multiple increments over time (Rickards and Howden, 2012). Again, the issue of concern and timeliness determines whether accumulative increments might be considered to be transformational or not. Making dualistic distinctions between transformation and incremental change is therefore simplistic without reference to the issue of concern and the depth, breadth and speed of change required.

Finally, climate change also implies a need for deliberate approaches to social transformation (O'Brien, 2012). While many transformations are emergent and dependent on wider societal cultures, structures and systems (Spaargaren, 2011; Tibbs, 2011), this emergence can occur through perceptual shifts in thinking, norms, beliefs and behaviours (Fischer et al., 2012), many of which can be influenced by deliberate practices and intent (Daniels, 2010a; Frame and Brown, 2008). This leads us to take the view in this paper that intentional transformative change is possible and that humanity is not entirely a slave to its past or current circumstances and trends. Questions do, however, remain about the capacity for human societies to induce the changes at the rates needed to overcome the climate change problem (O'Brien, 2012). If social change is intended to be directed in some way, then this also raises questions about for whom transformation is intended and

about who decides what this direction should be. Some of the issues relating to deliberate transformation, such as social justice, the need for capacities to better work in the present to create new futures, or the human limits to change are explored in later sections.

1. Theories of change to help understand and inform transformation

If the intention is to facilitate significant societal change through deliberate attempts for transformation, then this raises an important question about the kinds of theories that can help conceptualise approaches to creating change. There are numerous approaches that have been used to understand and conceptualise transformative change, including literature on transitions (Falcone, 2014; Markard et al., 2012), social practice theory (Shove, 2010; Spaargaren, 2011); creative destruction (Homer-Dixon, 2006); adaptive cycles (Holling, 2001) and complex systems (Kern and Smith, 2008; Loorbach, 2010). Many of these share a systems perspective, taking in social, ecological and technological domains in their endeavour to conceptualise and understand change (Markard et al., 2012). The more commonly applied concepts also often reflect roots from the natural sciences which both dominate current environmental discourse but which shy away from engaging with the contention and ambiguities involved in climate change (Markard et al., 2012; Victor, 2015). Importantly, while the literature provides many examples of frameworks for transformation and adaptation, there is little evidence from case studies that demonstrate a clear transformational impact. This raises questions about whether the concept of transformation is only conceptual or whether in real terms it only occurs over long-time frames and is therefore not visible over shorter projects or even individual lifetimes. This then raises further questions about whether or how deliberate transformations can be stimulated and about the intentions of studying the concept. Is the intention to stimulate critical thinking about the underlying process and nuances of social change, improve capacities to enact societal change, or both?

Importantly, there has been rather limited engagement of mainstream climate science with social theories relating to change. Three pertinent theories relevant to transformation from social science and humanities are highlighted in Table 2. The first is the interrelationship between '*structure*' (the recurrent patterned arrangements which influence or limit the choices and opportunities available) and '*agency*' (the capacity of individuals to act independently and to make their own free choices)(Barker, 2005). Relationships between structure and agency are considered essential in social and political theory and concerns the scope of a person or group to act within a given structure or context and instigate change or maintain continuity. An example of an approach to conceptualising structure and agency is Archer's morphogenetic cycle (Archer, 1995) (Table 2).

A second important area is new institutionalism. This is a multi-theoretical approach (including sociological, rational choice, historical, and discursive institutionalism) for examining institutional

change in relation to political processes and policy making (Greenwood and Hinings, 1996). In new institutionalism, 'institutions' are the 'rules of the game' and the predominant, (seemingly) stable, self-reinforcing and durable patterns in a given context (Greenwood and Hinings, 1996). New institutionalism highlights that transformative change needs to include an understanding of the factors that cause, or discourage, institutional change. An example of this approach is discursive institutionalism, which focuses on how ideas and discourses shape institutions (Schmidt, 2008) (Table 2).

A third area is power and how this relates to change. Power is a complex and illusive concept (Lyon and Fazey, In Press). Within social theory it is highly contested with diverse views of its nature and meaning (Lyon and Fazey, In Press). While an agreed understanding of power is unlikely to be achieved, it is highly relevant to shaping and understanding why transformative change may or may not occur. An example of a recent integrative conceptualisation of power specifically developed to assist analysis and approaches to change is the powercube, which can be used to conceptualise different facets and dimensions of power (Gaventa, 2006) (Table 2).

These three examples show how theories of social change contain a rich and continuously developing source of insights into why and how change happens, or does not happen, in a wide range of contexts and settings. Much of the climate change literature, however, has limited consideration of such theories beyond the application of systems epistemologies (Gillard et al., 2016). This is partly due to limited acknowledgement of social science concepts in a science dominated field (Victor, 2015) and difficulties accessing social theory literature that has extensive specialist terminology.

Overcoming such issues and engaging more deeply with different social theories will assist the development of practical approaches that are founded on more sophisticated understandings of social change. There is also a need for new research that helps understand the linkages between the intended uses of concepts like transformation and how change occurs, how transformation relates to other theories of social change, how particular concepts of change become embedded in societal discourse and shape change narratives and activities, and how dominant concepts and narratives like transformation or resilience shape the way in which people engage with the future. Such applied questions are important for understanding how change can be brought about.

Table 2: Examples of underutilised perspectives for conceptualising transformation

Theoretical Area	Example	Implications/strengths	Key texts
Structure and Agency	**The morphogenic approach** • Used to analyse social and political change. • Societies are 'morphogenetic', meaning that they have a capacity to change, and the approach analyses how change emerges over time. • Structure, culture and agency are viewed as analytically distinct but inter-related. Structure (and culture) are taken to predate agency, but people are in a position to continue or transform social and political structures but not to create them from scratch. • The morphogenic cycle comes in three parts: (i) existing structural conditions; (ii) scope for change through society-wide reflexive deliberations of ordinary people (e.g. independent thinking, political campaigning and activism); and (iii) the outcome of these processes which may or may not include change – this marks the beginning of another cycle.	• Stress is placed on 'culture' which becomes, in effect, a third element in the structure - agency relationship; the relationship between culture and agency as well as between structure and agency becomes the focus of analysis. This highlights the importance of 'ideas' and that this is distinct from the material realm of structure.	(Archer, 1995)
New Institutionalism	**Discursive institutionalism (DI)** • Focuses on ideas and discourses as key factors driving change. Ideas are the substantive content of discourse; whilst discourse is the shared, context-specific, process of articulating ideas. • Discourses articulate different levels, types and forms of ideas and are also tied up with context i.e. who speaks, who listens and the arenas in which this takes place; the intentions of the various actors; the nature and stage of the political process; and where in time and space all this is being played out. • Discursive abilities are key in explaining institutional change. The focus is on peoples' ability (agency) to think (have ideas) that are not determined by the institutions (structure) in which they act, to talk about these institutions in critical ways (the possibility of change and of alternatives), to persuade themselves and others to change their minds about institutions in which they act by, for example, creating 'discursive coalitions' advocating particular change.	• DI explains institutional change (ranging between complete breakdown and continuity) by the rise of previously subordinate discourses that alter the institutional set-up in a given context, including their reasons why they emerge (e.g. through authoritative individuals, or the emergence of 'common sense'). • It highlights that ideas and discourse have transformational power for change as well as continuity avoiding overly deterministic either / or explanations.	(Schmidt, 2008)
Power	**The Powercube** • The metaphor of a cube visually represents three facets of power: levels of power (e.g. local, national and global), spaces of power ('arenas' of action which can be 'closed', 'invited' or 'claimed'), and 'visible', invisible' and 'hidden' forms or manifestations of power. • The 'Powercube' is designed as an accessible integration and development of some of the more recent theorising on the meaning and nature of power - especially Lukes (2005)Lukes 2005 - with an orientation towards being a practical tool of analysis, action and change.	• The key claim made by advocates of the Power Cube is that it enables an 'aligning' of analysis and strategies for action across the three dimensions of the cube helping to analyse and orient approaches that aim to transform aspects of power that in turn may constrain social transformations.	(Gaventa, 2006)

2. Methods of monitoring and evaluation to help inform when transformation has occurred or is occurring

The diverse concepts and theories of change highlight that transformations can be complex, sometimes occurring over long time frames, and involve events that can extend past the lifespan of policies and projects. This makes it difficult to conceptualise how learning to shape trajectories of change can be supported through monitoring and evaluation. Transformation is also aimed at the creation of something new which requires different kinds of information to the maintenance of an incumbent system (Park et al., 2012) and often occurs in complex contexts where outcomes are vague and vision oriented rather than focused on pre-set goals and objectives. Thus, while practical frameworks increasingly attempt to encompass the complexities of natural, social, political and economic spheres and different spatial and temporal scales (Brooks et al., 2013; UNFCCC, 2010), new approaches are also needed to both assist transformation and help understand when transformation has occurred (Brooks et al., 2013).

Assessing transformation requires identifying levels of preparedness and the triggers and thresholds for change (Folke et al., 2010; Isoard and Winograd, 2013; Rickards and Howden, 2012). This is typically associated with explicitly planned changes. However, small-scale changes may aggregate over time and space to reach a threshold beyond which they can collectively be viewed as transformative (Rickards and Howden, 2012). Because deliberate large-scale transformation may only be accepted on evidence from small-scale transformations (Folke et al., 2010), monitoring needs to determine if there is tangible cross-scale awareness (Cork, 2010) and draw on evidence from across those scales (Rickards and Howden, 2012). Such multi-scale approaches can be helpful for identifying potential maladaptation that may occur if monitoring focuses on narrow, short-term projects alone (Bours et al., 2013).

In addition to examining multi-scale change, appropriate kinds of monitoring and evaluation are needed that more directly help facilitate rapid change. An example of such an approach is developmental evaluation (Patton, 2011). This is particularly suited to innovation (including organizational changes, policy reforms, and system interventions), radical program re-design, replication, complex issues, crises, and where key stakeholders may be in conflict about the right course of action. The approach helps to frame concepts, test quick iterations, track developments, and monitor emerging issues by emphasising participation and learning as opposed to conducting summative tests and focusing on accountability (Patton, 2011). Compared to traditional forms of evaluation, which measure success against pre-determined goals, developmental evaluation uses measures and tracking mechanisms that are developed quickly and as outcomes emerge (Patton, 2011). These and similar approaches more directly support and are part of change related activities, with examples from developing the enabling conditions for sustainable coastal management (Olsen

and Page, 2013), programs to address wicked challenges in poverty (Cabaj et al., 2016) and innovation in education (Lam and Shulha, 2015).

Overall, diverse aspects need to be considered in the process of developing monitoring and evaluation of transformation (Table 3). Broader questions are also raised, such as how current approaches to evaluation limit what is known about transformation, how decisions can be made about what needs to be assessed, whether particular transformations can be identified that precipitate multiple aggregate transformations, and how multi-scale interactions can be captured in meaningful and useful ways. Questions also arise about how to capture broader, more complex issues, such as changes in ideology that affect societal change and how these changes are shaped by existing ideologies. This leads to critical questions about the kinds of knowledge production and use systems that will be needed more generally that can support transformation and which might be expected in a transformed world.

Table 3: Some of the key characteristics of appropriate forms of monitoring and evaluation (M&E) for transformation

M&E for transformation
• Continuous M&E cycles embedded in and as part of the process of change
• Identification of triggers & thresholds
• Long-term vision and outlook
• M&E at multiple scales
• Identification of behavioural and institutional barriers and enabling conditions
• Able to examine extent of barriers to change (attitudinal surveys, resource allocation, horizontal and vertical cooperation)
• Mainstreaming of monitoring and learning
• Participatory approaches that assist co-learning
• Appropriate methods for quick iterations and that can support innovation
• Able to examine outcomes of long-term actions
• Process and outcome indicators
• Quantitative and qualitative framework
• M&E as a tool for learning and improvement not just a mechanism for reporting and accounting
• Effective knowledge exchange and co-production of learning
• Innovative data sources and mechanisms (e.g. open access data and tools)

3. Knowledge production and use in a transforming world

If significant and rapid change in societies towards fundamentally new and more sustainable patterns is needed to respond to climate change, then questions also need to be asked about the effectiveness of current modes of knowledge production and use in contributing to change (Healy, 2011; Kläy et al., 2015). Significant investment in science has already been made towards understanding and monitoring climate change and articulating the complexities and impacts on affected populations. This has helped frame and understand the extent of problem and in identifying solutions, but has had only modest impacts towards galvanising the depth, breadth and speed of societal change demanded by a changing climate. This has led to calls for much greater attention to understanding change itself, including the individual and collective approaches to change, why change is often resisted or impeded, and how wider or system scale changes can be achieved (O'Brien, 2013).

One of the challenges to accelerating learning about doing change is that it requires greater attention to developing practical knowledge. Academia traditionally produces epistemic knowledge, which is abstracted, teachable, and often presented as a set of principles. Yet practice (e.g. 'doing transformation') also requires 'know how' knowledge (techne) and wisdom about what constitutes a good outcome (phronesis) (Aristotle, 2004; Flyvberg, 2001). These kinds of knowledge are embodied and often difficult to articulate (Boiral, 2002), but are essential for working with the specificities and complexities (e.g. technical constraints, politics, local context, windows of opportunity) and ethical issues involved in facilitating change (Rolfe, 1998). Developing such knowledge and accelerating learning about doing transformation will require greater engagement of researchers and other stakeholders in learning from doing change and with the messy, ill-defined and context specific world of practice (Ison, 2010), and through iterative approaches that develop, design, and test diverse practices and processes aimed at facilitating change.

Another challenge is that greater attention to finding more effective ways of using knowledge is also needed. For example, addressing contemporary challenges needs more than just the development of knowledge: It also requires explicitly engaging in debates about what is 'good' (ethics) and 'beautiful' (aesthetics) (Hanlon et al., 2012). Climate change is largely a moral and ethical dilemma (Nolt, 2015) that has emerged through increased scientific knowledge that has enabled and created demands for abstraction of resources well beyond what is environmentally sustainable. Thus, good decisions and actions require more than just high quality knowledge (Hanlon et al., 2012). Finding better and more explicit ways to incorporate knowledge with ethics and aesthetics requires new approaches to both how knowledge is produced and how it is used.

There are signs of an emerging shift towards and mainstreaming of reflexive approaches to knowledge production for action and change that build on a rich tradition of interdisciplinary and

action research. This includes ever greater application of approaches that focus on understanding change processes; testing and learning from actions for change (Frame and Brown, 2008; Sharpe et al., 2016; Tschakert et al., 2014); a growing tendency for researchers to take on diverse roles as facilitators of learning (Fazey et al., 2010; van Mierlo et al., 2010b; Wittmayer and Schäpke, 2014); greater stakeholder involvement in co-production (Armitage et al., 2011; Brandt et al., 2013) (Wyborn, 2015); increased tendency towards transdisciplinary approaches (Lang et al., 2012); approaches that challenge the relationships between science and society (Nowotny et al., 2001); greater tendencies towards participatory and deliberative forms of research (Chambers, 1997; Fazey et al., 2010; Kenter, 2010; Kindon et al., 2007); and futures and anticipatory action oriented research to complement evidence-based knowledge from the past (Fazey et al., 2015; Sharpe et al., 2016; Tschakert and Dietrich, 2010).

Most of these approaches tend to reject the fundamental assumption underpinning much of science that a researcher can be independent from what is observed (Aufenvenne et al., 2014; Müller and Riegler, 2014). Yet researchers always have some influence on what is researched, even if only through being embedded in a particular culture which influences how research is framed, what questions are asked, what is funded, and what outcomes of research are considered to be 'useful' (Aufenvenne et al., 2014). Shifts towards interdisciplinary and action oriented reflexive 'second order' modes of research that engage diverse stakeholders therefore also represent deeper shifts in assumptions about knowledge production by acknowledging the influence of the observer on what is observed (Müller and Riegler, 2014). The source of validity and reliability then comes from actively and reflexively examining how a researcher shapes the knowledge which is produced and by being open and transparent about that process (Aufenvenne et al., 2014; Müller and Riegler, 2014; van Mierlo et al., 2010a).

Recognition of the need for second order science approaches is clearly growing, but attention and resources are still massively skewed towards first order modes of research. This limits scope for finding new ways of thinking about the problems and solutions related to climate change (Aufenvenne et al., 2014). Further, current knowledge production and use systems are criticised as being highly mutually reinforcing, with disciplinary silos produced by elites that enhance current and chronic global inequalities and which often subsume radical innovations in research into old patterns or ways of doing things (Kläy et al., 2015). Growing interest in approaches like transdiciplinarity cannot therefore be taken at face value, with suggestions that they may be more about realigning elite power bases in the face of change (e.g. by co-opting language and discourses) rather than focusing on deeper transformational change (Healy, 2011; Kläy et al., 2015).

Overall, society is still a long way from having the kinds of knowledge production and use systems needed for the world in which societies find themselves in. No longer can linear causality, control and certainty be assumed (Sardar, 2010), and instead the world is characterised by increasing

interconnectivity, uncertainty and concatenated crises where boundaries between who is considered to be the holder or producer of knowledge is increasingly blurred, greater participation in making decisions is needed, and where contestations of knowledge are often confused with contestations about values (Biggs et al., 2011; Cook et al., 2013; Nowotny et al., 2001; Sardar, 2010). As outlined in figure 1, knowledge production and use systems need to catch up with the postmodern world. This raises fundamental questions about what kinds of knowledge can best assist transformations; how learning from action can help generate the kinds of knowledge needed for transformation; how freeing up researchers to be part of the processes of creating change can help shape more meaningful knowledge production; the kinds of research that can best contribute directly to transformation; and how transformative knowledge production and use systems are related to wider modes of governance and what these might need to look like in a transformed world where society frames science in ethical and aesthetic terms rather than the other way around (Healy, 2011).

FIGURE 1 HERE

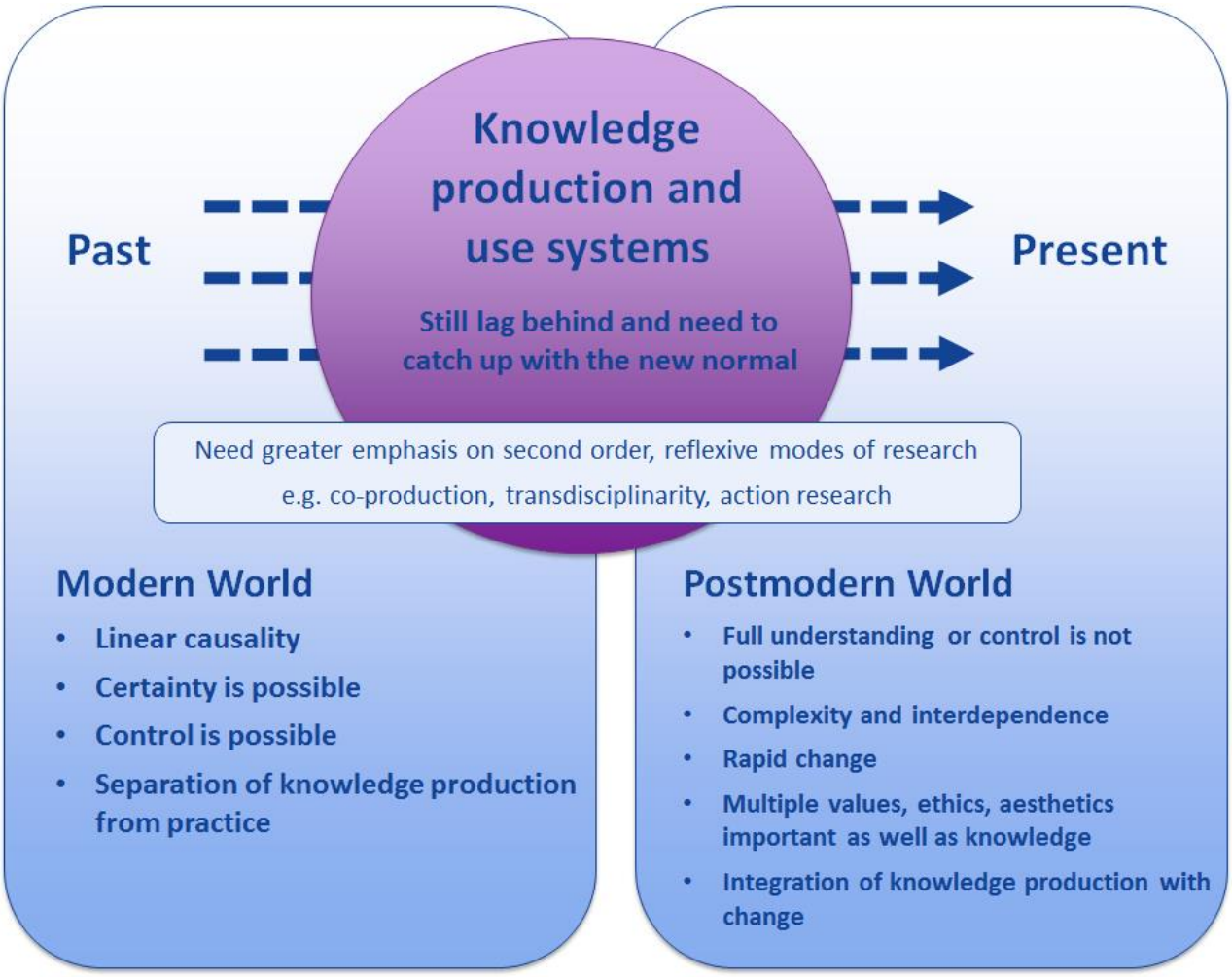

Figure 1: Envisioned transformation in the way knowledge is produced and used to both facilitate transformation and operate more appropriately in a postmodern world.

4. Modes of governance for encouraging transformation

Appropriate forms of governance and decision making are critical for transformative change, and are needed at all kinds of scales, and in many kinds of ways (Biermann et al., 2012). In general, liberal democracy is currently the dominant aspiration of decision making processes across the world, but 'politics as usual' are unlikely to result in the kinds of societal changes needed (Dryzek and Stevenson, 2011). While there are many different ideas about governance, here some of the key issues of governance for transformation are highlighted by contrasting ideas for engaging with deeper versions of democracy with those that suggest there is a need for greater authoritarianism to facilitate more rapid kinds of change. Raising this issue challenges our sureties and assumptions about engaging in transformative change.

Deepening of democracy has, for example, been advocated through the deliberative democracy academic and political discourse. This re-emerged in the early 1990s with close links to green political thought and practice. It was founded partly on a hopeful and optimistic vision of peoples' collective decision making capacities (Smith, 2001). Here much greater inclusion of affected parties in decision making processes (i.e. substantive political equality) is emphasised. Communication is a distinctive characteristic: aiming for a clear shift away from strategic and manipulative interactions towards open-mindedness and striving to be understood and understand others. Advocates claim that deliberative processes enable people to confront complexity and ambiguity and arrive at wise decisions (Gutmann and Thompson, 2009). However, the evidence that these versions of democracy in practice are workable across a range of formats and scales to produce ecologically efficacious, let alone transformative, decisions is patchy (Dryzek and Stevenson, 2011; Ryfe, 2005). A 'good' process does not necessarily guarantee a 'good' decision (Wong, 2015) particularly over the kinds of timeframes imposed by a rapidly changing climate.

In contrast, eco-authoritarianism purports rule by a benign eco-elite at the head of a strong, interventionist state (Hobson, 2012; Ophuls, 1977). Such thinking, while being on the fringes of debate, is largely predicated on doubts over the capacity of democratic processes to produce effective and timely climate change action (Hickman, 2010; Lovelock, 2009). Self-interested individualism is perceived to be at the heart of the environmental crisis and that liberal democratic institutions encourage this behaviour and are thus unable to prepare society to survive the crisis (Orr and Hill, 1978). Eco-authoritarianism also takes a pessimistic view of human nature and capacities and a despairing emphasis on 'survival' over human flourishing and quality of life results in the ends

justifying the means by which it is achieved. In this view a state is needed that can intervene in public and private aspects of peoples' lives and activities in a way that trumps democratic sensibilities and peoples' autonomy and rights (Shearman and Smith, 2007). Some observers highlight the perceived successes of the People's Republic of China in facing environmental issues as an example (Friedman, 2009).

Critiques of eco-authoritarianism highlight the danger of despotism and tyrannical rule, that it fails to build wider public interest or awareness of the environment (changing 'hearts and minds'), or build future deliberative capacity (Niemeyer, 2014) and that it assumes the presence of an eco-beneficially oriented elite and strong state which cannot be taken for granted. Additionally, empirical evidence counters the key claim that authoritarian systems produce (timely, systemic and wise) decision making, especially of the order and extent that eco-authoritarians consider necessary (Shahar, 2015).

Countenancing authoritarianism and, by implication, querying democracy should induce mild to severe (intellectual) discomfort, depending on one's orientation. This reaction serves to remind advocates of deliberate transformative change that it will be laden with deeply held assumptions. Thinking about radical shifts in politics, society and the environment requires inviting such discomfort and introspection: are our long-held values, worldviews, ideas, and aspirations really compatible with transformative change, and if so in what way? Questioning assumptions about the appropriate role of the state and government, individual freedom, human capacity, human nature, and the value and efficacy of democracy are critical to working towards transformation. Simply assuming that 'novel' democratic processes are appropriate or authoritarian alternatives inappropriate fails to acknowledge the challenges inherent in deliberate transformational change.

These issues also raise important areas for research, such as questions about the kinds of governance that will be needed in a transformed world versus those needed to achieve it, how such changes in governance can be achieved, whether a hybrid of these two different models of governance are possible (is this different from current models?) and the role of 'discomfort' in enhancing positive engagement with transformation. Finally this also raises questions about the extent to which a transformative process (means to an end) is necessary for a transformed society (an end in itself) and how more utopian views of governance can be imagined (see discussion about utopias and futures below).

5. How understanding social justice can assist transformation

While there is contention about the appropriate form of governance for transformation, many contemporary challenges are deeply rooted in, and reinforced by, massive global inequalities which are particularly emphasised in the context of climate and development. Irrespective of how they

come about, addressing issues of social justice is therefore critical when thinking about transformation. The concept of social justice highlights the ethical, moral, and human rights issues raised by climate change (Crate, 2011) and is concerned with social recognition and political participation, as well as the basic rights, needs and capabilities, of people (Schlosberg, 2013). Climate-related justice generally revolves around three aspects: distributive, procedural, and recognition justice, which together comprise aspects of fairness, institutional processes, and stakeholder legitimation (Popke et al., 2014). I

There are three areas that have particular relevance for transformation. First, considering social justice is important for enhancing agency and change. Neglect of issues of social justice risks masking people's everyday issues from broader transformation efforts (Lazrus, 2012). Engaging with social justice, on the other hand, can provide both a strong intrinsic motivation for change while also helping to focus on how existing conditions undermine the potential of individuals, communities and societies to be actively involved in shaping transformative processes (Tschakert and Machado, 2012). Social justice might therefore be understood to act as an ethical check on change, on the motivations for particular transformations, on the balance of participation in decision making, and the appropriate distribution of benefits and burdens.

Second, considering social justice can help identify the underlying causes of inequality, such as power relations and underlying social structures and global connections (Adger et al., 2013; Tschakert and Machado, 2012; Tsing, 2005). These factors both shape current circumstances and how futures can be envisioned and realized and are part of how societies understand and meet their obligations to future generations (Page, 1999; Read, 2012). The concept of social and environmental justice is thus an attempt to actively acknowledge these issues and help to hold to account implicit assumptions about who will or will not benefit from change.

Third, social justice is also about enhancing integrative and systemic thinking, which is essential for a post normal world. By directing concerns through a frame of social justice, research with climate change affected groups shows that social cohesion and the functioning and reproduction of community are foregrounded in a way that confronts liberal individualist notions of justice (Schlosberg, 2013). Social justice highlights the interconnectedness and mutual fragility of all people (and our wider environments) thus providing a basis for transformational change of social relations. This can occur through avoiding traditional hierarchies of discrete scales and moving towards understanding change as a 'continuum, ranging from localized daily experiences to a global ethics of care' (Tschakert and Machado, 2012).

There are also potential pitfalls through engaging with social justice. Discourses of justice can sometimes result in lack of attention to the causes of climate change leaving the status quo largely unchallenged (McLoughlin, 2012). Further, the creation of climate 'victims' and other reductionist

categorizations can obfuscate nuances of complex relations and connections (McDermott-Hughes, 2013; Tsing, 2005) absolving the consciences of some while rendering many others (often women and those of the Global South) helpless and disempowered (Lazrus, 2012; McDermott-Hughes, 2013). Therefore, while differential vulnerabilities certainly exist, justice issues highlight that it is crucial to also attend to the accountabilities, complicities and responsibilities of those who are emitting greenhouse gases (McDermott-Hughes, 2013) and ways to name injustice without stereotyping people into asset-less victims.

Overall, the difficult but transformative aspect of social justice in the era of global environmental change suggests that a new politics of 'human becoming' is needed that is open to new forms and expressions of identity and territorialization (Baldwin, 2014). Attempting to simply re-inscribe historical notions and dimensions of race, gender, class, and sovereign power (which are the dimensions on which social justice has often been founded) onto the risks of global climate futures is likely to deepen inequality, worsen poverty and further allow environmental and cultural degradation (Lyon and Fazey, In Press). Ultimately, appropriate engagement with social justice and transformation requires asking questions about equality and inclusion; the ways significant change is both enacted and felt at the everyday level of society; about whom transformation is by, whom it is done to, and whom it is for, and the origins of perceptions of winners and losers and mechanisms through which these are formed and enacted, and how theories of social, environmental and climate justice can be developed in more useful ways conducive to helping facilitate change.

6. Overcoming limits to human nature for transformation

The failure to face up to the basic facts of human nature has been suggested as a core obstacle to society's transformation toward a sustainable future (Rees, 2010). Humans are biophysical organisms-in-ecosystems, evolutionarily (and thereby neurologically) defined (Barkow et al., 1992; Bjorklund and Pellegrini, 2002). Neurological and biological traits allow humans to survive and thrive in extremes, create technologies and conceive beauty (DeFelipe, 2011) yet also support maladaptive, unsustainable behaviours (Rees, 2010). A more forthright acknowledgement of what humans are might, however, allow departure from unsustainable trajectories (Rees, 2010). This means recognising and privileging capacities for agency, reflexivity, and the human ability to conceive and embrace the creative (and destructive) abstractions, symbolism and aesthetics reflected in cultural discourses and practices, objects, ideas, built environments and technologies (Baudrillard, 1994; DeFelipe, 2011; Dixon, 2009; Hornborg, 2001; Ranciere, 2013; York, 2015), as well as acknowledging a degree of capacity to set aside cognitive biases in order to respond to events in ways which overcome the maladaptive manifestations of innate traits (Chiao, 2009; Chiao et al., 2009). The social processes behind these responses can be understood as individual and collective reflection on external environments leading to action and change (Archer, 1995). While

there may therefore at present be neurological limits on some forms of human thinking, perhaps highlighted by poor results from human-vs-artificial intelligence contests (Lee et al., 2010), the diversity of creative expressions of human agency also suggests a high degree of transformative potential.

There are numerous aspects of human nature that might impede radical and rapid transitions, such as denial, greed, or selfishness. An example considered here is desire. This can be understood as an affective representation of evolutionary expansion and accumulation strategies, now reflected in the cultural norm of economic growth and mass consumption (Daniels, 2010a; Daniels, 2010b). Considering the unsustainable implications of desire (or its sociobiological roots) creates space for contemplating changes in human behaviour. The renunciation of desire is possible, with examples from Buddhist practices that understand desire as a form of suffering, and which privilege cultural strategies of material detachment (Daniels, 2010a; Daniels, 2010b). Psychoanalytic practice leads to a similar repositioning of desire at the individual level (Laplanche and Pontalis, 1973).

Knowing that desire (or other aspects of human nature which might impede deliberative transformative change) may be overcome does not in itself promise a smooth road to transformative change. There is, for example, the issue of scaling-up alternative sustainable practices. Generally, a few early adopters of an alternative custom must persist before wider scale transformative uptake becomes possible (Rogers, 2003; Sharpe, 2013). Recognition and fostering of these cohorts is therefore crucial. Resistance to change is another fundamental barrier: people are constrained to consume for basic living requirements, but also for the creation and maintenance of social positions and identity which are precious and not easily abandoned (Skjærvø et al., 2011; Wilk, 2002). Further obstacles exist around society's preference for institutional-level problem solving over interventions in social phenomena like culture and power (Pelling, 2011). However, there is a difference between consumption driven by need and conspicuous consumption driven by desire.

The challenge confronting humans is therefore to understand how self-knowledge of our essential natures can enable people to overcome the evolutionary tendencies that are reflected in contemporary cultural practices (Guattari, 2000). Possibility exists in that humans have capacity to reflect on their behaviour in relation to the wider world, and its causes, implications, and alternative pathways (Foster, 2015) and to turn to action: not all cultural practices today are environmentally destructive, and early adopters of alternatives provide the seeds for broader social change (Sharpe et al., 2016). This highlights a need to harness the positive impulses of humanity that will assist in transformation. It also raises further questions about the kinds of cultural practices that can support rather than hinder change, the mechanisms that can support greater reflexivity, and how existing tendencies that are sometimes perceived as barriers, such as expansionism or competitiveness, can be used more effectively to facilitate social and environmental transformations.

7. The role of the utopian impulse for transformation

A particularly important capacity that has both contributed to global environmental problems but which also provides scope for transformation is human foresight and the impulse to seek new futures (Rickards et al., 2014). One aspect of this is 'utopia', which literally means 'no place' and/or 'good place' and suggests a way to push hard at, and breakthrough, the boundaries of what transformational change means. Utopianism - 'the dreams and nightmares that concern the ways in which groups of people arrange their lives and which usually envision a radically different society from the one in which the dreamers live' (Sargent, 2011, p. 5) - has unique possibilities for inspiring hope and optimism for the future (Webb, 2008), and for engaging people in transgressive, creative and critical reflexivity, dialogue and learning concerning the state of the world now and the shape of radical change (de Geus, 1999; Pepper, 2010). Nevertheless, utopianism is rooted in the human imagination, reflecting a deep human urge to imagine alternative ways of living (Davidson, 2010).Transformative change, as an idea and practice, needs to acknowledge and harness this 'utopian impulse'.

Utopian visions and debates about utopianism abound in political and social theory (Bloch, 1986; Popper, 2013), architectural thought (Aureli, 2011; Eaton, 2002), literature (Carey, 1999; Claeys, 2010) and other areas of human culture such as music and art (Levitas, 2013; Resor and Gandy, 2014). Utopianism is holistic in scope with 'the environment' a common concern (Sargisson, 2012; Stableford, 2010). Literary 'ecotopias' which emphasise the environment alongside other themes is an established sub-genre (see Table 4 for examples). 'Green' intentional communities - producer cooperatives, 'sixties' communes, housing cooperatives, eco-villages and the Occupy Movements - are sometimes described as 'practical utopias' (Levitas, 2013; Lockyer and Veteto, 2013; Sargisson, 2012).

Table 4: Examples of Literary Ecotopias

Example publication	Synopsis
William Morris, *News from Nowhere* (1891)	Set in 2102, England is a pastoral paradise free from capitalism and industrialisation where London's Trafalgar Square is an orchard and the Houses of Parliament are used to store dung.
Aldous Huxley, *Island* (1963)	Pala is an island where, for a century or more, science and Eastern spiritualism have created a paradise that is now under threat from the outside world.
Ernest Callenbach, *Ecotopia* (1978)	In 1980, Oregon, Washington and Northern California secede from the United States to form Ecotopia. An initially sceptical visitor describes Ecotopia's economic, social, cultural and political characteristics
Marge Piercy, *Woman on the Edge of Time* (1979)	Connie Ramos visits (or does she dream?) the village of Mattapoisett in 2127. She witnesses radically altered gender roles and relationships, selective use of technology and integration of human society with the natural world.
Kim Stanley Robinson, *Pacific Edge* (1990)	In the near future, the United States is akin to an ecological utopia, but the struggle against the still-present influence of greed and exploitation continues.

Utopian visions can be dismissed as unfeasible and implausible daydreaming. More significantly, utopias and the utopian impulse can be viewed as closing down rather than opening up possibilities if they impose blueprints of perfection on the world (Cohn, 1970; Gray, 2007; Popper, 2013), such as Nazism or Islamic State of Iraq and the Levant (ISIL). Utopias and attitudes to these expressions of desire are rooted in value judgements: one person's utopia can be another's nightmare (Sargisson, 2012; Ypi, 2008). It is therefore important to appreciate the context, motivations and intentions of those framing 'utopia' which again highlights the importance of being aware of underlying assumptions that shape societal directions and trajectories (Goeminne, 2011).

Harnessing the utopian impulse 'as a way of thinking hard, forensically and imaginatively about the world' (Sargisson, 2012, p. 241) can highlight otherwise unutterable and unimaginable routes and endpoints (alternatives to 'rational' and 'scientific' forecasting, prediction, projections and modelling, for example). Utopianism can then disrupt taken-for-granted visions of the present and future, and provide a way to provocatively 'play' with, and give form to, transformative ideas and practices (Levitas, 2013). Many questions remain, however, such as whether or how specifics of utopias can be made more concrete to maximise opportunity to build on transformative ideas, how powerful dystopias are compared with utopias, what kinds of responsibilities come with utopianism, and what are the links and tensions between utopianism and other concepts, issues and practices relevant to transformation.

8. Approaches to creating new futures

While utopianism may help imagine new futures, it does not itself result in the creation of those futures. A reconfiguration of the present for the future involves a massive and extensive re-patterning of agency and context (Goodwin, 2007). How such transformation emerges depends on diverse conditions and influences (Hodgson, 2012); how choices are made by multiple groups with different values; and on the reflexive capacity of humans to engage with diverse social and environmental issues. While employing foresight in policy and decision making at all levels and scales is needed, society still lacks the kinds of anticipatory forms of governance required for the Anthropocene era (Boyd et al., 2015; Fuerth and Faber, 2012).

Different approaches to change have considerable bearing on transitions towards new futures. Five of the most commonly identified viewpoints are summarised here (Table 5). A *deterministic* viewpoint treats the future as the inevitable outcome of causal drivers that can be extrapolated and enable prediction. In this view any transformation is seen as a predetermined mechanism. A *systemic emergent* viewpoint treats the future as a more open set of possibilities in which causal loops play a significant role. Dynamic systems have multiple properties; and their future behaviour cannot be predicted as in the first category although they can be simulated (Sterman, 2000). Another viewpoint is that the future emerges from *complex uncertainty* which is chaotic and both highly sensitive to initial conditions and to state boundaries (Kauffman, 1996). The fourth viewpoint is that of *design* in which the future is shaped as much as possible from intention and intervention by human actors who are driven by value choices as well as material performance(Bausch and Flanagan, 2013). The fifth viewpoint, *metamorphosis*, is less common but sees the transformative future as a paradigm shift in which a dominant pattern is replaced by a completely different pattern, which is often reached through a stage of deconstruction and reconstruction.

Each of these five viewpoints reveals the challenge of transformative resilience in a different light and corresponds to a different group of foresight tools and techniques (Table 5). In the face of the wicked problems of resilience and transformation there is a role for all of these approaches (Miller, 2007). However, the more complex the challenge the more the emphasis needs to move to approaches 4 and 5 where human agency is a critical component of the situation. This highlights that to harness the utopian and other impulses for change there is a need to develop future consciousness, defined as an awareness of the future potential of the present, i.e. how the future emerges from what is done now (Sharpe, 2013). As with many other forms of cognition, this can be developed and taught to encourage agency and change (Leicester et al., 2013).

Table 5: Viewpoints on the Future

Viewpoint	Example Foresight Methodology
1. Deterministic	Predictive trend analysis and mathematical modelling (e.g. Meade and Islam, 2006).
2. Systemic Emergent	Systems Dynamics modelling and simulation (Moorecroft, 2007); Scenario planning (Van der Heijden and Sharpe, 2007)
3. Complex Uncertainty	Participative Sense-making (Snowden and Boone, 2007)
4. Design	Causal Layered Analysis (Inayatullah, 2004); Transdisciplinary Synthesis (Hodgson, 2012)
5. Metamorphic	Three Horizons of Transformation (Hodgson, 2011; Sharpe, 2013)

There are several critical issues raised by the classification of approaches to the future. Perhaps the most significant is that each view makes certain assumptions regarding the ontological nature of the future, assumptions which are not usually questioned. This results in a number of confusions in foresight practice (Hodgson, 2013). For example, deterministic methods are applied to situations which are complex and where 'expert' analysis can limit the anticipatory signals that can be picked up. Such confusions result in fragmented mindsets about particular ways of doing things (e.g. in economics, politics, environmental sciences) being projected into the future (Ulrich, 2000). Multiple perspectives of experts and non-experts integrated by dialogue are therefore needed which are more likely to cover the range of issues and dimensions concerned (Christakis and Bausch, 2006). In recognition of these challenges, recent research in developing anticipation as a key systems concept in futures work is being expanded into an international research effort in this area (Miller, 2013; Poli, 2010). This raises important questions about the kinds of human agency needed for working more appropriately with the future, how our understanding of time may constrain or enable transformation and the kinds of methods and practices that can develop futures consciousness. This leads to questions about how other aspects of human consciousness may need to change for wider transformations in society to occur.

9. Transformation of human consciousness

Many argue that the real solutions to complex problems such as climate change lie in the transformation of human consciousness (Speth, 2009). Consciousness can be broadly defined as the phenomenological experience of something, although in common usage it is often synonymous with awareness, conscious awareness, experience, and even self-consciousness (Velmans, 2009). In an environmental context, it usually refers to the way people experience the world and their ecological sensibility (Dryzek, 2013). A "consciousness as awareness" interpretation implies that humans have a capacity and potential to embrace more inclusive and non-dualistic perspectives in relation to other people and the environment and develop their social and ecological consciousness.

Here, some see positive signs that human consciousness is already shifting in response to climate change (Suzuki, 2015). Indeed, a longitudinal survey of values provides evidence of a shift towards post-modern worldviews within some regions and populations (Inglehart and Welzel, 2005). In exploring the evolution of the worldview concept in Western thinking, Hedlund-De Witt (Hedlund-De Witt, 2013, p. 155) notes that the concept itself not only 'conveys that the world is viewed differently by different viewers, but also that those different viewers tend to enact, co-create, and bring forth different worlds—thereby emphasizing the power, significance and potential of one's worldview.' She interprets this as a sign of increasing reflexivity and a growing recognition of human creativity and responsibility. In other words, human nature is not a definitive obstacle to transformation (see previous discussion). This view is consistent with recent research on neuroplasticity, which shows that brains are dynamic structures, and developmental psychology, which shows that structures of meaning making can change throughout a lifetime (Cook-Greuter, 2000; Kegan, 1994; Siegel, 2007).

Transformations in human consciousness involve epistemological changes in how people know what they know, as well as ontological changes in who they understand themselves to be (Schlitz et al., 2010). Such changes in perspective do not occur easily, and it is often during times of personal and collective crisis that new meanings are ascribed to events and new narratives are developed to make sense of lived experiences. An important distinction is made between experiences (e.g. trauma) that lead to a contraction of self and those that are transformative and lead to an expansion of self (Schlitz et al., 2010). However, there is a wide range of empirical evidence indicating that intentional practices and experiential learning can influence both states and stages of consciousness (Fazey, 2010; Schlitz et al., 2007). This is important, for although transformations in consciousness may be desirable, they are considered less effective and even oppressive when they are imposed on others than when they are developed through reflective practices and critical and experiential education (Freire, 1970).

The development of consciousness is not only restricted to individuals, and collective trends in the development of consciousness have been identified, including moves towards an integral or biospheric consciousness (Rifkin, 2010; Wilber, 2001).This includes suggestions that a collective mind might represent the next stage of human evolution (see Brown and Harris (2014), who draw on the work of Teilhard de Chardin and others). Here, an important distinction is made between a collective mass mentality, which can be dangerous, and a collective mind that "*is taken to be the potential of each individual mind to think as a whole person and also to connect with others…"* (Brown and Harris, 2014, p. 183). Transformations towards such an integrated, biospheric, collective mind are also often associated with the notion of the noosphere, which is defined as the sphere of human consciousness and mental activity that surrounds and permeates across Earth (Samson and Pitt, 1999). The noosphere is the fourth in successive phases in the development of the Earth after emergence of the geosphere (inanimate matter), the biosphere (biological life), and the

technosphere (technological connections). Like the impact of the biosphere on the geosphere, the emergence of the noosphere is considered to be beginning to transform the biosphere (Samson and Pitt, 1999). This is likely to be partly enabled through increasingly and highly connected communication and interactions across the globe that makes up the technosphere. Transformations in the collective consciousness can therefore have a significant bearing on global change.

Although some scientists consider consciousness to be nothing more than the functional outcome of neural activity in the brain, others consider it to be a fundamental characteristic of the universe (Tononi and Koch, 2015; Velmans, 2009). Whatever the science of consciousness might reveal, there is empirical evidence showing that it is possible to develop a resonant consciousness, whereby people experience connection and interrelatedness that transcend the physical properties of the group (Schlitz et al., 2007). Importantly, any transformations in human consciousness will still call for human engagement with systems and structures that maintain the status quo and perpetuate risk and vulnerability. In other words, political engagement will still likely be essential to facilitating social transformations. Climate change may also, however, be an important catalyst for developing the shared experiences and resonant connections that can increase local and global capacities for humanity to respond skilfully and collectively to risks that threaten human existence.

Conclusions

This paper critically examined nine key themes relating to transformation in relation to climate change. This has resulted in numerous and diverse questions about the nature and processes involved in social transformations for sustainability (Table 6), which together represent a new research agenda about transformation from the perspectives of the humanities, arts and social sciences. Clearly there will be other questions and critical themes for such a broad topic. Nevertheless, the themes covered in this paper, which were chosen to cover a diversity of issues from different disciplinary perspectives, highlight both significant opportunities and challenges for facilitating, navigating and shaping trajectories towards more sustainable and equitable societal outcomes.

Together, the critical analysis of the themes highlights four key aspects. First, that transformation in relation to climate change will require much deeper engagement with the complex social processes, including culture, religion, ethics, values, governance, and ontologies of the future and human consciousness. Second, that there are vast opportunities for social science, humanities and the arts to engage more directly with the climate challenge, with many significant new and potentially ground-breaking or radical areas and questions needing to be explored. Third, that society is not currently very well equipped in terms of capacities, governance, and processes or knowledge production methodologies to deal with, facilitate or understand transformational change, particularly where it is

needed most. This suggests a need for a massive upscaling of efforts to understand and shape desired forms of change. Finally, the analysis emphasises that many prevailing notions around change and transformation in society and in academia are underpinned by deep rooted assumptions and that challenging these assumptions is itself an essential part of transformation. In addition to helping answer important questions about how to facilitate change, a key role of the social sciences, humanities and the arts in addressing climate change will therefore be in critiquing current societal patterns and to open up new thinking and possibilities.

Transformations often manifest as a process of flux and seeming disorder as attempts are made to hold on to old ways of doing things and as new innovations create the space for more radical changes to occur (Sharpe et al., 2016). In such processes of change, however, new innovations or thinking can easily be subsumed back into existing patterns, especially when prevailing ways of thinking seek to retain existing systems (Sharpe et al., 2016). The extent to which the social sciences, humanities and the arts are able to engage in transformative radical rethinking, to challenge some of the current assumptions underpinning society, or even to be included to a greater extent in discussions about climate change will therefore greatly depend on the openness in existing institutional structures to accommodate different disciplinary and potentially more radical perspectives. Focusing greater attention to the research fields presented in this paper (Table 6) would be a step towards acknowledging the importance of social disciplines, will help steer new research and encourage deeper, more open and critical thinking about what transformation might mean, and will help remind those engaging with the concept of transformation that it is important to be explicit about how the term is applied to help avoid it being used to describe all kinds of change as transformative.

The challenge posed by climate change is enormous. This is partly because the complex social, environmental and technological issues involved cannot be addressed by the same worldviews, assumptions and approaches that created them. It is also challenging because the new structures, processes and ways of living needed in a transformed and sustainable world are so difficult to imagine. The problem humanity faces is akin to the often used metaphor of trying to re-design an aeroplane while it is still flying, but with the difference being that the blueprint of the future design (which may not even be an aeroplane) is beyond current understanding or imagination. Yet re-designing something cannot occur without starting with the intention and desire for something different. Thus even if the concept of transformation remains relatively abstract, critically engaging with the idea is important to help expand thinking and open up dialogue about new possibilities and what it means to re-shape the way in which people live.

1 Table 6. Questions about our underlying assumptions that need to be considered for societal transformation

Section	Important questions for engaging with the concept of transformation
Theories of transformation and change	• What is the intended use of the concept of transformation and how can examining what transformation is help to achieve these ends? • What kinds of theories or concepts assist with understanding and shaping transformative narratives and the practices of change? • How do some concepts and narratives become embedded in societal discourse and how do they shape change? • In what ways do dominant theories and narratives (e.g. around resilience) shape people's visions of possible futures? • What aspects of society, politics, culture, technology *do not* need to change?
Knowing when transformation is occurring or has occurred	• What happens once everything has been 'transformed'? • What ideology is transformation moving away from, what ideology is it moving to, and how is transformation normalised by existing ideologies? • How do 'meaningful encounters' influence (societal) change? • Can 'stem-like transformations' be identified that precipitate multiple aggregate transformations? • How can the multi-scale nature of transformation be captured, e.g. causal links or feedback loops? • What are the appropriate measurements/indices/metrics for assessing transformational change and why? What are the inappropriate ones? • How context-specific are such measurements, and what are the implications of that for transferability, scaling-up (or down)? • How do the current ways of monitoring and evaluation limit what is known, can be known, or can be achieved? • We can't monitor everything, so how (and who) decides what are the most critical aspects to assess? • How important is it to know what is aimed for to develop appropriate measures? • What are the different approaches to monitoring, evaluation and learning that are best suited to facilitating rapid and significant changes at scale?
Knowledge production and use systems	• What kinds of knowledge are important for transformation? • What is the relationship between knowledge and other dimensions (e.g. ethics, aesthetics) and how does this constrain action? • What is the role of knowledge production in relation to action and how does action generate knowledge? • What are the direct and indirect consequences of freeing up researchers to be part of the processes of change?" • How can knowledge be brought to address both the "known unknowns" and "unknown unknowns" and to manage and broker this knowledge? • What is transformative research and how can it be facilitated? • What kinds of knowledge production and use systems are needed for transformation and in a transformed world?
Governance for transformation	• What kinds of governance are needed in a transformed world and in the transition to get there? • How can relevant knowledge be fed into appropriate parts of the governance systems in a timely and targeted manner to encourage transformation? • How can 'discomfort' be encouraged in a way which leads to positive engagement with transformation? • To what extent is a transformative process (means to an end) necessary for a transformed society (the end itself)?
Role of social justice	• How does procedural justice enable or constrain transformation? • Where do distributive, procedural and recognition forms of justice conflict or synergise for transformation? • Who are the winners and losers in certain kinds of transformation and is thinking in terms of winners and losers helpful?

	• Are perceptions of winners and losers based on historical norms more than future possibilities? • In what way do understandings of winners and losers need to shift for transformation to occur? • How should potentially violent resistance to transformation in the name of justice be addressed? • What scope and breadth of our concern with social justice is needed for transformation, e.g. is it human only, or does it need to include other sentient and non-sentient populations? • What patterns or characteristics of justice apply at local, regional, national and international scale? • Can theories of social, environmental and climate justice be categorised in any meaningful or useful way?
Limits to human nature	• How readily are people able to acknowledge maladaptive thinking and actions? • How might human tendencies toward expansionism, competitiveness and technological innovation be better used for transformative change toward a sustainable society? • What mechanisms for pause exist that could support reflexivity? • What kinds of dispositions, traits and tendencies exist that help societies to live within their means? • How might translation and scaling up of alternative sustainable practices, systems and processes be nurtured? • How can positive impulses (e.g. cooperation, desire for information) be harnessed within humanity? • What existing cultural practices could support transformative change?
Role of the utopian impulse	• What are the aesthetics of utopia and can utopia be separated from dystopia in any philosophically consistent way (e.g. cross culturally)? • Can the specifics of utopias be 'harvested', 'mapped' and made more concrete to maximise the opportunity of building on potential transformative ideas? • What are the influences of dystopias on choice and assessment of options? • How powerful are dystopias compared with utopias? • What are the barriers (e.g. social, political) to utopianism? • Does utopianism and the expression of utopian views come with responsibility? • What is the role of the utopian impulse in understanding and achieving transformation? • What are the links and tensions between utopianism and other concepts, issues and practices around the transformative change agenda?
Creating new futures	• What is our understanding of the relationship between the present and the future? • What kinds of human agency are essential for working with the future? • How is time understood and how does this constrain or enable transformative action? • What kinds of methods and practices can help develop futures consciousness? • How can futures work more meaningfully contribute to transformation research and practice?
Transforming human consciousness	• What social conditions generate transformations in human consciousness? • What role can education play in transforming worldviews? • What types of practices are conducive to transformations in consciousness? • What is the relationship between individual and collective consciousness? • What types of paradigm shifts are necessary in science to understand (and encourage) transformations in consciousness? • What are the dangers and risks associated with such intentional transformations in consciousness?

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