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Conceptualising the foundations of sustainability focused innovation policy: From constructivism to holism

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ABSTRACT

The emergence of complex global problems and related concerns about ‘sustainability’ are central pre-occupations of discourses concerning innovation and its pursuit. The pressing need to gain fresh insights into the nature of new ideas and collaborative endeavour that can be used to drive societal transitions, is increasingly acknowledged. The objective of this paper is to contribute to these insights by examining and enriching the conceptual foundations of sustainability focused innovation policy. It’s comparative metatheoretical approach enables exploration of the epistemological and political dimensions of the geography of transitions and systems literatures and the implications for the way in which they inform transformational change. The potential for deeper engagement with systems theory to create more holistic representations of complex problems, and the issues which must be addressed to resolve them, is explored. Findings regarding theory development and its implications for sustainability focused policy making provide a vital contribution to the fields of economic geography and the geography of transitions as well as to transitions literature more generally. As such it augments the foundations of ongoing empirical study and discourses which address the diminishing returns associated with current growth trajectories.

1. Introduction

A wide range of literature, across disciplines, engages with issues related to the emergence of complex global problems and how to address them through societal transition (Coenen et al., 2015; Coenen and Truffer, 2012; Fagerberg, 2018; Markard et al., 2012; Schot and Steinmueller, 2018; Sen, 2013; Torgerson, 2017; van den Bergh, 2013; Weber and Rohracher, 2012; Wells, 2013). The role of innovation, public policy and experimental governance across scales, such as nations and regions, are central concerns (Boschma, 2015; Boschma et al., 2017; Geels, 2002; Grin et al., 2010; Truffer and Coenen, 2012). Diverse theories provide insights and create knowledge about them. This paper considers the influence of paradigms on this knowledge creation by examining the development of theories which inform sustainability focused innovation policy. Specifically, it considers the potential for deeper engagement with systems theory to enhance the analytical lens through which sustainability concerns are conceived and addressed.

The objective is to contribute to the conceptual foundations of innovation policy that explicitly addresses the diminishing returns associated with current growth trajectories (Fagerberg, 2018; Jacobs and Mazzucato, 2016; Schot and Steinmueller, 2018; Stirling, 2014). The hypothesis is that, whilst the evolutionary principles of systems theory have been integrated into multiple, evolving transition frameworks which underlie development of policy, the unique contribution to knowledge concerning sustainability focused innovation (referred to as the phenomenon of interest or POI) provided by the distinct systems framework, has been under-realised. A comparative metatheoretical study of the epistemological and political foundations of theory (Burrell and Morgan, 1979; Edwards, 2014; Lewis and Grimes, 1999) is used to explore this proposition. The emerging Geography of Transitions literature (Coenen and Truffer, 2012; Murphy, 2015; Shove and Walker, 2007; Truffer et al., 2015), with its systemic, spatial focus, is considered alongside systems theory (Bertalanffy, 1968; Francois, 2006; Luhmann, 1995).

The intent is not to establish incontrovertible theoretical hierarchies or conduct comprehensive surveys of the relevant literatures. Rather, this exploratory paper considers some of their key attributes, to facilitate metatheoretical analysis. Given that scholars and practitioners are striving to formulate new approaches to addressing global problems, this philosophical discourse is crucial for grounding ongoing empirical research and policy development. Fresh insights will contribute to the ongoing evolution of the Geography of Transitions (GT) and will also be of interest to policy makers, transition scholars, and those exploring the notion of sustainability focused innovation more generally.

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GT (Boschma et al., 2017; Coenen and Truffer, 2012; Hansen and Coenen, 2015; Truffer et al., 2015) is a rapidly evolving field of research (Binz et al., 2020; Coenen and Truffer, 2012; Truffer et al., 2015). The question of how to generate and support sustainability focused innovation lies at its core. An increasingly diverse epistemic community is developing and refining its scope and theoretical approaches, to consider the influence of scale, place and spatial factors upon transitions (Binz et al., 2020; Binz et al., 2014; Lawhon and Murphy, 2012; Markard et al., 2012; Murphy, 2015; Truffer and Coenen, 2012). In order to analyse transition processes GT exploits the convergence of Economic Geography (EG) and, to a more limited degree, evolutionary economic geography (EEG), with conceptual frameworks that have emerged within the socio-technical systems (STS) literature; primarily technological innovations systems and the multi-level perspective (Truffer et al., 2015). It is presented, in this discussion, as an exemplar of an approach to conceptualising the POI, and exploring related issues regarding policy, that involves integration of concepts and ideas drawn from systems theory to refine its analytical lens. As such it provides the basis for the comparative analysis.

Systems theory, on the other hand, has been developing over approximately the last 100 years and is intrinsically related to the concepts of sustainability and innovation (Ashby, 1964; Beck, 1992; Bertalanffy, 1968; Capra, 1996; Hector et al., 2009; Wells, 2013). The first coherent metatheory in the area was consolidated by L. von Bertalanffy, an Austrian biologist working in the 1930’s. His book, published in 1968, was titled General Systems Theory (Bertalanffy, 1968) and proposed that systems are a collection of inter-related parts working together to create a coherent whole, open to exchanges of energy and information from the environment (Bertalanffy, 1968; Koestler, 1967). Much of this work, and the development of cardinal evolutionary concepts, originated in the biological and physical sciences but were then progressively applied to the social sciences through symbiotic processes of interdisciplinary and multi-disciplinary learning (Churchman, 1972; Foxon et al., 2013; Francois, 2006; Luhmann, 1995; Spash, 2012). The discipline of cybernetics, concerned with the trans-disciplinary study of complex systems, played a key role in facilitating this translation (Beer, 1969; Scott, 2001).

The concepts of self-organisation and emergence, and the teleological notion of feedback, were developed to enhance understanding of the dialectic between order and disorder and the importance of methods of communication and control which, in human systems, are shaped by consciousness (Beer, 1966; Luhmann, 1995). Critical systems theory (Churchman, 1972), open systems theory (Emery, 2000), and the theory of complex adaptive systems (Prigogine and Nicolis, 1977), amongst others, have enabled examination and development of analytical frameworks across disciplines and enhanced the richness of methodological approaches to problem solving (Bowers, 2011; Wells, 2013). The hypothesis is based upon the assertion that this maturation of systems theory has, in addition to its interrogative role, and refinement of influential concepts and ideas, led to unique analytical insights which create valuable knowledge regarding the POI, and enrich the conceptual foundations of sustainability focused innovation policy.

The argument proceeds in the first section by outlining the rationale for the research and methodology. This section also discusses the notion of sustainability using concepts and ideas which originate from systems theory but are also vital to the development of theories regarding societal transition, including GT. Section 3 describes the methodology and includes some reflection upon the nature of paradigms and theoretical hierarchies, to clarify the metatheoretical approach. The following section contains the metatheoretical analysis, which explores the paradigmatic orientations of GT and systems theory, and commences with a description of its structure. This is created by employing the three elements of cognition, power and scale to provide a coherent focus for the discussion. Section 5 considers the key findings and their contribution to the conceptual foundations of innovation policy in cases where pursuit and enhancement of the POI is the explicit goal. Section 6 concludes the discussion.

2. Rationale for the research

2.1. Overview

Over several decades, scholars in the fields of innovation studies and economic geography have explored the importance of scale for the formulation and implementation of innovation policy more generally (Asheim and Gertler, 2005; Cooke, 2001; Morgan, 1997; Shrolec, 2010). The historical focus on R&D, has been complemented by, and shifted toward, conceptualising ‘systems of innovation’, and developing progressively more refined approaches to reflecting the heterogeneity of sub-regional scales (Schot and Steinmueller, 2018b; Todtling and Trippi, 2005). The significance attributed to the development and exploitation of networks, the central role of agency and collaborative effort, and consideration of geographical localisation effects reflect the progressively place-based, systemic approach (Asheim et al., 2011; Barca et al., 2012; Rodríguez-Pose, 2018; Schot and Steinmueller, 2018b). Recognition of the ‘stickiness of knowledge’ and the need to consider both physical and cognitive proximity prompted movement from an emphasis on cluster policies to approaches based upon experimentation and reflexivity (Coenen et al., 2017; Heidenreich and Koschatzky, 2011; Isaksen, 2011). Concurrently, a rapidly evolving global system characterised by ‘wicked problems’ (Ackoff, 1995) led to the pressing need for scholars to generate new ideas capable of informing the pursuit of economic growth as part of a broader sustainability agenda (Smith et al., 2010). Growing appreciation of the importance of diversity and participatory democracy to achievement of this goal is reflected by, for example, the EU Smart Specialisation approach to regional development (Foray, 2014).

Transitions discourse which examines processes of socio-technical change consistent with the pursuit of sustainability, and the management of transition, has similarly been evolving, with systems theories lying at its core (Bulkeley et al., 2016; Geels, 2002; Jacobsson and Bergk, 2004; René Kemp et al., 2007; Markard and Truffer, 2008; Rip and Kemp, 1998). There is, accordingly, a degree of convergence between fields of research exploring the relevance and influence of geography upon innovation policy, on the one hand, and that which examines processes of socio-technical change, and related policy concerns, on the other. GT research occurring at this interface exploits the resultant synergies to consider how and why transitions are similar or different across locations (Köhler et al., 2019) and the influence of scale, place and spatial factors upon transitions (Binz et al., 2020). Some of the most prominent topical concerns have been energy transitions (Bridge et al., 2013; Dewald and Truffer, 2012; Hodson and Marvin, 2012; Murphy, 2015; Raven et al., 2012; Späth and Rohracher, 2012), and green mobility systems (Carvalho et al., 2012; Sengers and Raven, 2015) whilst others include food systems (Cohen and Ilieva, 2015) and the creation of socio-cognitive niches (Longhurst, 2015).

GT thus creates valuable knowledge regarding how to promote change consistent with renewal and resilience and strengthen the potential for communities to continue to survive and prosper. These are the issues which are encapsulated by the concept of sustainability focused innovation (the POI). The systemic character of the concept of sustainability is recognised and creates the basis for knowledge creation regarding the POI founded upon the integration of systemic concepts and ideas. The question considered in this paper concerns how the nature of this knowledge differs from that emanating from the distinct systems framework. This involves consideration of the lenses which shape their respective development. The intent is that resultant insights contribute to understanding the POI and thus enhance the conceptual foundations of sustainability focused innovation policy.

Based upon this rationale, it is vital to establish the dimensions of the core concept; sustainability. Ultimately, it is the relationship of different theoretical frameworks, and their interpretations of the POI, to this concept, that is at issue. Whilst its attributes are integral to the GT
literature and derive from systems theory, explicitly reflecting upon this abstract notion at the outset provides an understanding of the methodology, and the basis for synthesising the key insights that emerge from the analysis.

2.2. The core concept – sustainability

2.2.1. Overview

The focus upon sustainability, in transitions discourse, is motivated by recognition that extant global growth and development trajectories are associated with complex problems that destabilise institutions and systems of production, consumption and distribution (Bruntland Commission, 1987; Harcourt, 2014; Meadows et al., 1972). Pursuit by nations of successive increases in GDP, referred to as economic growth, in the context of exponential increases in global population, is contributing to this disruption (Foxon et al., 2013; Rauschmayer et al., 2015). Globalisation, rapid technological change and the volume and nature of human consumption, associated with this pursuit, are amongst the key factors driving increasing complexity and a proliferation of ‘spill over effects’ (Daly, 1974; Heinberg, 2011; van den Bergh, 2011). Declining biodiversity and climate change (United Nations, 2019), disempowerment of large sections of communities (Wilson et al., 2013), and inequality (Douglas et al., 2014), are some of the most pressing problems symptomatic of these dynamics. They are complex because they are interdependent and animated by the cognitive, interpretive processes, of a wide variety of increasingly connected agents and networks, across scales and by increasing biophysical interactions of human society with natural eco-systems across the globe (Greenhalgh, 2005; Jones, 2017; Shkliarevsky, 2016).

The knowledge required to avert multiple social and environmental crises must therefore radically transform and depart from dominant evaluative frameworks and dialogues associated with ‘economic growth’, within constrained time frames (Schot and Steinmueller, 2016). Transition, seen in this way, requires transformational change animated by collective, fundamental reconsideration, and discussion, about the concept of growth, and underlying notions of quality of life and how it may be enhanced (Jackson, 2006). Ultimately, institutions which structure social interaction and influence behavioural norms and routines across all facets of life, must reflect fresh perspectives and discourses, and iteratively redefine their purpose (Beck, 1992). As part of this process revised interpretations of the nature of innovation, and collaborative endeavour, required to drive renewal and positive change, would emerge (Ralston, 2012).

Sustainability is thus a temporal concept concerned with continuously evolving perceptions of the socio-ecological environment and interpretations of change (Cherlin, 2015; Luhrmann, 1995). The inter-relationships between cognition, the institutional environment, the biophysical human systems of production, consumption and distribution, which manifest behavioural norms and routines, and the natural environment (Jones, 2017; Shkliarevsky, 2016; Tainter and Taylor, 2014) are central. Cumulatively, these elements interact to create positive and negative feedback, the emergence of new rules and patterns, associated spill-over effects, and consequences for the balance between stability and disorder, and thus the way that we live (Meadows et al., 1972; Parrott and Meyer, 2012).

2.2.2. Theory development regarding sustainability and the POI

Theory development, which builds upon these systemic concepts and ideas, is a vital part of the multi-faceted process of knowledge creation and contributes to the conceptual foundations of sustainability focused innovation policy. Accumulation of information about the POI may be characterised as depictions of elements of these fundamental systemic dynamics and the factors that influence them. It must contribute to understanding the actions required to resolve complex problems and preserve the resilience and robustness of vital societal and environmental systems (Capano and Woo, 2017). Adaptation, based upon such learning, potentially enhances the capacity of these systems to respond to environmental shocks so they remain fundamentally intact. Ultimately, a balance between interdependent negative, equilibrating feedback that stabilises systems, and positive feedback, driven by deep-seated institutional and behavioural change, is crucial for avoidance of destabilisation that shifts systems toward crisis (Bertalanffy, 1968; Capano and Woo, 2017; Espinosa and Walker, 2011).

Systemic evolution is, however a non-linear, inherently spontaneous process of self-organisation. Its trajectory is not subject to direct control. The ability to influence the nature of change therefore relies upon the ability to describe and understand dynamics and emergent rules and patterns that are contributing to complex problems and the challenges they present (Ashby, 1964; Wells, 2013). A synthesis of diverse kinds of theoretical knowledge is essential. Consideration of differences and similarities between theoretical frameworks, using metatheoretical enquiry, enables the nature of distinct contributions to this synthesis to be examined (Burrell and Morgan, 1979; Colomy, 1991; Edwards, 2014; Lewis and Grimes, 1999).

3. Methods

3.1. Overview

The hypothesis which this paper tests is that, whilst the evolutionary foundations of systems theory have been integrated into multiple, evolving transition frameworks which underlie development of sustainability focused innovation policy, the unique contribution to knowledge concerning sustainability focused innovation (the POI) provided by the distinct systems framework has been under-realised. The proposition is based upon the assertion that the maturation of systems theory has, in addition to its interrogative role and contribution of key concepts and ideas, led to unique analytical insights which create valuable knowledge regarding the POI, and enrich the conceptual foundations of sustainability focused innovation policy. A comparative metatheoretical case study of the epistemological and political foundations of theory (Burrell and Morgan, 1979; Edwards, 2014; Lewis and Grimes, 1999) is used to explore the hypothesis and proposition.

Metatheoretical inquiry requires that a phenomenon of interest be identified (Lewis and Grimes, 1999). In the present study it is sustainability focused innovation (the POI). The method involves exploration of metatheoretical frameworks of GT and systems theory which are relevant to the POI, and the paradigm lenses which underlie and mould them. This exposes the way that data is interpreted and used to create meaning, and generate definitions of ‘information’ (Simms, 2015) in relation to key systemic dynamics which ground the concept of sustainability. Consideration of the way that key elements relevant to the POI; cognition, power and scale, are conceptualised, provides a coherent structure for the inquiry.

The methodology is pursued by first considering the GT literature and its paradigmatic influences, followed by examination of systems theory. Some initial discussion of paradigms, which encompass the epistemological and political dimensions of theory, (Burrell and Morgan, 1979; Edwards, 2014; Ormerod, 2016), helps to clarify the methodology and the significance of the results.

3.2. Paradigms

As with the systems concepts discussed in the section above, the philosophical notion of paradigms is generally well-understood. Nevertheless, some pertinent observations regarding their dimensions explains their foundational role in shaping different interpretations of the POI. Crucially, it also highlights the interconnectedness of the ways in which academics grapple with the complex, abstract ideas of consciousness and knowledge. Their lineage, from the ancient wisdom of Aristotle and Plato to the era of quantum mechanics and artificial intelligence, illuminates the struggle to describe ‘reality’ in ways that can
be used to explore the nature of human existence, survival and prosperity.

Paradigms are the superior tier of theoretical hierarchies. They co-evolve with metatheory, comprised of the general theories of social systems, which, most notably for this discussion, include evolutionary and institutional economics (Edwards, 2014; Kogetsidis, 2012; Overton, 2007). The core concepts and principles of metatheory, and their epistemological influences, are built upon and tested through the development of hypotheses, by mid-range theories such as GT and systems theories. The latter are as crucial as they are close to observed data to guide empirical enquiry, involving deductive and inductive reasoning, in relation to a phenomenon of interest (Edwards, 2010; Lewis and Grimes, 1999). They co-evolve with the paradigmatic lens and thus drive the iterative cycle of knowledge creation (Overton, 2007). These learning processes reflect judgements about what is valuable and must therefore be measured and evaluated, and inform methodological approaches to data collection (Burrell and Morgan, 1979). This hierarchical co-evolution is illustrated in Figure 1.

Understanding diverse hierarchies, and their evolution, assists comprehension of their inter-relationships. Burrell and Morgan's typology of paradigms is useful for exploring them (Burrell and Morgan, 1979). The ontological - epistemological spectrum ranges from a focus on the objective nature of reality and positivist, linear, cause and effect reasoning to a focus on subjective interpretive processes, non-linear interactions and feedback, and the socially constructed nature of reality. The political dimension includes a spectrum from determinism and control, to free will and recognition of the importance of ideology (Burrell and Morgan, 1979; Jashapara, 2011). As such it defines the scope and potential for reflexive learning and the normative dimensions of theory relevant to the POI. For example, knowledge about markets and knowledge about ‘spirit’ populate a wide spectrum, which is captured to different degrees, with implications for the way that transformational change is understood and pursued.

On the one hand, in a societal sense, paradigms are worldviews which mould ideas about what it means to live a good life, and shape interpretive processes, discourse and agency. On the other hand, in relation to theory, they define the parameters which create the analytical lens through which systemic dynamics are described. This co-evolutionary, intertwined evaluative matrix has the potential to generate reserves of problem-solving capability, development of excess capacity and redundancy, and notions of innovation that contribute to reflexivity as conditions continue to evolve (Jackson, 2006; Laszlo, 2004).

3.3. The importance of positivist foundations

As discussed, the knowledge required to avert multiple social and environmental crises must radically transform and depart from dominant evaluative frameworks and dialogues associated with ‘economic growth’, within constrained time frames. However, despite criticism of the rapidly evolving but relatively objective, positivist approach to knowledge creation associated with economic growth, useful interpretations of socio-ecological conditions and their underlying drivers can be drawn from application of this lens to the POI. It is helpful to consider these before examining the epistemological and political commitments of GT and systems theory, given that knowledge creation relevant to sustainability is most usefully based upon a synthesis of diverse points of view, and given that transformational change is a temporal, relative concept. Positivist analysis provides a valuable foundation for describing the issues and challenges associated with complex problems, and related conceptualisation of the POI, in a way that resonates with extant, dominant dialogues.

Discharge of greenhouse gases, extraction and conversion of finite natural resources, impingement upon, and destruction of habitats and ecosystems, pollution and generation of waste may be described, for example, as some of the most important drivers of environmental problems which innovative activity must confront (Millennium Ecosystem Assessment, 2005; United Nations, 2019); inequality can be characterised as divergence of incomes and wealth between capital and labour, and corporatisation (Giuliani, 2018); while the resultant ‘democracy of the market-place’ (Bersn, 2015) may be viewed as the underlying issue leading to disempowerment of communities (Horsell, 2013). These interpretations provide vital information regarding the directionality of institutional and behavioural change consistent with sustainability (Weber and Rohracher, 2012) and intelligence regarding policy levers and barriers for achieving this change.

The ideology of neoliberalism (Bockman, 2013) which underlies the individualistic, materialist concept of economic growth, is shaped by a similarly positivist lens. Related notions of sustainability and the POI inform approaches to crafting solutions to these problems by, for example, innovative, supply-side, technological solutions and preservation of ‘eco-system services’; increased innovation-led growth and penetration of global markets, accompanied by increased demand and consumption; and increased opportunity to be involved in economic activity. The tendency toward linear reasoning and determinism is pervasive, and the basis of intense critique, given that co-evolution of these depictions of challenges, and approaches to their resolution, are presently leading to crisis (Rauschmayer et al., 2015). Further information, gained from other theoretical standpoints, about evolutionary dynamics relevant to the POI, can be used to analyse, challenge and augment this foundation.

After outlining the structure of the analysis, interrogation of key facets of the theoretical hierarchies of GT and systems theory, relevant to their interpretations of the POI and interface with the concept of sustainability, is undertaken. As noted in the introduction, the intention is not to construct illustrations of theory development that are incontrovertibly ‘correct’ or present a survey of the relevant literatures. Indeed, a significant benefit of using the metatheoretical methodology to meet the objective of the study is to engender discussion and debate.

4. Analysis

4.1. Structure - cognition, power and scale

Examination of the way that several factors, which are crucial to explanations of the POI, are elucidated within different theoretical frameworks provides a structure for the analysis. This allows meaningful investigation of their theoretical hierarchies without which the metatheoretical inquiry would be a prohibitively convoluted endeavour. Three vital elements, and the rationale for their selection, is discussed below. They are not definitive of a hierarchy of importance. Rather, their pivotal role is extrapolated from the evolutionary concepts and ideas central to both systems theory and GT, and the emphasis placed upon them in the development of the latter.
4.1. Cognition

A widely acknowledged controversy arising from the systemic foundations of the notion of sustainability, that diverse theory must confront, is that, within society, systems are products of perception (Ashby, 1964). Ideas about their essential characteristics and views about how these ‘systems’ may be maintained and enhanced, vary widely and are associated with notions of quality of life and its pursuit (Capano and Woo, 2017; Capra, 1996; Garnsey and McGlade, 2006; Garud and Gehman, 2012; Hielscher and Will, 2014; Luhmann, 1995; Sen, 2013). Interpretations of change, are shaped by world-views which frame the way that value is construed and measured (Ashby, 1964; Beer, 1966; Espinosa and Walker, 2011; Luhmann, 1995; Maturana and Varela, 1988; von Foerster, 1981). Theory necessarily engages with these perceptual, normative issues in the process of distilling key concepts and ideas regarding innovation and sustainability, and portrays complex problems, and how to address them, accordingly. Concurrently, it describes the range of worldviews and knowledgebases which underlie the POI and explains why they are important, with ramifications for the development and implementation of policy. The human and natural elements of the meta-system are represented in ways which valorise certain discourses and associated, collective behaviours, for driving adaptation, innovation and renewal.

4.1.2. Power

The notion of the ‘collective’ is, however, fluid (Capra, 1996; Coenen and Truffer, 2012). When change is the issue being explored, groups of people and networks, their roles and importance to the pursuit of the POI, are necessarily characterised relative to the existing institutional framework and associated behavioural norms and routines (Coenen et al., 2010). For example, some which are considered most pertinent to the POI by GT are businesses, research organisations, representative, democratically elected governments which develop innovation policy, ‘civil society’ and, increasingly, the global community (Späth and Rohracher, 2012). Theory validates different kinds of information for analysing the relationship between such organisations and aggregations, and the POI, and either explicitly or implicitly discusses the balance between consolidation or destabilisation of the power of incumbents. This shapes the parameters of the institutional and biophysical ‘systems’ which it is proposed must survive, through adaptation and transformation, and justifiable trade-offs which may be made to allow this to occur (Jørgensen, 2012). Consideration of knowledge creation regarding these inherently political issues, and the factors that influence the capacity to escape lock-in and path dependency, is crucial (Geels, 2002; Loorbach, 2010).

4.1.3. Scale

A further important dimension of the POI is scale, which influences the way that system dynamics are scrutinised (Valentino and Chatalova, 2016). Their characterisation reflects standpoints from which the evolution of systems, and the factors which impact upon their stability, are observed (Kauffman, 1995). Spatial parameters define significant attributes of the physical, institutional, cultural and socio-economic setting in which learning, animated by discourse, and behaviour relevant to the pursuit of the POI takes place (Cherlin, 2015; Loorbach, 2010; Rodríguez-Pose, 2013; Skliarevsky, 2016). The interplay between the global and local in how ‘novelty’ is understood, as well as the importance of different kinds of cross-scale interactions and relationships which correlate with diverse notions of proximity (Coenen et al., 2010) must be captured by theory, given their importance for innovative endeavour. Depiction of multi-scalearity is therefore another factor which reflects the nature of knowledge creation regarding the POI.

4.2. Geography of transitions

4.2.1. Institutional and evolutionary economics – metatheory

GT is a diverse, inter-disciplinary research field being developed by a growing epistemic community. The term is used in this discussion to refer to theory development which exploits synergies between Economic Geography (EG) and the socio-technical systems (STS) discourse, and to some degree, Evolutionary Economic Geography (EEG) (Boschma et al., 2017; Coenen et al., 2017; Coenen et al., 2012; Murphy, 2015). Whilst the field is developing rapidly, the analytical lens is co-evolving with a metatheoretical framework substantially defined by the general social theories of evolutionary and institutional economics. Evolutionary economics considers the establishment of habits and routines in the context of bounded rationality, and their evolution through processes of variation, selection and retention (Nelson and Winter, 1982). The essentially Darwinian notion of Schumpeter’s ‘creative destruction’ builds upon this idea through application of the systemic concepts of co-evolution and non-linear economic evolution, transcending reliance upon cause and effect reasoning, by observation of consequences (Schumpeter, 1934). Emphasis upon the dialectic between conflicting worldviews as the driver for creativity reflects its inately constructivist philosophical foundations (Harris and Metcalfe, 2015).

Institutional economics complements evolutionary theories by emphasising the role of institutions or ‘social rule systems’ as important contexts in which behaviour is enacted (Dodgson et al., 2011; Foxon et al., 2013; Greenwood and Suddaby, 2006; North, 2005; Ostrom, 1990; Rodríguez-Pose, 2013; Santos and Eisenhardt, 2005). Recognition of the importance of networks, rather than individual economic elements (DiMaggio and Powell, 1983; Gupta et al., 2007), is accompanied by the insight that evolutionary strategies for collective action evolve and adapt through the medium of institutions, informed by economic theory (Geels, 2002; Truffer and Coenen, 2012). These ‘parent disciplines’ contain the core ideas and principles which are incorporated and developed by mid-range theories including those which coalesce in the GT discourse.

4.2.2. GT – inter-disciplinary mid-range theory development

The mutual advancement of EG, EEG and STS, through exploration of their intersections and complementarities, reflects the metatheoretical commitment to challenge the utility of the relatively positivist, neo-classical concept of economic growth for understanding and pursuing the POI. Exploitation of their synergies is an evolving focus within each of the disciplines (Boschma et al., 2017; Murphy, 2015; Truffer and Coenen, 2012; Truffer et al., 2015) and enables consideration of broader notions of innovation and ‘grand challenges’ (Coenen et al., 2015).

STS researchers have progressively engaged with the work of geographers to better account for the role that multi-scale, spatial, and context-specific factors play in shaping the pace, scope, and direction of change (Coenen and Truffer, 2012; Dewald and Fromhold-Eisebit, 2015; Murphy, 2015). Concurrently, economic geographers have employed transition concepts and approaches to exploring socio-technical change in spatial environments. The evolutionary foundations of STS (Nelson and Winter, 1982), are combined with the relational and institutional aspects of EG (Murphy, 2015), and the evolutionary focus of EEG (Martin and Sunley, 2015), to create a nuanced lens for examining environmental innovation, and broader dimensions of co-evolutionary societal and technological change (Boschma et al., 2017; Hansen and Coenen, 2015; Longhurst, 2015; Murphy, 2015; Shove and Walker, 2007). The proposition underlying the development of this inter-disciplinary discourse is that transitions research would benefit from more comprehensive engagement with the concepts of socio-spatial and socio-technical embeddedness, multi-scalearity, and the role...
of incumbency and power in influencing transition (Murphy, 2015; Truffer et al., 2015).

As part of this emerging research agenda EG and EEG’s exploration of heterogeneous development paths in geographical territories is increasingly intertwined with the relational concepts of cognitive, organisational, social and institutional proximity, accentuating that the definition and practice of innovation are influenced by interactions across these different dimensions (Coenen et al., 2010). The importance of power relationships, governance frameworks, transnational networks (Carvalho et al., 2012; Coenen et al., 2012; Raven et al., 2012) and, generally, the socially constructed nature of space is incorporated into a sharpening analytical lens (Hansen and Coenen, 2015).

STS, on the other hand, explore processes related to learning and regime change, in political, power-laden environments (Markard et al., 2012; Rip, 2006). Importantly they consider the interplay between stability and disruptive change and broader processes of transition (Geels, 2002). Technological innovation systems, and the multi-level perspective, are conceptual frameworks which are integral to STS, and facilitate examination of the co-evolution of societies and technical systems. Whilst they have developed independently they have common theoretical roots (Markard and Truffer, 2008) and have a sharp focus upon sustainability and sustainable development (Truffer et al., 2015). Technological innovation systems has been primarily concerned with the development of technological niches (Rip and Kemp, 1998) and examines drivers and barriers for successful diffusion of a particular technology or product (Markard and Truffer, 2008). On the other hand, the multi-level perspective explores broader technological transitions and employs the concept of self-organisation to consider the development of niches within emergent institutional structures known as regimes, in the context of slow-moving socio-economic and political landscapes (Geels, 2002; Gupta et al., 2007). The associated concept of transition management (R. Kemp and Loorbach, 2007) provides a methodological framework useful for informing policy interventions (Markard and Truffer, 2008). Examination of interactions between emerging niches within existing regimes and their prevailing, dominant cognitive, institutional and political configurations has been enhanced by recognition of the importance of the geographical scale within which they are meaningfully defined (Hodson and Marvin, 2012; Lawhon and Murphy, 2012; Longhurst, 2015; Raven et al., 2012; Späth and Rohracher, 2012). Acknowledgment of the place-dependence of socio-technical transition processes, and the importance of spill-over effects and related variety, in addition to the integral concept of path-dependence, is a discernible contribution by EEG as part of this discourse (Boschma et al., 2017). Preoccupation with the requirement for fresh perspectives and framings of innovation and innovation policy is a key feature of prevailing inquiry.

GT reflects a commitment to using evolutionary concepts and ideas to describe systemic dynamics in relation to the concept of sustainability, to explore the nature and drivers of the POI. The constructivism evident in both evolutionary and institutional economics is manifest, highlighting the development of an evaluative framework beyond that associated with economic growth. This is magnified by the enrichment of the field through discussion of theoretical frameworks which include those associated with political ecology (Lawhon and Murphy, 2012); urban and political geography and place-making literature (Murphy, 2015; Pierce et al., 2011); and social practice theory (Cohen and Ilieva, 2015). The complex nature of the POI and the dynamics which animate its successful pursuit are increasingly captured by an inter-disciplinary, multi-dimensional lens through which the three factors, cognition (including collective, social processes, and learning); power (and incumbency); and scale, are considered and described.

4.2.3. The emerging paradigm

Consideration of the political dimensions of the paradigm, together with the readily observable, epistemologically constructivist lens is also important for understanding the knowledge creation emerging from the ongoing development of GT. Examination of progressively reflexive processes of inductive and deductive reasoning, evident in the literature, demonstrate progress toward creating a more nuanced perspective regarding the POI. There is growing recognition in some of the literature of the pivotal importance of the innate value of the natural environment, ideology and the normative dimensions of the POI, different aspects of what it means to live a good life, and the utility of challenging the determinism inherent in the conflation of progress with economic growth. These advances are evidence of reflection upon the complex nature of interdependent social and environmental problems and their contribution to destabilisation of similarly interdependent institutional, production, consumption and distribution systems.

Some notable, very diverse examples which illustrate recognition of the need to explore this complexity in order to inform the pursuit of transformational change are described in Table 1.

Further information regarding the political dimensions of the paradigm can be gained by considering pervasive attributes and themes, evident from the body of GT literature discussed in this paper, presented in Table 2. They complement the examples presented in Table 1, which illustrate the diversity that characterises mid-range theory development, by providing more general, overarching insights into how the intertwined facets of cognition, power and scale are addressed, and the implications for the nature of knowledge creation.

### Table 1
Exploiting the political dimensions of the GT paradigm - radicalism

| Attributes relevant to interpretation of paradigm                                                                 | (Binz et al., 2016; Boschma et al., 2017) |
|-------------------------------------------------------------------------------------------------------------------|------------------------------------------|
| Discussion of the importance of institutional entrepreneurship and the exercise of strategic agency by individuals, networks and informal institutions | (Binz et al., 2016)                      |
| Increasing emphasis upon grand challenges                                                                         | (Coenen et al., 2015)                    |
| Recognition of the need for demand articulation to ensure innovation drives decisive changes in consumption patterns | (Devald and Truffer, 2012)               |
| Consideration of the significance of a diversity of characterisations of 'proximity' which capture the complexity of the concept of sustainability | (Hansen and Coenen, 2015)               |
| Exploration of bundles of practices considered through the lens of social practice theory                         | (Cohen and Ilieva, 2015)                 |
| Establishing the potential of migration to stimulate diversity                                                     | (Listerborn, 2012)                      |
| Examination of the concept of place-making to promote engagement with a broad range of issues that influence quality of life | (Murphy, 2015; Pierce et al., 2011)      |
| Case studies of communities in which epistemological and political pluralism have generated new lifestyles and economies | (Longhurst, 2015);                      |
| Development of more expansive framings of problems and social innovation                                         | (Smith et al., 2010)                     |
| Strengthening focus upon diversification, unrelated variety, 'radical novelty' and the related notion of bricolage across industries, sectors and communities | (Boschma et al., 2017)                  |
| Increased attention to social and cultural conditions that enable and constrain change                             | (Hansen and Coenen, 2015)               |
Cognition
Tendency toward ex-post, occasionally linear reasoning regarding technology ‘transfer,’ reflecting a relatively deterministic view of innovation, rather than substantively engaging with the concept of emergence

Dominant characterisation of the natural environment as an ‘endowment’ and category of capital rather than as the foundation of human life, often without acknowledgement of this implicit value judgement

A persistent focus on bringing about industrial change, and the micro-foundations of supply-side economics, with less attention paid to behaviour and lifestyles

Limited attention to defining systemic hierarchies or place-based problems and behavioural patterns in relation to the issue of sustainability, reflecting the lack of fluidity of the normative dimensions of theory

Tendency to emphasise the importance of visions which are prone to be based upon existing notions of growth and the deterministic expectation that it will continue

Power
Persistent focus on firms as the micro-foundations of ‘growth’. Notions of landscapes and regimes, power, and innovation, are often framed in relation to associated perspectives on ‘value’ and quality of life, implicitly validating incumbency based on the notion of economic growth

Explicit exploration of the interdependence of complex problems (despite growing discussion about demand articulation, social innovation and more expansive framings of problems) remains relatively minimal, contributing to their depoliticisation

Scale
Focus on the concept of ‘embeddedness’ contributes to relatively static characterisations of space and scale, despite the increased emphasis on local institutions and culture

Generally, a lack of clarity regarding the scale which shapes depictions of complex problems and how they may be addressed. In many cases manifestations of complex problems at a local scale are subsumed into discussion about technological approaches to addressing ‘grand challenges’, reflecting a limited focus on the fluidity of perceptions of quality of life evident within smaller communities

These attributes of the GT literature, which are admittedly contestable and by no means exhaustive, suggest that, the political dimensions of the prevailing paradigm exhibit persistent, distinct elements of conservativism. While the extent to which each of these observations is true varies across the diversity which GT represents, they capture some of the most salient characteristics of the paradigm which has co-evolved with the research field. The theoretical roots of the framework constrain conceptions of innovation and socio-technical processes of interdisciplinary and multi-disciplinary learning (Churchman, 1972; Foxon et al., 2013; Francois, 2006; Luhmann, 1995; Spash, 2012). This has involved movement from seeing teleological mechanisms, dictated by maintenance of the design of a system consistent with its purpose, to feedback loops based on mechanisms of communication and control shaped by consciousness (Beer, 1966; Espinosa and Walker, 2011) von Foerster).

The metatheoretical framework of systems theory encompasses the foundational concepts of systems, resilience, emergence and self-organisation. Chaordic systems thinking (Putnik and van Eijnatten, 2004), creative holism (Jackson, 2006) and evolutionary systems design (Laszlo, 2004) are applied theories within this framework which help to define its parameters. Learning and mental models (Senge, 1990), holism, and creativity and empowerment, respectively, elucidate essential insights regarding the implications of theory development for problem solving. Associated literatures of risk and collapse sit alongside this framework to examine the systemic ramifications of different approaches to addressing complex problems (Tainter and Taylor, 2014; Wells, 2013). An increased emphasis upon the concept of complexity has deepened the metatheoretical focus on escalating interactions between human and natural systems, and between human systems, as a driver of destabilising, increasingly novel feedback (Garney and McGlade, 2006; Lozada, 2017; Parrott and Meyer, 2012; Wells, 2013).

The discipline of cybernetics, which emerged in the 1940s and 1950’s, translates systemic concepts into social and organisational settings and, similarly, highlights the paramount importance of the idea of complexity. Ashby’s law of requisite variety (Ashby, 1964; Scott, 2001), a foundation of the discipline, states that the degree of influence or control over a system is proportional to the amount of information available. Knowledge creation through theory development plays an important role in determining whether this information is sufficient for informing the achievement of defined goals in relation to a phenomenon of interest (von Foerster, 1981) (in this case the goals relate to the development of sustainability focused innovation policy). The corollary is that institutional systems either filter out, or process the complexity associated with pressing global problems (Beer, 1966). The central premise is that if key factors driving change are not observed they cannot inform collective adaptive processes.

4.3.2. Mid-range theory

A diverse range of mid-range theories have been built upon, and symbiotically co-evolved with these foundations. Their unique analytical lenses have been refined by inductive and deductive reasoning as part of a wide range of biological and sociological studies that have been carried out in multiple cultural and political contexts, over decades of research. They include critical systems thinking (Jackson, 2006), critical systems theory (Churchman, 1972; Kogetsidis, 2012), open systems theory (Emery, 2000), the applied theory of systems dynamics (Wolstenholme, 1999), and the governance theory of the viable systems model (Barile et al., 2014; Espinosa and Walker, 2011). Arguably, the most important of these theories in relation to the POI, which incorporates the evolutionary principles which define the notion of sustainability, is complex adaptive systems. A complex adaptive system is described as an open system whose elements interact dynamically and non-linearly, which exhibits unpredictable behaviours, is affected by positive and negative feedback loops and co-evolves with its environment (Espinosa and Walker, 2011; Kauffman, 1995). The six basic principles are nonlinearity, feedback, networks, hierarchy, emergence and self-organisation (Wells, 2013).

Knowledge regarding the key inter-related issues of cognition, power, and scale, which is crucial for understanding the POI, is created through application of these principles. Some pertinent examples, which draw upon, and reflect the overlapping, synergistic layers of the systems theoretical hierarchy, and related cybernetics literature, highlight the distinctiveness of the framework, and its insights into the POI.

Table 2
Exploring the political dimensions of the GT paradigm – enduring conservatism

| Attributes relevant to interpretation of paradigm |
|------------------------------------------------|
| Cognition |
| Tendency toward ex-post, occasionally linear reasoning regarding technology ‘transfer,’ reflecting a relatively deterministic view of innovation, rather than substantively engaging with the concept of emergence |
| Dominant characterisation of the natural environment as an ‘endowment’ and category of capital rather than as the foundation of human life, often without acknowledgement of this implicit value judgement |
| A persistent focus on bringing about industrial change, and the micro-foundations of supply-side economics, with less attention paid to behaviour and lifestyles |
| Limited attention to defining systemic hierarchies or place-based problems and behavioural patterns in relation to the issue of sustainability, reflecting the lack of fluidity of the normative dimensions of theory |
| Tendency to emphasise the importance of visions which are prone to be based upon existing notions of growth and the deterministic expectation that it will continue |
| Power |
| Persistent focus on firms as the micro-foundations of ‘growth’. Notions of landscapes and regimes, power, and innovation, are often framed in relation to associated perspectives on ‘value’ and quality of life, implicitly validating incumbency based on the notion of economic growth |
| Explicit exploration of the interdependence of complex problems (despite growing discussion about demand articulation, social innovation and more expansive framings of problems) remains relatively minimal, contributing to their depoliticisation |
| Scale |
| Focus on the concept of ‘embeddedness’ contributes to relatively static characterisations of space and scale, despite the increased emphasis on local institutions and culture |
| Generally, a lack of clarity regarding the scale which shapes depictions of complex problems and how they may be addressed. In many cases manifestations of complex problems at a local scale are subsumed into discussion about technological approaches to addressing ‘grand challenges’, reflecting a limited focus on the fluidity of perceptions of quality of life evident within smaller communities |
In systems theory cognition, or perspective, and scale are explored through the notion of systemic hierarchies (Koestler, 1967). These constructs provide the basis for delineating systemic boundaries and their spatial, institutional and biophysical dimensions, identification of relevant collectives and observation of interactions which are relevant to the POI (Beer, 1966). The ‘collective mind’ (Capra, 1996) is thus described in diverse ways, with the observer explicitly acknowledged (Senge, 1990; Wells, 2013). Engagement with the issues of subjectivity, ideology and normative dimensions of quality of life, are central (Ashby, 1964; Barton et al., 2004). This reflects the preeminence of consciousness as the factor which animates meta-system dynamics that impact upon the sustainability of human systems. Whilst the emphasis of GT on the co-evolution of the socio-spatial and socio-technical is based upon these ideas, and acknowledges their importance for the POI, systems theory sharpens the focus on the typology, and level in the hierarchy, which drives understandings of novelty and innovation (Churchman, 1972). This entails divergence from the characterisations of cognition by GT described in Table 2. A pertinent example relates to the way that the natural environment is considered. The approach of systems theories to exploring the notion of cognition enables the inter-relationship between scientific, relatively positivist viewpoints, and those relating to spirit and old knowledge (Wells, 2013) regarding the way that the natural environment is considered. The approach of GT on the co-evolution of the socio-spatial and socio-technical is represented as crucial because of its character as the material, geographical domain in which feedback and socio-ecological change is experienced and ‘consequences’ interpreted (Beer, 1966; Parrott and Meyer, 2012). As such, it has the capacity to drive conceptions of novelty intimately connected with a wide range of notions of what constitutes a good life, and how it may be sustained, beyond those emanating from more narrowly defined groups, who are often identified by GT in relation to the positivist concept of economic growth and job creation, or global norms (Checkland, 1981). Characterisations of niches, regimes and landscapes in the STS and GT literature, is nuanced and fine-grained in its discussion of the POI and its pursuit, but emphasises the value of transferring and embedding new ideas and practices, while systems approaches reflect a greater acceptance of perception and ideology as being intrinsically interconnected with community and place (Bell and Morse, 2005; Laszlo, 2004). This enables a focus upon observation and interpretation of processes of institutional and biophysical self-organisation, emanating from a diverse array of scalar hierarchies, which contribute to the complexity of dynamics relevant to transition and renewal (Francois, 2006; Tainter and Taylor, 2014).

The notions of power and incumbency are captured, in systems theory, by concepts of feedback and emergence (Prigogine and Nicolis, 1977). The propensity for stasis and loss of reflexivity is depicted as a corollary of situations where changing socio-ecological conditions arising from dominant dialogues, and associated behaviours, are widely perceived to be enhancing quality of life (Ashby, 1964; Barile et al., 2014). Given the intimate connection between cognition, institutional structures and biophysical systems, the nature of networks and institutions considered important for defining and pursuing innovation drives accumulation of biophysical resources by elites, magnifying their power, and entrenches incumbency and path dependency (Tainter and Taylor, 2014). Systems theory highlights the tendency, arising from this rigidity and failure to recognise crucial interdependencies, to ignore unintended spill-over effects which lead to destabilising feedback and unpredictable, emergent rules and patterns (Laszlo, 2004). Concurrently, over-emphasis upon the capacity for control and the predictability of factors which impact upon the stability of vital systems, is identified as a key issue that creates the potential for non-linear change to shift the balance from transition to crisis (Simms, 2015). The overriding importance often placed upon the development of scientific, technological solutions to global problems, whose complexity is transparent to a limited cohort, may from this perspective, be charged with magnifying this potential (Wells, 2013).

Together, this body of knowledge reflects the increasing metatheoretical engagement with the concept of complexity and the necessity to perceive it in order to achieve sustainability goals. Systems theories discuss cognition, scale and power, and conceptualise the POI in ways which demonstrate their distinct theoretical heritage and hierarchy. In doing so they clearly exhibit a constructivist epistemological perspective, as was also observed in relation to GT.

4.3.3. The emerging paradigm

Consideration of the corresponding political dimension of the paradigm, evident from the aspects of development of mid-range theory discussed in the previous section, is decisive. It illuminates the unique insights into the POI provided by the systems framework. Concepts such as scalar hierarchies, recognition of the pre-eminence of the observer, the focus on consequences, and the interdependencies which give rise to them, reflects its value as a framework for creating knowledge about dynamics associated with different ways of thinking and living, and sustainability. Recognition of the importance of ideology is integral.

Concurrently, the commitment to exploring social processes using diverse knowledge across multi-paradigmatic disciplines, including neo-classical, institutional and evolutionary economics, and other environmental and social theory, reflects an appreciation of their complementary and contradictory insights, and creates the basis for creativity, learning and holistic depictions of systemic dynamics (Bell and Morse, 2005; Capra, 1996; Luhmann, 1995). Relatively, linear positivist interpretations of systems and their evolution are recognised for providing information relevant to directionality, policy levers and challenges, whilst information considered valuable within other theoretical frameworks is used to enrich understanding of the self-organising processes which coalesce to give rise to complex problems and the challenges they present. The proposition is that this analytical lens counters fragmentation of knowledge and broadens the range of what is considered valuable information. The scope of measurement and evaluation, and the reflexivity of learning concerning the POI, is enhanced accordingly (Espinosa and Walker, 2011; Tainter and Taylor, 2014). This generates knowledge about systemic dynamics which founds the potential to influence them by, most notably for this discussion, informing the generation of positive societal feedback that increases the ability of systems to respond to a rapidly changing environment. The potential to meaningfully revise interpretations of ‘optimal’ trade-offs across social and ecological dimensions, and make a significant contribution to understanding the factors which contribute to transformative rather than incremental change, is the result (Rouwette et al., 2016).

The radicalism of this approach is reflected by the assertion that systems sciences have developed through a series of paradigm shifts, which are explicit and recognisable, given their inherent focus on learning and knowledge creation (Edwards, 2014). These are described by Jackson (2006, p. 654) as “functionalist, interpretive, emancipatory and post-modern” representing a shift from mechanistic thinking toward a greater focus on capturing the interplay of human thought with systemic dynamics. Edwards notes that scholars have suggested an additional phase, which could be described as: “complexity” (Leleur, 2008), ‘creative holism’ (Jackson, 2006; Liu et al., 2007) or ‘integrated coupled human and natural systems’ (Liu et al., 2007)” (Edwards, 2014, p. 730). These shifts further demonstrate the unique and distinct nature of the systems hierarchy, its recognition of the fundamental importance of the notion of complexity and the requirement for transdisciplinary approaches to analysis and problem-solving (Bowers, 2011; Francois, 2006). Systems theories are thus distinguished
and liberated from more deterministic orientations (Arora-Jonsson, 2016).

5. Discussion

This paper examines the creation of knowledge required to avert multiple social and environmental crises which arise from the increasing instability and disruption of vital institutional, production, consumption and distribution systems. The primary finding is that the hypothesis which states that, whilst the evolutionary principles of systems theory have been integrated into multiple, evolving transition frameworks which underlie development of relevant policy, the unique contribution to knowledge concerning sustainability focused innovation provided by the distinct systems framework, has been under-realised, is valid. This has been established by verifying the proposition the maturation of systems theory has, in addition to its interrogative role and contribution of key concepts and ideas, led to unique analytical insights which create valuable knowledge regarding the POI.

These insights into the POI, and their importance, were explored by considering the way that GT and systems theory characterise the three elements of cognition, power and scale. This facilitated the development of ‘paradigm accounts’ and the metatheoretical analysis. Interrogation of the theoretical hierarchies associated with GT and systems theory, and the paradigmatic influences which underlie and mould them, revealed the particularity of their respective lenses, apparent from their divergent political dimensions. The systems theoretical hierarchy reflected profoundly more radical philosophical foundations than GT and fundamental departure from dominant evaluative frameworks associated with the more positivist notion of economic growth. This highlighted that its depictions of challenges underlying complex problems, and conceptualisations of the POI, are of vital importance for informing action intended to drive positive feedback and transformational change. Recognition of this distinctiveness, and scrutiny of the nature of the knowledge created through the application of this lens, enriches the conceptual foundations which can be drawn upon to inform sustainability focused innovation policy.

The metatheoretical approach highlighted the intrinsic connections between thought systems, social systems and biophysical systems which shape an emergent ‘reality’. The underlying proposition is that this must be understood at the deepest level, and entails describing challenges and approaches to their resolution as products of cognition and deliberation. When sustainability focused innovation is the phenomenon of interest, systems theory highlights that exploration of the multiple ways that communities, across a broad ideological spectrum, ‘see’ and portray challenges associated with complex problems, is required. Observation of related behaviour and resultant dynamics, and formulation of new innovative ideas intended to contribute to sustainable growth must be based upon this multi-faceted lens. In this way, diverse world views which highlight the different dimensions of ‘being human’ (Nakamori and Sawaragi, 2000), and their inter-relationships, can illuminate the complexity of challenges and identify institutional and behavioural factors which must be considered. Without this understanding it is contended that key factors which influence the dynamics of vital systems will be ignored and instability reinforced. Development of the central concept of complexity, as part of the maturation of systems theory thus elucidates the urgent need for holistic approaches to knowledge creation and plays an important role in promoting trans-disciplinarity.

The propositions regarding directionality provided by the relatively positivist lens which often shapes current discourse, are therefore vital. On the other hand, systems theory highlights the pre-eminent role of the observer in driving interdependent feedback loops and socio-ecological change. Examination of ideological spectrums that span markets to spirituality, individualism to collectivism, consumption to connection, amongst many others, provide valuable interrogatory tools. Co-evolutionary metatheory and mid-range theories that have been shaped by this lens can be applied to their interrogation.

The analysis also illuminates the contribution of GT to enhancement of understandings of the POI. Its constructivist metatheoretical foundations have co-evolved with mid-range theory to enable consideration of factors that drive transition in spatial contexts across scales. Depictions of key processes are progressively refined in a nuanced way capable of meaningfully informing policy development and deepening the focus on second-order learning and participatory discourse. Its potential to inform action intended to drive negative, equilibrating feedback which co-evolves with interdependent positive feedback, is significant and crucial. This imperative arises from the pressing need to stabilise human and natural systems which are facing an ever-increasing possibility of descent into crisis. Nevertheless, the enduring, relative political conservatism is also evident, to varying degrees, in the development of GT, which carries with it the risk of perpetuating approaches to innovation policy that are associated with incremental change and stasis.

The insights provided by this discussion highlight the fundamental difference between theory which integrates the evolutionary foundations and concepts and ideas developed by systems theory, and systems theory itself, for informing debate about the POI. This suggests that the distinctiveness and importance of the contributions of GT and systems theory which emerged from the discussion create the basis for a powerful metatheoretical synthesis. This facilitates the key insights of each of them to be fully exploited based upon their complementarities and divergences and enhances their respective capacity to inform sustainability focused innovation policy. For example, issues which may arise in the policy-making process include: defining the parameters and processes of participatory forums that depart from a pervasive focus upon ‘representativeness’; the development of evaluation frameworks that fuel wide-ranging reflexive learning; consideration of the importance awarded to ‘place’ as a driver of novelty, and interrogation of multi-scalar interactions which impact upon the realisation of its potential; examination and reflection upon the inter-relationship of place-based conceptions of novelty with those being generated within accelerators, incubators, hubs, experimental labs and technological start-ups; and analysis of how recognition of the interdependence of complex problems (including declining biodiversity, climate change, inequality and disempowerment), may be leveraged for generating new ideas that challenge incumbency, and for shaping policy mixes. It is evident from the preceding discussion regarding cognition, scale and power that GT and systems theory contribute knowledge which may be leveraged to identify, and address matters relevant to these concerns. A multi-paradigm approach to exploring them requires commitment to creativity, acceptance of ambiguity, and pursuit of synergy rather than consensus (Espinosa and Walker, 2011; Leach et al., 2010; Rouwette et al., 2016; Stroh, 2015) as the essential foundation for ongoing endeavour.

6. Conclusion

The POI, or sustainability focused innovation, requires knowledge to be created about how to promote change consistent with renewal and resilience and thus strengthen the potential for communities to continue to survive and prosper. The way its dimensions are conceived go to the heart of the idea of growth and the nature of positive change. They have often been interpreted within economic discourse shaped by the metatheoretical lenses of evolutionary and institutional economics. It is evident from this discussion that, when sustainability and transition are the central concerns, this lens curtails its wider interpretation. However, the adoption of a more expansive lens challenges ideas about what innovation is and the purview of ‘innovation policy’. The lack of boundaries and potential indeterminacy of the concept potentially precludes its utility. Nevertheless, the metatheoretical analysis illustrates how crucial this ‘zooming out’ is for creating enriched foundations for more discrete analysis in diverse settings. Critical thinking and
reflection on foundational concepts and ideas is vital.

In circumstances where radical change in dominant evaluative frameworks within constrained time frames is required, knowledge creation regarding sustainability challenges, and approaches to their resolution, can only be sufficiently transformative where ‘old certainties’ about what makes a good life and what can be sustained, are challenged. Given the nexus between policy makers and incumbents, it is argued that radical disruption of the status quo will be more likely to emanate from communities and activism rather than ‘innovation policy’. Despite this, the potential for creativity and learning may be enriched by wider, more exploratory discussions. It is also possible that the forces which generate inertia are so integral to current ways of living and perceiving the notion of growth, that change will necessarily be driven only by crisis. In this scenario adaptive responses to socio-ecological change will occur in an environment where there is limited capacity to exert control over dynamics which threaten prosperity, and in the extreme, survival. Even if this proposition is accepted the quality of deliberative processes across ideological divides, and the vibrancy of the ideas that animate them, remain vital to the preservation of resilience.

The paradox that the positivist mindsets which valorise linear thinking, and a somewhat singular focus on individualism and the ‘material’, through notions such as economic growth, are most likely to undermine vital systems, lies at the heart of many current dilemmas. The challenges are compounded because systems that are derived from these ways of thinking create employment and a sense of meaning for people across the globe (Wilson et al., 2013). The current COVID-19 pandemic has placed these issues into sharp relief. The proposition that this disruption provides a chance to ‘reset’ our priorities and ways of living, is countered by a sense of urgency to emerge from crippling recessions and return to economic growth. Research which explores issues raised in this paper, as part of ongoing discourse concerning the role of innovation and innovation policy in driving transition, will make a vital contribution to understanding processes of emergence animated by this dichotomy. This research did not receive any specific grant from funding agencies in the public, commercial, or non-profit sectors.

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