Environmental Science and Policy 132 (2022) 24–34

Contents lists available at ScienceDirect

Environmental Science and Policy

journal homepage: www.elsevier.com/locate/envsci

Cultures of transformation: An integrated framework for transformative action

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ARTICLE INFO

JEL Classifications:
O35
O39
O33
Z1

Keywords:
Sustainability transitions
Knowledge co-production
Energy Cultures Framework
Multi-level Perspective
Psychology of behavioural change

ABSTRACT

The challenges posed by climate change have generated many initiatives that seek to implement societal transformations. In most cases, these focus on technology developments, adoption and diffusion but neglect the social and cultural dimensions of a transformation. Insights from systems and behavioural sciences can provide valuable guidance on these aspects, but the utility of this literature is limited by two factors. Firstly, the literature on the intersection between social transformation and psychological processes of behaviour change by individuals is limited. Secondly, the complex technical nature of much of the transition relevant literature limits its accessibility by stakeholders outside academia. We seek to address these challenges through the development of a transdisciplinary Transformation Process Framework for use as a 'knowledge integration' tool as part of a co-design process for transformative change. The Framework: (1) develops a systematic narrative of the transformational changes that need to be triggered at multiple scales (from individual to society), (2) generates a map to identify key variables, drivers, and blockers in a transformation process integrating different knowledge from fragmented disciplines; (3) serves as a tool to support the exploration of relevant academic (and other) literature to collate and utilise relevant knowledge.

1. Introduction

Grand societal challenges such as the climate crises have led to calls not just for a technology-led transition, but for a fundamental transformation in the economic, political, and institutional arrangements shaping the way society operates (Brand, 2016; Gillard et al., 2016; Scoones, 2016; Fazey et al., 2018a). Programs and policy agendas seeking sustainability-oriented transformations are now underway across many sectors and scales in society - the European Green Deal (EGD) being a recent example (European Commission, 2019). Many initiatives prioritise technology development, technology switching, adoption and diffusion as the key to transitions but neglect to incorporate consideration of the changes in social relations and (cultural) systems needed for a widespread transformation (Fazey et al., 2018a). This is problematic as insights from systems and behavioural sciences literature (i.e., sociology, institutional economics, technology studies, sustainability science) over 40 years demonstrate the vital role that individual and collective behaviour, culture, institutions, beliefs and norms, and multi-stakeholder partnerships play in facilitating and driving patterns of economic activity, diffusion of technological developments and the imagining of, and transition to, sustainable outcomes (Ostrom, 1990; Geels and Schot, 2007; Loorbach, 2010; Stephenson et al., 2010; Clark et al., 2016; Hollo, 2018; Köhler et al., 2019).

These relevant literatures for understanding the social and cultural dimensions of transformations and supporting innovation initiatives and policies (Loorbach et al., 2017) are rich in theoretical and empirical evidence that could support investments in co-designed, multi--stakeholder transformational programs. The field of transitions research is particularly well-suited to this task as it draws together and integrates

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https://doi.org/10.1016/j.envsci.2022.02.008
Received 26 July 2021; Received in revised form 17 December 2021; Accepted 8 February 2022
Available online 18 February 2022

insights from different literatures and has a strong tradition for advocating, and being implemented, through co-design or co-production process that "connect… researchers and diverse societal actors collaboratively and iteratively … [to]…produce knowledge, action and social change" (Chambers et al., 2021) that is considered key to facilitating transformation in complex social systems (Clark et al., 2016). Yet, for practitioners (individuals, communities, grassroots organizations, businesses and governments) wishing to engage with transformations as *practitioners*, accessing concepts from complex technical literatures, integrating them with other forms of knowledge, and putting them into action is difficult and attempts are often abandoned (Fazey et al., 2018b).

Building better links between existing technical knowledge developed within the (fragmented) transition academic literature, and the needs of practitioners operating in messy, complex, real-world settings requires addressing several challenges:

Challenge 1) Different streams within the transition literature (socio-technical, socio-institutional, socio-ecological, transitions governance, Loorbach et al., 2017) shares some methodological assumptions (e.g., a multi-actor and multi-level inquiry and the consideration of several temporal and spatial levels) but differ in their *foci* of analysis and the emphasis on the role of individual agency, social structures, technological innovation or ecological limits as central catalyst of the analysis (Loorbach et al., 2017). In practice, changing patterns of economic activity, diffusion of technological developments, the imagining of, and transition to, sustainable outcomes is the result of an interplay of technology development, institutional factors, ecological processes, cultural processes, and social dynamics (Ostrom, 1990; Geels and Schot, 2007; Loorbach, 2010; Stephenson et al., 2010; Hollo, 2018; Köhler et al., 2019). This implies that, a priori, all four streams in transitions studies (socio-technical, socio-institutional, socio-ecological, transitions governance) may hold useful insights for practitioners, but as yet, the literature is lacking an analytical method that can meaningfully link useful knowledge from across the Transition literature and in ways that can integrate with other forms of knowledge.

Challenge 2) The intersections between the literature examining psychological processes of behavioural change at the individual level and frameworks examining social construction of meaning and behaviours are poorly examined (Bögel and Upham, 2018). This limits the transformation narrative to either a broad social process (Geels, 2010) taking place over extended periods of time or transformation is simply the journey of individuals, neither of which present a complete picture. Transition practitioners need to develop insights, transition narratives and actionable propositions that address behavioural change at both individual and collective scales and examine the cross over between the two (Laakso et al., 2021).

Challenge 3) The dominant approach of focusing on the process of transitions have contributed to theorisation of the transition mechanisms at various scales (Papachristos, 2018), and the development of powerful analytical frameworks. However, analysis of the variables required to animate these frameworks has been inadequately addressed. While a great diversity of variables may be relevant – making generalisations difficult - we argue that for transformation practitioners working outside academia more specific guidance could be developed on what constitutes a variable and how it may work to drive or block transformative change. Here, we argue that Ostrom's (2005, 2009) call for the development of a generic set of variables that "could be used to analyse all types of [institutional] settings" (Ostrom, 2005, p. 28) is relevant for transition analysis. At a minimum, transformation frameworks could guide practitioners through targeted deliberative inquiry into the vast amount of information, data, and scholarship available on potential variables and support them through the process of identifying and selecting variables specific to a particular transition context.

To address these challenges, we present an innovative, action-oriented, narrative-based framework – the Transformation Process Framework (TPF) - that is designed to support the creation of "useable knowledge" (Clark et al., 2016) suitable for use by practitioners and the researchers who support them. The Framework - presented as a conceptual contribution to the literature –takes the form of a transdisciplinary boundary object (Wyborn et al., 2019) that links cognitive-affective processes, which drive individual behaviour, and social interactions based on the institutional structures and cultural phenomena that drive system-level transformational change. Using this Framework, we link different knowledge fields into a 'concept map' of the "most general set of variables" that could be used to diagnose, describe and analyse different types of transition processes (Ostrom, 2005, p. 28) (see also Cherp et al., 2018).

Specifically, our aim is not to create new theories, but to make better use of existing ones in order to support practitioners to identify and ask the "right" questions to facilitate their work. That is, probing questions of how, what, and why existing patterns of resource use exist and what specific factors need to change at multiple scales (individual, societal, technical, cultural). This can provide a robust basis to direct practitioners' attention to the most useful sources of existing (formal and informal) knowledge and, by doing so, serve as a springboard for action-based research and transformation (Fazey et al., 2018b).

2. Framework structure and variables: theoretical foundations

In this section, we briefly describe the literature used to build our Transformation Process Framework (TPF). Typically, four main approaches are used in the literature to analyse transitions: the socio-institutional, the socio-technical, the socio-ecological and transitions governance (Loorbach et al., 2017; Köhler et al., 2019). We bridge these four approaches and draw from them to identify the relevant set of variables, and processes, to structure and animate a transitions analysis. The TPF structure draws on a combination of the Energy Cultures Framework (ECF) (Stephenson et al., 2010) and the Multi-Level Perspective (MLP) (Geels, 2020) because of the capacities of these frameworks in bridging diverse approaches to studying actor-centred transformations (Ford et al., 2017). Specifically, they vertically link actor-centred analysis to societal level transformations and horizontally link across institutional and cultural analyses and their role in understanding the use of technology and physical materials (Ford et al., 2017: Hopkins, 2017; Geels, 2020; Sovacool and Griffiths, 2020) (Table 1).

This structure allows researchers and practitioners to analyse a given problem from multiple scales and perspectives, ranging from individual, practice-based transitions to societal and cultural transformations over longer timelines frames (challenge 1 discussed above) as required by the specific transition problem under examination.

Next, we observe that the literature that can support action-based transformation research and practice is transdisciplinary in nature and can span a wide range of scholarship across the fields of psychology, sustainability science, knowledge co-production, institutional analysis, socio-ecological systems amongst others, as well drawing directly upon the rapidly growing 'transitions literature' itself (Loorbach et al., 2017). As a starting point for addressing challenges 2 and 3 above, we draw on these disciplines as our analytical lenses and sources of content for the variables to animate TPF, and to provide guidance on how the Framework could be implemented (Table 2). The TPF is therefore constructed as a dialogue between "analytical approaches" (Turnheim et al., 2015) starting with "identifying and applying concepts that can bridge the epistemological differences between the disciplines, bringing richer accounts of agency-related processes to sociotechnical thinking" (Upham et al., 2020, p10) and vice versa. However, we recognize that other fields may be relevant, and our choices about the theories used in the TFP is necessarily limited, for practical reasons, and dependant on the authors' disciplinary backgrounds and biases (Loorbach et al., 2017)., We acknowledge that capturing the true essence, richness and complexity of the social world in a single framework with limited variables makes it an almost impossible task, but have made an initial attempt to synthesize useful frameworks in a reflexive manner. We also

Table 1
Theories and Frameworks- Integrating concepts from across the transitions literature.

	Socio-institutional	Socio-technical	Socio-ecological	Transitions Governance
Challenge 1: Different starting points/ different applicable theories (framework structure)	Energy Cultures Framework provides a structure	The Multi-Level Perspective (MLP)		
Challenge 2: Intersection between psychological processes of behavioural change and social theories of transformation	Energy Cultures Framework (ECF)			
	Psychological approaches to understanding behavioural change			
Challenge 3: Identifying variables/ approaches to analysis (see table 2 for more detail)	Role of beliefs and emotions in understanding behavioural change (social practice theory)	The Multi-Level Perspective (MLP)	Socio-ecological approaches (SES)	Knowledge Co-production
	Institutional Analysis and Development (IAD)			

recognise that future research could provide additional insights or layers from other theories and disciplines that could further enrich the TPF and would invite other scholars to contribute to its ongoing development. With these in mind, the key concepts used from each literature, and the role they play in the TPF are discussed below.

2.1. Energy cultures framework

Stephenson et al., (2010, 2015) developed the ECF to examine the role of culture as a set of variables that influence and shape energy use at the household level. Within this study, we utilise the ECF as a structural component of the TPF to represent the process of transformation at the individual unit level (i.e., individual, business, community). The ECF framework hypothesizes that resource use or conservation behaviour can be understood as an interaction between (cognitive) norms (beliefs and understandings), material cultures (technologies and physical forms), and energy practices (behaviour, activities and processes). In turn, each of these elements is influenced by a range of external factors that sit outside, but act upon, the norms, material culture and behaviours of individuals. The framework is gaining much traction in the literature (Sweeny et al., 2013; Hopkins and McCarthy, 2016; Ford et al., 2017; Bardazzi and Pazienza, 2017; Hopkins, 2017; Stephenson, 2020) due to its relative ease of use as an analytical heuristic (particularly by non-academic practitioners) and its capacity to integrate multiple disciplines and different forms of knowledge (Stephenson, 2020). The framework is now being applied to areas beyond energy (Hopkins, 2017) and at different scales of analysis (Stephenson, 2020).

We argue that the ECF is incomplete because it provides insufficient attention to the agency dimension within the cultures processes. While

Table 2
Key variables, and their origins, in the Transformation Process Framework.

Field of knowledge	Key variables	Role in Transformation Process Framework
Energy Cultures Framework	(Cognitive) norms Material Cultures Practices	Provides the internal structure for the TFP and the key operationalising elements.
Multi-level perspective (transitions theory)	Niches/innovation niches	The multi-dimensional learning concept is included in the action situation to add a normative experimental dimension where actors explore different ideas, networks and resources required for transformation.
	Socio-technical regimes	Part of the external variables that drive the action situation. A set of variables that describes the combination of formal and informal institutions, practices or beliefs, structures of power and relationships that stabilize specific resource practices within an action situation.
	Landscape trends	A set of variables that capture the wider context influencing the regime, institutions and action situation. Includes broader concepts such as demographic change, social values, macro-economic patterns, etc.
Institutional Analysis and Development Framework	Action-Situation	Name given to the core analytical unit. The social space where agents with common or with varied interests meet, interact, and make decisions.
	Formal and informal institutions	Identifies specific formal (e.g. laws) and informal (e.g. customs) institutions, operating at different scales.
	Power and agency	Identifies who has the power to make specific decisions on specific issues at specific times/place
	'Rules in use' to organise, coordinate and regularise behaviour	Can be a formal or informal institution. Articulates how these institutions act to incentivise, manage, alter or circumscribe behaviour in particular contexts.
	Linking institutions to the physical world	Facilitates identification variables that describe how the institutions act to shape different states
Psychological approaches to understanding behavioural change	Beliefs and emotions	Variables to capture the psychological dimension of transformation.
Transitions Governance	Knowledge/research co-production and co-design	A set of principles that guide how the TPF may be implemented in practice as a partnership between researchers, practitioners and stakeholders. An approach that facilitates integration between formal academic knowledge and other knowledge types – such as indigenous, local, site-specific, cultural knowledge.

(*continued on next page*)

Table 2 (*continued*)

Field of knowledge	Key variables	Role in Transformation Process Framework
Socio-ecological systems	Physical/built environment interacting with institutions/human behaviour	Facilitates identification of variables that describe how the physical and natural systems act to shape, and be shaped by, transformations; system behaviours, such as self-organization, emergent properties, non-linearity, and path-dependency could be included to describe how agents and variables may behave over time with the Framework.

the ECF was originally intended to reconcile and integrate both the individual and social dimensions of transformation, its application tends to emphasise structuring concepts such as *habitus* or practices and their reflection in cognitive norms, such as social aspirations. The ECF misses a more fine-grained approach to cognitive constructs (such as emotions or beliefs) that could help or hinder sustainable transformations. Also, beyond some general suggestions, it leaves an open question on what exactly the external influences may be. To address these limitations, we incorporate the insights from five other literatures into the ECF, each of which are discussed in the following sections.

2.2. Psychological approaches to understanding behavioural change

The application of psychological processes of behavioural change (challenge 2 above) is considered a fundamental requisite to understand system transformation but is yet to be fully addressed in existing transformation models (Bögel and Upham, 2018), despite a growing body of research that aims to explore the cross overs between the MLP and social practice theory (Laakso et al., 2021).

To address this gap, we draw on psychological approaches to consumers' adoption of innovations that emphasize the role of beliefs, and the emotions they activate, as fundamental predictors of innovation adoption and transformation. We incorporate these psychological processes into the TPF via augmenting the ECF structure to incorporate a new node representing psychological processes (Fig. 1).

Examining the role of emotions and beliefs in the TPF places an emphasis on a sub-set of factors that are explored in social practice theory. We argue this is both a practical tactic to focus analytical efforts by practitioners and reflects the dominant theories on innovation adoption that frame consumers' adoption as a result of beliefs and emotions (i.e., Technology Adoption Model Davis, 1987; Innovation Diffusion, Rogers, 1983; Decomposed Theory of Planned Behaviour, Taylor and Todd, 1995). Similarly, recent work has shown the importance of the role of beliefs in the take up of sustainable or eco-products,

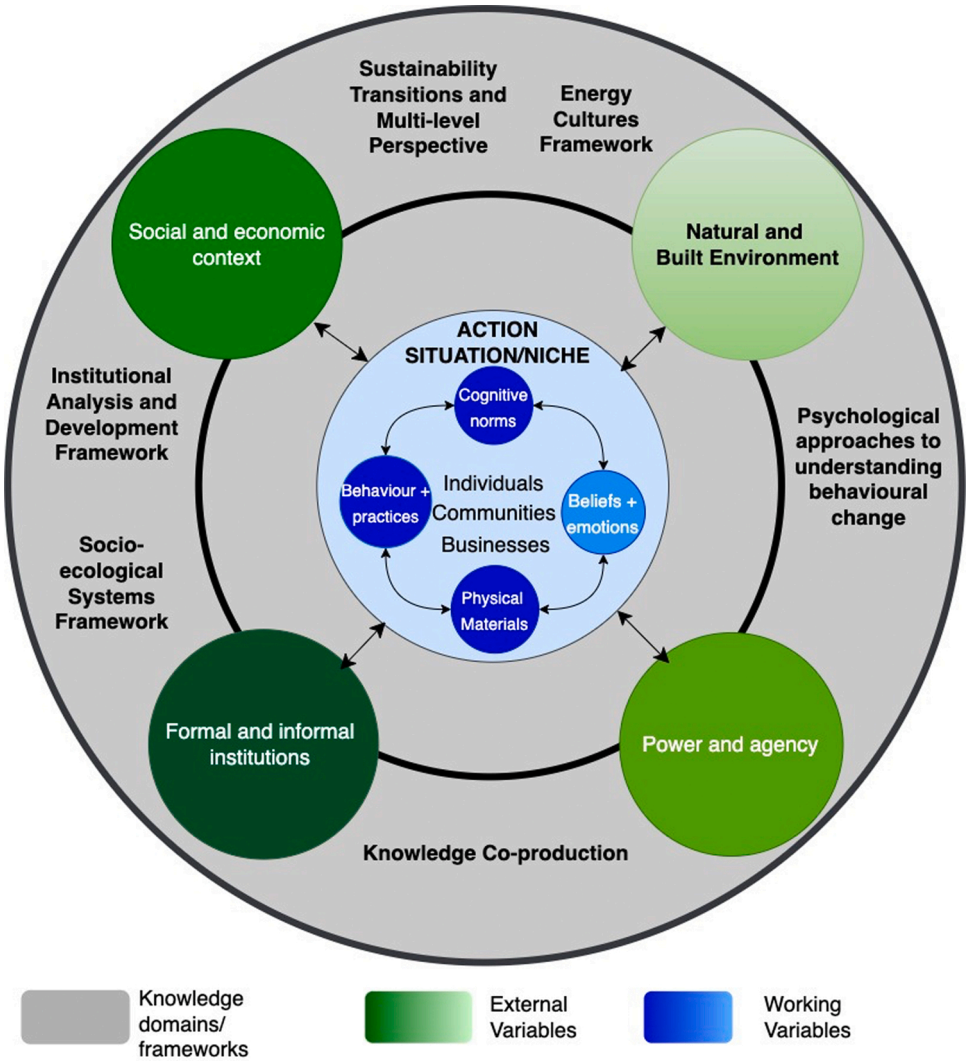

Fig. 1. Conceptual Overview of the Transformation Process Framework.

relative to alternatives, and that congruency between innovations and individual identity are important drivers of individual transitions (see, for example, the work of Luchs et al., 2010 and Skard et al., 2020 on product functionality; and Antonetti and Maklan, 2016 and Montoya-Robledo et al., 2020 on the role of self-beliefs and identity in adoption of eco-innovations). Other work (Perlaviciute et al., 2018; Wagner et al., 2019; Steinert and Roeser, 2020; Wagner and Heinzel, 2020) has shown that beliefs are accompanied by emotional phenomena that may reinforce and amplify the beliefs about a transition process or even activate new emotions (Pham, 2007; Lerner et al., 2015). For instance, anticipated anxiety has been proven a fundamental brake for adopting car-sharing schemes, even when the benefits of these schemes are known and acknowledged by users (Valor, 2020). Beliefs and emotions are also fundamental variables for diagnosing and guiding transformation processes. For example, beliefs about the perceived difficulty (or self-ability) of an individual, together with the emotions of stress or anxiety, may require support to nurture feelings of competence, or support new skills development. Conversely, a poor fit between an innovation needed for a transformation and individuals' identity - and the ensuing emotions of shame -would suggest that the social image of the innovation needs changing.

Thus, the variables beliefs and emotions are included to complement the focus on social norms and practices taken from the ECF (Section 2.1). The addition of beliefs and emotions to the TPF is relevant for two reasons. Firstly, because beliefs and emotions are malleable, contrary to personality traits, habits, or values that are more difficult to shift. Secondly, because we can make a connection between cultural constructs and processes, and the resulting beliefs/emotions (i.e., when altruistic or green actions becomes a social status symbol – for example, the uptake of electric vehicles as a symbol of innovation, White and Sintov, 2017), so that we can more effectively devise change strategies for transformation. This latest factor becomes an important element in using our Framework as part of an action research strategy.

2.3. Sustainability transitions framework(s)

Within the socio-technical approach in the transitions literature, the *multi-level perspective* (MLP) (Geels, 2004, 2010) has gained theoretical prominence in the field, partly for its ability to support construction of credible narratives about how society comes to adopt new technologies across multiple scales and the multi-dimensional relationships between these scales (for alternative views see Berkhout et al., 2004; Genus and Coles, 2008). In MLP theory, transitions to a new technology and a new technological regime occur when three interconnected processes come together: (i) actors within a social niche (micro-level) develop a new innovation; (ii) this new innovation, combined with changes in broader social trends place pressures on mainstream activities and structures ('regime') to change existing arrangements (meso-level regimes); and (iii) broader social trends emerge from the dynamic social, physical and economic context operating across society (macro-level landscape). Overall, shifts at the broader scale place pressure on the socio-technical institution (the prevailing set of institutions that embed current technology in everyday practice) to change and adopt the new technology (Geels, 2011).

We build on the MLP in two ways. First, we use the MLP as one source for filling in the details of the required external factors in the ECF by reimagining these "factors" as the socio-technical landscapes and socio-technical regimes described by Geels (2020) – these become part of the list of potential variables that we create to animate the TPF (challenge 3). We also use the MLP to re-imagine cultural process transformation (i.e., presented by the use of the Energy Cultures Framework - see Section 3.2.) not only as a space of action but also for experimentation (i.e., a niche) where new combinations of materials are used and where interventions are tested and scaled up.

Second, we recognise that there are critical gaps in the MLP. Important concepts around policy development, power dynamics (Cherp et al., 2018), agency (Smith et al., 2005) and political influence (Meadowcroft, 2011) are recognised within the MLP (Geels, 2010) but are downplayed. These dimensions are crucial in determining who defines desired transformation pathways, who has the authority to govern this change and who is responsible for implementing the transformation (Nightingale, 2018). Therefore, we consider explicit consideration of power, working and evolving alongside the socio-technical regime (Cherp et al., 2018), as critical to the TPF through incorporating the insights about power and governance from the institutional economic literature (Section 2.4).

Similarly, the MLP omits spatial and temporality dimensions (Bridge, 2018), and connections with the natural and physical systems, which are vital concepts in examining transformations. To address this gap, we draw on the extensive socio-ecological systems (SES) literature to incorporate these dimensions (Section 2.5).

2.4. Institutional analysis and development (IAD) framework

Institutions are shared concepts (rules) that are used to organise, coordinate and regularise behaviour in repetitive situations (Ostrom, 1990). Rules or 'rules in use' are defined as sets of "shared linguistic constraints and opportunities that prescribe, permit or advise actions for participants' in a specific situation" (Crawford and Ostrom, 2005, p 137–138) Collectively, these rules create the incentive structures that govern individual behaviour, and interactions between individuals and between individuals and their physical environments (Ostrom, 1990, 2005). The IAD Framework is widely recognised as a useful conceptual map designed for analysing institutionally derived incentives, the corresponding behaviour patterns, and how changes to rules-in-use can change resource use outcomes (Ostrom, 2005).

We borrow three ideas from the IAD literature. Firstly, we adopt the term "action situation" to define our analytical unit (Fig. 1) which we adapt from the core "working variables" of the ECF - that is, the "norms", "practices" and "material cultures" elements which together are used to describe an "energy culture" (Stephenson et al., 2010). Secondly, we borrow the "rules-in-use" concept to describe two key processes: (1) the relationship between the "behaviour" and "material cultures" working variables within the action situation. (2) the bilateral processes between the action situation and the "external factors" (which we call *external variables)* that influence the characterisation and/or behaviour of working variables (Stephenson et al., 2010, 2015). Thirdly, we draw on the extensive IAD literature to specify the broad range of external variables that act to influence or shape the action situation and is discussed in Section 3. We are influenced by the IAD themes of power and agency - who gets to make the rules and who implements them - and its emphasis on linking institutions to the physical world – which are critical components of effective knowledge co-production and use (Miller and Wyborn, 2020).

2.5. Socio-ecological systems theory

SES is a theoretical description of a network or system of highly interlinked social and ecological sub-systems that are mutually interdependent to such an extent that separation between the two is artificial and arbitrary (Berkes and Folke, 1998). Here we draw on the branch of SES literature that explores the complex dynamics of how the social and ecological systems, separately and together, respond to endogenous and exogenous systems of change (Berrouet et al., 2018). This literature examines the concepts of vulnerability, resilience and robustness of SES in the face of global crisis (such as climate change) and seeks to develop policy remedies to promote improved governance and sustainability outcomes.

SES theory provides a fundamental variable in transformation processes, namely, the physically built and natural ecological system that serves to incorporate place-based physical variables that provide barriers and opportunities to transformation. We also borrow some key

variables of SES to describe observable behaviours within a transformation process: self-organisation, emergent properties from interacting variables, non-linear development pathways and path-dependent development and the use of leverage points that can be used to change trajectories, actions, and outcomes (Dorninger et al., 2020, Meadows, 1999). This research also introduces a solutions orientation to the literature and provides a framework for turning the analysis of transformations into an action agenda (see also Abson et al., 2017; Leventon et al., 2021).

2.6. Knowledge Co-production and transition governance

Knowledge (or research) co-production is a core organising principle in the transition governance stream of the literature (Loorbach, 2010; Loorbach et al., 2017). In practice, this means that both researchers and end-users are responsible for all aspects of the research process: sharing information, collaboratively generating transformative visioning, joint design of research ideas/questions and collecting data, and co-operatively conducting the analysis and interpretation of the results (see also Clark et al., 2016 and Norström et al., 2020). Within the broader literature, this process of co-design is commonly implemented using collaboration tools, such as 'boundary spanning' experts/tools who translate different types of knowledge across disciplinary, political, and institutional boundaries (Lang et al., 2012). However, within the transitions governance literature, more emphasis is placed on providing guidance on the process of conducting co-design, rather than the process of integrating knowledge – through for example the development of operational tools such as 'transitions management', 'transitions governance' and 'strategic niche management' (Loorbach et al., 2017). We argue that both 'knowledge integration' and guidance on the 'process of doing' co-design is equally important in co-production work.

3. The transformation process framework

The Transformation Process Framework is designed as a 'knowledge-integration' boundary tool that build upon and syncretize the analytical frameworks and theories discussed in Section 2 to identify the working and external variables that are needed for the analysis of sustainability-oriented transformations across scales.

In doing so, the framework works to: (i) look into the potential of incorporating new information (psychological approaches to understanding behavioural change) into a body of existing knowledge (e.g. transitions literature) (knowledge-integration), (ii) examine the insights generated at the inter-sections between disciplines and academic research and local knowledge, action-based research and vice versa and (iii) interrogate horizontal and vertical connections that might emerge when bridging multiple knowledge domains into a systematic conceptualization under the TPF.

The scope of our Framework focuses, firstly, on interrogating the role of individuals and other actors with agency to pursue transformation (e.g., communities and businesses) and, secondly, on examining the multi-direction influence and context provided by the multi-scaled socio-ecological systems within which these agents operate. A summary of the key concepts in Section 2 and how they are used in the Framework are set out in Table 2 and Fig. 1 and discussed in the remainder of this section.

3.1. The Concept: a transdisciplinary research framework

Our Framework has two structural components. Firstly, we expand the ECF (Stephenson et al., 2010) to include the beliefs/emotional component that reflects the psychological dimension of an individual's transformation. This separates and describes individual processes that support or resist change in individual behaviours and material use as a distinct process from the formation of norms which retains its role in capturing socially constructed beliefs. This is the key difference between the original ECF and our concept of an action situation (Section 2.4) (represented by the blue circles in Fig. 1) where individuals, communities and businesses *combine their beliefs and emotions* with socially constructed norms to make decisions about their patterns of behaviour. This can refer to, for example, how resources such as energy, single use plastics, transport or clothing are used. Each of these elements – socially constructed norms, emotions, behaviours/practices and physical/material elements ('working variables') are governed by the prevailing rules-in-use and actively shape each other through dynamic relationships as described in the original ECF. Examples of 'working variables' are set out in Table 3. Drawing on the MLP work on niches and multi-dimensional learning (Schot and Geels, 2008), we also expand the notion of niche to incorporate the idea of the action situation as a space for conducting radical learning and experimentation focused on how to do transformations and identification of what works. Action situations thereby become a device to both understand cultural behaviour that may require transformation and to experiment with different approaches to how this transformation could be initiated.

Secondly, as noted in Section 2, the role of external variables with the ECF needs additional theorisation and exploration. We therefore introduce a second structural element - sets of named external variables - visualised by the outer circles in Fig. 1, that represent the broader social, cultural, economic, and physical environment within which the action situation operates, and which will influence and shape what is done and what is observed.

External variables provide explanations for why drivers and influences exist, how they act to shape the action situation (through 'rules in use') and how they, in turn, are shaped by other external variables or even the action situation itself (Ostrom et al., 1994; Ostrom, 2005). Drawing on the literature described in Section 2, we describe four groups of external variables: distribution of power, formal and informal institutions, social and economic context, and the natural and built environment. (Schlager et al., 1994; Waylen, 2013; Raymond et al., 2014; Schlager and Cox, 2018). A non-exhaustive list of potential external variables from each group that is relevant for analysing sustainability-oriented transformations is set out in Table 3.

External Variables are likely to operate across multiple geographical, time and social scales, exhibiting properties such as non-linearity (e.g., rate of transformational change speeds up over time), self-organisation (e.g., actors develop and self-organise their own informal institutions to incentivise transformation), path-dependency (e.g., range of transformation options is limited by existing arrangements) and their collective impact on the (physical, social, cultural, economic) system undergoing transformation may be surprising and unintended (e.g., emergent behaviour). Understanding how these variables are formed, how they behave and the nature of their role in the transformation process is a core task in using the Framework.

External variables may also be used as mechanisms in the scaling up and replication of sustainability practices from one specific action situation to other places and other challenges - through, for example, replication of specific institutional rules across jurisdictions or the sharing of social innovation and business cultures between companies or industries. Therefore, explicit consideration of these variables becomes an important mechanism for examining the mainstreaming of transformational experiments carried out in an action situation and making the jump from niche to becoming the new socio-technical regime.

3.2. Co-creating academic and practitioner transformations

Following on from Stephenson et al. (2015), we have deliberately kept the variable "categories" broad so that the framework can be applied flexibly to the scale of the individual, the community or the organization. The starting point of an analysis is problem-dependent but will begin by selecting the most relevant node within the "action situation/niche" and "working outwards". For example, for individuals, key variables that influence the action situation may be beliefs about a

Table 3
Working variables and external variables shaping the Transformation Process Framework.

Variables within the Action Situation (working variables)	Potential Variables to consider	Specific Examples
Behaviour and practices	Habitual activities, processes of choosing and acquiring material objects, routine responses stimuli, usual or customary action (Stephenson et al., 2015)	Existing work practices limiting the transition to the use of EVs in service and craft enterprises (Julsrud and Denstadli, 2020)
		Habits used to meet needs in daily life (e.g., cooking, clothing or transport) (Stephenson et al., 2010)
		Traditional land management practices supporting the ongoing use of wood heating systems (Klaniecki et al., 2020)
		Analysis of existing practices may show the need to nurture new competences and skills to change existing habits (Gram-Hanssen, 2010).
Cognitive norms	Expectations or aspirations about how "things should be done" (Stephenson et al., 2015)	Expected levels of "warmth" or "coolth" in a household or expectations around mobility (Raven et al., 2021)
		Changing fashions for clothing (Fletcher, 2017)
		Protecting and valuing building heritage features at the expense of energy efficiency retrofitting (Sovacool and Griffiths, 2020)
Emotions/beliefs	Beliefs or emotions about a particular practice or object (Perlaviciute et al., 2018; Wagner et al., 2019; Wagner and Heinzel, 2020)	Anxiety about access to transport with car sharing schemes (Valor, 2020).
		Disgust about use of second-hand clothing (Hur, 2020; Kim et al., 2021).
		Positive symbolic outcomes/status symbols of adoption of sustainable innovations such as the electric car (Steg et al., 2015).
Physical Materials and energy resources	Objects, buildings, infrastructure used for functional and/or symbolic purposes (Stephenson et al., 2015)	Building design, urban design, transport infrastructure, energy infrastructure, household or personal objects (e.g., lighting used or clothing used), technologies (Stephenson et al., 2015)
External Variables	**Potential Variables to consider**	**Specific Examples**
Power	Who gets to decide which agendas are adopted and which actions are supported and funded? (Turnhout et al., 2020, Just Transition Alliance, n.d.)	The role of social movements (Armstrong, 2021), political coalitions (Hess, 2014) and civil society coalitions on the pace of transitions (Hess, 2020).
Social and Economic Context	Patterns of economic development, dominant industries, industrial organisation, available skills in the labour force and alternative just recovery/post growth plans (UNFCCC, 2016).	Structure of supply chains influencing resource availability, and market conditions (Ulmanen and Bergek, 2021).
		Coal resources leading to economic dependence on a single industry (Skoczkowski et al., 2020)
Institutions	Formal institutions: public policy, legislation, regulations, government funding programs, international agreements, etc. (Ostrom, 2005)	Formal institutions:
	Informal institutions: customs, norms, values, language, discourses, media, customs, taboos etc. (Dryzek, 1997; Lakoff, 2010; Schlüter and Theesfeld, 2010)	Strategic and statutory guidance provided by the legislated Climate Change Act (UK) (Averchenkova et al., 2021)
		National strategies for developing a bioeconomy (Imbert et al., 2017)
		Technical standards shaping the design of wastewater infrastructure (Rogers et al., 2015)
		Fishing quotas regulating access to fishing resources (Yandle and Dewees, 2003)
		Informal institutions: Codes of behaviour that are considered common sense (Ostrom, 1990).
		Traditional territorial systems (e.g., "harvest gangs") used for fishing access (Acheson and Brewer, 2003)
		Changing norms around meat consumption (Tziva et al., 2020).
Natural and Built Environment	Location-based physical resources, physical geography, natural resources, natural capital.	The influence of urban form on transitions (Nielsen and Farrelly, 2019)
		The influence of physical landscapes in triggering transitions (Weng et al., 2020)
		Agricultural soils shift from high moisture content to low moisture content due to changing precipitation under climate change (Fedele et al., 2019)
		Natural resource endowments (e.g., extent and availability of forestry and fishing resources) (Ostrom, 2009)

proposed solution represented by the "beliefs and emotions" node (e.g., emotions towards electric vehicles, Moons and De Pelsmacker, 2012)- whereas the application of the methodology to a community will consider the role of social and cultural properties and processes such as logics, social identities or emotional *habitus* represented by the "cognitive norms" mode (Thornton et al., 2005; Zietsma and Lawrence, 2010; Voronov and Vince, 2012).

From there, analysts can begin to explore relevant variables at other nodes which influence, or are influenced by, the phenomena under examination. These variables could occur at other nodes in the "action situation" and/ or be derived from one or more of the four external categories identified in Fig. 1. This flexibility allows for the Framework to be used to explore a broad range of questions from diagnostic and

Box 1
Sample questions in the Transformation Process Framework.

Description of key variables in the action situation
1. What are the key material objects that are involved in the specific resource use phenomenon under study? How are they used? Why are they used? 2. How do people feel about the existing patterns of behaviour and material use? 3. What are the key cognitive (social) norms that make the existing pattern of behaviour and material use 'the norm'? Do these norms vary between groups? Are they strengthening or weakening over time?
To analyse the relationship between action situation variables
4. What beliefs and emotions hinder or help the transformation process? Are there differences in the process of belief/emotions and behavioural change between different groups of citizens – e.g., across genders, different socio-economic groups, age groups or between communities in different geographies-? 5. How dependent is the existing behaviour on the existing set of physical materials? Could a change in the physical setup of materials change existing unsustainable behaviour patterns? 6. How do individuals interpret cognitive norms? How does this shape beliefs/emotions and behaviour?
To identify external variables in the socio-technical regime and (physical, natural, social) landscape relevant to the transition and analyse their relationship to the 'action situation'.
7. How do policy development or changes in social or cultural processes lock in or shift these beliefs/emotions and create (block) adoption of sustainable solutions? 8. What role do different cultural networks, governance and power structures play in facilitating the transformations? 9. Of the prevailing natural environment, and existing physical infrastructure, what could be useful in supporting a transformation? What, if any, investments are needed in physical infrastructure as part of the transition process?
Visioning, experimenting, learning about 'what works' for a transformation
10. What would a successful transformation look like in a particular context? What variables need to change? What variables need (or must) to stay the same? 11. What are the levers needed to facilitate change in the identified variables? How do these levers work? Who has the power to change them? 12. Can successful interventions in one location be successfully replicated in another? What changes are needed to adapt to local conditions? Who can be identified as change agents and influencers that can facilitate these cultural shifts?

descriptive "what is"-type analysis that identify and characterise key variables and explore the relationships between them, to crafting new visions for transformation. Sample questions that can be asked to guide this transformation are illustrated in Box 1.

A broad range of theories, forms of knowledge, analytical methods and techniques, and models can, and should, be used to identify, describe and explain variables identified through this (iterative) process. This could include, inter alia, academic evidence or theory (such as the theories discussed in Section 2) from different, relevant disciplines, local, expert and experimental or field work data undertaken for the purposes of filling knowledge gaps. For example, if practitioners and researchers identify beliefs and emotion variables as an important part of the analysis, they can further draw from relevant theories such as the Theory of Planned Behaviour which is one of the dominant models used to explain social behaviour used in the psychological literature (Azjen, 2011). Similarly, if practitioners wish to explore how narratives (norms, informal institutions) shape the use of materials (practices/material objects), they could draw on discourse analysis (Dryzek, 1997) to provide an operational model for deconstructing the use of language in discourse and its implications for behaviour. Alternatively, they could conduct field observation, field experiments, or collaborative projects such as Urban Living Labs (Steen and van Bueren, 2017) to generate a primary data set. Ultimately, there are a wide variety of theories and models that could be used to animate variable analysis, with the choice depending on the methodological choices made by practitioners and the researchers who support them.

Co-creating this knowledge base as a collaboration between researchers and practitioners provides a narrative and a data set for understanding both immediate and the broader systemic transformations. This delivers a strong basis for practitioners to use their in-depth, specific, and place-based knowledge to develop and incubate leverage points for change, in particular identifying deeper and more effective approaches to transformation focusing on re-design of system structures and objectives (Meadows, 1999: Dorninger et al., 2020).

By establishing collaboration with academics, transformation practitioners can use this process to explore the relevant academic research which can shed light on their transformation challenges. For academics, this process can ensure that theoretical questions around transformation at different scales of society are informed and shaped by lived experience of practitioners and other stakeholders. Here we see the Framework is used in a positive sense to explore and test for evidence on the theoretical relationship between social processes and individual psychological processes and theories of behavioural change - the interplay of psychological and social variables (Section 2.2) being one example.

4. Conclusions

The TPF makes several contributions to the literature. First, it pairs psychological approaches to understanding behavioural change - on beliefs and emotions – explicitly to two commonly used socio-institutional and socio-technical frameworks – providing a knowledge integration response to Bögel and Upham's (2018) call for additional theorisation to bridge between the psychology and transitions literatures. Second, the TPF builds on the complementarities between the different approaches in the transitions literature to synthesize and facilitate a more effective use of existing knowledge as a springboard for

action-based research. Lastly, our approach supports researchers and practitioners to move to a more systemic and contextualised conceptualization of transformation practice and theory as called for in Köhler et al. (2019). Through a broader focus on context, our Framework brings into attention indirect drivers of blockers and/or facilitators within an action situation/niche. Addressing these may warrant expanding the range and scope of activities that are needed for achieving a successful transformation.

We see the TPF as a first step in drawing together key theories within a systemic process of identifying variables within transformation action-based research. However, further in-depth theoretical and field work in partnership with practitioners is required to test, refine and revise our approach and elaborate on the mechanisms and links between the concepts discussed; in particular, the mechanisms between psychological process and its interplay with cultural constructs in the context of transitions.

Currently the Framework is oriented towards identifying variables to describe a transformation problem and pathway forward. Further extension is required to incorporate mechanisms for evaluating the outcomes of a transformative process. However, till then, this Transformation Process Framework can serve as a synthesis guide to integrate knowledge in support of implementing transformations at the multiple scales, across multiple agents in order to tackle the numerous challenges faced by societies today.

CRediT authorship contribution statement

Hannah Parris: Conceptualization, Methodology, Writing – original draft preparation, Visualisation**. Alevgul Sorman:** Conceptualization, Methodology, Writing – original draft preparation, Writing – review & editing, Visualisation. **Carmen Valor:** Conceptualization, Methodology, Writing – original draft preparation, Writing – review & editing, Annela **Anger-Kraavi:** Conceptualization, Writing – review & editing, Supervision. **Andreas Tuerk:** Conceptualization, Writing – review & editing, Supervision.

Conflict of interest statement

We confirm that the work described has not been published previously, that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by our respective institutions where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form. Further, we confirm we have no competing interests that could influence or bias this work. Our CRediT statement is as follows:.

Acknowledgements

H.P., A.H.S. and A.A.K was supported by the H2020 European Commission Project ‘PARIS REINFORCE’ under grant agreement no. 820846. This work also originated in, and benefited from, discussions with multiple research and non-governmental organisations. We acknowledge and thank all involved in helping us develop and refine our ideas. We also thank two anonymous referees who provided valuable and insights comments that significantly helped in improving the original manuscript. We also grateful for the constructive and thoughtful comments provided by two anonymous referees.

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